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1 Agilent Technologies Test & Measurement Catalog 2000

Introduction, Indexes & New Products 1

Look for reusable reference tabs following page 608.

Agilent Technologies' Test & Measurement Organization

Agilent Technologies new headquarters rises on the same site in Palo Alto where Dave Packard and Bill Hewlett built their first factory, The Redwood Building, in 1942.

About This Catalog

Our first Agilent Technologies catalog brings you a tremendous range of high quality technology products, as well as many advances in measurement and test technology that provide optimized solutions. For sixty years we have developed products and services that are unequaled in their ability to help you improve your engineering results.

In response to your comments and suggestions, we've restructured the catalog to make it easier for you to find the information that you need. See pages 6 and 7 for an overview of how to use the catalog.

New Products

The "New Product" section (pages 43-66) highlights our most recent product introductions, such as these exciting developments:

- HP Router Test System
- HP 4294A Precision Impedance Analyzer
- HP ESA-E Series Spectrum Analyzers
- HP 8960 series I/O Wireless Communications Test Set
- HP Logic*Wave* Logic Analyzer
- HP VXI Microwave Synthesizer

Support and Services

We have increased our technical support, resources and professional services to help you get the most from your Agilent Technologies experience. Turn to Chapter 2 (page 68) for a comprehensive description of "Total Support."

For special needs or situations requiring customized test and measurement solutions, our professional consultants can help you make the right selection.

Total Commitment to Quality

We are dedicated to providing quality products and services that meet your changing needs. Agilent Technologies employees uphold high standards for performance, reliability and service. The standards set by our Quality Maturity System (QMS) exceed the intent of ISO 9000, the international standards for quality management and quality assurance.

Nearly all Agilent Technologies divisions and calibration laboratories worldwide are ISO 9000 registered, which requires periodic audits by independent experts. Selected laboratories are accredited to the high standards of ISO Guide 25. The integrity ensured by these periodic audits enables many customers to augment their own internal quality systems without the expense of hiring audit teams. We include an ISO 9000 compliant calibration certificate with almost every new instrument to make it easier for you to put your Agilent equipment into service immediately.

Agilent Technologies Web Site

We expanded our World Wide Web site (**http://www.hp.com/go.tmc00**) to meet your requests for more information about Agilent Technologies products and services. We encourage you to visit the site, where you can obtain updated technical information and download application notes, interactive selection guides and free demonstration software. The site gives you quick access to the latest Agilent Technologies news and training course schedules. See page 5 for our guide to on-line information services.

Connectivity and Standards

To meet your needs for connectivity between instruments, systems, and networks, we design our products to fit into locally and publicly connected domains by using interfaces with industry standard and often computer standard protocols. For your convenience, we have identified these products with special symbols denoting their capabilities. Turn to page 7 for specific information about these instrument functions.

While the transition to Agilent Technologies from Hewlett-Packard continues, you can find both the Agilent and HP designators and addresses in this catalog. Be assured that all product information, including model numbers, document identification, phone and fax numbers, as well as web site addresses, are entirely accurate and will get you the product, service, information, or help you need.

"The Redwood Building" at 395 Page Mill Road, Palo Alto, California. Hewlett-Packard's first company owned factory built in 1942.

The Test & Measurement website: your convenient way to get information and transact business

Take advantage of the vast and growing range of information, support, and business resources and services available at our website.

The Internet today is much more than a vast information archive. It's a convenient, often indispensable, tool for conducting business. As Internet use has grown and new services have been launched, the Test & Measurement website has steadily expanded in functionality and content.

The design of the website encourages browsing the many product, sales, and support areas and using the site's resources. Better navigation aids, web page reconstructions, and other upgrades make your investigations, explorations, and activities pleasant and productive.

To keep up to date, visit often!

The content of the website constantly varies as news happens, new products are introduced, application and sales literature is developed and updated, product evaluation tools and learning aids are added, sales promotions are initiated, and events are scheduled. You can keep up-to-date by browsing the web site regularly.

Find... Get... Buy...

The Test & Measurement web site lets you take immediate action, at any time. You can use it to quickly

- find, evaluate, compare, and select the products and services you need
- get updated, expert information for solving application problems
- buy some types of products online, using a credit card

The website also gives you access to the many support resources Agilent Technologies provides. You can now obtain information in your local language*, see the latest price list in your local currency*, and check the status of your order.

A special "datasheet" format* is particularly helpful. It cuts the steps needed to access product overviews, technical details, FAQs, manuals, software, and application notes.

Helpful buttons on the navigation bar

Buttons on the navigation bar let you activate key functions or jump between major areas of the website:

- Click on the *Search* button to quickly find specific information.
- Activate the *Assistance* function to find the quickest way to get help.
- Press the *Product Information* button to explore the wide range of available products and services.
- Use the *Services* button to review education and consulting services.
- Press the *Technical Support* button to access online help, software and drivers, and Year 2000 data.
- Click on the *How to Buy* button to see how to get more for your budget.
- Use the *Applications* button to learn more about complete test solutions for the automotive, communications, and wireless markets.
- Hit the *What's New* button to get the latest news information.
- Press the *Publications* button to access many types of literature.
- Push the *Special Interest* button to find the Educator's Corner, US Federal government and US Channel Partner areas.
- Click on the *Events* button to see trade show and seminar schedules.
- Use the *Country* button to visit online resources in many countries.

Your personalized news service

The T&M Update Service can send you monthly e-mail messages that match your interests and needs. You get news stories, event notifications, details of special promotions, and more. It's easy to sign up for this service (your information is held in strict confidence), and you can cancel your participation at any time.

*Availability of this feature may be limited; an expansion program is ongoing.

Use our Test & Measurement web site often!

www.hp.com/go/tmc00

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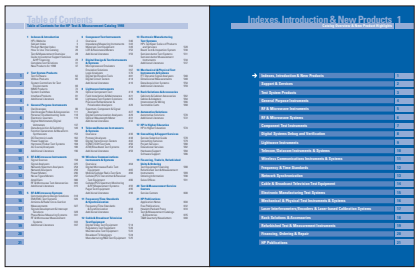
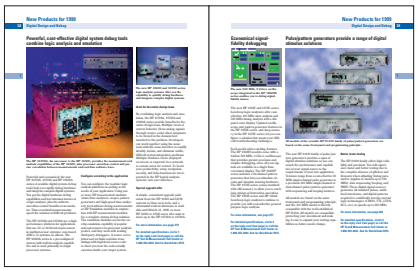


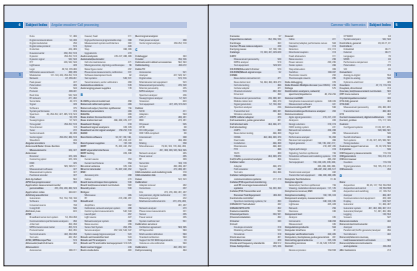
Easily find the major section of products or systems that you need. Refer to major sections by the number on the thumb tabs. Major sections and subsections are listed throughout the contents by page number. The contents of each major section and additional references are repeated for you on the first page of each section. **See page 2.**

New Products for 2000



Agilent Technologies introduces hundreds of new products each year. This full-color section features 49 new products for 2000 from Agilent's Test & Measurement Organization. These exciting and innovative new products reflect Agilent's commitment to research and develop-ment investments. They also illustrate major technology and market trends. **See page 43.**

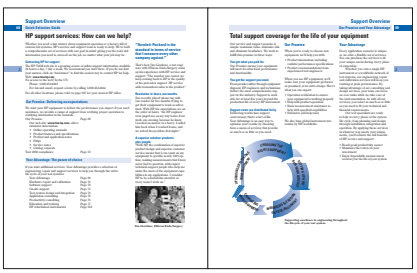
Indexes



There are two indexes in this catalog. The Subject Index references product categories, key terms, applications, and other useful information. **See page 8**

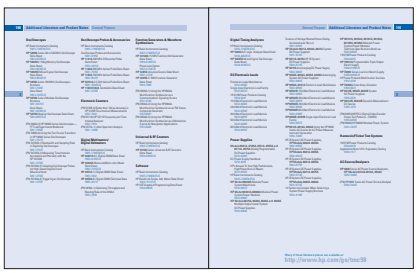
The Product Number Index allows you to find Agilent products if you already know their product numbers. All new products for 2000 are identified. Page numbers in bold type indicate the main references for that product. **See page 30.**

Support & Services



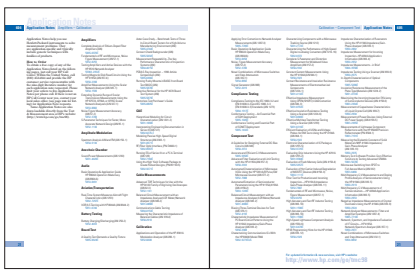
This section provides you with an overview of the wide range of consulting and support services available through Agilent's Test & Measurement Organization. Agilent offers services and consulting for all phases of your test & measurement solution life cycle. **See page 68**

Additional Literature & Product Notes



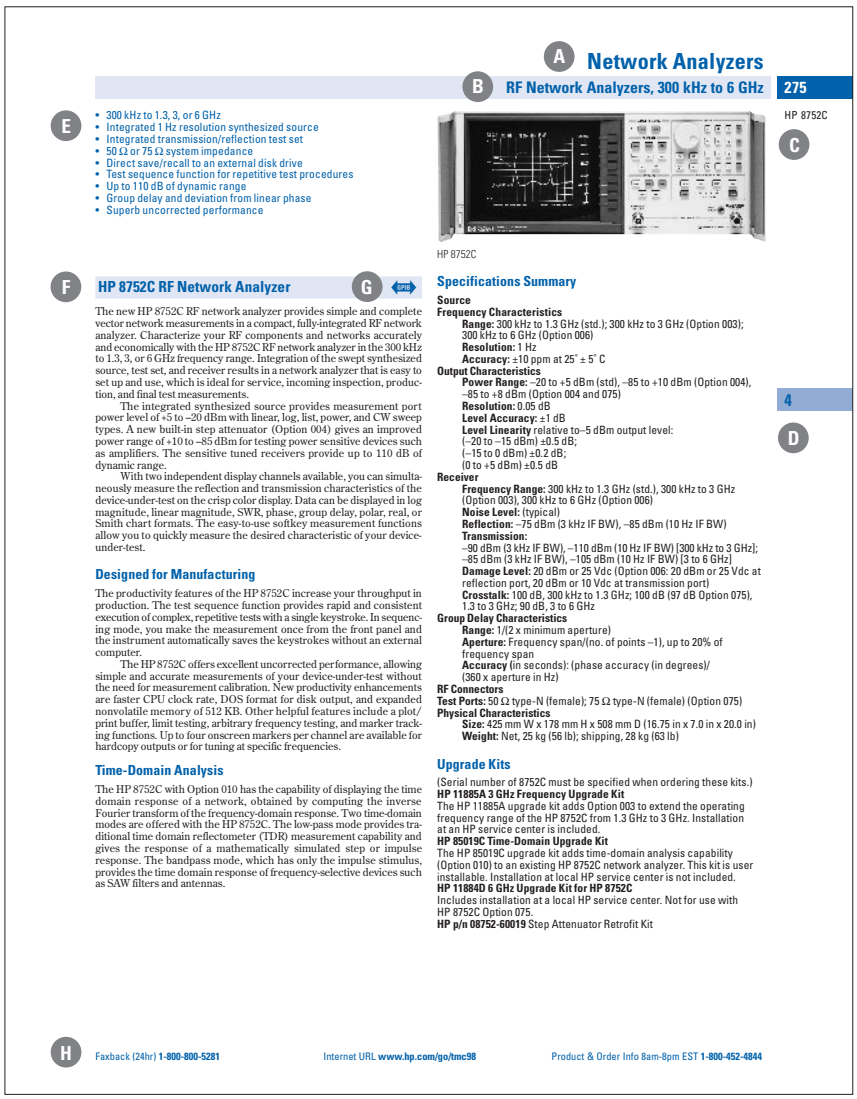
Agilent has published considerable additional information on the instruments noted at the end of most sections of the Catalog. This includes focused data sheets, brochures and catalogs. In addition, Product Notes, written for specific instruments, are available on request. You may obtain this literature from our web site: **http://www.hp.com/go/tmc00,** or use our convenient reply card in the back.

Application Notes



The 2000 Catalog contains a comprehensive listing of Application Notes, all of which are available to you free of charge. **See pages 578–601.** This literature covers topics such as impedance, modulation, and semiconductors, and provides information to help you solve many test and measurement problems. A list of Application Notes is also available from our web site: **http://www.hp.com/go/tmc00**

Product Descriptions



A Network Analyzers

B RF Network Analyzers, 300 kHz to 6 GHz

275

HP 8752C

C

E
- 300 kHz to 1.3, 3, or 6 GHz
- Integrated 1 Hz resolution synthesized source
- Integrated transmission/reflection test set
- 50 Ω or 75 Ω system impedance
- Direct save/recall to an external disk drive
- Test sequence function for repetitive test procedures
- Up to 110 dB of dynamic range
- Group delay and deviation from linear phase
- Superb uncorrected performance

HP 8752C

F HP 8752C RF Network Analyzer G

The new HP 8752C RF network analyzer provides simple and complete vector network measurements in a compact, fully-integrated RF network analyzer. Characterize your RF components and networks accurately and economically with the HP 8752C RF network analyzer in the 300 kHz to 1.3, 3, or 6 GHz frequency range. Integration of the swept synthesized source, test set, and receiver results in a network analyzer that is easy to set up and use, which is ideal for service, incoming inspection, production, and final test measurements.

The integrated synthesized source provides measurement port power level of +5 to –20 dBm with linear, log, list, power, and CW sweep types. A new built-in step attenuator (Option 004) gives an improved power range of +10 to –85 dBm for testing power sensitive devices such as amplifiers. The sensitive tuned receivers provide up to 110 dB of dynamic range.

With two independent display channels available, you can simultaneously measure the reflection and transmission characteristics of the device-under-test on the crisp color display. Data can be displayed in log magnitude, linear magnitude, SWR, phase, group delay, polar, real, or Smith chart formats. The easy-to-use softkey measurement functions allow you to quickly measure the desired characteristic of your device-under-test.

Designed for Manufacturing

The productivity features of the HP 8752C increase your throughput in production. The test sequence function provides rapid and consistent execution of complex, repetitive tests with a single keystroke. In sequencing mode, you make the measurement once from the front panel and the instrument automatically saves the keystrokes without an external computer.

The HP 8752C offers excellent uncorrected performance, allowing simple and accurate measurements of your device-under-test without the need for measurement calibration. New productivity enhancements are faster CPU clock rate, DOS format for disk output, and expanded nonvolatile memory of 512 KB. Other helpful features include a plot/print buffer, limit testing, arbitrary frequency testing, and marker tracking functions. Up to four onscreen markers per channel are available for hardcopy outputs or for tuning at specific frequencies.

Time-Domain Analysis

The HP 8752C with Option 010 has the capability of displaying the time domain response of a network, obtained by computing the inverse Fourier transform of the frequency-domain response. Two time-domain modes are offered with the HP 8752C. The low-pass mode provides traditional time domain reflectometer (TDR) measurement capability and gives the response of a mathematically simulated step or impulse response. The bandpass mode, which has only the impulse stimulus, provides the time domain response of frequency-selective devices such as SAW filters and antennas.

Specifications Summary

Source
Frequency Characteristics
Range: 300 kHz to 1.3 GHz (std.); 300 kHz to 3 GHz (Option 003); 300 kHz to 6 GHz (Option 006)
Resolution: 1 Hz
Accuracy: ±10 ppm at 25° ± 5° C
Output Characteristics
Power Range: –20 to +5 dBm (std), –85 to +10 dBm (Option 004), –85 to +8 dBm (Option 004 and 075)
Resolution: 0.05 dB
Level Accuracy: ±1 dB
Level Linearity relative to –5 dBm output level:
(–20 to –15 dBm) ±0.5 dB;
(–15 to 0 dBm) ±0.2 dB;
(0 to +5 dBm) ±0.5 dB
Receiver
Frequency Range: 300 kHz to 1.3 GHz (std.), 300 kHz to 3 GHz (Option 003), 300 kHz to 6 GHz (Option 006)
Noise Level: (typical)
Reflection: –75 dBm (3 kHz IF BW), –85 dBm (10 Hz IF BW)
Transmission:
–90 dBm (3 kHz IF BW), –110 dBm (10 Hz IF BW) [300 kHz to 3 GHz];
–85 dBm (3 kHz IF BW), –105 dBm (10 Hz IF BW) [3 to 6 GHz]
Damage Level: 20 dBm or 25 Vdc (Option 006: 20 dBm or 25 Vdc at reflection port, 20 dBm or 10 Vdc at transmission port)
Crosstalk: 100 dB, 300 kHz to 1.3 GHz; 100 dB (97 dB Option 075), 1.3 to 3 GHz; 90 dB, 3 to 6 GHz
Group Delay Characteristics
Range: 1/(2 x minimum aperture)
Aperture: Frequency span/(no. of points –1), up to 20% of frequency span
Accuracy (in seconds): (phase accuracy (in degrees)/(360 x aperture in Hz)
RF Connectors
Test Ports: 50 Ω type-N (female); 75 Ω type-N (female) (Option 075)
Physical Characteristics
Size: 425 mm W x 178 mm H x 508 mm D (16.75 in x 7.0 in x 20.0 in)
Weight: Net, 25 kg (56 lb); shipping, 28 kg (63 lb)

4

D

Upgrade Kits

(Serial number of 8752C must be specified when ordering these kits.)
HP 11885A 3 GHz Frequency Upgrade Kit
The HP 11885A upgrade kit adds Option 003 to extend the operating frequency range of the HP 8752C from 1.3 GHz to 3 GHz. Installation at an HP service center is included.
HP 85019C Time-Domain Upgrade Kit
The HP 85019C upgrade kit adds time-domain analysis capability (Option 010) to an existing HP 8752C network analyzer. This kit is user installable. Installation at local HP service center is not included.
HP 11884D 6 GHz Upgrade Kit for HP 8752C
Includes installation at a local HP service center. Not for use with HP 8752C Option 075.
HP p/n 08752-60019 Step Attenuator Retrofit Kit

H Faxback (24hr) **1-800-800-5281** Internet URL **www.hp.com/go/tmc98** Product & Order Info 8am-8pm EST **1-800-452-4844**

The body of this catalog contains over 10,000 new and existing test and measurement products and accessories from Agilent. Although not every Agilent product is included, you will find all relevant references to other sources.

A General product headline
Identifies the broad product category of the instrument, system or service described in the section.

B Product description
Defines the specific purpose and function for the product described.

C Product number
Defines the specific Agilent model numbers and versions that are described on the page.

D Section tab number
Relates to the Section numbers identified in the Table of Contents, and defines a product family.

E Product features
Give an "at-a-glance" view of the key features of the products on the page.

F Specific product identification
Defines the features and specifications of one model in the family of products on the page.

G Product attribute marks
Define, by symbols described below, which special features or services apply to this product.

H Agilent action and help locations

1

Symbols

NEW

This symbol identifies all new products for 2000 throughout the general products and systems pages.

GPIB

This symbol is used throughout the catalog and identifies products that have GPIB (IEEE-488) capability.

The QuickShip symbol, used in the ordering information, indicates specific products available for quick delivery. To order QuickShip items, call 1-800-829-4444.

Outside the U.S. contact your local call center or sales office to order products available through QuickShip.

UID

This symbol identifies programmable instruments that support the Agilent Technoliges family of Instrument Drivers, which allow test code development using standard links in multiple vendor hardware, and are based on the VISA I/O libraries. Additional information is available: **http://www.hp.com/go/inst_drivers**

X11

This symbol identifies products that include an Agilent interface for simplified FTP and NFS LAN/WAN remote access and control via an X11 window display. This Agilent networked user interface adds instrumentation resources to client-server computing systems and increases the capability of existing network connections.

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Trademark Information

Case studies show customer successes with HP Complete Test Solutions

Siemans automotive systems achieves more throughput flexibility at reduced cost with HP TS 5400 systems.

In the following pages we have compiled a set of examples of the successful "Complete Test Solutions" developed by HP and a customer. These represent large and small companies from around the world which have a variety of needs. The thing they have in common is that in cooperation with HP, they were able to solve a major test and measurement problem. A brief overview of these case studies may give you some ideas about how HP can help you improve your business results.

Lockheed Martin cuts costs and cycle time with HP VXIbus solution.

To cut costs and improve cycle times, Lockheed Martin developed a re-useable, re-configurable system called "Common Core Test Station." In addition to the VXIbus backplane and equipment, HP contributed special software, and design elements. (Page 40)

Apsco uses HP Pay-Per-Use test system for flexibility and low cost

Using the HP Pay-Per-Use test system Apsco has achieved nearly 100 percent first pass yield, reduced its internal defects, and lowered costs while having access to different levels of test as required. (Page 40)

National Power uses HP RTAP to cut costs and improve control

To increase flexibility and responsiveness in coal-based power stations, National Power of Swindon, England chose an "advanced plant management system" with HP Real-Time-Applications Program (RTAP) data base at its core.(Page 41)

Harris Broadcasting DTV Field Test Vehicle uses HP 89441 V

Harris Broadcasting uses HP 89411 V vector signal analyzer to replace multiple instruments in mobile field test vehicle to map signal coverage, with measurements and calculations done automatically. (Page 41)

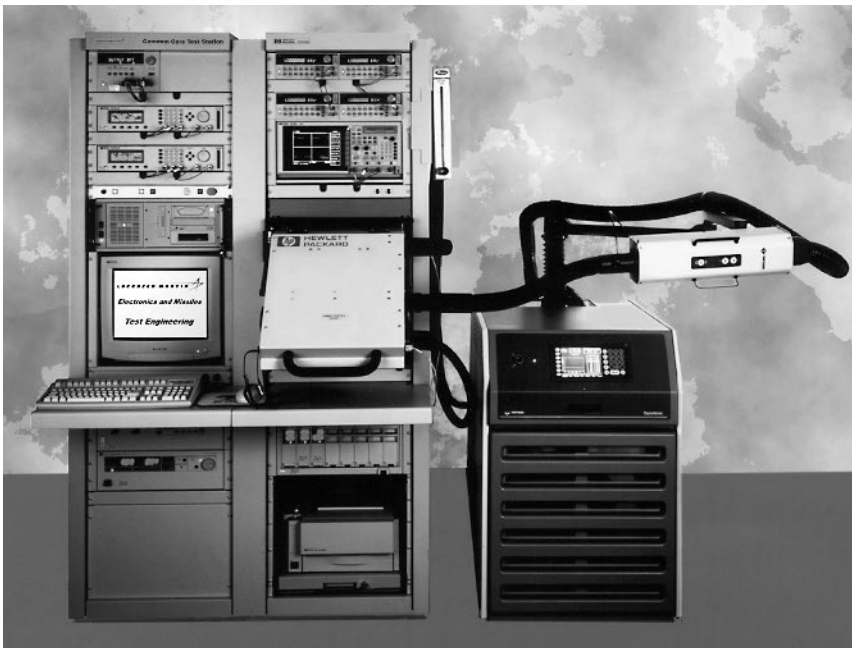
Motorola and HP develop mobile phone test system for product life cycle

The complex architecture of cellular networks, especially digital systems, and the fast turn over of new products makes it impossible to use traditional test instruments. Motorola designers worked with HP experts to develop the test systems for all phases of the phone life cycle. (Page 42)

IPM Datacom cuts test time sharply and improves throughput with HP ATE

IPM Datacom manufactures for the very competitive telecommunications field. With product testing a major cost driver, they needed an automatic test system to meet present demand, keep costs low, and allow them to expand rapidly in the near future. (Page 42)

Lockheed Martin achieves sharp reductions in cost and cycle times with VXIbus test station



Hellfire II Common Core Test Station with Temperature Forcing Unit.

Lockheed Martin, like businesses worldwide, has continued to drive process improvements to cut costs and reduce cycle times to remain competitive. This creates an especially big challenge for test equipment development departments to deliver complete and debugged test devices and systems just as the design of the product is finished and ready for production.

The design of automatic test equipment represents a significant portion of the non-recurring cost of developing state of the art production lines, especially when each system is one-of-a-kind, such as Lockheed Martin's typical situation. In addition, the ongoing support costs of the large number of unique systems throughout numerous production and depot facilities is a significant part of the total program. To meet this challenge, Lockheed Martin Electronics and Missiles has implemented a formal hardware and software design re-use strategy resulting in a re-useable, re-configurable system called "Common Core Test Station."

Central to the Common Core Test Station platform is the VXIbus, a robust industry standard test equipment architecture. Standard "plug & play" instrument software provides universal support by commercially available test development software and portability from one generation to the next. HP's contribution to this Lockheed Martin initiative was far more than providing commercial off the shelf that met their high quality and reliability standards. HP also combined Lockheed Martin's standard test executive software with HP developed application software, designed the rack layout, cables and custom interface panel; designed the fixture, which enabled use of a temperature forcing unit during test; and developed and delivered training for users, system programmers, and maintenance personnel.

The total result is documented reductions in development costs of more than 50 % along with development cycle time reductions in excess of 25%.

Apsco nears 100 per cent yields and lowers costs with HP Pay-Per-Use board test system

Apsco, of Perry, Ohio, ranks in the top 75 of contract manufacturers, with products for consumer electronics, medical equipment and office business machine customers. The HP Series II Pay-Per-Use (PPU) Board Test System allows Apsco to manufacture 1600 different low-to-high complexity assemblies without incurring high financial risk.

"The HP 3070 PPU is a very versatile system that does not burden us with a large capital investment or high expenses," says Steve Schmidt, Apsco's director of engineering. "The state-of-the-art testing capabilities allow us to compete and win highly competitive contracts." He explained, "It's the most technologically advanced system for in-circuit test on the market today. The pay-per-use feature gives us the most cost-effective system for bringing on a new product. What test capabilities we don't use, we don't pay for, and we don't charge our customers. It's as simple as that, and only HP offers this type of solution."

The HP 3070 system integrates the capabilities of unpowered process test through combinational test. A user can access the different levels of test through HP test credit buttons. These buttons, attached to the machine work very much like a subway token card. The buttons record the test capabilities that are used and charges the user according. "The HP 3070 Pay-Per-Use System is half the cost of a non-pay-per-use system, yet it arms us to compete, and win, against companies with much more expensive systems," commented Schmidt.

Using the HP system, Apsco has achieved nearly 100 percent first pass yield and has also significantly reduced internal defects to provide customers with the highest quality manufacturing at the lowest costs.

HP (RTAP) provides core foundation for National Power cost and control improvements

National Power was created in the United Kingdom in 1991 following the privatization of the electricity power industry. NP is one the U.K.'s leading electricity generators and has the largest installed capacity.

National Power (NP) of Swindon, England, is one of the largest electricity generators in the world, with an interest in 40,000 megawatts of power. Since its creation, as a result of the privatization of the electric power industry in the UK its stated aims have been to provide the highest quality of service to customers while maintaining the highest quality of efficiency.

As a step in achieving these goals, NP decided to improve the systems it was using to control the generation of electricity in coal-fired power stations. Specifically, NP wanted to increase flexibility and responsiveness in the coal-based power stations, integrate diverse control systems at all sites, create a uniform operator interface, and a managed engineering interface; create a generic database for hierarchy of coal-plant, business and support data; and manage plant component life and integrity. Of the options available, NP chose to add a supervisory layer above the existing control systems. Since no single product on the market could satisfy these objectives, NP looked to create a new system, using existing software packages as building blocks.

Syseca, an international systems and service company, was chosen for its "advanced plant management system" (APMS) based on its own OpenPMS Supervisor, with HP Real-time applications platform (RTAP) data base at its core. The HP RTAP provides the control desk with up-to-the-minute operating information, which represents all coal-fired plants. The results have been noteworthy in achieving the goals, with examples of major improvements in controlling the startup process and reducing energy costs. "The Hewlett-Packard RTAP product was considered to have the best performing real time database on the market," said Andrew Lichnowski, Team Leader, Process Control Systems, National Power.

Harris Broadcasting Systems test vehicle uses HP 89441V for DTV coverage mapping

1

The transition to digital television has increased the need for accurate and timely mapping of broadcast coverage areas. "Coverage mapping" involves understanding the limits and quality of existing NTSC broadcast, and then performing measurements on signal level and quality of a digital test transmission over that area.

Hewlett-Packard proposed the HP 89441V vector signal analyzer to Harris Broadcast Systems to replace multiple instruments, such as a spectrum analyzer, power meter, and frequency counter. This, integrated into a Harris Broadcast System mobile test vehicle, equipped to go out and record signal strength in multiple locations, enables them to provide cost-effective results to their clients.

The HP 89441V performs measurements automatically. It looks at the channel, and when the band power markers are set on 6MHx bandwidth, it automatically calculates the signal power inside the band. The analyzer can also automatically apply the FCC weighting mask to the measured signals. The automation and digital modulation entirely in software are important elements.

Understanding what's required to provide comparable coverage with a digital transmitter can produce a streamlined and cost-effective system that provides information for the future. As the DTV market expands, and the inevitable spectral interference issues arise, the advantages of having both measurement flexibilityand recognized standard instrumentation become even more apparent, and Harris Boradcast Systems, with HP equipment is prepared to provide that information.

Motorola uses HP mobile phone test system to test products during total life cycle

1

HP test systems equip this Motorola mobile phone repair facility in Italy.

The cell phone market demands a regular turnover of innovative products. To produce large volumes of a new design at short notice, the manufacturer must be able to test its functions all the way through the production process, from design to completion, with a minimum amount of test design and development for each product. As a result the system used must have comprehensive capabilities, plus the ability to change easily and inexpensively with the development of new products.

The complex architecture of cellular networks, especially digital systems, makes it impossible to use traditional instruments. Motorola designers work side by side with HP experts to develop nearly all the test and measurement instrumentation used worldwide by Motorola in their mobile phone plants. In addition, the entire Motorola after-sales service sector uses HP designed test sets for GSM (Global Standard for Mobile Communications) mobile phones that simulate the real network, as well as the stimuli that the phone will receive in use. While the need for mobile phone repair is not a frequent occurrence, the HP test sets give Motorola technicians the accuracy and repeatability required for their precise work. By using the same test set for final testing after repair as that used during manufacture, results are practically identical to the original product.

IPM Datacom uses HP 3279CT automatic testing system to increase throughput sharply

IPM Datacom, a privately-held company with 80 employees, designs and manufactures systems and terminals for public and private telephone companies, and also for data transmission and electronic components. One of the newest products designed and created by IPM Datacom is the network terminator for ISDN access. This product is known as NT1 Plus (Network Terminator). The “Plus” indicates that the terminator allows the ISDN subscriber to connect digital equipment as well as traditional analog equipment.

ISDN terminators are made by various suppliers. In order to emerge as a winning supplier, IPM Datacom decided to use a system of automatic testing which allows it to reduce the time and cost involved with functional testing and to maintain flexibility in the dynamic telecommunications market.

After analyzing its testing needs, IPM Datacom realized that using a measurement device equipped in a traditional way, that is with specialized instrumentation and coordinated by a PC connected by IEEE-488, would require 10-15 minutes to test an NT board. Using the faster, more sophisticated HP 3279CT (Automatic Test Equipment) they were able to reduce this time by 7 -8 minutes. In addition, IPM Datacom needed to produce and deliver thousands of ISDN terminators in just a few months, which was possible with the increased throughput.

Another product, a High-speed Digital Subscriber Line (HDSL), allows the equivalent of 15 telephone channels to be transmitted on a single duplex cable. Using traditional methods to test the most recent HDSL equipment would take about an hour, but by using the HP 3279CT, testing time is reduced to about 15 minutes.

Innovative products that make a difference

The exciting new products in this section of the catalog offer you important new capabilities and enhanced benefits. They reflect the wide scope of HP's research investments and underscore an unwavering commitment to meeting your changing test and measurement needs with continually improved instruments, systems, software, and services.

Among the characteristics and trends illustrated by the new products in this section are the following:

Increased value—and affordability, with nothing left out, has been achieved through improved designs, patented measurement techniques, higher integration, and efficient manufacturing.

Ease of use—features such as one-button test capabilities, voice control, and advanced graphical user interfaces make sophisticated HP instruments easier to operate and help you achieve results faster.

Collaboration—linkage software allows an X-ray inspection system and an in-circuit test system test systems to collaborate intelligently to decrease test redundancy, reduce fixture complexity, and boost fault coverage.

Enhanced flexibility—hardware and software products add capabilities that boost the flexibility and utility of versatile platforms such as the HP Broadband Series Test System (BSTS).

Breakthroughs—unique solutions to long-standing problems have been developed by HP engineers, continuing a legacy of product innovations.

Higher performance—new, extended performance limits permit insights into problems that were previously impossible to analyze.

More powerful methodologies—new, advanced troubleshooting techniques let you analyze problems with unprecedented speed.

Modularity—modular test solutions give you greater measurement flexibility with considerable economy—a combination that offers value now and in the future.

Faster test speeds—higher measurement throughputs increase productivity in both engineering and production environments.

Improved data-analysis capabilities—new HP instruments make it easier than ever to complete the entire test and measurement task, including data analysis and report preparation.

Upgradeability—the flexible architectures used in many HP instruments enable timely software performance and feature upgrades, extending the equipment's useful life, and safeguarding capital investments.

Portability—many new HP analysis instruments are exceptionally small and lightweight, so they are easily carried to the problem site for efficient troubleshooting.

Application-specific solutions—HP now has an expanded capability to support the complete test engineering solution process, from consulting services to fully configured test systems, and offers more standard products optimized for applications such as data communications and video.

User familiarity—leveraging familiar user elements of computers to allow you to spend more time on your project and less time learning the instrument.

Web enabled—more instruments that interface directly to the internet to make HP and other resources more readily available.

More products, more solutions

HP, the worldwide test and measurement leader, offers you the industry's most extensive, most trusted line of standard and custom solutions. The new products for 2000 build on a vast base of existing products. To obtain a more complete picture of how HP products and services can help you, please refer to the main product sections, which begin on page 79. If you need additional information on a specific application, contact the HP Call Center in your region.

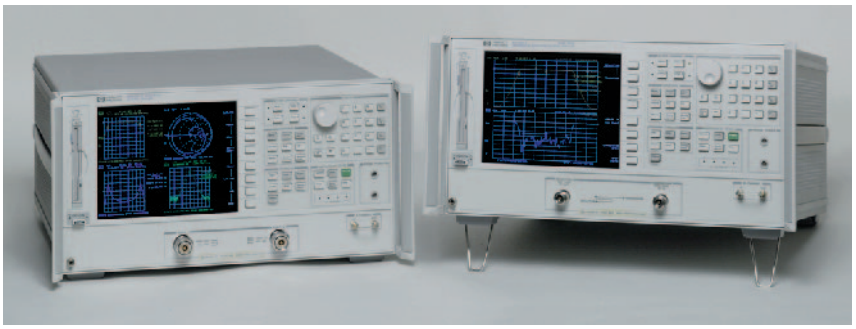
New product line expansion through acquisition

Agilent Technologies continues to add new products that expand its capabilities to support customer test and measurement needs through acquisition as well as internal development. The following are two examples:

Solutions targeted toward keeping an enterprise network secure are now available through the acquisition of Security Force Software of Research Park Triangle, North Carolina. (More details on page 373.)

Systems providing remote control and end-to-end analysis for Fax and Voice Over IP telephony networks are new solutions introduced by Telegra Corporation of Santa Clara, California, which became part of Agilent in April 1999.

Powerful RF vector network analyzers



The new HP 8753ET and 8753ES RF vector network analyzers offer more choices to fit your performance and budget needs.

If you need an RF vector network analyzer, you can now choose either the HP 8753ES—which offers the same integrated S-parameter test set found in the HP 8753E—or the HP 8753ET, with its more economical transmission/reflection test set. These analyzers have the speed, accuracy, and productivity features you need to improve your designs in R&D or maximize your measurement throughput in manufacturing.

The HP 8753ET, which replaces the HP 8752C, provides transmission and reflection measurements of devices in the forward direction. The HP 8753ES allows you to measure both the forward and reverse characteristics of your components with a single connection. It also provides full two-port calibration for the best measurement accuracy. New test set options give you more flexibility in configuring the HP 8753ES for your application.

Both the HP 8753ET and 8753ES analyzers cover frequency ranges to 3 GHz or 6 GHz and offer up to 110 dB of dynamic range. Frequency and power sweeps let you characterize the linear and nonlinear behavior of active and passive components with magnitude and phase information, absolute power, gain compression, group delay, and time-domain measurements.

For more information, see page 273.

For detailed specifications, circle 1 on the reply card (last page) or contact the HP Call Center in your region.

Microwave vector network analyzers

HP gives you a choice of microwave vector network analyzers: S-parameter and transmission/reflection models.

The HP 8720E family of microwave vector network analyzers has expanded. Now you can now choose from the traditional high-performance S-parameter analyzers (ES models), or the more economical transmission/reflection analyzers (ET models).

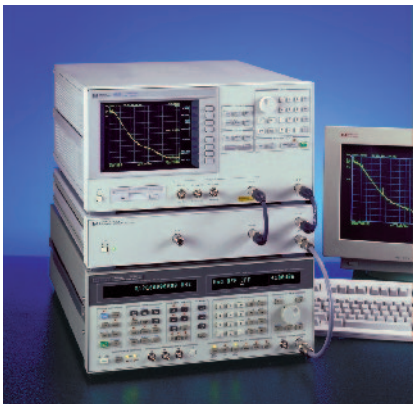
The S-parameter analyzers measure the forward and reverse characteristics of components with one connection and provide full 2-port calibration for the best measurement accuracy. The transmission/reflection analyzers provide forward transmission and reflection measurements of devices, at an affordable price.

From the 13.5-GHz HP 8719ET analyzer to the 40-GHz HP 8722ES analyzer, each model in the HP 8720E series meets different needs. All are built to HP's exacting standards for quality, reliability, and performance.

For more information, see page 279.

For detailed specifications, circle 2 on the reply card (last page) or contact the HP Call Center in your region.

12.6 GHz VCO/PLL signal test system



Perform comprehensive design evaluations and production tests of VCOs and PLLs that operate at frequencies up to 12.6 GHz.

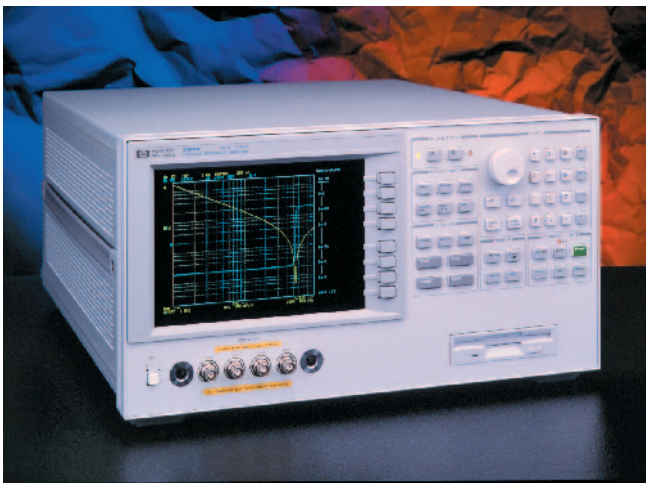
The enhanced frequency range of the HP 4352S—the industry standard for VCO/PLL testing—extends from 10 MHz to 12.6 GHz. This simple, multifunctional signal test system combines the HP 4352B VCO/PLL signal analyzer, an HP 43521A downconverter/frequency doubler, and a 6 GHz signal generator (the HP 8665B with Option 004). It accurately measures frequency, phase noise, RF power, spectrum, FM deviation, transients, settling time, and the many other parameters that characterize RF oscillators used in wireless communication equipment.

The HP 4352S test system serves both production test and research and development (R&D) applications. As a production test system, the HP 4352S offers high-speed measurement and two operating modes: "signal analyzer" and "VCO tester." It can make pass/fail decisions based on a predetermined set of tests and test limits. In lab environments, the VCO/PLL test system provides a powerful analysis capability for design evaluation and verification.

For more information, see page 324.

For detailed specifications, circle 3 on the reply card (last page) or contact the HP Call Center in your region.

Precision impedance analyzer: New/improved functions and capabilities for higher engineering efficiency



Perform accurate impedance measurement and analysis on a wide variety of electronic devices with a new-generation instrument—the HP 4294A precision impedance analyzer.

The HP 4294A precision impedance analyzer is an integrated solution for efficient impedance measurement and component/circuit analysis. The analyzer covers a broad test-frequency range (40 Hz to 110 MHz) with ±0.08% basic impedance accuracy. Its excellent high-Q/low-D accuracy enables the analysis of low-loss components, and its wide signal-level ranges allow you to evaluate devices under actual operating conditions. The test signal level is 5 mV to 1 V rms, or 200 µA to 20 mA rms; dc bias is 0 to ±40 V, or 0 to ±100 mA. Built-in advanced calibration and error-compensation functions eliminate measurement error factors when you perform measurements on in-fixture devices.

Advanced modeling

The HP 4294A's equivalent-circuit analysis function provides advanced modeling (3- and 4-element models) based on circuit constant values of five circuit models. This function simulates the frequency characteristics of components by using either derived circuit values or user-specified values. Comparisons of design values to measurement values can help make component design more efficient.

The precision impedance analyzer offers features highly useful in today's PC environment: LAN capability allows you to share files, data, or instrument control. A VGA monitor output lets you use a larger display to increase productivity and reduce eye strain. A TIFF capability lets you format graphics data such as display screens. Measurement setup information, results, and graphics (in TIFF format) can be exchanged with other team members via file transfer protocol (FTP).

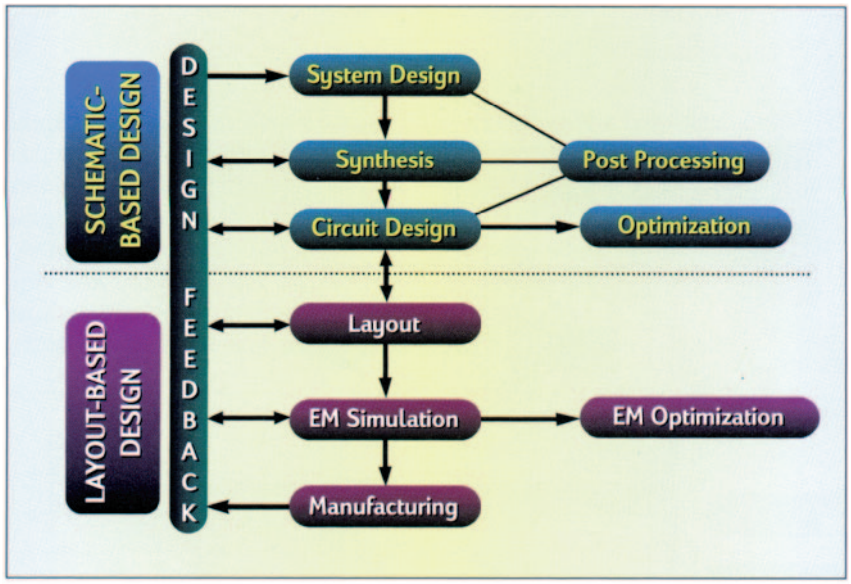
Complete solutions

You can use HP test fixtures and impedance analyzer accessories to implement complete impedance measurement solutions that improve device quality and reduce circuit development cycle time. By combining an HP 4294A analyzer with an HP 42941A impedance probe kit, for example, you can perform in-circuit measurements (printed circuit patterns, the input/output impedance of circuits, and more) and get better accuracy and wider impedance coverage than possible with LF impedance probes. By combining the new analyzer with an HP 42942A four-terminal pair (4TP) to APC-7 terminal adapter, you can use many RF test fixtures developed for the HP 4291B RF impedance/material analyzer.

For more information, see page 474.

For detailed specifications, circle 4 on the reply card (last page) or contact the HP Call Center in your region.

Software takes EM technology from analysis to design automation



The HP Momentum Optimization software improves a typical design flow by providing layout-based optimization of geometries.

You can get a comprehensive software system for electromagnetic (EM) design automation when you use the new optional software package with the popular HP Momentum software tool for high-frequency circuit boards, antennas, and ICs.

The HP Momentum Optimization package provides planar EM simulation design automation capabilities that increase the efficiency of the RF and microwave design process. The software helps you fine-tune circuit performance by exploring design variations and geometry sensitivities you might not otherwise investigate. The combination of this design approach and the optimization software's ease-of-use features can let you attain better circuit performance in less development time.

Geometry capture

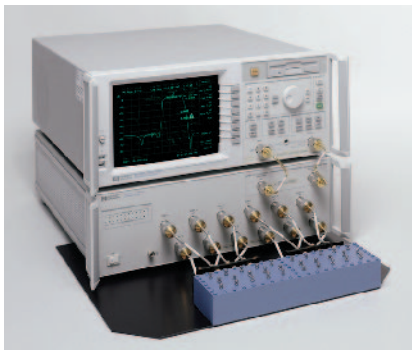
You can easily set up geometric parameters as candidate variables for optimization with a process called geometry capture. After you request a parameter to optimize, the HP Momentum Optimization software automatically creates a copy of the nominal geometry in a new layout window. Then, you can move the vertices of the copied geometry to create the geometric parameter and specify its range for optimization.

The HP Momentum Optimization software package is an option for the HP Advanced Design System version 1.3. To get an overview of the capability of this package, visit our web site: **www.hp.com/go/hpeesof.**

For more information, see page 549.

For detailed specifications, circle 5 on the reply card (last page) or contact the HP Call Center in your region.

Multiport measurement systems dramatically increase throughput



Connect your device one time to measure all signal paths and ports.

HP 87050E multiport test sets work with the HP 8712E series of RF series vector network analyzers to provide complete multiport measurement systems up to 12 ports. This combination minimizes RF connections, allowing dramatic increases in measurement throughput.

Low-cost HP 8712E/87050E multiport test systems deliver fully specified performance at the actual test ports. You get the same measurement results on any test station. This reduces measurement uncertainty and lets you tighten your product specifications, which will increase customer confidence in your products.

Advanced calibration techniques eliminate redundant connections of standards, reducing the amount of calibration time by a factor of twenty. The effect of test set drift is also reduced, for better measurement accuracy. In addition, the HP 8712E series of network analyzers has many productivity features that speed tune/test time, increase throughput, and simplify automation.

For more information, see page 270.

For detailed specifications, circle 6 on the reply card (last page) or contact the HP Call Center in your region.

High-speed test systems for the manufacturing floor

The HP E6520A millimeter wave module test system provides the high test throughput needed for efficient volume production.

The HP E6520A series millimeter (mm) wave module test systems enable complete characterization of microwave and mm wave modules in high-volume production environments. They are ideal for applications where a large volume and/or mix of measurements or devices require full test plan execution within a few seconds. The test systems have a flexible architecture that incorporates a high-speed, DSP-based receiver with single-touch, multiple-measurement design.

Easy-to-use software lets you quickly create or modify test plans and perform system calibrations. By greatly decreasing the amount of code generation necessary to test complex devices, the HP E6520A series test systems help reduce time-to-market.

For more information, see page 327.

For detailed specifications, circle 7 on the reply card (last page) or contact the HP Call Center in your region.

General-purpose spectrum analyzers reduce test time

These new portable spectrum analyzers offer best-in-class speed and performance.

The five spectrum analyzers in the new general-purpose HP ESA-E series have the best speed, accuracy, dynamic range, and resolving power in their price class. These analyzers let you spend less time testing, and more time designing, building, and troubleshooting components and products. Available in frequency ranges from 1.5 GHz to 26.5 GHz, the analyzers can be upgraded for enhanced performance as test needs change.

Fast and accurate in R&D

Research and development engineers can use HP ESA-E series spectrum analyzers to reduce test time while being confident of test results. Optional 10-Hz digital, narrow-resolution bandwidth (RBW) filters improve the analysis of closely spaced signals and boost resolution.

Quicker tests in manufacturing

The ESA-E series analyzers can help to reduce manufacturing test time, time to market, and costs. The spectrum analyzers provide 5-ms full-span RF sweep time and up to 28 measurements per second (up to 19 per second when the data is transferred over GPIB).

Rapid, flexible field service

The ESA-E series spectrum analyzers are protected by an exceptionally rugged case and can make calibrated measurements in just 5 minutes. Wireless communications engineers can use the analyzers to perform one-button, format-specific tests for GSM and CDMA formats.

For more information, see page 227.

For detailed specifications, circle 8 on the reply card (last page) or contact the HP Call Center in your region.

High-performance microwave synthesizer for VXI-based test systems

A VCO-based design and patented shielding and interfacing techniques produce synthesizer performance unprecedented in the VXI platform.

The HP E6432A VXI Microwave Synthesizer ushers in the next generation of microwave synthesized signal sources and is designed:

- For automated test equipment (ATE) systems.
- With a rugged design well suited for test applications ranging from high-volume automated production environments to field-test sets.
- With a small footprint for significant space and weight reduction.

The HP E6432A combines the speed of voltage-controlled oscillators with new patented shielding and interfacing to provide a level of performance never before available in the VXI platform.

This leading-edge spectral performance combined with the fast frequency switching speed of the source, allows for significant reduction in test times.

Key features:

- 3-slot VXI register-based design
- 10 MHz to 20 GHz frequency range
- -90 to +20 dBm output power
- 1 Hz tuning resolution
- <400 µs switching time
- <AM, FM and pulse modulators standard
- <VXI Plug&Play driver

For more information, see page 208.

For detailed specifications, circle 9 on the reply card (last page) or contact the HP Call Center in your region.

EMC analyzers make in-house testing a reality

Reduce development time and cost by finding EMI problems early in design and evaluation processes.

The HP E7400 A-series EMC analyzer is an easy-to-use, fully automated pre-compliance measurement system that helps product manufacturers meet electromagnetic compliance (EMC), reduce product-development costs and time to market. Designed for in-house pre-compliance and diagnostic EMC measurements, the HP E7400 A-series EMC analyzers help development engineers perform EMC testing throughout the design and evaluation processes.

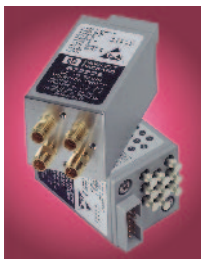
Users can capture measurements directly from the panel of the EMC analyzer or use the interactive software to carry out tests from a PC. Automatic re-measure functions deliver accurate, fast and repeatable results for one or more signals. The color display and built-in floppy-disk drive provide visual clarity of signals and the ability to export measurement results.

To address frequency and amplitude requirements, HP offers the EMC analyzer in frequencies up to 26.5 GHz, with low start-up costs. In addition, the HP E7415A EMC measurement software helps reduce startup time with fully automated, easy-to-learn diagnostic and EMI measurements.

For more information, see page 314.

For detailed specifications, circle 10 on the reply card (last page) or contact the HP Call Center in your region.

High-reliability, 4-port coaxial transfer switches



These versatile, high-performance transfer switches help you simplify high-frequency test applications

You can simplify the design of high-frequency test systems with the new HP 87222 series 4-port coaxial transfer switches: The HP 87222C (dc-to-26.5 GHz) and 87222E (dc-to-50 GHz). The HP 87222C and HP 87222E allow you to use fewer switches and thus obtain higher test system performance and a lower cost of ownership.

These switches feature excellent repeatability (<0.03 dB, typical) and long life (5 million cycles, minimum) which is essential in signal routing applications such as single-pole double-throw, a drop out switch, switching two inputs and two outputs or signal reversal switching.

The standard version of these switches has a plug-in connector: options include solder lugs (Option 100) and mounting brackets (Option 201).

For more information, see page 302.

For detailed specifications, circle 11 on the reply card (last page) or call the HP Test & Measurement Call Center at 1-800-452-4844. Ask for QuickCode 6605.

Signal generators offer superior phase noise performance, digital modulation flexibility

By using the programmable hardware of the digital signal generators, you can modify existing modulation standards or create new formats.

Eight high-spectral-purity RF signal generators join the popular HP ESG family. The HP ESG-AP (analog) series and HP ESG-DP (digital) series models have frequency capabilities from 250 kHz to 1, 2, 3, or 4 GHz. They deliver the built-in multiple functionality needed for general-purpose research and development use, and are especially good choices for applications that span both digital and analog technologies. With <–135 dBc/Hz at 20 kHz offset from 1-GHz carrier frequency, the new models are an economical alternative at nearly half the price of HP's higher-performance RF signal generators.

Analog signal generators

The HP ESG-AP series analog signal generators have excellent phase-noise performance. They provide amplitude, frequency, phase and pulse modulation, have built-in step-sweep features and offer a versatile function generator.

Digital signal generators

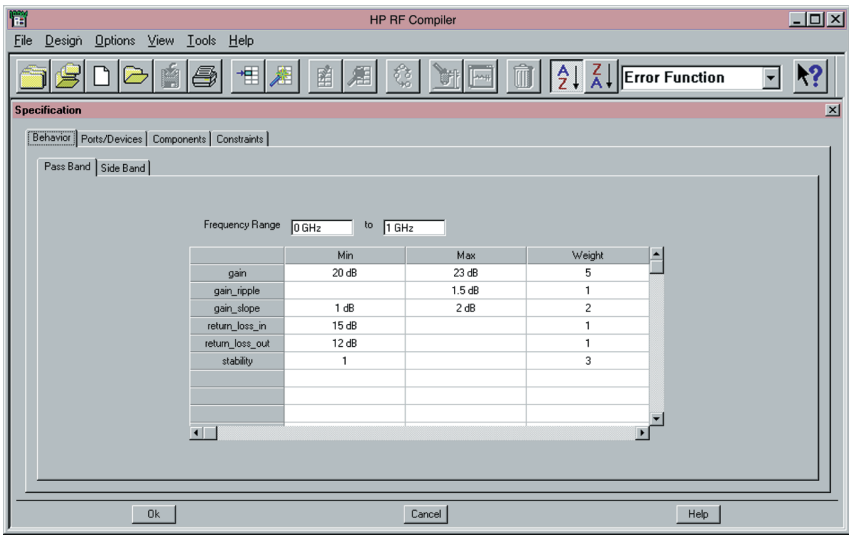
Models in the HP ESG-DP series combine a wide range of powerful digital capabilities and all of the features of the HP ESG-AP models. These signal generators can be used as substitutes for local oscillators. They are ideal for the development of digital communications standards, where you can use their programmable hardware to modify existing modulation standards or create new formats. These signal sources are also easily upgradable to future levels of performance.

The HP ESG-DP series digital signal generators provide broadband I/Q modulation for all major communication standards: W-CDMA, cdma2000, EDGE, GSM, IS95 CDMA, NADC, DECT, PDC, PHS, and TETRA. Optionally, they offer a dual arbitrary-waveform generator for creating complex digitally modulated signals, a real-time I/Q baseband generator for generating custom signals, a bit-error-rate analyzer for sensitivity/selectivity measurements, and improved ACPR performance.

For information, see pages 192 and 199.

For detailed specifications, circle 12 on the reply card (last page) or contact the HP Call Center in your region.

Create topologies and component values from circuit specifications



The HP RF Compiler speeds the transition from system-level specification to working schematic.

The HP RF Compiler is a unique, wizard-driven circuit synthesis tool that extends the capabilities of traditional schematic capture design and existing circuit synthesis tools. It is useful for microwave circuit design and the design of RF boards with lumped or distributed circuits. It can also be used to synthesize off-chip filter and matching networks for RFICs.

With the HP RF Compiler, you no longer need to specify a circuit topology or component values. Instead, you enter easily recognizable circuit specifications, such as gain and return loss. The software synthesizes and returns both the topology and the component values. It then writes this typology and set of component values to an HP Advanced Design System schematic. The process is completely self contained, from specification to working circuit.

The individual application modules that the HP RF Compiler provides are contained inside a simple, wizard-like dialog box. It guides you through the process of creating a target specification, setting the topology and component constraints, and configuring other search parameters. The compiler takes behavioral-level specifications written in engineering terms, such as gain and return loss, and produces a machine-readable HP Advanced Design System schematic that is ready to simulate.

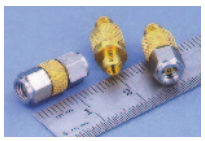
A wide range of optimization goals are available during the specification phase, depending on the application. These include: gain, gain ripple and gain slope, phase, phase ripple and phase slope, delay and group delay, S-parameters and stability.

The HP RF Compiler uses a "correct-by-construction" approach to ensure that the components in the newly generated circuit are physically realizable. It does this by constraining both the component type and the range of component values as part of the specification process. This restricts the HP RF Compiler to a known set of components before the synthesis process begins. By letting you predetermine a set of allowable components, and by giving you the ability to automatically generate circuit topologies, HP RF Compiler puts more power into your hands than any other commercially available synthesis tool.

For more information, see page 548.

For detailed specifications, circle 13 on the reply card (last page) or contact the HP Call Center in your region.

1 mm adapters ease test setups



HP 11920/1/2

HP 11923A

RF & microwave test accessories, such as these 1.0 mm adapters ease test setups.

For Microwave and RF engineers making coax measurements at 50, 65 or 110 GHz, the HP 11920/1/2 series 1.0 mm adapters provide an easy way of measuring coaxial devices at high frequencies. The HP 11920 A/B/C, 1.0 mm to 1.0 mm are designed for the measurement of components with 50 ohm 1.0 mm connectors. The HP 11921 A/B/C/D, 1.0 mm to 1.85 mm and the HP 11922 A/B/C/D, 1.0 mm to 2.4 mm adapters are intended to be used as general purpose adapters that are versatile and interchangeable. These adapters enhance the capability needed to use test systems, such as the HP 8510XF.

The HP 11923A connector launch is intended for use with 8510XF and other test systems up to 110 GHz. The HP 11923A 1.0 mm female-connector launch threads into a package or fixture housing to transition a microwave circuit from microstrip to coaxial connector.

The HP 11923A 1.0 mm female connector has an air dielectric interface and center conductor that is supported by a low-loss plastic bead on one end, and a glass-to-metal seal interface on the other end.

For more information on this connector launch, see page 285.

For detailed specifications, circle 14 on the reply card (last page) or contact the HP Call Center in your region.

Accurate power measurements of multiple formats

HP sensors provide accurate average power measurements of multiple wireless formats over a wide dynamic range.

The HP E-series E9300 power sensors for the HP EPM-series E4418 and E4419 power meters allow you to measure the average power of RF and microwave signals, regardless of modulation format, over a wide dynamic range.

With a single HP E9300 power sensor, you can measure complex digital modulation formats—including those used in wireless communication, satellite, and cable TV systems—at low and high power levels.

The new power sensors feature an HP-developed diode-attenuator-diode topology that ensures accurate and repeatable measurements across their full –60 to +20 dBm dynamic range. Offering high maximum-power and peak-power specifications, the sensors can handle the large crest factors typical of the newest signal modulation formats.

For more information, see page 291.

For detailed specifications, circle 15 on the reply card (last page) or contact the HP Call Center in your region.

Increase the test throughput and quality of CDMA mobile phones

This CDMA mobile station test set increases test throughput and product quality when manufacturing mobile phones.

The HP E8285A CDMA mobile station test set helps mobile-phone manufacturers produce high-quality phones in the least amount of time. Based on the industry-standard HP 8924C, the new HP E8285A offers improved measurement speed, accuracy, performance, and reliability for cellular and PCS CDMA testing—in a single, easier-to-use box. Its more powerful microprocessor and improved measurement algorithms make test measurements faster. CDMA transmitter and receiver measurements run concurrently to further speed the test process.

The test set supports hard handoffs between RF channels, CDMA-to-analog handoffs from both the cellular and PCS bands, and softer handoffs. These capabilities allow you to test all soft-handoff functionality except decision of power control bits.

For realistic base station simulation, the HP E8285A provides pilot, sync, paging, and traffic-channel simulation. The test set is an excellent value not only for manufacturing and R&D lab use, but also for high-volume CDMA phone service and repair shops.

For more information, see page 344.

For detailed specifications, circle 16 on the reply card (last page) or contact the HP Call Center in your region.

Test set for GSM mobile phone repair

Service shops can use the HP E6392A GSM mobile station test set to economically increase their repair capability.

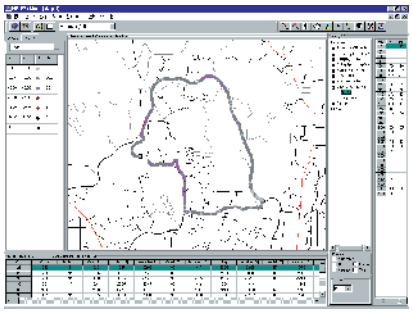
To help service technicians cope with the growing number of mobile phones brought to repair shops, the HP E6392A GSM mobile station test set provides a module-level repair capability for the price of an entry-level "go/no go" tester. With this single instrument, technicians can check most GSM phones, troubleshoot a problem to the mechanical or module level, and make necessary module replacement. The test set offers a combination of just-enough functionality, good performance, and a low price. It can increase the repair capability and effectiveness of an entire service network, while also reducing the number of "no trouble found" phones that must be sent back to the manufacturer.

Comprehensive, automatic measurements speed the inspection and testing of GSM phones. The test set has full test capabilities for the GSM900, E-GSM, DSC1800 and PCS1900 formats. It provides a dc power consumption check, performs various transmitter and receiver tests, and has optional spectrum monitoring and signal generation capabilities. An intuitive user interface and a PC memory card reader (for uploading different test conditions) help make the HP E6392A easy to learn, set up, and operate.

For more information, see page 348.

For detailed specifications, circle 17 on the reply card (last page) or contact the HP Call Center in your region.

Troubleshoot network problems quickly



Save time and improve network quality through fast, accurate interpretation of integrated receiver and phone measurements.

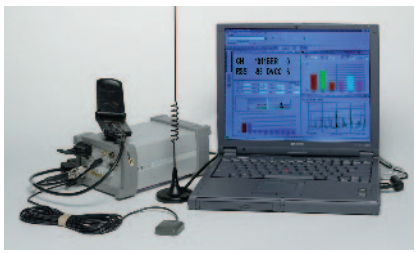
To help wireless-service providers and network equipment manufacturers deploy, optimize and troubleshoot CDMA cellular networks more efficiently and accurately, the HP E7480A post processing software graphically presents information that highlights network problems and indicates possible causes for the difficulties. Its integrated phone and receiver data reduces the time it takes to find problems such as dropped calls, excessive frame erasure rates, and blocked calls. The data it provides also facilitates the identification of the root causes of the problems, including pilot pollution, coverage holes, search-window problems, and base-station timing errors.

The HP E7480A software enhances HP's CDMA drive test system, which includes receiver and phone-based wireless optimization capabilities, a phone-based service quality analysis system, and a receiver-based RF coverage measurement system.

For more information, see page 367.

For detailed specifications, circle 18 on the reply card (last page) or contact the HP Call Center in your region.

Drive-test system for TDMA networks



Use the integrated phone- and receiver-based drive-test system to find network problems quickly.

The HP E7474A portable drive-test system provides air-interface measurements for TDMA networks that use IS-136, IS-54, and AMPS technologies. The system helps eliminate network problems fast, while improving network quality, decreasing downtime, and reducing costs. Its flexible graphical user interface and sophisticated alarms minimize the time and effort required to solve RF problems.

With the HP E7474A's advanced technology, you can perform drive-testing across network technologies and frequency bands simultaneously. The TDMA drive-test system includes a receiver-based RF-coverage measurement system, a phone-based service-quality analysis system, and an air-interface measurement system that integrates receiver and phone measurements to provide comprehensive drive-test capability.

For more information, see page 367.

For detailed specifications, circle 19 on the reply card (last page) or contact the HP Call Center in your region.

Breakthrough speed and throughput for GSM mobile phone manufacturing tests

This wireless communications test set provides an immediate competitive advantage in high-volume GSM mobile production environments.

The HP 8960 series 10 wireless communications test set performs automated tests of GSM900 (EGSM & PGSM), DSC1800, and PCS1900 mobile phones, quickly delivering accurate, repeatable measurements. It helps manufacturers raise production test throughput up to 300%, and reduce costs.

Tests run up to 30x faster

Individual tests run from ten to thirty times faster than on previous instruments, so fewer test sets can be used. Alternatively, to improve quality, tests can now be performed that were previously considered too slow for high-volume environments.

To achieve its breakthrough speed, the test set uses optimized hardware with fast-processing algorithms, high-speed processor technology, and HP's Reduced Instructional Parallel Processing (RIPP) architecture, which allows concurrent measurements. The flexible hardware and software design is easily upgraded, and HP plans to add more wireless formats and new features.

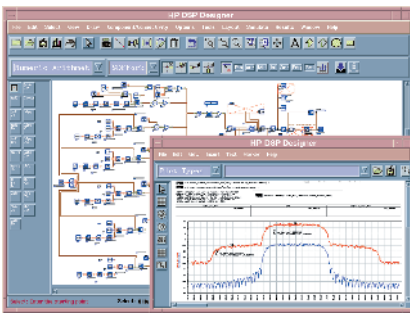
Easy to program and control

The test set allows high-level tests to launch measurements and retrieve results, and to perform complex measurement processing and error handling. The HP RIPP architecture greatly simplifies test programs, so there are fewer lines of code to write and maintain. Also, the code is easier to modify when changes must be made.

For more information, see page 342.

For detailed specifications, circle 20 on the reply card (last page) or contact the HP Call Center in your region.

Design libraries for 3G communication design



The HP W-CDMA design library lets you perform accurate adjacent channel power ratio (ACPR) analysis for the complete signal path design of critical 3G applications.

Three communication system libraries—HP W-CDMA, CDMA, and GSM—are options for the HP Advanced Design System. They help you design communication systems from the top level in a true, mixed-signal environment that supports a range of design and simulation tools.

The HP CDMA design library, compliant with the TIA/EIA-95 specifications, includes a complete set of behavioral models and test benches for development and refinement of specification-compliant algorithms at the system level. The HP W-CDMA library complies with ARIB's standard proposal version 0.0. The HP GSM design library includes behavioral models and test benches compliant with the ETSI GSM standard.

For more information, see page 550.

For detailed specifications, circle 21 on the reply card (last page) or contact the HP Call Center in your region.

Fast, accurate mobile communications dc sources

Simulate batteries during production testing of wireless phones and other battery-powered devices.

Use an HP mobile communications dc source to simulate batteries during production testing of wireless phones and other battery-powered devices that draw current in short, pulsed bursts.

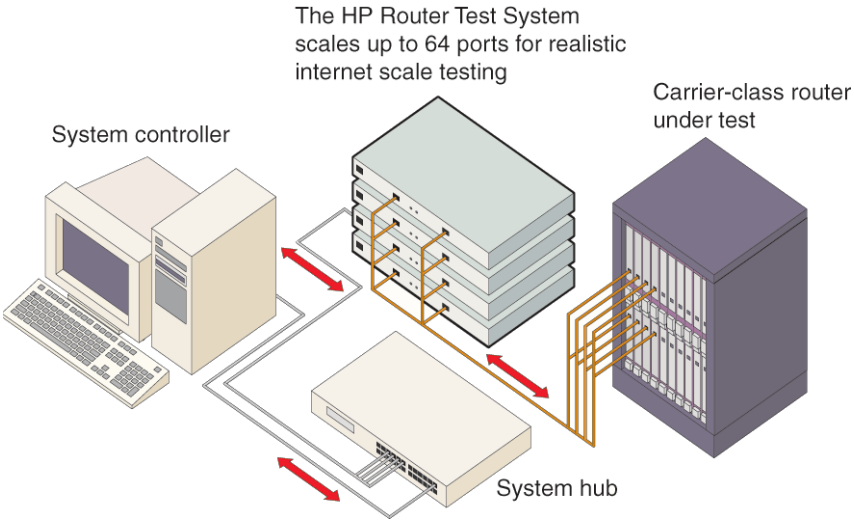
The HP 66309B/D, 66311B/D, and 66111A incorporate HP Fast Response Power Technology, which enables fast and low voltage transient response, minimizes device shutdown, and ensures maximum test system throughput. They can detect open sense wire connections to prevent inaccurate test results, incorrect battery charger calibration, and low-voltage phone shut down. The dc sources also offer built-in GPIB connectivity with programming response times as fast as 400 µs.

These one-box solutions combine both high-level sourcing (up to 5A peak) and fast, accurate, low-level current measurements, so they are valuable tools for R&D labs and production environments. The range of models makes it easy to find an HP mobile dc source that meets your wireless testing needs.

For more information, see page 164.

For detailed specifications, circle 22 on the reply card (last page) or contact the HP Call Center in your region.

Router test system measures the performance of gigabit/terabit routers



The router test system is a multiport, scalable solution for testing the performance of gigabit and terabit routers.

The router test system is designed specifically for testing gigabit and terabit routers.

In order to test the performance of high powered, high performance routers, a test system capable of generating millions of packets per second, over many ports and with many varying mixtures of traffic per port, is needed. The router test system is that system.

The router test system simulates realistic Internet traffic through integrated multi-flow traffic generation and routing protocol emulation. On the receive side, The router test system performs real-time IP Quality of Service performance measurements on multiple traffic flows over many ports.

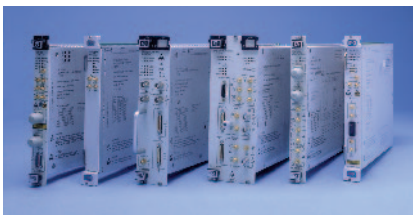
- By providing up to 64 ports of OC-12c or OC-48c Packet over SONET/SDH interfaces in a scalable architecture, the router test system is sized to simulate internet scale networks.
- By mixing multiple streams of traffic and simulating a mixture of voice, data and other applications carried across the internet, the router test system tests the ability of a router to deliver varying Quality of Service levels.
- By measuring per-stream results in real time, the router test system reveals the latency, frame loss and throughput encountered by each type of traffic as it is forwarded through a gigabit or terabit router.
- By emulating a BGP-4 routing protocol peer, the router test system appears to a router under test as if it is connected to a real network.

The multiport router test system handles mixed traffic, makes real-time measurements and performs routing protocol emulation. It is the complete solution for evaluating the performance of today's backbone gigabit and terabit routers.

For more information, see page 391.

For detailed specifications, circle 23 on the reply card (last page), see the Internet Test System web site at www.hp.com/go/InternetTestSystem, or contact the HP Call Center in your region.

Packet over SONET/SDH (POS) test solutions



Verify your designs faster with 2.4-Gb/s, and 622 and 155 Mb/s POS test solutions based on the popular HP BSTS.

With the evolution of wire-speed switch routers from enterprise to public carrier data networks, packet-over-SONET/SDH (POS) is now an attractive Layer-2 protocol for high-speed IP packet network connectivity. The HP Broadband Series Test System (BSTS) POS solution helps manufacturers test and verify the carrier-class gigabit router designs used to implement POS services. This powerful evaluation tool, which has 155-Mb/s/, 622-Mb/s, and 2.4 Gb/s configurations, also can help service providers select the best routing devices for their networks.

The test system's full-rate generation and analysis capabilities help detect implementation errors and performance problems. The HP BSTS POS solutions can verify PPP (point-to-point protocol) link establishment procedures. They support PPP, Cisco-HDLC, and MAPOS encapsulation of IP packets into SONET/SDH frames, including payload scrambling.

For more information, see page 388.

For detailed specifications, circle 24 on the reply card (last page) or contact the HP Call Center in your region.

Flexible telecom toolkit simplifies transmission and protocol testing

The toolkit includes a protocol analyzer and a portable test tablet, as well as low-cost, interchangeable test modules that work with both platforms.

The HP Telecom Toolkit speeds and simplifies transmission and high-speed data communications testing for carrier and service-provider field service organizations. It includes a choice of two platforms—the HP Internet Advisor protocol analyzer and the HP Service Advisor portable test tablet—as well as low-cost, interchangeable, application-specific test modules that function on both platforms. The toolkit minimizes training and support needs by providing a consistent "look and feel" and an intuitive user interface across all platforms and modules.

Check/verify full range of services

The combination of the two platforms enables you to check and verify a full range of communications services, and gives you a wide array of capabilities: from physical transmission testing to the sophisticated analysis of WAN data service performance needed to verify service-level agreements. The remote access capabilities of the HP Internet Advisor and Service Advisor enable field technicians to collaborate with network specialists to troubleshoot and resolve problems.

Toolkit modules are available now for testing the physical copper plant and the following services: voice, ISDN, xDSL, T1, and ATM at OC-1 and OC-3 rates. Modules for DS3/E3, frame relay, and other ATM rates are planned. A time domain reflectometer (TDR) module is also offered. All modules plug directly into slots on the HP Service Advisor tablet or the Service Advisor undercradle on the HP Internet Advisor.

For more information, see page 377.

For detailed specifications, circle 25 on the reply card (last page) or contact the HP Call Center in your region.

1

Clock recovery modules produce scope triggers

Now you can trigger a high-speed scope with a reference signal recovered from the data stream.

When you use a high-bandwidth oscilloscope such as an HP 83480A or 54750A to analyze communication system problems, you need an external timing reference for triggering data acquisition. Three new clock recovery plug-in modules generate that reference signal by recovering a clock from data being transmitted at standard telecom and datacom rates. The modules also provide trigger-on-data capabilities for nonstandard rates.

The clock recovery modules address each of the major high-speed digital transmission media now in use. The HP 83491A handles electrical lines; the HP 83492A is for multimode fiber; and the HP 83943A works with single-mode fiber. All have a built-in coupler/splitter that reduces the external hardware required for triggering. When you use these modules, you simply connect your test signal, select your data rate, and make your measurements.

For more information, see page 463.

For detailed specifications, circle 26 on the reply card (last page) or contact the HP Call Center in your region.

Communication mask test kit for HP Infiniium scopes

Now you can use an HP Infiniium scope to quickly make ANSI, ITU, and IEEE industry-standard tests.

With the Option 100 communication mask test kit, you can easily perform product compliance testing with an HP Infiniium oscilloscope. For example, you only use one dialog box to set up test conditions. All triggering is set up automatically when a specific mask is loaded, and an align button automatically aligns that mask to the signal under test.

The communication mask test kit includes a library of over 20 ANSI T1.102, ITU-T G.703, and IEEE 802.3 masks. Using these masks will help ensure that your communication and networking products will operate successfully in multivendor environments. The kit also provides two termination adapters, commonly needed adapter cables, system performance accessories to assure accurate connections to your device under test, and a protective, hard-shell case.

For more information, see page 113.

For detailed specifications, circle 27 on the reply card (last page) or contact the HP Call Center in your region.

Scalable, expandable 2.5 Gb/s DWDM test solution

Use this modular transmit/receive measurement solution to test 2.5 Gb/s DWDM and OADM network products.

The HP SpectralBER 2.5 Gb/s DWDM test system lets manufacturers of optical network products tailor their test equipment to their production strategy. Modular and scalable, the VXI-based tester is cost-effective for both low-volume, high-product mix applications and high-volume production environments. It provides high test-port density in a small footprint, and can be configured to test communication systems with high channel counts simultaneously for fast, convenient throughput. A configuration that fits in a standard test stand can test an 80-channel system at 2.5 Gb/s.

The VXI-based HP SpectralBER functionally tests optical add/drop multiplexers, optical translators, transponders, and multichannel systems. Its major DWDM test capabilities include BER performance, concatenated payloads to simulate live traffic, and path trace to identify individual channels for continuity tests. Additional capabilities include SONET/SDH overhead performance monitoring and analysis, error injection, and alarm monitoring.

For more information, see page 385.

For detailed specifications, circle 28 on the reply card (last page) or contact the HP Call Center in your region.

One-box dc power supply for telecommunication applications

The HP E4356A telecom dc power supply offers the reliability of an integrated system in a convenient one-box solution.

The HP E4356A telecom dc power supply is a one-box solution that delivers the reliable power-sourcing capabilities of an integrated system. It produces clean, reliable, low-noise power at 80 V and 30 A and up to 2100 W. The HP E4356A ensures that power supply noise does not interfere with the testing of telecom devices.

The HP E4356A is ideal for manufacturing and R&D engineers who build telecom equipment such as base stations, switches, public and private telephone network equipment, and PBX systems, as well as the dc/dc power supplies that provide power to this equipment.

For more information, see page 164.

For detailed specifications, circle 29 on the reply card (last page) or contact the HP Call Center in your region.

Automation system speeds verification and emulation of telecom applications

Products in the HP FASTest family support the simultaneous testing of SS7, ISDN, and PTS circuits. This is the HP J1845A FASTest-PC.

The HP FASTest family of products comprises an end-to-end emulation and verification platform that telecom equipment manufacturers and service providers can use to speed up the development and deployment of new systems and services.

As telecom networks grow more complex, rapid test creation and automation are critical to ensure that network elements and applications are quickly and less-expensively deployed, while maintaining network interoperability. HP FASTest products can be used to create and execute reusable test cases that let manufacturers and operators quickly test network elements, systems, and applications in the lab and in the network. Because the HP FASTest architecture is flexible and scalable, products in this family can grow with the network as new applications and technologies evolve.

Three configurations launch the HP FASTest platform:

- the FASTest-PC, a single-user PC-based standalone unit
- the FASTest automation system, a multiuser UNIX-based system
- the FASTest-NET, a multiuser, distributed system for network-level testing

These emulation and verification products are ideal for today's public switched networks and wireless networks. They are also excellent choices for next-generation converging networks.

For more information, see page 399.

For detailed specifications, circle 30 on the reply card (last page) or contact the HP Call Center in your region.

1

Complete SDH and SONET test solution from 56 kb/s to 2.5 Gb/s

The HP OmniBER communications performance analyzers now have multirate 155 Mb/s, 622 Mb/s, and 1 Gb/s options and jitter capability.

The HP OmniBER family of communications performance analyzers offers multirate testing at all standard telecom rates and includes new DS1, DS3, and 52 Mb/s jitter capability. Two models are now available: the HP OmniBER 718 and OmniBER 719.

WDM, SDH/SONET, PDH tester

The HP OmniBER 718 analyzer meets the varied requirements of network equipment manufacturers and network operators by providing both functional and parametric testing of WDM, SDH/SONET, and PDH equipment. The analyzer also offers jitter generation and measurement at all synchronous and asynchronous rates to ITU-T and ANSI standards.

To rigorously test new services carried in synchronous networks, the analyzer is equipped with STM-16c and STM-4c concatenated payloads for complete clear-channel testing, as well as mixed payloads for evaluating networks carrying mixed rates of traffic. In addition, automatic protection switch times on SDH/SONET rings and linear networks can be verified against ITU-T and Bellcore standards.

The HP OmniBER 718 offers configuration flexibility. Different versions perform multirate testing to 155 Mb/s, to 622 Mb/s, or up to 2.5 Gb/s. They are available with or without PDH/T-carrier interfaces. Configurations can also be ordered that have SDH-only or dual-standard SDH/SONET test capabilities.

SONET-only analyzer

The HP OmniBER 71 is a SONET-only analyzer that shares all the measurement attributes of the HP OmniBER 718. Additionally, it provides multirate test capability, including jitter, up to OC-48c. This analyzer is ideal for installing, commissioning, and maintaining SONET/T-carrier networks, and resolving quality-of-service (QoS) issues.

For more information, see page 386.

For detailed specifications, circle 31 on the reply card (last page) or contact the HP Call Center in your region.

ATM traffic management testing

The HP ATM Stream Processor is a dedicated functional and performance ATM test module for the HP BSTS.

Despite the maturity of standards for ATM traffic engineering (ATM Forum Traffic Management V4.0), techniques for forwarding, buffering, tuning, policing, and frame-level QoS guarantees vary widely. The HP ATM Stream Processor (ASP) gives you the functional and performance ATM switch benchmarking you need to ensure standards compliance, device interoperability, competitive differentiation, and accurate network provisioning. This dedicated real-time, full-rate (0-155 and 0-622 Mb/s) generator/analyzer offers ATM traffic management simulation modeling, contract analysis, and packet-over-ATM integrity checking. It provides real-time ATM Quality of Service (QoS) testing using the industry-standard ITU-T O.191 techniques.

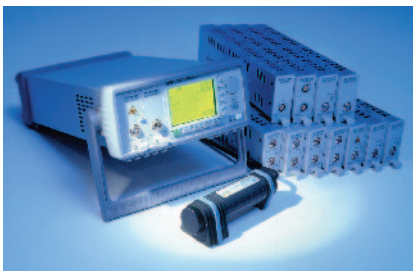
For complete service category testing, the HP ASP offers multiple CBR-, VBRrt-, VBRnrt-, and UBR-compliant sources. It can simulate up to 16,384 VP/VCs from a single port. Full-rate capture and post-processing analysis is provided on a 262,000 cell viewer.

The HP ASP is a single-slot VXI companion module to the many HP BSTS ATM line interfaces. In effect, it is the "heart" of the BSTS for PVC-based ATM traffic generation and analysis test cases.

For more information, see page 388.

For detailed specifications, circle 32 on the reply card (last page) or contact the HP Call Center in your region.

New generation of fast, reliable optical component test solutions



The HP 8163A lightwave multimeter improves the performance standard set by its predecessor, the HP 8153A.

With the latest generation of powerful HP test solutions—the HP 8163A lightwave multimeter, the HP 8166A lightwave multichannel system, and the HP 8164A family of tunable lasers and mainframe—you can push the limits of optical component tests, and get the speed, accuracy, and reliability you need to have total confidence in your test results.

Lightwave multimeter

The HP 8163A family builds on all the key attributes that made the HP 8153A lightwave multimeter the standard basic measurement tool in fiber optic R&D laboratories. The new modular multimeter ensures accurate and fast results, even for your most demanding measurements on optical components and systems. To protect existing investments, the HP 8163A mainframe is compatible with HP 8153A-series source, sensor, and return-loss modules.

The lightwave multimeter's stabilized source modules are not insensitive to back reflections, so they eliminate measurement uncertainty when you use the instrument to monitor signal loss over long periods of time. New fixed source modules have improved stability and produce higher output power than previous modules. The ITU channel source lets you build up the wavelength grid to optimally characterize your components or systems, and compact tunable laser modules allow you to check devices and links at all wavelengths in the DWDM window.

The 17 slots of the versatile HP 8166A lightwave multichannel test system accommodate a wide range of plug-in modules.

New sensor modules and optical heads for the HP 8163A provide the industry's highest sensitivity, high linearity, the lowest polarization dependent loss (PDL) specifications, and the lowest spectral ripple. High-precision return loss modules for the multimeter ensure easy, fast, and repeatable measurements.

For more information, see page 456.

Multichannel test system

The HP 8166A lightwave multichannel test system saves bench space and enables fast and easy multichannel tests for today's requirements—and tomorrow's. With this versatile test solution, you can configure any combination of all modules in the HP 8163A lightwave multimeter family, as well as the HP 81689A compact tunable laser module. The result is a complete stimulus/response solution for fast and simultaneous multi-channel listing.

The HP 8166A's synchronized and parallel measurement capabilities ensure high throughput. The test system offers an excellent per-channel price/performance ratio.

For more information, see page 454.

Tunable lasers and mainframe

The HP 8164A family consists of a series of tunable laser source modules and the HP 8164A mainframe, which supports all modules in the HP 8163A and 8153A series. The modules and

The HP 8164A lightwave measurement system is an excellent platform for implementing tests of DWDM fiber optic components.

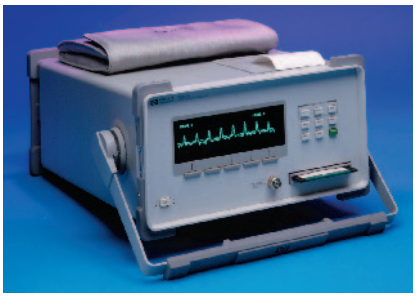
mainframe combine to implement the HP Lightwave Measurement System. This new system offers:

- optimum tuning precision for testing dense WDM (DWDM) devices—The HP 81640A module covers the 1500 to 1640 nm range, and the HP 81680A and 81682A modules operate in the 1550 nm band. These laser sources have a built-in wavelength control loop for outstanding performance, and are mode-hop free tunable with continuous output power.
- low spontaneous emission for maximum measurement range—The HP 81640A and 81680A tunable laser sources have two optical outputs, one of which delivers ultra-low source spontaneous emission (SSE) performance. This enables you to make accurate crosstalk measurements of DWDM system components that have many channels with narrow channel spacings. A power meter module alone is sufficient to characterize steep notch filters such as Fiber Bragg Gratings.
- compact size for multichannel systems—The HP 81689A tunable laser module is small enough to allow realistic multichannel test beds using the HP 8164A, 8166A, or 8163A mainframes. This signal source provides continuous, mode-hop free tuning and has full remote capabilities. It produces an extremely clean lightwave output signal with very low source spontaneous emissions.

For more information, see page 452.

For detailed specifications, circle 33 on the reply card (last page) or contact the HP Call Center in your region.

Simultaneously measure wavelengths and powers of up to 200 channels



Characterize WDM systems easily and accurately during field installation and verification.

The HP 86121A WDM Channel analyzer is a Michelson interferometer-based instrument that can measure wavelengths, powers, and optical signal-to-noise ratios of up to 200 channels simultaneously, with single-button operation. Even advanced measurements such as channel spacing and drift are easy to make.

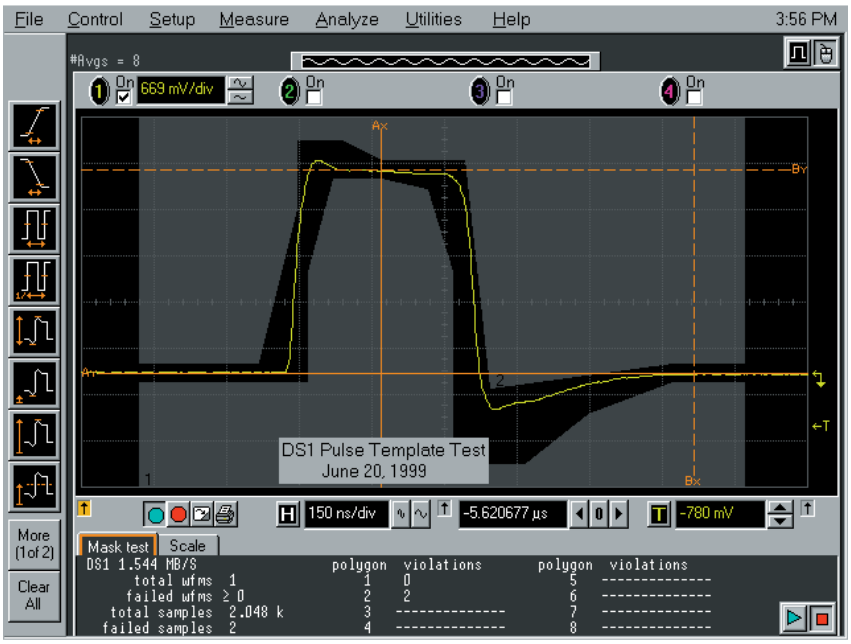
The outstanding performance, rugged design, light weight (9 kg), and portability of the HP 86121A make the analyzer the ideal field instrument for DWDM system turn-up and commissioning, as well as for preventative and reactive maintenance applications.

The WDM Channel Analyzer includes a built-in disk drive and printer. RS-232 and GPIB interfaces provide control and communication capabilities.

For more information, see page 459.

For detailed specifications, circle 34 on the reply card (last page) or contact the HP Call Center in your region.

Four-channel, 1-GHz Infiniium oscilloscope



The expanding HP Infiniium family of high-performance, low-frustration oscilloscopes makes it easier to find a model that precisely meets your needs.

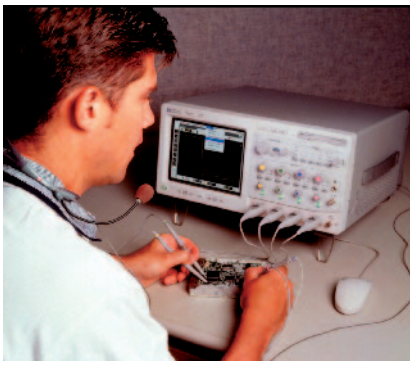
The HP 54835A—newest member of the Infiniium family of high-performance oscilloscopes—has a 1 GHz bandwidth and four channels, each with 32k of memory. Configured for four-channel operation, the easy-to-use, low-frustration scope samples at 2 GSa/s across all channels. Configured for two-channel operation, it samples at 4 GSa/s across both channels, and each channel has 64k of memory.

Like all Infiniium oscilloscopes, the HP 54835A has an analog-like front panel with dedicated vertical controls for each channel, a graphical user interface based on Windows 98, and a large 8.4-inch color display. The new scope has a high-speed processor that provides fast, 2000 waveform/s screen update rate, and includes a built-in 3.2-GB hard disk drive and a high-capacity (120 MB) floppy disk drive. Its LAN interface makes it easy to document your work and share that information with others.

For more information, please see page 111.

For detailed specifications, circle 35 on the reply card (last page) or contact the HP Call Center in your region.

Voice control allows hands-free operation of Infiniium scopes



You can use both hands for probing when you control the scope's front-panel functions with your voice.

When you probe fine-pitch, surface-mount ICs with a scope, often both hands are holding scope probes, so it's nearly impossible to adjust the scope controls to better view the signals under test. To solve this problem, you can now use the Option 200 with your HP Infiniium scope. This voice control option lets you easily control front-panel functions using a natural-language command set spoken in English.

With the collar-mounted microphone included in the Option 200, you can control functions such as run, stop, autoscale, time/division, volts/division, and printing, as well as measurements. A typical command might be, "set channel one to 100 millivolts per division." Voice recognition is speaker- and gender-independent and requires no training for the scope to recognize a particular user. A tutorial helps you learn common front-panel commands for controlling scope operation.

For more information, see page 111.

For detailed specifications, circle 36 on the reply card (last page) or contact the HP Call Center in your region.

Low-cost, 200-W dc power supply

This programmable dc power supply provides 200 W of clean, low noise power at an affordable price.

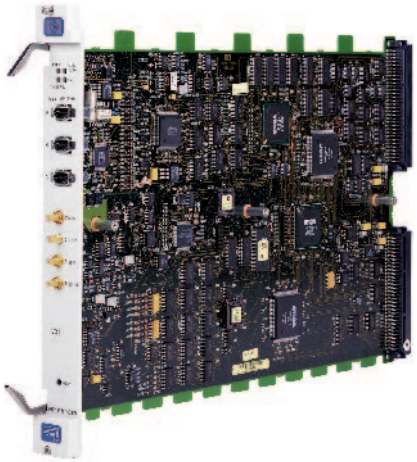
The HP E3634A general-purpose 200-W dc power supply is a single-output, dual-range model with a standard GPIB/RS-232 interface. It's an ideal low-cost solution for test and evaluation setups that require high power, steady line/load regulation, and low ripple and noise. Its two ranges, 0-50 V/4 A and 0–25 V/7 A, suffice for many applications. The 1 mV/1 mA resolution of the easy-to-read front-panel vacuum fluorescent dual display allows fine adjustment and readback. Standard features include both front and rear output terminals and over-voltage and over-current load protection. Remote sense eliminates errors associated with voltage drops on the load leads.

The power supply can be controlled and monitored remotely by an instrument controller or PC for stimulus/response measurements. The HP E3634A can be commanded to provide a stimulus or bias to DUT and its current or voltage can be read as the response.

For more information, see page 178.

For detailed specifications, circle 37 on the reply card (last page) or contact the HP Call Center in your region.

PC to VXI link transfers data five times faster



The new PC-to-VIX link adds a IEEE-1394 (FireWire) interface to your VXI test system.

The HP E8491B PC-to-VXI link can transfer data blocks greater than 64 kB at 14 MB/s, five times faster than its predecessor. The link provides a direct connection from a personal computer to a VXIbus mainframe via the industry-standard IEEE-1394 interface bus, also known as FireWire.

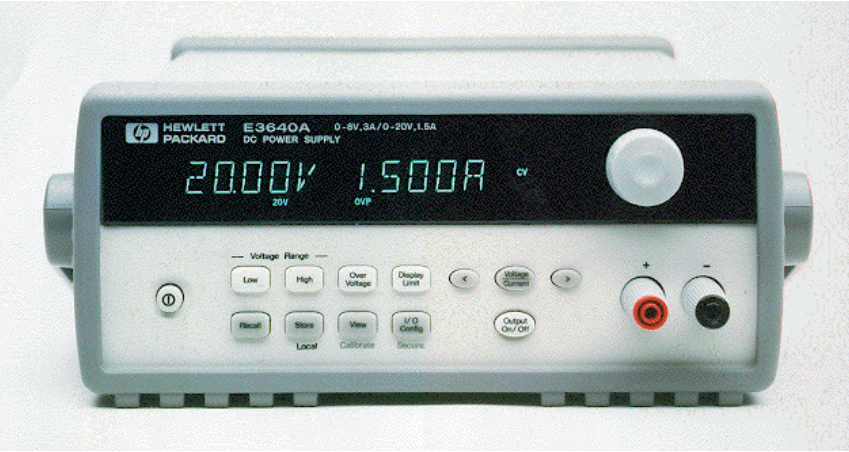
The HP E8491B product includes a C-sized VXI module with software and an IEEE-1394 cable. Option 001 provides an open host computer interface (OHCI) card that is installed into the personal computer.

An upgrade kit is available for owners of the HP E8491A link. It includes the OHCI PC plug-in card and new software.

For more information, see page 85.

For detailed specifications, circle 38 on the reply card (last page) or contact the HP Call Center in your region.

Programmable dc supplies: clean power, affordable prices



This programmable dc power supply provides 30-80 W of clean, stable power at an affordable price.

The HP E3640A/41A (30 W), E3642A (50 W), and E3644A (80 W) are single-output, dual-range dc power supplies with standard GPIB/RS-232 programmability. They are ideal for laboratory and manufacturing test applications because they offer the performance of system power supplies for less money.

All models in the HP E3640A series deliver clean, reliable power. They have constant voltage (CV) and constant-current (CC) operating modes, dependable regulation (0.01%), and a fast settling time (<90 ms). Their vacuum fluorescent dual display is easily readable. Front and rear output terminals are standard, and the output load is protected against overvoltage conditions.

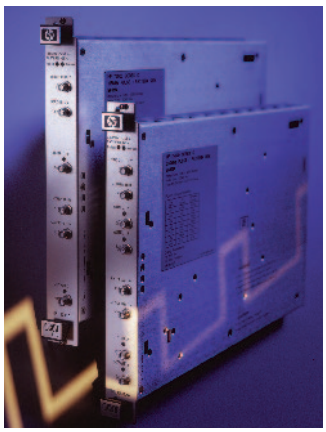
Ideal for automated systems

Because these supplies include GPIB and RS-232 interfaces, SCPI programming capability, and plug&play drivers for HP VEE and NI LabView, you can readily integrate them into automated test systems. Remote sensing eliminates errors caused by voltage drop on the load leads. Front-panel binding posts allow power connections with safety test leads, banana plugs, or stripped wires.

For more information, see page 177.

For detailed specifications, circle 39 on the reply card (last page) or contact the HP Call Center in your region.

Accurate VXI pulse/ pattern generators



These versatile, high-speed digital sources provide excellent signal generation capabilities for VXI test systems.

The HP E8311A (165-MHz) and E8312A (330-MHz) pulse/pattern generators are ideal signal sources for VXI automated functional test systems. Applications range from functional verification of high-speed digital or mixed-signal devices to clock generation and serial bus testing.

The highly accurate digital signal generators have excellent timing parameters that are amplitude and offset adjustable. For testing both low-speed (10–100 MHz) and high-speed (>100 MHz) logic, they have variable transition times and inverted outputs. For radar testing, they provide reliable, stable synchronization, even on precise points in time and double pulses. For communications applications, the signal sources offer serial pattern capabilities up to 16 kbits per channel and have the flexibility needed to simulate complex protocols and create pulse width modulated (PWM), as well as different signals.

To reduce integration time and effort, VXI plug&play software drivers are available. The VXI digital signal sources are compatible with HP 81110A pulse/ pattern generators.

For more information, see page 445.

For detailed specifications, circle 40 on the reply card (last page) or contact the HP Call Center in your region.

Deep-memory analyzer for difficult debug problems

The new HP 1670G series benchtop logic analyzers offer up to 2M of memory depth, useful when the source and problem are widely separated.

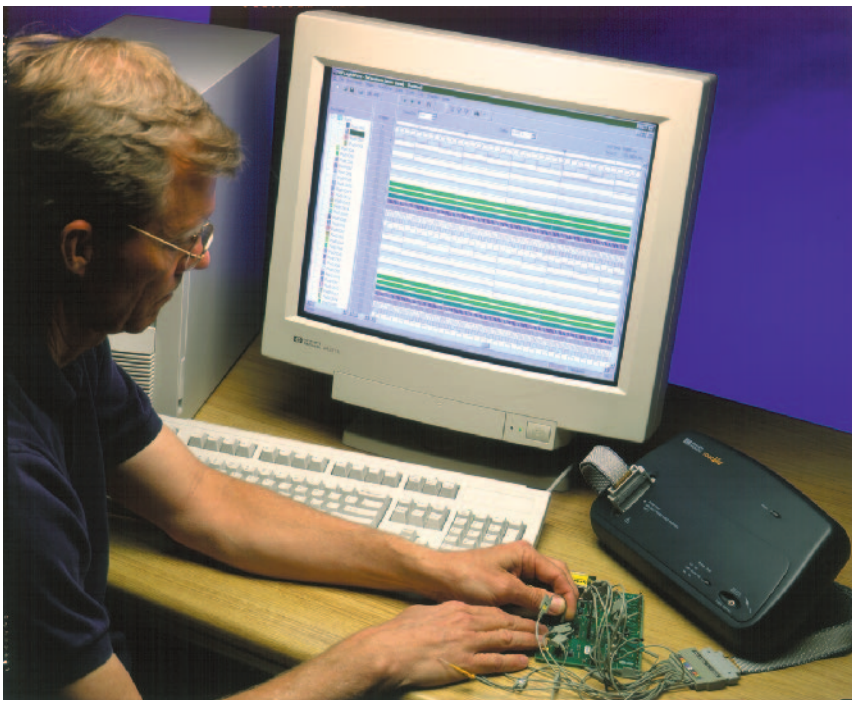
The HP 1670G series logic analyzers offer cost-effective 150-MHz state analysis, and timing analysis at speeds up to 500 MHz. You can configure the high-speed acquisition memory for depths up to 2M samples over as many as 136 acquisition channels. An optional 2-channel, 500-MHz oscilloscope or a 32-channel, 200-MVector/sec pattern generator can be added for signal integrity or stimulus-response applications. Tailor the HP 1670G series analyzer to meet your specific needs at a price that matches your budget. Never before has so much measurement power been available in such an affordable package.

A deep memory analyzer is a powerful tool for the solution of difficult or poorly understood problems in digital systems. It saves time you might otherwise spend taking multiple traces to piece together a complete picture of system behavior. It reduces the need to set up multi-level triggers because you don't have to be as precise about the data you capture. Deep memory is invaluable for successfully analyzing problems where the cause and effect are widely separated in time. All models in the HP 1670G series may be configured with optional 256k or 2M samples of memory depth. The standard configuration is 64k samples.

For more information, see page 418.

For detailed specifications, circle 41 on the reply card (last page) or contact the HP Call Center in your region.

Affordable, extremely user-friendly logic analysis



The easy-to-use HP Logic*Wave* logic analyzer offers impressive performance at our lowest price ever for a full-featured state and timing analyzer.

The new HP LogicWave logic analyzer offers 100-MHz state analysis, 250-MHz timing analysis, and 128k memory across all 34 channels for just $3200. To fit tight budgets, it is priced lower than any full-featured analyzer HP has ever offered.

The lightweight (4.5 lb/2.1 kg), compact (11.5 x 9 x 2.5 in.) logic analyzer is truly portable, and a real space-saver for crowded lab benches. It connects to the parallel port of your laptop or desktop computer. High data throughput rates and optimized host software combine to provide a responsive user interface with fast display update rates.

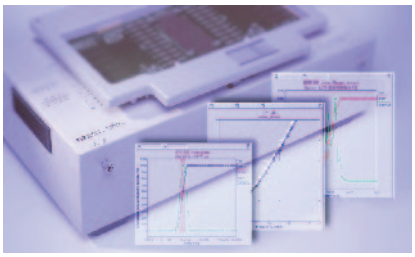
A Windows-based user interface provides efficient single-window operation; All setup, triggering, and data display functions can be accomplished in a single window. The streamlined user interface is surprisingly easy to use, the result of extensive research on how engineers use logic analyzers., so you won't haveto relearn it every time. Its innovations include: "What you draw is what you capture" timing trigger, zoom box, drag & drop labels, expand/collapse buses, group into bus, tool tip bus values, activity indicators, off-line analysis, and more. (You can experience these features firsthand by downloading the user interface from our web site: **www.hp.com/go/logicwave**)

Infrequent or first-time users of logic analyzers will find the HP LogicWave logic analyzer extremely helpful. Problems that can take days to hunt down using only an oscilloscope can be found in hours with the help of this analyzer. This low-cost design and debug tool eliminates the need to wait until an expensive, high-end logic analyzer is available before you can make basic measurements.

For more information, see page 417.

For detailed specifications, circle 42 on the reply card (last page) or contact the HP Call Center in your region.

Characterize digital and mixed-signal devices



Develop reliable, repeatable tests in less time with the IC/circuit characterization package for the HP 81200 Data Generator/Analyzer Platform.

You can speed up and simplify the characterization of digital and mixed-signal devices with a new IC/circuit characterization package for the HP 81200 Data Generator/Analyzer Platform. This package is comprised of the three elements:

- The HP E4874A Characterization Software Components, a selection of common engineering test templates and ActiveX graphic control components that enable you to design and automate your own measurement tasks easily, using only a few commands.

- The HP E4839A Test Fixture, which provides a reliable and reproducible platform for stable tests of DUTs with up to 192 pins.

- The BestLink/81200 simulation data link, which allows you to leverage knowledge and data gained during design simulation by automatically moving that simulation data to the devices' test setup.

For more information, see page 439, or visit us at: www.hp.com/info/ic_characterization

For detailed specifications, circle 43 on the reply card (last page) or contact the HP Call Center in your region.

3-GHz LCR meter: fast, accurate component testing

The HP 4287A is compatible with the new HP 16196A/B/C RF test fixtures which support up to 3 GHz.

The HP 4287A RF LCR meter improves quality and boosts test throughput in electronic component production. It offers accurate, reliable, and fast measurements from 1 MHz to 3 GHz.

The meter handles a wide impedance range because it uses the direct-current voltage-measurement technique, rather than the reflection-measurement technique. It provides superior measurement repeatability at low currents, such as 100 µA or 200 µA. The meter requires less averaging to determine a measurement result, and this increases throughput.

The HP 4287A's 8.4-inch color display gives you a clear view of measurement settings and results, and its user interface makes operation easy and error-free. Built-in statistical analysis functions permit monitoring of test quality and efficiency. You can use the LAN interface for centralized production control and monitoring.

Simplifies system integration

The HP 4287A is ideal for production applications that use device handlers. The test head cable can be easily connected close to the tip of the device-under-test (of the handler) without any increase in error. The LCR meter's built-in comparator function, high-speed GPIB interface, and a handler interface simplify integration with the handler and PC. The enhanced comparator function makes sophisticated binning possible for multifrequency or array chip testing.

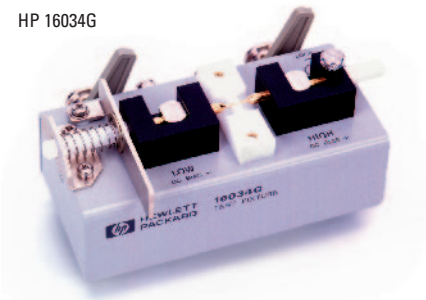
For more information, see page 482.

For detailed specifications, circle 44 on the reply card (last page) or contact the HP Call Center in your region.

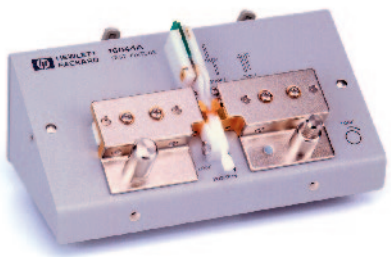
SMD test fixtures allow precise impedance measurements

HP 16034H

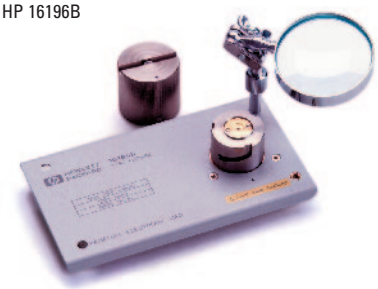
HP 16034G



HP 16044A



HP 16196B



Use HP test fixtures to perform accurate LF and RF evaluations of various types and sizes of SMD passive components.

Four new durable, high-quality HP text fixtures for surface-mount devices (SMDs) can help you achieve the superior accuracy and measurement repeatability you need to precisely evaluate small passive components.

110 MHz test fixtures

The HP 16034G dc-to-110 MHz test fixture can be used for SMDs that have the size code of 0603(mm)/0201(inch). Its very thin measurement electrodes allow accurate, stable results.

You can use the HP 16034H dc-to-110 MHz test fixture for characterizations of array-type SMD devices. Its holder applies a very even pressure to the DUT. Therefore, as the device is shifted so that the measurement electrodes connect to successive elements of the array, the steady pressure of the holder ensures that the electrodes make a good contact with each element.

Fixture for low-impedances

The HP 16044A dc-to-10 MHz test fixture has a Kelvin (4-terminal) contact set, the preferred type of connection for measuring low-impedance SMDs. It also has a special mechanism for performing Open/Short compensation, and this allows you to make very accurate measurements of ESR and phase angle.

High-frequency test fixtures

The HP 16196A, 16196B, and 16196C are coaxial-structured high performance test fixtures for impedance measurements at frequencies ranging 1 MHz to 3 GHz. These fixtures provide superior measurement repeatability and are your best choice for the characterization of parallel-electrode chip inductors and other passive RF components.

The HP 16196A accommodates SMDs with the size code 1608(mm)/0603(inch). The HP 16196B handles SMDs that have the size code 1005 (mm)/0402 (inch). The HP 16196C is for size code 0603 (mm)/0201 (inch) SMDs.

For more information, see page 470

For detailed specifications, circle 45 on the reply card (last page) or contact the HP Call Center in your region.

A cost-effective strategy for testing highly complex PCBAs

By leveraging the X-ray inspection power of the HP 5DX system, you can simplify in-circuit test fixtures and tests of complex printed circuit boards.

Electronic components are becoming smaller; printed circuit board assemblies (PCBAs) are getting more crowded and complex; test access is diminishing; and node count is increasing. All of these trends push up the cost of test fixtures. HP has an elegant solution to the challenges of testing highly complex printed circuit boards—the HP AwareTest xi software linkage (HP E6220A).

The HP AwareTest xi is the key to an effective strategy for testing highly complex printed circuit board assemblies (PCBAs). The software linkage allows an HP 5DX automated X-ray inspection system to share pc-board CAD and test data with an HP 3070 Series 3 in-circuit test system. The two systems collaborate intelligently to decrease test redundancy and boost fault coverage beyond that provided by in-circuit test alone.

The X-ray system focuses on structural faults, and the in-circuit tester concentrates on electrical defects. A real-time data link ensures that boards are tested and repaired before in-circuit testing occurs. A typical result of using HP AwareTest xi: an in-circuit test of a 6000-node board can be performed with a 3000-node test fixture.

For more information, see page 518.

For detailed specifications, circle 46 on the reply card (last page) or contact the HP Call Center in your region.

Small footprint, high-speed memory test system

The HP 95000 HSM series systems offer memory manufacturers the lowest-risk test solution with the lowest cost of test.

Hewlett-Packard and Rambus Inc. have worked together since 1991 to develop engineering and production test systems for Rambus and its manufacturing partners. The result of these efforts is an integrated, cost-effective solution that is more than a match for the challenges of volume production tests of RDRAM devices and other high-speed memory ICs: the HP 95000 high-speed memory (HSM) series test system and a production-ready test cell with integrated Delta Castle handler.

Designed from the ground up for multisite testing, the low-risk HP 95000 HSM series semiconductor test system provides a higher throughput, lower overall cost-of-test, and a faster time-to-volume than previous test systems. To save space on the production floor, its total footprint is less than half that of competing systems.

For more information, see page 523.

For detailed specifications, circle 47 on the reply card (last page) or contact the HP Call Center in your region.

Obtain greater parametric test capability

This advanced parametric test system overcomes restrictions of previous testers.

The HP 4072A advanced parametric test system meets multiple semiconductor-processing needs. The system combines the accuracy, high throughput, and reliability of the popular HP 4071A, and adds a high-frequency matrix and a pulse multiplexer unit. It handles the full spectrum of advanced parametric tests, as well as Flash memory cell evaluation, ring oscillator measurements (up to 300 MHz), and advanced Wafer Level Reliability tests.

A built-in Flash cell read/write endurance testing feature allows you to perform a typical million-cycle test in just a few hours. You can create pulses up to 40 V, peak-to-peak. dc measurements between 200 V and 2 µV, and between 1A and 1 fA, are achievable.

Software for the HP 4072A test system includes an improved interactive debug panel (IDP) utility for making manual measurements and creating and performing flash memory cell tests.

The HP 4072A is fully compatible with probe cards, docking mechanisms, wafer probers, and test software for HP 4701A test systems. Upgrades for HP 4701A systems are available.

For more information, see page 524.

For detailed specifications, circle 48 on the reply card (last page) or contact the HP Call Center in your region.

Production test solution for SOC devices

HP 93000 SOC series systems effectively test the most highly integrated semiconductor devices.

To effectively test system-on-a-chip (SOC) devices, you must have the flexibility, capability, and foresight to fully test all of the functions integrated on the chip: digital, memory, analog, communications, and high-speed busses. Your test system has to be performance-scalable. And to achieve the highest levels of system utilization and throughput, your solution should be based on a single platform. These issues helped define the new HP 93000 SOC-series test systems.

Powerful HP 93000 SOC-series test systems meet the needs of both cost-driven and performance-driven SOC applications. They provide full test coverage with high levels of throughput, performance, accuracy, and reliability. They offer data rates of up to 1 Gb/s today; deliver an overall timing accuracy (OTA) of ±200 ps; and include analog instrumentation that has the lowest noise-floor available. Standard configurations offer up to 960 digital pins plus 4 analog instruments.

For more information, see page 522.

For detailed specifications, circle 49 on the reply card (last page) or contact the HP Call Center in your region.

"HP really became a part of our team in developing the solution. They didn't just sell us a box that we had to determine how to implement on our own."

Dan Finch, C-Cor Electronics

HP support services: How can we help?

Whether you need a fast answer about equipment operation or a factory full of custom test systems, HP's service and support team is ready to help. We've built a comprehensive set of services with one goal in mind: giving you the tools and information you need to succeed on the job, no matter what your job may be.

Contacting HP for support

The HP T&M web site is a growing source of online support information, available 24 hours a day, 7 day a week. We recommend you start there. If you do not find your answer, click on "Assistance" to find the easiest way to contact HP for help.
Web: **www.tmo.hp.com**
No access to the web? In the US:
Phone: 1-800-452-4844
For fax and email, request a form by calling 1-800-452-4844.

For all other locations, please refer to page 607 for your nearest HP office.

Our Promise: Delivering on expectations

We want your HP equipment to deliver the performance you expect. If you need assistance, we provide a range of support from verifying proper operation to clarifying information in the manuals.

Our Promise Page 69

Our web site: **www.tmo.hp.com**, offers extensive information:

- Online operating manuals
- Product features and specifications
- Product and application notes
- FAQs
- Service notes
- Catalog requests

Year 2000 compliance Page 72

Your Advantage: The power of choice

If you want additional services, Your Advantage provides a selection of engineering, repair and support services to help you through the entire life cycle of your test systems:

Your Advantage Page 69
Hardware repair and calibration Page 70
Software support Page 70
On-site support Page 71
Test system design and integration Page 74
Application consulting Page 76
Productivity consulting Page 76
Education and training Page 77
HP refurbished instruments Page 552

"Hewlett-Packard is the standard in terms of service that I measure every other company against."

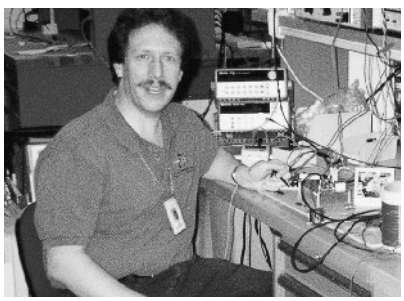
That's how Jim Giordano, a test engineer with Ethicon Endo-Surgery sums up his experience with HP service and support. "The number one reason we keep coming back to HP is the quality of the post-sales support. HP service adds tremendous value to the product."

Resolution in hours, not months

Jim recently played phone tag with one vendor for two months trying to get their equipment to work as advertised. With HP, his expectations are on the order of hours. "An HP engineer even paged me on my way home from work one evening because he knew I needed an answer in a hurry. I called him back when I reached home, and we solved the problem that night."

A superior solution: products plus people

"With HP, the combination of superior product design and superior customer service means that I can count on my equipment to provide nearly 100% uptime, making measurements that I have never had to question, with expert technical support people who help me make the most of the equipment capabilities in my applications. I consider HP to be a dotted-line member of every team I work on."



Jim Giordano, Ethicon Endo-Surgery

Total support coverage for the life of your equipment

Our service and support promise is simple: maximize value, minimize risk and eliminate headaches. We work to fulfill this promise in three ways:

You get what you paid for.
Our Promise means your equipment will meet its advertised performance and functionality.

You get the support you need.
From presales advice through equipment disposal, HP engineers and technicians deliver the most comprehensive support in the industry. Support is available for at least five years beyond the production life of every HP instrument.

Support costs are distributed fairly.
Delivering world-class support costs money; that's a fact of life. Your Advantage is an easy way to optimize your results by choosing from a menu of services that provide as much or as little as you need.

Our Promise

When you're ready to choose new equipment, we'll help you with:

- Product information, including realistic performance specifications
- Product recommendations from experienced test engineers

When you use HP equipment, we'll make sure your equipment performs as promised, at no extra charge. Here's what you can expect:

- Operation verification to ensure your equipment is working properly
- Help with product operation
- Basic measurement assistance to help with specified capabilities
- Extensive self-help tools

We also have global instrument warranties by HP, worldwide.

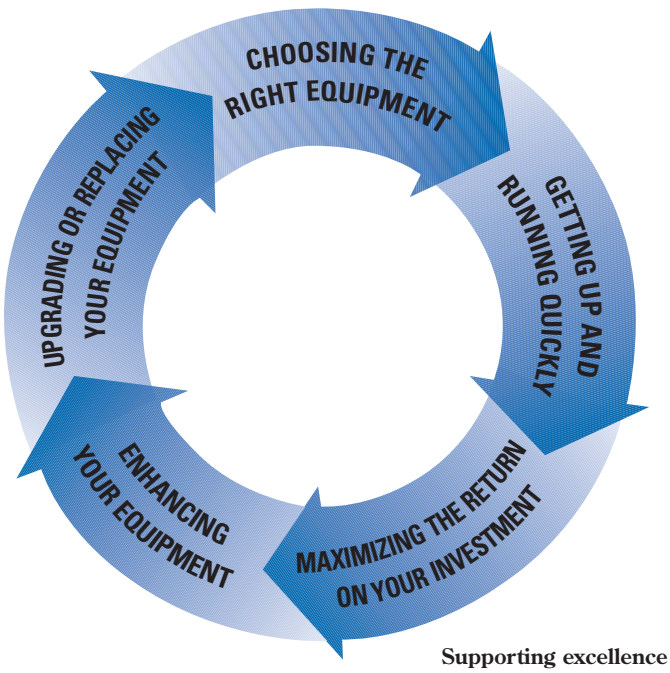
Your Advantage

Every application scenario is unique, so we offer a flexible set of services. You can purchase the services to fit your unique needs during every phase of ownership.

Whether you own a single HP instrument or a worldwide network of test systems, our engineering, repair and calibration services will keep you running at peak performance. By taking advantage of our consulting and design services, your team can focus on core tasks while we take care of the instrumentation. As with all our services, you select as much as or little as you need to fit your technical and financial requirements.

Our test specialists are ready to help at every phase of the system life cycle, from planning and design through installation, integration and operation. By applying these services in whatever way meets your unique needs, you'll achieve the full benefits of HP service and support:

- Reach peak productivity sooner
- Maximize the return on your investment
- Enjoy dependable measurement accuracy for the life of your system



Supporting excellence in engineering throughout the lifecycle of your test system.

Maximize uptime with peak product performance

No matter what kind of HP equipment you have, or how much you have, we offer dependable support that maximizes your uptime while making sure you're getting the optimum measurement quality. You can choose the level of support you need to balance costs and response times.

With customer service centers that span the globe, we can support your equipment wherever your work takes you. All major HP service centers are ISO 9000 registered and comply with major national and international metrology standards.

Flexible choices

HP's product support programs are designed with flexibility to meet a variety of needs. Because support requirements vary widely from application to application and product to product, discuss your specific needs with an HP sales or support engineer.

For example, you can select either per-incident or contracted programs for both repair and calibration. Purchase HP support options when you buy new or HP refurbished equipment, or select from a variety of repair, calibration and system support programs at any point after purchase.

Repair services

Repair services are a great example of our flexible approach:

HP support options extend your warranty coverage (typically to three or five years, depending on the product).

Standard Repair (STREP) for one-time, fixed-price repairs outside of warranty. This alternative is a good choice for low-usage applications.

One-year repair agreements are usually the most cost-effective option for instruments in high-usage applications.

These repair programs assure your investment will be supported even after our standard warranties, which are some of the longest in the industry, expire.

For systems and selected instruments, we offer a variety of on-site support options, outlined on the following page.

Calibration services

HP's instrument and system calibration services give you peace of mind by keeping your equipment operating with peak precision. All calibration measurements are traceable to national and international standards to ensure reliable, accurate results.

As with repair, calibration services are available in several programs to fit different needs. For individual instruments, returning the product to HP is often the most cost-effective choice. You can choose between per-incident calibrations and a calibration agreement for regularly scheduled calibration services. An expedited service for faster turnaround is also available.

For large instrument pools and systems, we offer on-site calibration programs to minimize costs and downtime.

" HP was very responsive to our business needs and budget pressures. Overall, HP gave Netwave the exact level of quality service needed, when needed, and within budget."

Jerry Ulrich,
Netwave Technologies

Type of Installation	Hardware Repair		Hardware Calibration		Software Support
	At HP	On-site	At HP	On-site	
Instruments: small number	Most cost effective	On selected instruments	Most cost effective	On selected instruments	Software and firmware support depends on product
Instruments: large number	Available on any scale	Usually most cost effective	Available on any scale	Usually most cost effective	Software and firmware support depends on product
Systems	Several levels of repair services		Several levels of calibration services		Response center support, software subscription and notification services
Mix of instruments and systems	Choose the best mix of support services for instruments and systems				

HP's flexible support programs adapt to any installation.

On-site support services

We offer four levels of on-site system support, so you can choose the level of support you need for every key system:

1. Priority-Plus Support
The fastest response for mission-critical systems, with 24-hour on-site coverage 365 days a year. Four-hour response within 100 miles of selected HP support centers.

2. Priority Support
The best choice for important systems when substitute equipment is unavailable. On-site coverage from 8:00 a.m. to 9:00 p.m Monday through Friday (except HP holidays). Four-hour response within 100 miles of HP support centers.

3. Next-Day Support
An economical choice when you have substitute equipment available. Provides next-day on-site coverage from 8:00 a.m. to 5:00 p.m, Monday through Friday (except HP holidays), within 100 miles of HP support centers.

4. Cooperative Support
An option for customers who maintain their own systems and need backup support for replacement parts, diagnostic tools and other services. Available on selected systems.

These support programs are available for a variety of HP systems:

- Board test systems
- Semiconductor test systems
- Telecom test products
- Datacom test products
- High-frequency design systems
- Digital design and debug systems
- VXI test systems
- Dynamic signal analyzers
- General-purpose test and measurement software (e.g., HP VEE)
- RF and microwave products
- Manufacturing functional test systems
- Electromagnetic compatibility products

Response Center support

HP Response Centers offer system users a fast, easy way to solve a wide variety of operational problems. One call to the Response Center puts you in contact with a system expert with access to our extensive database of system characteristics, known problems, workarounds, product performance data, and other information you need to stay productive.

Response Center contracts are available for one designated person on your staff or for multiple callers if you need broader support.

Software update services

To ensure access to the latest system software and documentation, make sure a Software Update Subscription is part of your support strategy. These subscriptions are flexible, letting you buy only the materials and licenses needed for a specific application.

In addition to these updates, we provide notification services for mature products and hardware products with minimal software. These updates cover software, firmware and hardware upgrades, as well as servicing and support availability issues.

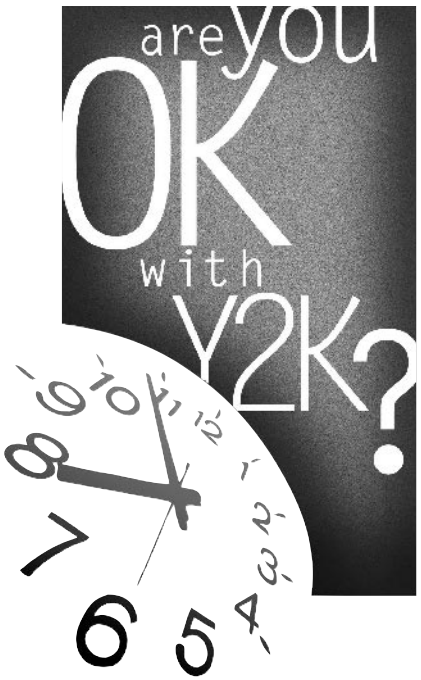
HP's worldwide repair centers are equipped with state-of-the-art test equipment traceable to relevant standards.

Maximizing uptime at Artesyn Technologies

As one of the world's leading manufacturers of communications power systems, Hong Kong-based Artesyn Technologies relies on the availability and accuracy of more than 1,000 test and measurement instruments.

With both profitibility and competition on the line, Artesyn knew it couldn't take a chance with calibration. The company worked with HP's Volume On-Site Calibration Services Team to devise a production and calibration schedule that has minimized disruptions and reduced calibration downtimes from days to mere hours.

Smooth test operations: 2000 and beyond



The HP year 2000 website (www.hp.com/go/tm-year2000) has all the information you need to identify and resolve any compliance issues with Hewlett-Packard Test and Measurement equipment.

What HP is doing to help you move smoothly into the year 2000

More than 81% of the 18,500 Hewlett-Packard Test and Measurement models in use today do not perform any date-related processing, so by definition don't present a Y2K concern. Another 12% have been certified Y2K compliant, leaving just 7% that require updating.

We've taken several steps to help resolve any Y2K issues related to HP instruments and systems:

1. Set up a Y2K product status website with compliance service notes for easy customer access
2. Established a Y2K customer-care program
3. Made a commitment to make available compliance updates for a wide range of HP's most popular instruments and systems
4. Made a commitment that all new test and measurement products are Y2K compliant

Identifying your Y2K status

Visit our Y2K website at: **www.hp.com/go/tm-year2000** to see if your Hewlett-Packard Test and Measurement products are Y2K compliant (simply enter the product name or number). You'll also find service notes that give specific instructions on how to update non-compliant models.

In addition, the site offers testing protocols, answers to frequently asked questions, and links to our service and support centers. If you don't have web access or have questions after visiting the website, please call your local HP office listed on the inside back cover.

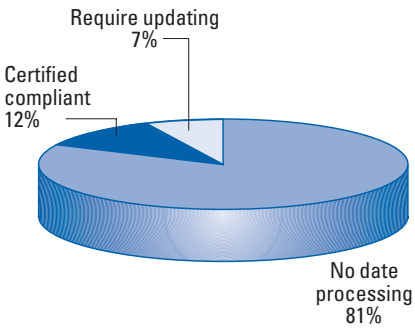
Updating non-compliant products

Updating a non-compliant product may be as simple as performing a customer-installable software update, which we will give to you free of charge for all Test and Measurement products that meet any one of the following criteria:

- Covered under current, applicable support agreement
- Still under warranty
- Delivered after January 1, 1997

If you decide to have HP install this software, there will be a labor charge for installation and test.

For products requiring more extensive updates, such as hardware and/or firmware updates (with the exception of controller, disk drives, and additional memory), the update parts and installation/test labor will be free of charge for all products that meet any one of the above criteria.



Only 7% of Hewlett-Packard Test and Measurement products require updating for Y2K compliance.

Lucent Technologies helps networks feed bandwidth–hungry applications and services

Fiber optics have given telecom and datacom networks a huge capacity boost in recent years. Unfortunately, the Internet's appetite has grown even faster. In North America, for instance, all that new fiber is already running at 70 to 80 percent of capacity.

Lucent WaveStar to the rescue

Network operators can respond in two ways: add more fiber, and make better use of the fiber they already have in place. Lucent Technologies' optical networking specialists are leading the way in this second effort, using a technology called Dense Wave Division Multiplexing (DWDM), that transmits multiple wavelengths of light simultaneously.

Lucent has deployed more than 2,400 DWDM systems already, and its powerful new 80-wavelength WaveStar™ OLS 400G boasts a maximum capacity of 3.2 terabits of voice, data and video per second.

Teaming up to slice time-to-market

At the beginning of the product development cycle, Lucent committed to delivering the new WaveStar OLS 400G to its customers in under a year, significantly less than typical cycle times for a project of this magnitude. To help meet this ambitious goal, Lucent needed quick development of a test system, too. Moreover, Lucent's engineers needed a way to automatically test all 80 channels efficiently and effectively.

"In selecting a vendor for this test solution, we looked for a company that would really see us through our tight schedule," said Yassi Moghaddam, technical manager of system test for Lucent Optical Networking Group. "We chose HP and were pleased that they followed through well every time, and sometimes came through even sooner than expected."

HP's test system developers and integrators worked in parallel with Lucent's development and test teams, freeing Lucent to focus on product development and meeting all of its high standards for product quality assurance.

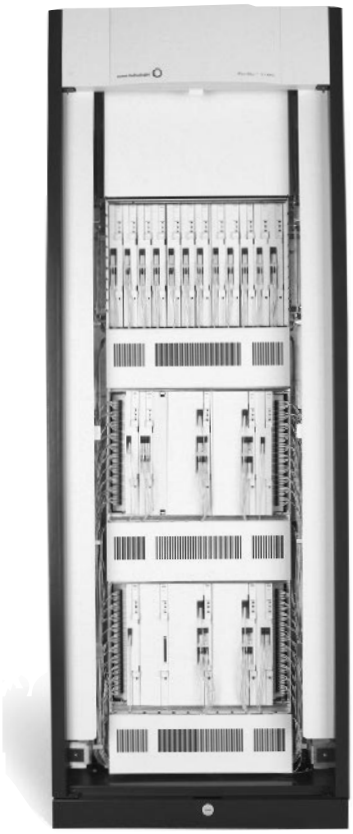
"We optimize our processes to address each customer's needs, allowing them to take as much ownership of test-solution design and construction as they like," explains David Kent, operations manager of HP's Test Solutions Operations. "Lucent's team collaborated very closely with ours to draw up the system definition, and then we took over to complete hardware and software design and construction rapidly. It was an incredible team effort."

The benefits of a common test platform

A cornerstone of the rapid test development strategy was a common test platform that helped Lucent leverage its convergent, cross-disciplinary efforts. As a result, time invested in one area shortened the cycles needed for other areas of development. For example, automation scripts and test routines created for the development stage were refined and promptly implemented during the system test phase.

HP's test solution, based on HP E1676B VXI OC-48c transceivers, lets Lucent examine each bit in a synchronous optical network (SONET) signal. To save time, Lucent's engineers can perform each automated test remotely. Plus, HP's modular system approach makes it easy to add channels quickly, providing as much scalability as Lucent's development cycle required.

As Lucent continues its leadership in the competitive optical networking market, the company can continue to count on HP test systems to help deliver advanced networking solutions to those bandwidth-hungry customers.



Lucent Technologies WaveStar™ OLS 400G offers data rates up to 3.2 terabits per second to help ISPs and other network operators meet skyrocketing demand for capacity.

Integration services designed to meet your unique needs

In the world of automated test, no two projects and no two customers are alike. That's why every system integration project from HP is designed around your unique requirements and available resources:

Level 1: Build-to-print test solutions

If your test engineers already have a plan in place, we can build a system to your design. We'll procure and coordinate the materials; then build, deliver, integrate and support the system.

Level 2: Collaborative test solution services

We'll work with your R&D, manufacturing, and field service teams to design, specify, and support an electronic test solution. Sharing the design and implementation tasks is often the best approach when product and test development need to progress simultaneously.

Level 3: Turnkey test solution services

At this level, we'll cover the project from start to finish; from business needs analysis through field support for the life of the system. You get all the advantages of a professionally designed system without pulling staff away from other projects.

Choosing HP as your development partner

Customers have used our integration services for hundreds of systems worldwide, enjoying significant business benefits:

- Getting products to market in less time
- Making better use of people and resources
- Cutting test costs
- Delivering better products through more complete and better focused testing

A complete range of services and support

Our engineers and technicians are experienced in every phase of custom system development:

- Business and technical analysis
- Specification
- Test system design
- Software design and development
- Materials procurement
- Integration
- Documentation
- Training
- Delivery, installation and inspection
- Specialized test fixtures
- Long-term support
- Performance analysis
- System relocation

Our areas of concentrated expertise include wireless cell phone and infrastructure equipment, other communications equipment, satellite communication systems and aerospace/defense systems.

We can offer a unique combination of expertise that goes far beyond system integration. As the world's largest test and measurement company and one of the largest manufacturing firms, we understand electronic test from the ground up.

Moreover, our global design, support and delivery teams mean we can support you wherever your business takes you. After we've worked with you to deliver a final solution, we can quickly create multiple similar systems to deliver anywhere in the world.

Controlling test at Allen-Bradley

When you manufacture more than 350,000 different products and product variations, from power devices and sensors to programmable controllers and quality management systems, keeping a lid on test costs can be a challenge. Moreover, Allen-Bradley wanted to streamline its test processes to simplify quality control, get new products to market faster and even conserve valuable floor space. The ability to test increasingly complex products was another major concern.

To meet all these goals, Allen-Bradley turned to HP's custom test specialists. The answer: a fully integrated solution based on a scaleable, common test architecture adaptable at more than two dozen sites worldwide. The results: a 10% reduction in test development costs, test execution times cut by as much as 50%, and development cycle times cut by as much as 12 weeks.

Synchronizing planning and production at Henkel Waschmittel GmbH

The ecologically-oriented Henkel Group, a renowned specialist in applied chemistry, is dedicated to making people's lives easier, safer and more enjoyable. Pursuing these goals, the company has achieved leading positions in many areas of chemical production, including the European detergent and cosmetics markets, the worldwide market for metal surface treatment, and the manufacturing of adhesive products. Its Henkel Waschmittel GmbH division is a leading producer of detergents in liquid and powdered form.

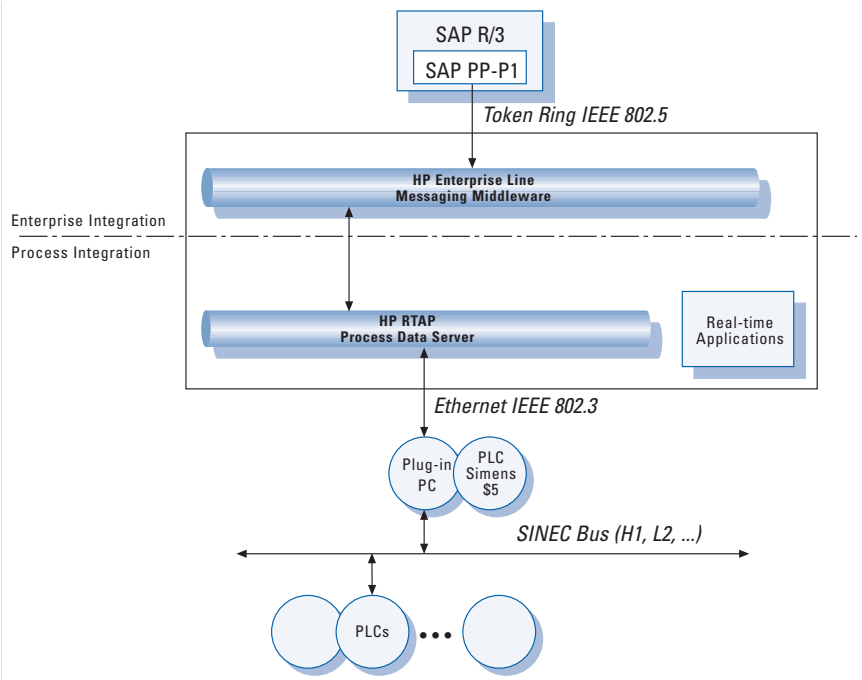
Responding to changing customer needs

In the early 1990s, the Henkel Group deployed SAP R/3 as a standard enterprise resource planning (ERP) application throughout its operations. To increase its responsiveness to customer requirements, the Henkel Group wanted to take the next step: plant-to-enterprise integration. Specific goals included synchronizing activities at the enterprise level with the process control level, achieving faster product delivery and reducing inventories.

Linking processes across the enterprise

To achieve this next level of integration, Henkel Waschmittel called on HP Consulting in Germany. The company had several reasons for selecting HP, starting with HP's reputation for high quality products. Henkel Waschmittel's strong, decades-long relationship with HP was also a key factor. Plus, HP's size, stability and worldwide presence met the needs of their global operation.

Working with HP consultants, Henkel Waschmittel installed HP Real Time Applications Platform (RTAP), a process data server that provides flexible, scalable and dependable data management.



The custom HP systems installed at Henkel Waschmittel provide seamless data integration throughout the organization.

Henkel Waschmittel installed four HP RTAP systems, with two at the Düsseldorf-Holthausen site and two at the Genthin site. At the ERP level, HP Consulting recommended installation of HP Enterprise Link at Henkel Düsseldorf-Holthausen. Enterprise Link is a certified messaging middleware that integrates SAP's R/3 system with real-time control systems.

HP integrated these systems into Henkel's existing IT environment, giving users easy access to online data from the central server via their Windows NT PCs. Production data of interest include temperature, viscosity, pH value, and the product level in each storage tank. The system can automatically generate reports for five major production areas: process information, operational data, failure reporting, production cycle times, and production quantities. This ready access to production information has increased the efficiency of decision making, problem detection and control.

Recipe management is also more efficient, thanks to the link between planning and production that HP RTAP provides.

Leveraging the results

The team at Henkel Waschmittel GmbH is very pleased with the HP systems. HP Consulting helped Henkel overcome the challenges of a complex implementation, and results have exceeded expectations. Plans are already in place to install similar systems at other plants and to expand data correlation and fault detection features for more in-depth analysis.

Knowledge is power: getting the right information at the right time

From a few hours of productivity assistance to a specialized design project, HP's engineers can help you make the most of your HP equipment while freeing your staff for key projects.

As a technical professional, you understand that having the right information at the right time can pay for itself many times over. Our test specialists stay on top of the latest developments in technologies, test techniques, measurement equipment and regulatory details.

Is consulting or training the better choice for you?

If a measurement technique or other required knowledge represents an ongoing need, building the expertise in your organization through one of our many training courses (see the following page) is often the best answer. However, if your needs are short-term or highly specialized, it usually makes better economic sense to bring in a consultant while you focus on your core business needs. Our consulting services range from productivity assistance to advanced application solutions.

Productivity assistance

Having an experienced user by your side can be a great help when you need to get up to speed quickly with your new HP equipment. A few hours of productivity assistance can result in both better operating efficiency and higher quality measurements, thanks to our engineers' in-depth knowledge of HP equipment.

This productivity assistance can include just about any service your staff would find beneficial:

- Setting up, installing and initializing new systems
- Training users or production line operators
- Interfacing instruments, systems and workstations
- Configuring data management or presentation options

Productivity assistance is available in flexible increments, so you can buy as much or as little as you need, scheduled at your convenience.

Application assistance

Our engineers are also available for more in-depth application support, from specialized measurements and troubleshooting to test process reviews and system optimization. Here are just a few of the application areas in which they've helped clients with unique test challenges:

- Phase noise measurements
- RF and microwave component design and testing
- Digital systems design and debugging
- Data acquisition and dynamic signal analysis
- Communication systems testing and troubleshooting
- Establishing measurement processes and procedures

Take advantage of the latest test and measurement techniques

HP's industry and technology specific training services are a cost effective way to develop measurement expertise, from fundamental principles to the newest techniques in digital debugging or high-frequency design.

Training based on your specialized requirements

As with all of our professional services, HP training courses can be adapted to fit your specific needs:

- In addition to classroom training, some of our most popular courses are available in self-paced, computer-based formats
- On-site delivery is available for nearly all instructor-led courses
- Custom training courses can be developed for specialized needs

Learn more in less time

HP training courses employ both the latest in training technology and proven techniques for professional education:

- Our instructors understand your industry and speak your language; they know how to make the measurements you need to make
- Product and industry specialists, curriculum engineers, writers and instructors develop course materials as a team to ensure effective knowledge transfer
- Class sizes are limited, often ranging from 6-10 students
- Most courses include extensive hands-on experience
- Instruction includes the physics behind the measurements to help students apply their knowledge on the job

Variety of courses

Training courses cover a wide range of test and measurement applications and industries:

- Automated testing using HP VEE
- Electromagnetic compatibility
- RF, analog and digital signal analysis and monitoring
- RF component and materials testing
- High-frequency design systems
- Datacom, telecom and mobile communications
- Board test systems
- Digital design and debugging, including embedded control systems
- Mixed signal, memory and processor testing

Course descriptions and schedules for each region of the world are available by calling HP or by visiting our training web site at: **www.hp.com/go/tmeducation**

HP's experienced instructors use the latest technologies and training approaches to maximize educational effectiveness.

Building competitive advantage with an informed work force

A large wireless maufacturer in Singapore recently faced one of the biggest challenges a rapidly growing company can encounter: developing a trained work force fast enough to keep up with soaring demand.

The company turned to HP for help. Our wireless experts analyzed their immediate and long-term needs, then developed a custom curriculum around the needs of technicians, engineers and equipment operators. Ten on-site classes were established, with over 100 employees passing certification examinations. Ongoing curriculum enhancements help the staff stay up to speed on emerging technical developments.

Support makes the difference in the fast-moving telecommunications market

From its base in the "Silicon Valley of Taiwan," Microelectronics Technology, Inc. (MTI) has gained an international reputation as a supplier of communications components. Major manufacturers in the U.S. and Europe rely on MTI components for personal communication systems and other popular technology-driven products.

Responding to competition by getting closer to customers

To respond to the high level of competition in these markets, MTI is working hard to foster close relationships with all its customers. According to Jason Chang, MTI's Vice President of R&D, "Microwave communications technology is rapidly developing and the market is becoming more and more competitive. As a result, equipment suppliers and manufacturers have needed to establish better and closer relationships."

To keep up with the the rapidly changing and complex technologies in the communications market, and to shorten product development cycles, MTI needed to make sure its R&D department was equipped with leading-edge design, development and test solutions.

Cutting test development time with reprogrammable systems

In the past, MTI created hardware setup methods for its test procedures, in which each test setup could perform tests on only one particular component. Once the standard or component was changed, all the procedures had to be redone. The result was inevitable delays, delays that became unacceptable as customers demanded faster and faster turnaround times on new designs.

MTI needed a more flexible test system in R&D, along with a partner who could be relied upon to deliver and support such a system locally.

Prior to working with HP, MTI had been negotiating a purchase arrangement with another equipment supplier. As Mr. Chang explains, though, "We had an opportunity to meet with the HP people to talk about their new IQG signal test system. Based on that discussion, we suspended the other purchase order and evaluated the HP solution. The evaluation indicated the HP was a better match with MTI's current needs in terms of pricing, performance, flexibility and support."

Supporting customers in fast-paced markets

William Wang, Director of MTI's Special Electronics Department, believes the key factor affecting the decision was after-sales service and technical support. To cope with the fast pace of development in the microwave communication market, strong support is crucial during research and development.

HP's test specialists in Taiwan wrote the software for the new system, so any problem that might arise could be solved by the programmers directly and efficiently.

The nature of HP's support team in Taiwan was an important factor as well. Unlike some companies that deliver support through a single technician, HP Taiwan supports clients with an integrated team of more than 30 engineers.

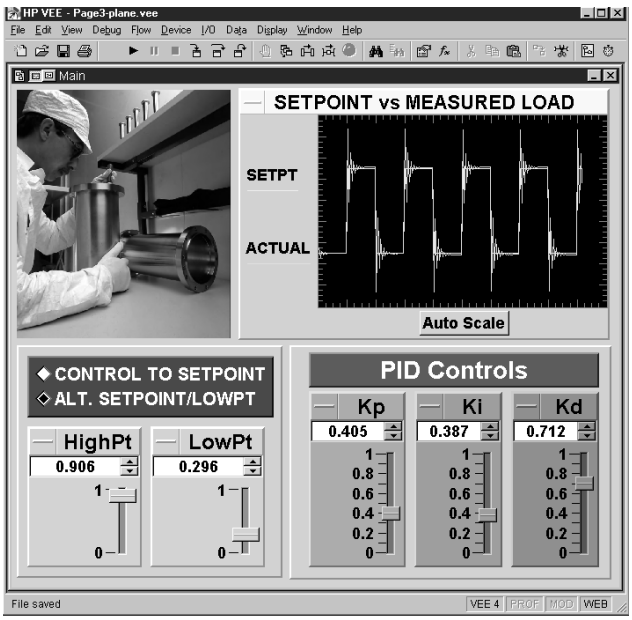
The cooperation between MTI and HP over the years has established a mutual understanding that minimizes problems and quickly resolves those that do arise. MTI is looking forward to a continued partnership as the integration of the telecom, electronic media and computer businesses provides continued development opportunities and challenges.

From left to right: William W.S. Wang, MTI Director of Special Products; Jason L.C. Chang, MTI Vice President of R&D; Tony Chen, HP Consultant; and Lobo Wong, HP Senior Account Manager; stand before display of MTI communications products tested by HP test system.

HP VEE Visual Programming Language

HP VEE 5.0

- For Windows 95/NT and HP-UX
- Simplifies communication to and from instrumentation
- Used in manufacturing test, design characterization, verification, and data acquisition
- Usability benchmarks show HP VEE improves engineering productivity
- Now in version 5.0



With its wide variety of user interface objects, HP VEE makes it easy to create operator interfaces and soft front panels.

Rapid Program Development

HP VEE is a visual programming language for developing instrument-control and data acquisition programs. With HP VEE you create a visual program by linking together functional objects to form a kind of block diagram. The range of functions within HP VEE makes it a universal tool for measurement and control programs.

Using HP VEE, you can:

- Gather data from instrumentation and PC plug-in modules.
- Control interfaces and equipment (serial, GPIB, VXI).
- Display data using many different plots, alphanumeric displays, and display objects.
- Load and use ActiveX Controls to add functionality to HP VEE.
- Communicate with other Windows programs using ActiveX Automation.
- Save programs using many formats such as binary, ASCII, table formats.
- Process data as strings, arrays, bytes, records, etc.
- Compute, analyze and simulate from simple addition to FFTs, fitting, integration, etc.
- Work with loops such as if/then/else, <, =, >, for, while, repeat until, etc.
- Control and regulate to simulate data, measure and compute output variables, etc.
- Create structured programs and user interfaces.
- Access any HP VEE panel over the World Wide Web.

Worldwide Service and Support

With HP VEE, you have access to HP's worldwide resources for start-up assistance, telephone support, training classes, and update services. Additionally, through contracts with leading PC plug-in card suppliers, HP provides total solutions for test, measurement, and data acquisition. Many companies offer hardware/software solutions based on HP VEE.

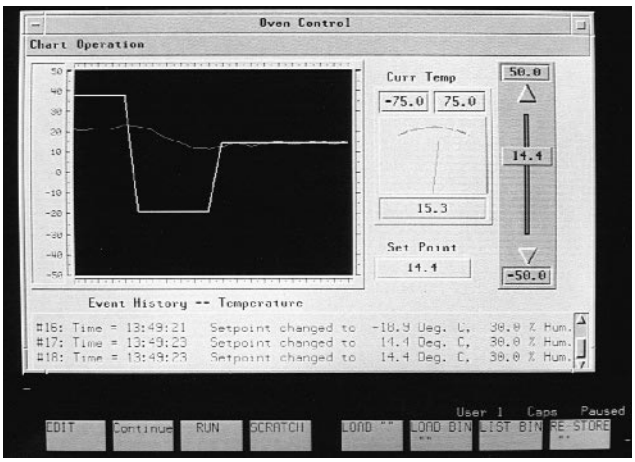
Join the HP VEE electronic users group. Sign up through the HP VEE web site and get assistance on using HP VEE from experts around the world: **www.hp.com/go/hpvee**

Evaluation Copy

There's only one way to fully appreciate the power and elegance of HP VEE. You need to get your hands on it. The HP VEE evaluation kit includes a full working copy of HP VEE plus instrument I/O libraries. To download the evaluation copy or to request it on CD-ROM visit the HP VEE web site: **www.hp.com/go/hpvee**

Ordering Information

Standard Products
HP E2120F HP VEE 5.0 for Windows 95/NT
HP E2111F HP VEE 5.0 for HP-UX
HP 82345F HP VEE 5.0 for Windows 95/NT plus HP 82341C GPIB Card
HP 82351F HP VEE 5.0 for Windows 95/NT plus HP 82350A PCI GPIB card



HP BASIC: The Premier Language for Measurement Automation

HP BASIC is a computer language that is optimized for test and measurement. It includes many test-oriented features:

- I/O libraries integrated within HP BASIC, as opposed to add-on I/O libraries used by other languages.
- Unified I/O, permitting a common approach to instrument control —no matter what interface you use.
- Syntax checking—HP BASIC checks the syntax of every line—as you type it in.
- Automatic use of direct memory access (DMA) if DMA hardware is available.
- Support of separate context subprograms. Code modules are easily reused, shared, or updated.
- Full interrupt processing, with 15 levels of software prioritization.
- Advanced commands for analysis, such as complex data types and matrix manipulation.
- Powerful graphics commands that allow quick development of sophisticated graphics displays, enhanced with the addition of HP BASIC Plus.
- Excellent HP support and documentation.
- Ease of use that lets you create results quickly.

Ordering Information

HP BASIC for Windows
HP E2060B for Windows 3.1/95/NT, media and manuals plus one license-to-use, software includes HP BASIC Plus
HP E2066B HP BASIC for Windows additional license-to-use
HP 82346B HP BASIC for Windows plus HP 82341C GPIB card
HP E82356B HP BASIC for Windows plus HP 82350A PCI GPIB card
HP BASIC/UX HP
E2045C HP BASIC for HP-UX 10.2 media and manual; does not include license-to-use; to be used in conjunction with HP E2046A product
HP E2046A HP BASIC for HP-UX 10.2 license-to-use

- Optimized for RF and microwave automatic test systems
- Modular for easier system integration
- Wide variety of products and configurations available

HP developed and supplies an integrated rack of RF test equipment for communication satellite payload test. MMS signal generators, spectrum analyzers and power meters were selected for a compact, EMC-rugged, highly-accurate, 1 GHz to 20 GHz broadband system. The HP 70611A Attenuator/Switch Driver (an MMS system module) is included providing a convenient interface to a custom switch matrix.

Modular Measurement System

The Modular Measurement System (MMS) is an open, industry standard controlled by a consortium. The high-performance, modular platform is especially suited for RF, microwave, and lightwave text applications. It offers the lowest life-cycle cost when you integrate, support or upgrade your system. The MMS offers system designers a number of advantages:

- A wide variety of over 50 modules offer low frequency, RF, microwave and lightwave measurement capability.
- Easy system integration is aided by standard- and custom-switching modules, plus an open architecture with design tools that allow you to design and build your own specialized modules.
- Easy-to-use displays allow you to operate a system from local or remote locations, and mainframes and displays can be separated by up to 1 kilometer.
- Electromagnetic compatibility (EMC) design is optimized for microwave environments. Rugged mainframes, shielded enclosures, grounding and a 40 kHz switched power supply reduce emissions and module-to-module interference.
- Automatic system control can be based on DOS, HP BASIC or UNIX® operating systems.
- Compatibility with other open standards allows you to make use of new and existing hardware, software and engineering expertise. MMS and VXI combine easily to solve complex measurement requirements. Both platforms continue to take advantage of their own internal high-speed bus, but can be tied to a common 10 MHz clock reference. Both use common trigger signal levels.

Maximize Your Investment

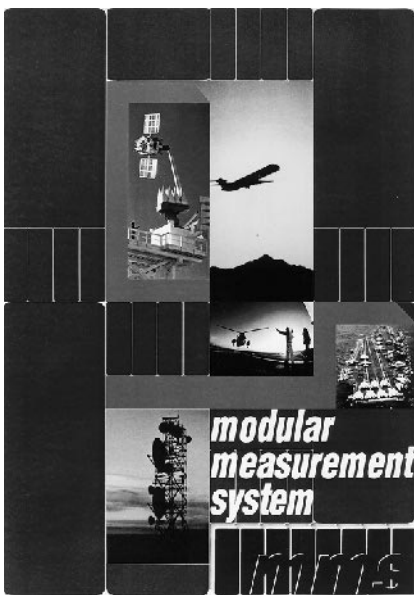
Several factors reduce MMS life-cycle costs:

- MMS integrates quickly, using off-the-shelf mainframes, components and software packages.
- MMS allows system configuration to provide just the right amount of measurement capability.
- Downsizing enhances ATE systems by reducing rack space.
- A central, shared display allows operator focus and monitors up to four instruments at once in real time. This further reduces rack space. The system will even work without a display, saving more space and reducing cost.
- Built-in diagnostics and modularity team up to maximize system uptime, allowing you to make the best use of your investment.

HP 70000 Modular Measurement System

HP offers a variety of products and services to help you customize your entire system. Multiple support alternatives allow you to customize the logistics of each system to fit installation needs. With MMS, you are assured of the highest performance and best customer support—today, and in the years to come. Your HP sales representative can help you configure the best solution for your specific application.

The following pages highlight selected components and systems in the HP 70000 family. A complete listing of all HP MMS products and most MMS products from other suppliers with full descriptions, specifications and services is also available.

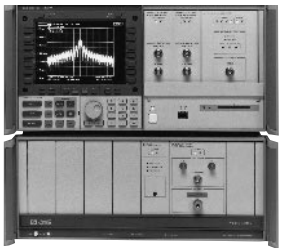


Key Literature

HP 70000 Modular Measurement System Catalog, p/n 5965-2818E

MMS Products

Modular Measurement System



HP 71400C with HP 70810B

HP 71451B

HP 70000 MMS Product Information

Mainframes and Displays

Product	Description
HP 70001A System Mainframe	8-slot mainframe for MMS plug-in modules
HP 70205A Display	Compact, 3-slot module format
HP 70207B PC Display for MMS	Provides the MMS display and user interface on a PC
HP 70004A Color Display and Mainframe	Integrated mainframe and display 4 available module slots

Instruments

Choose from instruments that are single modules or multiple modules configured into a system.

Sources

Product	Description
HP 70340A Microwave Synthesizer, 1 to 20 GHz	Synthesized signal generator with add-on frequency extension +13 to –90 dBm amplitude range 4-slot width + 1-slot extension module
HP 70341A Frequency Extension Module, 10 MHz to 1 GHz	
HP 71708A Microwave Source, 2.4 to 25.8 GHz	LO
HP 70428A Microwave Source Module, 2.4 to 25.8 GHz	

Signal Analyzers

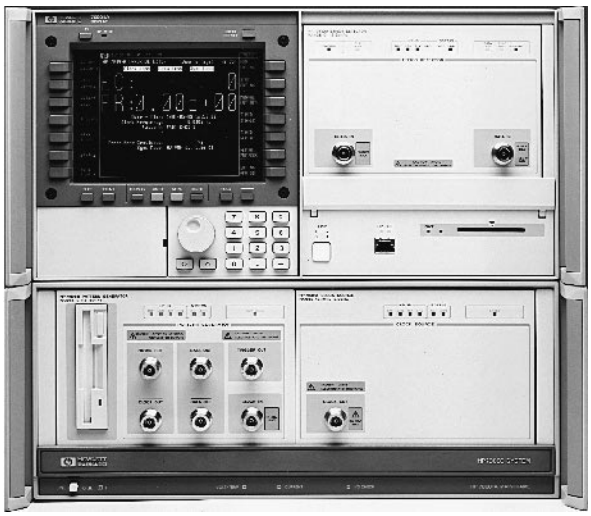
Product	Description
HP 70100A Power Meter, 100 kHz to 50 GHz	Single-channel module with features, capability of HP 437B 1-slot width
HP 70110A Digital Multimeter	3 ½ to 6 ½ digits of resolution 2-slot width
HP 70120A Universal Counter	100 MHz, 200 MHz, 2.4 GHz inputs 1-slot width
HP 70700A Digitizer	20 megasamples per second, 10 bits 1-slot module
HP 70703A Digitizing Oscilloscope	4-input, 2-channel operation 500 MHz 2-slot width
HP 71500A Microwave Transition Analyzer, DC to 40 GHz	2-channels, sampler-based, internal trigger Time-domain measurements with FFTs
HP 71707A Microwave Downconverter, 2 GHz to 26.5 GHz	Translates microwave signals to RF frequencies for phase noise measurements
HP 70427A Microwave Downconverter Module, 2 GHz to 26.5 GHz	

Spectrum Analyzers and Receivers

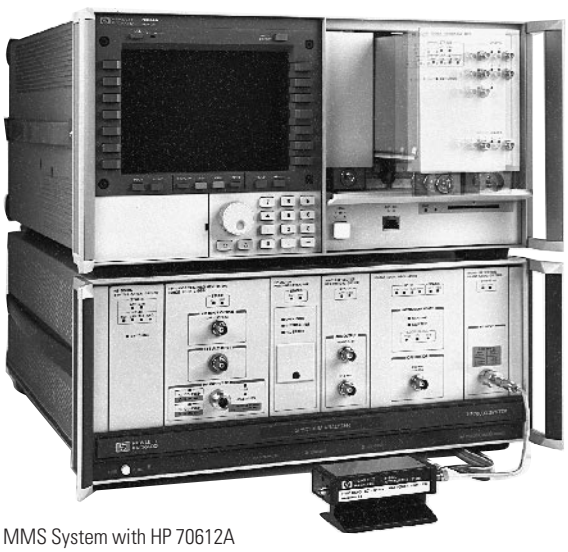
Product	Description
All HP 70000 series spectrum analyzers offer the following:	10 Hz minimum bandwidth 90 dB calibrated display range 0.1 ppm frequency stability
HP 71100C RF Spectrum Analyzer, 100 Hz to 2.9 GHz	Synthesized, high performance RF spectrum analysis –134 dBm sensitivity, –156 dBm with preamplifiers
HP 71100P RF Spectrum Analyzer, 100 Hz to 2.9 GHz	2-mainframe system with 6 slots available or 1 mainframe with PC display
HP 71209A Microwave Spectrum Analyzer, 100 Hz to 26.5 GHz	Continuous sweeps from 100 Hz to 26.5 or 40 GHz –138 to –128 dBm sensitivity across the frequency range (HP 71209A/P); –107 dBm at 40 GHz (Option Z40)
HP 71209A Option Z40 Spectrum Analyzer, 100 Hz to 40 GHz	Built-in external mixer interface for mm applications
HP 71209P Microwave Spectrum Analyzer, 100 Hz to 26.5 GHz	2-mainframe system with 5 slots (HP 71209A) or 3 slots (Option Z40) available or 1 mainframe with PC display
HP 71210C Microwave Spectrum Analyzer, 100 Hz to 22 GHz	Fundamentally mixed, highest microwave performance –139 dBm sensitivity at 1 GHz; –133 dBm at 22 GHz; –155 dBm at 22 GHz with HP 70620B preamplifier
HP 71210P Microwave Spectrum Analyzer, 100 Hz to 22 GHz	2-mainframe system with 5 slots available or 1 mainframe with PC display
HP 71910A HP 71910P Wide Bandwidth Receiver	Includes HP 71209A/P Adds 10 MHz to 100 MHz linear bandwidth capability See page 24.35

Lightwave and Communication

Product	Description
HP 71400C Lightwave Signal Analyzer, 100 Hz to 22 GHz	Calibrated measurement of intensity modulation from 100 kHz to 22 GHz 1200 to 1600 nm operation (750 to 870 nm option 850)
HP 71401C Lightwave Signal Analyzer, 100 Hz to 2.9 GHz	RIN measurements to –165 dB/Hz Interferometer for laser linewidth and chirp measurements Systems based on HP 71210C spectrum analyzer
HP 70810B Lightwave Signal Analyzer Module	2-mainframe systems with 4 slots available
HP 71450B Optical Spectrum Analyzer	Spectral measurements from 600 to 1700 nm Double-pass monochromator
HP 71451B Optical Spectrum Analyzer	Real-time sweep rates –90 dBm sensitivity, 60 dB dynamic range Wavelength and amplitude calibration across full measurement range
HP 71452B Optical Spectrum Analyzer	Optional current source and white light source 5 modes of operation (HP 71452B) 1 mainframe system with color display
HP 71501C Jitter Analysis System	Expanded measurement range: 50 Mb/s to > 12 Gb/s Jitter transfer, tolerance, output/generation Test systems, networks, modules or components, MUX/DEMUX Eye-diagram and analysis capability



HP 71604B



MMS System with HP 70612A

Product	Description	
HP 71603B Gigabit Error Performance Analyzer **HP 71604B Pattern Generator**	100 Mb/s to 1 Gb/s pattern generation and error performance analysis Low-phase-noise clock source User-programmable patterns up to 4 Mb with screen-based editor Ability to trigger anywhere in pattern Variable clock/data delay Automatic setting of threshold and decision point True complementary outputs 2-mainframe systems with color display	
HP 71612A Series Gigabit Error Performance Analyzers and Pattern Generators	100 Mb/s to 12 Gb/s pattern generation and error performance analysis 8 Mb programmable pattern Fast transition times, low jitter Burst-mode capability for fiberloop testing Four sub-rate outputs Location of specific errored bits 2-mainframe systems with color display	

[1] Price on application.

System Building Blocks

Configure an instrument or system for unique applications using off-the-shelf modules.

Product	Description	
HP 70310A Precision Frequency Reference	10 MHz to 100 MHz precision reference 1-slot width	
HP 70620B Preamplifier, 1 GHz to 26.5 GHz **HP 70621A Preamplifier,** 100 kHz to 2.9 GHz	Boost sensitivity of analyzers by 15 to 25 dB –156 dBm sensitivity at 2.9 GHz –150 dBm sensitivity at 22 GHz Optional 100 kHz low-end frequency Built-in switches for preamplifier bypass	
HP 70900B Local Oscillator	Master control module for spectrum analyzers 2-slot width	
HP 70860A Upgrade Kit	High-speed controller board upgrades HP 70900A with features of HP 70900B	
HP 70861A Upgrade Kit	RAM/ROM board upgrades firmware to HP 70900B capabilities	
HP 70902A IF Section, 10 Hz to 300 kHz **HP 70903A IF Section,** 100 kHz to 3 MHz	Adds signal processing elements for spectrum analyzers 1-slot width	
HP 70911A IF Section, 10 MHz to 100 MHz bandwidths	Used in HP 71910A wide bandwidth receiver 2-slot width	
HP 70904A RF Section, 100 Hz to 2.9 GHz	Broadband input conversion for spectrum analyzers 1-slot width	
HP 70908A RF Section, 100 Hz to 22 GHz	Fundamentally mixed broadband input conversion for analyzers 2-slot width	
HP 70909A RF Section, 100 Hz to 26.5 GHz **HP 70910A RF Section,** 100 Hz to 26.5 GHz	Diode-pair mixing, built-in preamplifier for improved sensitivity Switchable bypass filter around YIG tuned filter (HP 70910A) 2-slot width	
HP 70907B External Mixer Interface Module	Interface for external mixers 1-slot width	

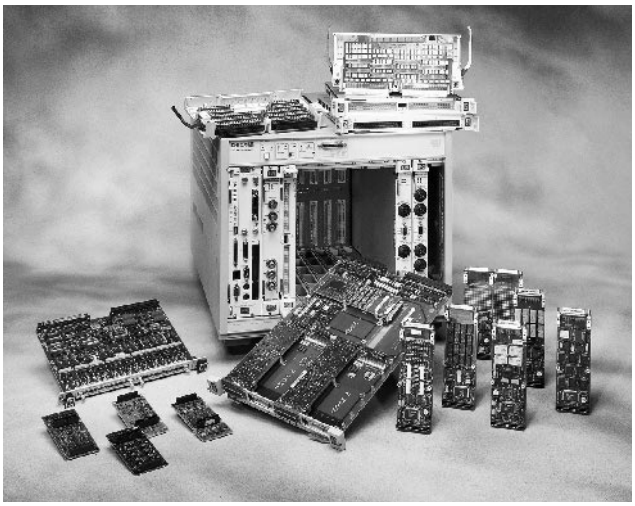
System Integration

Quickly integrate your test system using these resources and tools.

Product	Description
HP 70611A Attenuator/ Switch Driver	Controls up to 31 electro-mechanical mechanical switches or attenuator 1-slot module

Service and Support

The MMS offers many support alternatives. The sytem design allows modules to be exchanged in the field without loss of system calibration. For multiple-module systems, you can add new modules or replace existing ones and run the one-button internal calibration routine. Spares can be stocked based on the MTBF of individual modules—often greater than 15,000 hours. Many MMS instruments have built-in or downloadable diagnostic routines for locating faults. And HP provides for return-to-factory repair and calibration of systems, and offers MIL-STD-45622A certification that is valid for up to three years.



The HP E8408A is HP's smallest footprint, lowest-priced C-size mainframe.

VXIbus Introduction

In 1987, a consortium led by several major test and measurement manufacturers, including Hewlett-Packard, introduced VXIbus, a new standard modular instrument architecture. VXIbus was developed to meet the needs for portable applications, particularly for the military, and to provide an industry-standard instrument architecture with an interface speed significantly higher than that of the GPIB interface. The design of this new architecture allowed the integration of VXIbus products into traditional GPIB test systems and for standalone applications. Today, the VXIbus Consortium continues to refine the VXIbus standard and Hewlett-Packard remains an active member.

Since the inception of VXIbus, other standards have been developed, which reduce users' dependence on any one vendor. This lowers the risks and provides maximum investment protection in hardware and software purchases and system development. HP's VXIbus products support the industry-accepted VXI*plug&play* instrument drivers[1]. One set of these standard drivers for the MS Windows environment, for example, is supported by any of several popular software packages: HP VEE, Microsoft C/C++, Visual Basic, Borland C/C++, and NI Lab Windows. Other supported environments are Windows 95/NT, HP-UX, and SUN-OS.

Compact size, high throughput, and flexibility best characterize VXIbus. Today you can use VXIbus products to build a variety of test systems from portable testers for field use and remote data acquisition applications to high-performance data acquisition and functional test systems. While some systems are entirely VXIbus products, many users are integrating VXIbus along with traditional GPIB instruments. Today VXIbus manufacturers and numerous third-party integrators now are offering dedicated measurement solutions using the VXIbus platform. HP offers several integrated products based on VXIbus.

The pages which follow give a brief overview of the VXIbus Standard and a list of VXIbus products offered. For additional configuration and product ordering information, separate documents are available. For a free HP Test System and VXI Products Catalog, in the USA call 1-800-452-4844 or visit our web site: **www.hp.com/go/vxi**.

[1] HP joined the VXI*plug&play* Alliance in 1994 and has contributed to the definition of its industry-standard instrument drivers now provided by numerous VXI manufacturers.

The VXIbus Architecture

VXIbus is defined around the highly popular VMEbus architecture known for its excellent computer backplane. High-speed data rates of 40 MB/s along with the necessary communication protocols make it ideal for building instrument systems for high throughputs. VXIbus incorporates the ease-of-use features of intelligent GPIB instruments (for example, ASCII-level programming) into its message-based devices. It also takes advantage of the high-throughput capability of VMEbus devices which are programmed and communicate directly in binary.

Although VMEbus is an excellent computer backplane, it is not adequate for instrumentation without further standardization. The VXIbus Consortium fully defined the operating environment for instrumentation modules. All VXIbus mainframes must state how much power and cooling they provide. And all VXIbus modules must state how much power and cooling they require. Also, there are strict limits on how much conducted and radiated interference is allowed between modules. These parameters allow you to easily configure a workable system.

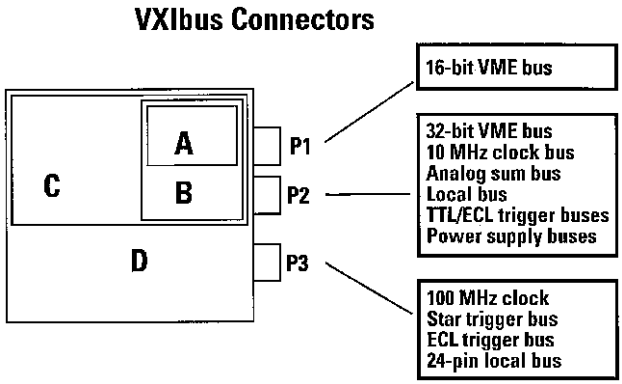
VXIbus systems provide backplane management and resource management functions. Slot 0, a unique physical location in every VXIbus mainframe, handles the backplane by providing clock signals, data movement arbitration, and more. The Resource Manager program configures the modules for proper operation whenever the system is powered on.

Mechanical and Electrical

The VXIbus specification defines a scalable family of four module sizes. The two smaller sizes, A and B, are the defined VMEbus module sizes, and are true VMEbus modules in every sense of the word. The two larger sizes, C and D, are additional sizes to allow higher performance instrumentation. Increased module spacing in the C- and D-size systems makes it possible to fully shield sensitive circuits for high-performance measurements. VXIbus is a scalable architecture, and allows smaller module sizes to fit into larger mainframes.

VXIbus provides other resources for instrumentation. These include additional power supply voltages for powering analog and ECL circuits, and implementation buses for measurement synchronization and triggering. Included are an analog summing bus and a set of local bus lines for private module-to-module communication. Additionally, stringent EMC and noise requirements are specified to maintain an interference-free environment for sensitive instrumentation.

VXIbus specifies three 96-pin DIN connectors: P1, P2, and P3 (page 85). The P1 connector, the only mandatory connector in VMEbus or VXIbus, carries the data transfer bus (up to 24 bits addressing and 16 bits data), the interrupt buses, and some power. The optional P2 connector, available to all card sizes except A-size, expands the data transfer bus and provides the additional resources as shown with particular pin assignments. The local bus indicated is a powerful feature provided by VXIbus. This flexible daisy-chain bus structure allows for adjacent modules to conduct private, high-speed communication.



Power and Cooling

VXIbus specifies a set of guidelines to ensure adequate cooling. Every vendor's mainframe specifications sheet provides cooling specifications for worse-case module configuration. Available airflow as a function of the maximum allowable pressure differential across any module is specified. This is matched against the specified airflow and pressure parameters specified for each module.

Values of peak dc current and peak-to-peak dynamic current are specified for each module. The system integrator can match the total module current loading to the capacity of the mainframe. The dynamic current specification assures ripple-free noise on the mainframe's power supply lines.

Communications

A more standardized set of communication protocols is defined for VXIbus systems to handle autoconfiguration, resource management, and device communication. The Resource Manager, a message-based commander, takes care of the configuration tasks. It sets up the shared address space, manages the system self-test, creates the commander-servant hierarchies, and then releases the system for operation fully configured.

A message-based device, which communicates directly in SCPI (ASCII), is commonly the most intelligent VXIbus device. Typically it uses a microprocessor and is more costly than a register-based device, but is easier to integrate into a VXIbus system. Most message-based devices provide moderate throughput performance in a VXIbus system.

The most basic level of communication is that handled through register-level (binary-level) reads and writes to the registers of the register-based device (in some instances, direct-register access is provided on a message-based device to improve throughput performance). The register-based device is often controlled by an intelligent message-based device, its commander (command module or embedded controller). The commander interprets SCPI (ASCII) instrument commands converting them into binary for communication to the register-based device. To avoid the speed-reducing effects of the SCPI interpretation, compiled SCPI is used to compile the SCPI instrument commands before runtime. Runtime speeds, then, are commensurate with binary-level speeds as though the user had programmed directly in binary.

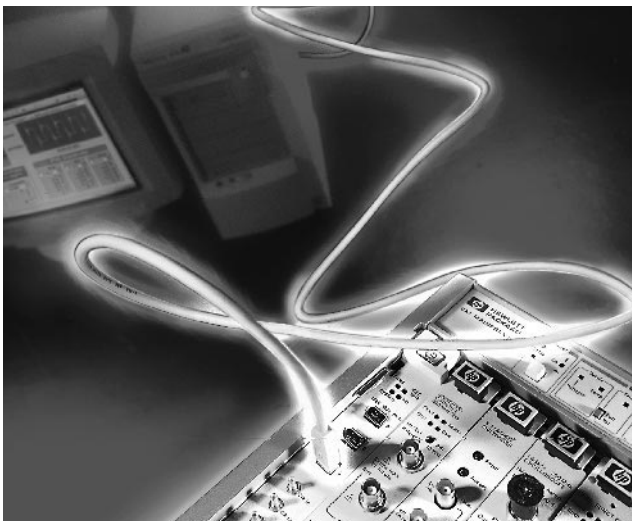
An IEEE-488-to-VXIbus interface is also defined in the VXIbus specification allowing for easy integration of VXIbus and GPIB products into one system. HP's Command Module (HP E1406A), for example, provides the GPIB connection for interfacing to an external GPIB controller. For high-throughput systems, an industry-standard interface, IEEE-1394 (FireWire), is provided in the HP E8491B PC link to VXI.

Summary

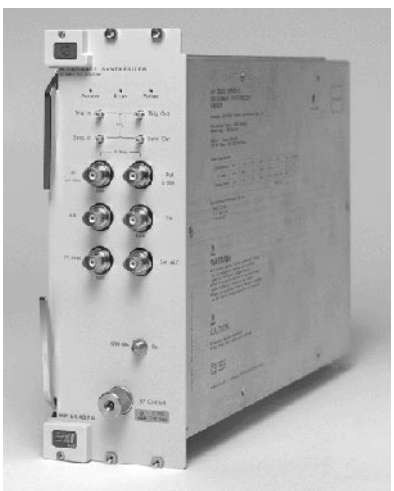
The benefits of industry-standard VXIbus systems are these:

- Downsizing to save costly rack space
- High-performance, high-throughput measurement capability
- Reduced time and cost for system development
- Reduced dependency on proprietary architectures

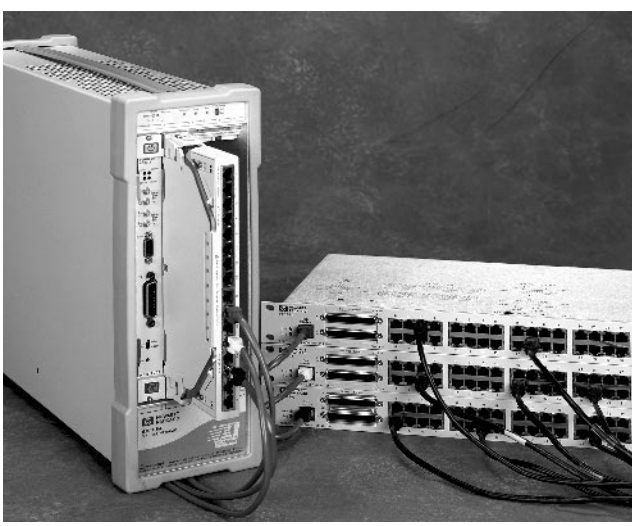
The following pages provide a listing of HP's VXI products. For product details and specifications, please refer to HP's Test System and VXI Products Catalog. To obtain a copy, please visit our web site: **www.hp.com/go/vxi**, or in the U.S. call 800-452-4844.



The HP E8491B PC to VXI Link provides IEEE-1394 (FireWire) interface capability to your VXI test system.



The HP E6432A VXI Microwave Synthesizer delivers CW signals with low phase noise and excellent spectral purity.



The HP E1529A Remote Strain Conditioning Unit simplifies structural testing of designs that require many channels of strain measurement.

HP 75000 VXI Products Information

Model No.	Description	
Mainframes		
HP E8408A	4-Slot, C-Size VXI Mainframe with options to add GPIB Command Module or IEEE-1394 Slot-0 Interface	NEW
HP E8401A	Low-cost, Medium Power C-Size VXI Mainframe, 13-Slot	
HP E8402A	Medium Power, Enhanced Monitoring, C-Size VXI Mainframe, 13-Slot	
HP E8403A	High Power, C-Size VXI Mainframe, 13-Slot, standard monitoring.	
HP E8404A	High Power, Enhanced Monitoring C-Size VXI Mainframe, 13-Slot	
HP E1401B	High-Power Mainframe, C-size, 13-slot; racking options available	
HP E1421B	Mainframe, C-size, 6-slot; racking options	
HP E1302A	VME/VXI Mainframe, B-size, 20-slot; embedded PC or GPIB controller and racking options available	
HP E1300B/01B	Mainframes, B-size, 7-slot; built-in 68000 processor and IEEE-488 and RS-232 interfaces; Options: dc power, memory, mass storage, IBASIC	
Controllers		
HP E1406A	Command Module, C-1, message-based commander, SCPI translator for register-based modules; optional expanded memory available	
HP E6234A **HP E6237A**	VXI Pentium® PC Controller WIN 95/NT VXI Pentium® PC Controller LynxOS	
Storage		
HP E1488A	Instrument Memory, C-1, RB, 2-16 MB for extending memory of HP E1429/30/45/85	
HP E4208D	SCSI Disk, C-1, 4 GB hard drive, 1.44 MB, 3.5-inch floppy	
HP E3249B	SCSI System Disk, C-2, 4.3 GB hard drive, 4 GB DAT tape	
HP E1562D/E/F	VXI Data Disk, DAT and SCSI-2 Interface Module, C-2, > 5.0 MB/s data rate, > 4 GB disk storage	
Interface		
HP E8491B	IEEE-1394 PC Link to VXI C-Size, Opt 001	NEW
HP E1482B	VXIbus-to-MXIbus Extender, C-size, 1-slot; Connect two or more VXI mainframes together, or interface to external MXIbus controllers	
HP E1489C	EISA/ISA-to-MXI interface; For direct VXI backplane interface to HP 9000 series 700 controllers	
HP E2749A	Fibre Channel Data I/O Module	
Application Software		
HP E2120F	HP VEE: Graphical Programming Language; Supports MS Windows	
HP E2060B	HP BASIC for Windows: based on the popular HP Rocky Mountain Basic language	

Model No.	Description	
Measurement		
HP E1312A, **HP E1412A**	6.5 Digit Multimeter, B-2/C-1, RB/MB, Vac/dc, Iac/dc, 2/4-w ohms, frequency, period	
HP E1410A	6.5 Digit Multimeter, C-1, MB, Vdc/ac, 2/4-w Ω, frequency, period, temperature	
HP E1411B, **HP E1326B**	5 Digit Multimeter, C-1/B1, RB, Vdc/ac, 2/4-w Ω, temperature	
HP E1426A	500 MHz Digitizing Oscilloscope, C-2, MB, 4-Ch., 8 b, 20 MSa/s, 500 MHz	
HP E1428A	1GSa/s Digitizing Oscilloscope, C-1, MB, 2-Ch., 8 b, 250 MHz bw	
HP E1430A	10 MSa/s A/D with DSP, C-1, RB 1-Ch., 23 b, 4 MHz bw, 24 digital filters, FIFO	
HP E1432A	16-Ch. 51.2 kHz Digitizer plus DSP C-1, RB, 16-bit, 4-32 MB FIFO, digital anti-alias filters	
HP E1433A	8-Ch. 196 kSa/s Digitizer plus DSP, C-1, RB, 16 b, digital anti-alias filters, 4-32 MB FIFO, 88 kHz bw	
HP E1437A	20 MSa/s Digitizer with DSP, C-1, MB/RB, 1-Ch., 23 b, 8 MHz bw, 24 digital filters, FIFO	
HP SCMVX008	Digital Signal Processor,Dual 60 MHz, Tms 320, C40 DSP with 6 expansion slots	
HP E3242A	Breakout Box accessory interfaces charge and IEPE accelerometers to HP E1432A/33AVXI Digitizers	
HP E3243A	Breakout Box accessory interfaces microphones and IEPE accelerometers to HP E1432A/33A VXI Digitizers	
HP E3245A	12-channel mini-phone plugbreakout box to 26-pin high density connector.	
HP E1313A	32-Ch. or 64-Ch. Scanning A/D, B-size, 3 or 4 slots, RB, 16 b, 100 kSa/s	
HP E1413C	64-Ch. Scanning A/D, C-1, RB, 16 b, 100 kSa/s	
HP E1414A	Pressure Scanning A/D, C-1, RB, up to 512 channels	
HP E1415A	Algorithmic Closed-Loop Controller, C-1, RB, 16 b A/D with signal conditioning	
HP E1419A	Multi-Function Measurement and Control	
HP E1420B	High-Performance Universal Counter, C-1, MB, 2-Ch., 200 MHz/2 GHz	
HP E1332A	4-Ch. Counter/Totalizer, B-1, RB, 4 MHz	
HP E1333A	3-Ch. Universal Counter, B-1, RB, 1 GHz	
HP E1740A	150 MHz Time Interval Analyzer, C-2, MB, 80 M rdgs/s, 100 ps rms	
HP E1416A	Power Meter, C-1, MB, 1-Ch., 110 GHz	
HP E1485C	Digital Signal Processor, C-1, 40 MHz Motorola 96002 DSPwith 4 expansion slots	
HP E1529A	Remote strain conditioning unit	
HP E1563A, **HP E1564A**	2-, 4-Ch., 800 kSa/s Digitizers	
M-Modules		
HP E2250A	B-Size M-Module Carrier	
HP E2251A	C-Size M-Module Carrier	
HP E2259A	Double-Wide Breadboard M-Module	
HP E2261A	Quad RS-232 Interface M-Module	
HP E2270A	16-Ch. Form A Switch M-Module	
HP E2271A	4x4 Matrix Switch M-Module	
HP E2272A	Dual 8-to-1 Relay Multiplexer M-Module	
HP E2273A	8-Ch. Form C Switch M-Module	
HP E2274A	4-Ch. Form C Power Relay M-Module	
HP E2290A	16-bit Digital I/O M-Module	
HP E2291A	16-Ch. Isolated Digital Output M-Module	

HP 75000 VXI Products Information

Model No.	Description
Sources and Amplifiers	
HP E1340A	Arbitrary Function Generator, B-1, RB, 12 b, 42 Msa/s, 10.2 V p-p (50 Ω), sweep, waveforms: arbitrary plus sine, square, ramp, triangle, sin(x)x, noise, haversine; Optional waveform software available
HP E1445A	Arbitrary Function Generator, C-1, MB, 13 b, 40 Msa/s, 10.2 V p-p (50 Ω), sweep, waveforms: arb, sine, square, ramp; Optional waveform software available
HP E1328A	4-Ch. D/A Converter, B-1, RB, 16 b, 1.3 kSa/s, 10.92 V dc
HP E1434A	4-Ch. 65 kSa/s Arbitrary Source, C-1, RB, 16-20 bit,10 V, sine, 25.6 kHz, bw, random, swept sine, 4-32 MB RAM FIFO
HP E1418A	8/16-Ch D/A Converter, C-1, RB programmable isolation, ± 16 V, ± 20 mA, 16 bit 1 kHz update rate
HP E1441A	Arbitrary Waveform Generator
HP E1446A	Summing Amplifier, C-1, RB, 15 MHz, 2-Ch., sine + dc, 20 V p-p (50 Ω)
HP E1750A/52A	Broadband Freq./Pulse Amplifiers, C-1, RB, 10 MHz/10 M PPS, 6-Ch., sine/pulse, 1 Vrms (50Ω)
HP E6432A	Microwave synthesizer (10 MHz to 20 GHz with 1 Hz resolution)
HP E8311A	C-1, 165 MHz/Pulse/Pattern Generator, 2 output channels, 10Vpp (50 Ω into 50 Ω), 20Vpp (1KΩ into 50Ω), 16kbit patterns, 5ps timing resolution, 0.01% frequency accuracy, variable transition times (2 ns to 200 ms) NEW
HP E8312A	C-1, 330 MHz/660 Mbit/s, Pulse/Pattern Generator, 2 output channels, 3.8Vpp, 16kbit patterns, 5ps timing resolution, 0.01% frequency accuracy, 0.8ns or 1.6ns fixed transition times NEW
Digital	
HP E1330B	Quad 8-bit Digital I/O, B-1, RB, 32-Ch., I or O, TTL, 325 kb/s
HP E1339A	72-Ch. Open-Collector Dig Out/Relay Driver
HP E1452A	Pattern I/O Module, C-1, RB 32-Ch., Input or Output, TTL/CMOS, 20 M patterns/s
HP E1458A	96-Ch. Digital I/O, C-2, RB, 96-Ch., I or O, TTL
HP E1459A	64-Ch. Isolated Dig Input/Interrupt
Switches—Relay Multiplexer	
HP E1343A	16-Ch., 3-w, B-1, RB, Reed, < 10 μV, 250 V, 10 MHz, 50 mA
HP E1344A	16-Ch., T/C, 3-w, B-1, RB, Reed, < 10 μV, 250 V, 10 MHz, 50 mA
HP E1345A	16-Ch., 3-w, B-1, RB, Reed, < 4 μV, 120 V, 10 MHz, 50 mA
HP E1346A	48-Ch., 1-w, B-1, RB, Reed, < 50 μV, 120 V, 10 MHz, 50 mA
HP E1347A	16-Ch., T/C, 3-w, B-1, RB, Reed, < 4 μV, 120 V, 10 MHz, 50 mA
HP E1351A	16-Ch., 2-w, B-1, RB, FET, < 25 μV, 16 V, 100 kHz, 1 mA
HP E1352A	32-Ch., 2-w, B-1, RB, FET, < 25 μV, 16 V, 100 kHz, 1 mA
HP E1353A	16-Ch., 1-w, B-1, RB, FET, < 25 μV, 16 V, 100 kHz, 1 mA
HP E1355A	8-Ch., 120 Ω Strain, B-1, RB, Reed, < 4μV, 120 V, 10 MHz, 50 mA
HP E1358A	8-Ch., 350 Ω Strain, B-1, RB, FET, < 25 μV, 16 V, 100 kHz, 1 mA
HP E1460A	64/32/128-Ch. 2/3/1-w, C-1, RB, Armature/L, < 7 μV, 60 V, 1 MHz, 1 A
HP E1476A	64-Ch. 3-w, 32-Ch. 4-w, C-1, RB, Reed, voltage, current, temperature (T/C)
HP E8460A	256-Ch. Reed Relay Multiplexer
HP E8462A	256-Ch. Armature Relay Multiplexer
Switches—RF Relay Multiplexer	
HP E1366A	Dual 1x4, 50 Ω, B-1, RB, Armature, < 6 μV, 42 V, 1.3 GHz, 1A
HP E1367A	Dual 1x4, 75 Ω, B-1, RB, Armature, < 6 μV, 42 V, 1.3 GHz, 1A
HP E1470A	60-Ch. Cascade RF Multiplexer, 60:1 to 20 3:1, 50 Ω, C-1, RB, Armature, < 6 μV, 30 V, 500 MHz (3:1), 450 mA (AC)
HP E1472A/73A	Six 1x4, 50 Ω, C-1, RB, Armature, < 6 μV, 42 V, 1.3 GHz, 1A
HP E1474A/75A	Six 1x4, 75 Ω, C-1, RB, Armature, < 6 μV, 42 V, 1.3 GHz, 1A
Switches—Microwave	
HP E1368A	50 Ω, 3-Ch. Form C (SPDT), B-1, RB, Armature, 18 GHz
HP E1369A	Switch Driver, B-1, RB, drives switches up to 26.5 GHz
HP E1370A	Switch/Attenuator Driver, B-2, RB, drives switches up to 26.5 GHz
Switches—Matrix	
HP E1361A	4x4, 2-w, B-1, RB, Armature, < 14 μV, 250 V, 10 MHz, 1 A
HP E1465A	16x16, 2-w, C-1, RB, Armature/L, < 5 μV, 200 V, 10 MHz, 1 A
HP E1466A	4x64, 2-w, C-1, RB, Armature/L, < 5 μV, 200 V, 10 MHz, 1 A
HP E1467A	8x32, 2-w, C-1, RB, Armature/L, < 5 μV, 200 V, 10 MHz, 1A
HP E1468A	8x8, 2-w, C-1, RB, Armature/L, < 7 μV, 220 V, 10 MHz, 1 A
HP E1469A	4x16, 2-w, C-1, RB, Armature/L, < 7 μV, 220 V, 10 MHz, 1A
Switches—General Purpose	
HP E1364A	16-Ch., Form C (SPDT), B-1, RB, Armature, < 7 mV, 250 V, 10 MHz, 1 A
HP E1463A	32-Ch. Form C (SPDT), C-1, RB, Armature, < 7 mV, 125 V, 10 MHz, 5 A
HP E1442A	64-Ch., Form C/A (SPDT), C-1, RB, Armature, < 170 mV, 150 V, 10 MHz, 1 A
Optical Switches	
E4502A/ 03A/04A	2-1x4 / 1-1x16 / 2-1x8 Optical Switches, C-1, RB
Special Purpose Modules	
WJC9119L/R	High-Frequency Tuner (down converter) C-2, RB, 32 MHz
Mass Interconnect	
HP 9420A/21A	Rackmount ICA, High Density, 21 slots, Connector blocks, Cable assemblies
HP E3722A, HP 9421A	Hinged ICA, High Density, 21 slots, Connector blocks, Cable assemblies

C-1 means C-size, 1 slot; B-2 means B-size, 2 slot; RB means Register-based; MB means Message-based, DIO means digital input/output

System Switches

Signal Routing and Measurement

Hewlett-Packard's switch family provides you with long-lasting quality, reliability, and performance for your small, medium, or large test system. Hewlett-Packard offers modular test systems with plug-in switch modules and dedicated instrumentation and fixturing.

HP VXIbus Modular Test Systems

The HP 75000 B- and C-size VXI test systems provide a modular architecture with numerous switches and instruments. These systems contain the most versatile switching solutions in the industry-standard VXI format. The C-size VXI system is the most popular architecture for high-performance, high-speed applications that require both switching and instrumentation. The B-size VXI system is ideal for applications requiring switching and some instrumentation.

- General purpose
- Matrix
- Multiplexers/scanners
- Microwave/RF
- Full line of instruments (refer to pages 86– 87 for more information on VXI test systems)

HP 3499 for Manufacturing Test and Desktop switching

The new HP 3499A/B switch units are ideal for use in manufacturing test applications where a high-speed switching solution is needed. The HP 3499 family includes two mainframes, one with two slots and one with five slots, making it cost effective for any size application. Existing HP 3488A users can easily upgrade to the HP 3499A because both the hardware and software are compatible. The following new modules are available for the HP 3499:

- 40-channel Multiplexer
- 40-channel Isolated General Purpose
- 4 x 8 Matrix
- 32-bit Digital I/O
- Isolated GP + Power Relay + 16-bit Digital I/O
- 4 x 4 Matrix + 16-bit Digital I/O

HP 3488A for Reliable Switching

The HP 3488A is a modular switch system for low point-count applications and proven reliability. The following switches are available:

- Multiplexers (DC to microwave)
- General Purpose
- Simple Matrix
- Digital I/O

HP 34970A for Low-Cost Switching

The HP 34970A Data Acquisition/Switch Unit is ideal for cost-sensitive applications with small- to mid-sized channel count requirements. The three-slot mainframe offers eight switch and control modules which cover a broad spectrum of capabilities.

- Low-frequency multiplexing to 300 V
- 2 GHz RF switching (both 50 and 75 ohms)
- Matrix switching/General Purpose/Form-C switching
- Digital IO/Analog output/Event counting

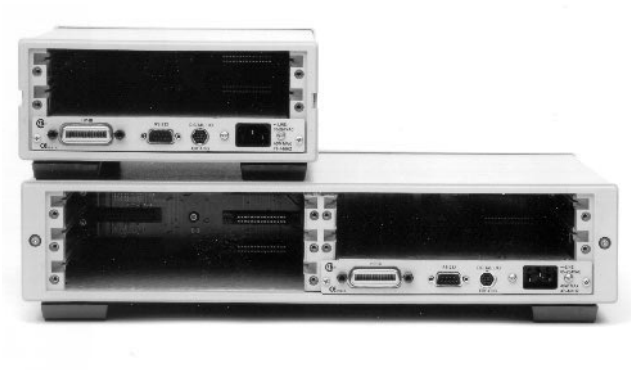
Refer to page 148 for more information on the HP 34970A.

The Switch Module Selection Table on this page provides comparative information for each of the VXIbus switches.

Model #	Description	Size, Slots	Switching Type (L-latching)	Thermal Offset (per ch.)	Max. Volts (DC)	Bandwidth (–3 dB)	Current Rating	Closed Channel Resistance (Ω , initial)
Relay Multiplexers								
HP E1343A	16-Channel, 3-wire	B, 1	Reed relay	<10 µV	250 V	10 MHz	50 mA	100 ±10%
HP E1344A	16-Channel T/C, 3-wire	B, 1	Reed relay	<10 µV	250 V	10 MHz	50 mA	100 ±10%
HP E1345A	16-Channel, 3-wire	B, 1	Reed relay	<4 µV	120 V	10 MHz	50 mA	100 ±10%
HP E1346A	48-Channel, 1-wire	B, 1	Reed relay	<50 µV	120 V	10 MHz	50 mA	100 ±10%
HP E1347A	16-Channel T/C, 3-wire	B, 1	Reed relay	<4 µV	120 V	10 MHz	50 mA	100 ±10%
HP E1351A	16-Channel, 3-wire	B, 1	FET	<25 µV	16 V	100 kHz	1 mA	<3.1 k
HP E1352A	32-Channel, 1-wire	B, 1	FET	<25 µV	16 V	500 kHz	1 mA	<3.1 k
HP E1353A	16-Channel, T/C 3-wire	B, 1	FET	<25 µV	16 V	500 kHz	1 mA	<3.1 k
HP E1460A	64 Channel Relay Unit	C, 1	Armature, L	<7 µV	220 V	3/10 MHz	0.3, 1 A	<1.5
HP E1476A	64-Channel, 3-wire	C, 1	Reed relay	<2 µV	120 V	100 kHz	35 mA	100 ±5%
HP E8460A	256-Ch. Relay Multiplexer	C, 1	Reed relay	50 µV	200 V	100 kHz	300 mA	<3
HP E8462A	256-Ch. Armature MUX	C, 1	Armature	3µV	250 V	—	2 A	<0.5
HP E2272A	Dual 8 x 1, MUX	M-Mod	DPST, L	<3 µV	60 V	>10 MHz	2 A	0.2
RF Multiplexers								
HP E1366A	Dual 1 x 4, 50 Ω	B, 1	Armature	<6 µV	42 V	1.3 GHz	1 A	<1
HP E1472A/73A	Six 1 x 4, 50 Ω	C, 1	Armature	<6 µV	42 V	1.3 GHz	1 A	<1
HP E1367A	Dual 1 x 4, 75 Ω	B, 1	Armature	<6 µV	42 V	1.3 GHz	1 A	<1
HP E1474A/75A	Six 1 x 4, 75 Ω	C, 1	Armature	<6 µV	42 V	1.3 GHz	1 A	<1
HP E1470A	60-Channel RF Cascade Multiplexer	C, 1	Armature	—	30 V	500 MHz (1 x 3)	400 MA	<1.5 (typical)
Microwave Switches								
HP E1368A	50 Ω, 3-Ch. Form C (SPDT)	B, 1	Armature	—	—	18 GHz	—	—
HP E1369A	Switch Driver	B, 1	–	—	—	Up to 26.5 GHz	—	—
HP E1370A	Switch/Attenuator Driver	B, 2	–	—	—	Up to 26.5 GHz	—	—
Matrix Switches								
HP E1361A	4 x 4, 2-wire	B, 1	Armature	<14 µV	250 V	10 MHz	1 A	<1.5
HP E1465A/66A	16 x 16/4 x 64, 2-wire	C, 1	Armature, L	<5 µV	200 V	10 MHz	1 A	<1.8
HP E1467A	8 x 32, 2-wire	C, 1	Armature, L	<5 µV	200 V	10 MHz	1 A	<1.8
HP E1468A	8 x 8, 2-wire	C, 1		<7 µV	220 V	10 MHz	1A	<1.5
HP E1469A	4 x 16, 2-wire	C, 1	Armature, L	<7 µV	220 V	10 MHz	1 A	<1.5
HP E2271A	4 x 4 Matrix	M-Mod	DPST, L	<3 µV	60 V	>10 MHz	—	0.3
General Purpose Switches								
HP E1364A	16-Channel Form C (SPDT)	B, 1	Armature	<7 µV	250 V	10 MHz	1 A	<1.5
HP E1442A	64-Ch. Form C/A (SPDT)	C, 1	Armature	<70 µV	150 V	10 MHz	1 A	<1.5
HP E1463A	32-Channel Form C (SPDT)	C, 1	Armature	<7 µV	125 V	10 MHz	5 A	<0.25
HP E2270A	16-Ch. Form A Switch	M-Mod	SPST, L	<3 µV	60 V	>10 MHz	2 A	<0.2
HP E2273A	8-Ch. Form C Switch	M-Mod	Armature	<20 µV	60 V	>10 MHz	1 A	–
HP E2274A	4-Ch. Form C Power Relay	M-Mod	Armature	<20 µV	60 V	>10 MHz	5 A	.03 @ 1A + 6 Vdc

- Close/open 200 channels in parallel in 0.1 seconds
- New modules with built-in relay cycle counters
- Multi-function modules for space saving
- DC to 26.5 GHz, 1 mA to 5 A, 1 mV to 250 V
- Easy wiring with connection kits

HP 3499A/B front panel



HP 3499A/B back panel

HP 3499A/B Switch/Control System NEW

The HP 3499 family is a high-speed, high-density switching solution for automated test (ATE) applications that provides a 30% cost and space improvement over its predecessor—the HP 3488A.

It can scan at rates up to 80 channels per second, or open/close 200 channels in less than 0.1 second. The HP 3499A can accommodate up to 5 plug-in option modules, routing up to 200 channels in a test system. The user can choose from 19 option modules to switch signals from DC to 26 GHz, 1 mV to 250 V, and 1 mA to 5 A.

The HP 3499B is a half-rack-width, 2-slot mainframe, switching up to 80 channels for ATE or desktop operations. Both units have a concise user interface that can be extremely useful for manual operation on the manufacturing floor or in desktop applications.

High-Speed Switching

While traditional switching mainframes open/close relays in sequence, the HP 3499A/B use innovative parallel driving circuits to open/close switches simultaneously. The HP 3499A can simultaneously drive as many as 50 channels in 25 ms. The parallel operation of the HP 3499A/B dramatically increases the test throughput of an automated test system.

High-Density Switches

The HP 3499 family allows the user to select a cost-effective configuration for a specific application. Newly designed high-density switch modules reduce cost by condensing a large number of channels on a single module. The HP 3499A contains five slots that accommodate up to 200 channels of switching for those large applications on the manufacturing floor. The HP 3499B contains two slots for switching up to 80 channels, a cost-effective solution for small manufacturing or desktop applications. Both units are designed for easy installation in a standard rack.

Ease of Maintenance

The built-in relay cycle counters on five newly designed switching modules help you to predict relay end-of-life, avoiding costly production line down-time. The relay cycle counter automatically counts every individual relay closure and stores the numbers in the on-board non-volatile memory. A simple command recalls the total number of cycles for individual relays, making preventative maintenance much simpler.

Ease of Wiring

The HP 3499 family comes with two connection kits to reduce the time and effort of wiring. Both the removable screw connection and crimp & insert connection kits are detachable from the switching modules, eliminating the need to rewire the connectors if a switching module is changed.

The HP 3499 is also equipped with Din96-to-D50(25) cables for easy attachment to your DUTs and test instruments.

Compatibility

The HP 3499 family is both the hardware and software compatible with the world's most popular switch/control unit—the HP 3488A. All of the 13 HP 3488A modules work in the HP 3499A/B mainframes. The HP 3499 can be operated with SCPI (Standard Commands for Programmable Instruments) or the HP 3488 command set. Upgrading from the HP 3488 to HP 3499A doubles your channel capacity and lowers your cost per channel.

Applications

The HP 3499A/B are ideal switching solutions for the automated test system applications. Typical applications include the production test system for cellular phones, pagers, printers, and power supplies. You will find the HP 3499 family is the preferred switching solution with its high-density option modules, high switching speed, ease of wiring, ease of maintenance, and low cost per channel.

HP 3488A Switch/Control Unit

The HP 3488A is a versatile switch/control unit for low channel count switching. All new automated test applications should use the HP 3499 for more performance.

HP 3499A
HP 3499B
HP 3488A

Option Module Descriptions

NEW

40-Channel Multiplexer — HP N2260A
The HP N2260A can be reconfigured as a 1-wire 80-channel, 2-wire 40-channel, dual 2-wire 20-channel, or 4-wire 20-channel multiplexer for scanning or multiple-signal/instrument connections.

40-Channel General Purpose — HP N2261A
The HP N2261A is ideal for creating isolated control between circuits, providing power control of DUTs, or controlling stepping motors and solenoids.

4 X 8 Matrix — HP N2262A
The HP N2262A provides the most flexible way to connect a group of test instruments to multiple test points on DUTs.

3

32-Bit Digital I/O — HP N2263A
The HP N2263A, with its 32 TTL-compatible digital bits and three handshake lines, can be used to drive/control external devices, to monitor external status, or to communicate with other devices. It provides three modes (Static, Strobe, and Handshake) for different I/O control applications.

12 GP +3 GP + 16-Bit Digital I/O — HP N2264A
The HP N2264A multi-function module is designed for applications that require general purpose relays and up to 3 high current relays (5A maximum) within one module for saving rack space. Its three power relays are useful in applications where low resistance channels are needed, such as in cellular phone or battery production test systems. There also 16 bits of digital I/O on this module.

4 X 4 Matrix + 16-Bit Digital I/O — HP N2265A
The HP N2265A is designed for applications that require a 4x4 matrix and 16 bit digital I/O within one module for saving rack space.

10-Channel Multiplexer — HP 44470A
20-Channel Multiplexer — HP 44470D
10-Channel General Purpose — HP 44471A
20-Channel General Purpose — HP 44471D
Dual 1 x 4 RF Multiplexer — HP 44472A
4 x 4 Matrix Switch — HP 44473A
16-Bit Digital I/O — HP 44474A
Breadboard — HP 44475A
7-Channel Form-C Relay — HP 44477A
18 GHz Microwave Switches — HP 44476A
1.3 GHz 50Ω RF Multiplexer — HP 44478A
1.3 GHz 75Ω RF Multiplexer — HP 44478B
Microwave Relay Driver — HP 44476B

This module can drive any two HP 876XX coaxial switches. HP coaxial switches that can be used are:

HP Coaxial Switch	Port	Frequency
HP 8762A/Option 011	3	DC to 4 GHz
HP 8762B/Option 011	3	DC to 18 GHz
HP 8762C/Option 011	3	DC to 26.5 GHz
HP 8762F/Option 011	3	DC to 4 GHz (see note)
HP 8763B/Option 011	4	DC to 18 GHz
HP 8763C/Option 011	4	DC to 26.5 GHz
HP 8764B/Option 011	5	DC to 18 GHz
HP 8764C/Option 011	5	DC to 26.5 GHz

Note: 75Ω impedance.

HP 3499 Mainframe Specifications

Items	Specifications
General	
Display	Vacuum fluorescent
Rear Panel Connectors	GPIB; RS-232; 8-pin mini DIN Connector (5 pins for digital I/O, 3 pins for external trigger)
Power Supply	100 to 240 Vac universal input; 47 Hz to 440 Hz; 40 VA maximum
Operating Environment	0° C to 55° C, <80% RH (0° C to 40° C)
Storage Environment	–40° C to +70° C
Net Weight	HP 3499A: 3.8 kg (8.4bs); HP 3499B: 2.5 kg (5.5bs)
Dimensions	HP 3499A: H 89 mm, W 426 mm, L 348 mm; HP 3499B: H 89 mm, W 213 mm, L 348 mm
Safety	Conforms to CSA, UL-1244, IEC 1010 Cat II
RFI and ESD	CISPR 11, IEC 80 1/2/3/4
Warranty	3 years
System	
Slot Capacity	HP 3499A: 5 slots; HP 3499B: 2 slots
Memory	Battery backup, 4-year typical life (Temperature over 40° C will decrease battery life); Store States: 10 states in SCPI mode; 40 states in HP 3488 mode; Error store: 10 in SCPI mode, 1 in 3488 mode
Switching Setting Time	Automatically selected by the mainframe for each module
Trigger Source	External trigger (real panel mini-DIN connector); GPIB (GET,*TRG) or RS-232 (*TRG)
External Trigger	Trigger pulse width: >2 µs; External Trigger Delay: <2 ms
Built-in 4 Digital I/O	Input: TTL compatable; Vo (L): <0.8V@Io=–100 mA;Vo (H): >2.4 V@Io=1 mA; Vout (H) ≤42 V

Please refer to the following table for option modules selection.

Modules	Description	Max. Voltage	Max. Current per chan.	Initial closed channel resistance	Thermal offset per chan.	Bandwidth	Connection Type	Relay Cycle Counter
General Purpose Multiplexers								
HP N2260A	40-Channel	200 V	1 A	<1 Ω	<3 µV	10 MHz	T or C	Yes
HP 44470A	10-Channel	250 V	2 A	<1 Ω	<3 µV	10 MHz	T	No
HP 44470D	20-Channel	250 V	2 A	<1 Ω	<3 µV	10 MHz	T	No
General Purpose Relay Modules								
HP N2261A	40-Channel	200 V	1 A	<0.5 Ω	<3 µV	10 MHz	T or C	Yes
HP 44471A	10-Channel	250 V	2 A	<1 Ω	<3 µV	10 MHz	T	No
HP 44471D	20-Channel	250 V	1 A	<1 Ω	<3 µV	10 MHz	T	No
Matrix Modules								
HP N2262A	4 x 8 matrix	200 v	1 A	<1 Ω	<3 µV	10 MHz	T or C	Yes
HP 44473A	4 x 4 matrix	250 V	2 A	<1 Ω	<3 µV	10 MHz	T	No
Digital Input/Output Modules								
HP N2263A	32-bit TTL	42 V	600 mA	–	–	–	T or C	
HP 44474A	16-bit TTL	30 V	125 mA	–	–	–	T	
Multifunction Modules								
HP N2264A	12 General Purpose	200 V	1 A	<0.5 Ω	<3 µV	10 MHz	T or C	Yes
	3 GP	125 V	5 A	<0.1 Ω	<3 µV	10 MHz	T or C	Yes
	16-bit DIO	42 V	0.6 A	–	–	–	T or C	
HP N2265A	4x4 matrix	200 V	1 A	<1 Ω	<3 µV	10 MHz	T or C	Yes
	16-bit DIO	42 V	0.6 A	–	–	–	T or C	
Form-C Relay Modules								
HP 44477A	7-channel	250 V	2 A	<1 Ω	<3 µV	10 MHz	T	No

Notes: T=Terminal Block; C=Cable; DIO=Digital I/O; GP=General Purpose

RF & Microwave Modules

Modules	Description	Insertion loss	Crosstalk	SWR	Bandwidth	Impedance	Connector
HP 44472A	Dual 1 x 4	<0.75 dB	<–85 dB	<1.12	300 MHz	50Ω	BNC
HP 44478A	Dual 1 x 4	<1.1 dB	<–70 dB	<1.35	1.3 GHz	50Ω	BNC
HP 44478B	Dual 1 x 4	<1.1 dB	<–70 dB	<1.35	1.3 GHz	75Ω	BNC
HP 44476A	Triple 1 x 2	<0.25 dB	<–90 dB	<1.15	18 GHz	50Ω	SMA
HP 44476B	Microwave Relay Driver can support 2 microwave switches.			Technical specs depends on the mounted relays.			

Key Literature

HP 3499 Family Overview/Technical Specifications, p/n 5965-6217E

Ordering Information

HP 3499A 5-slot, full-rack-width, Switch/Control System includes manual and power cord. Option modules are purchased separately and are required to operate.
- **Opt 0B0** Delete Hardcopy Manual
- **Opt 1CP** Rackmount Kit with handles
- **Opt 1CM** Rackmount Kit

HP 3499B 2-slot half, rack width, Switch/Control System includes manual and power cord. Option modules are purchased separately and are required to operate.
- **Opt 0B0** Delete Hardcopy Manual
- **Opt 1CM** Rackmount Kit with Filler Panel

HP N2260A 40-Channel Multiplexer Module
HP N2261A 40-Channel General Purpose Relay Module
HP N2262A 4 X 8 Matrix Module
HP N2263A 32-Bit Digital I/O Module
HP N2264A 12 GP + 3 GP+ 16-Bit Digital I/O Module
HP N2265A 4 X 4 Matrix + 16-Bit Digital I/O Module
HP N2289A Mini-Din-to-D9 cable for built-in Digital I/O in HP 3499A/B
HP N2290A Screw Connection Kit for HP N2260A
HP N2291A Screw Connection Kit for HP N2261A
HP N2292A Screw Connection Kit for HP N2262A
HP N2293A Screw Connection Kit for HP N2263A
HP N2294A Screw Connection Kit for HP N2264A
HP N2295A Screw Connection Kit for HP N2265A
HP N2296A Crimp & Insert Connection Kit for HP N2260-65A modules
HP N2297A DIN-to-D(2x50) cable for 6 modules (N2260-65A)
HP N2298A DIN-to-D(1x25) cable for 4x8 matrix (N2262A)
HP N2299A DIN-to-D(4x25) cable for 6 modules (N2260-65A)

All option modules for HP 3488A will work in HP 3499A/B.
HP 3488A Switch/Control Unit (only supports 11 of the HP 4447xx option modules)
- **Opt 023** New version of HP 3488A with firmware upgraded, also supporting the HP 44470D, 44471D.

HP 44488A used for upgrading existing HP 3488A to support HP 44470D, 44471D.

Rackmount Kits
- **Opt 908** Rack Flange Kit (HP p/n 5061-1168)
- **Opt 909** Rack Flange with Handles (HP p/n 5061-1169)

Option Modules (work in the HP 3488A and the HP 3499A/B) include terminal connectors.
HP 44470A 10-Channel Relay Multiplexer Module
HP 44470D 20-Channel Relay Multiplexer Module
HP 44471A 10-Channel G.P. Relay Module
HP 44471D 20-Channel G.P. Relay Module
HP 44472A Dual 4-Channel RF Multiplexer Module
HP 44473A 4x4 Matrix Switch Module
HP 44474A 16-Bit Digital Input/Output Module
HP 44475A Breadboard Module
HP 44476A Microwave Multiplexer Module
HP 44477A Form-C Relay Module
HP 44476B Microwave Switch Driver Module
HP 44478A 1.3 GHz 50 Ω RF Multiplexer Module
HP 44478B 1.3 GHz 75 Ω RF Multiplexer Module

Interface Products

GPIB Cards and Kits

HP offers a full line of interface products to connect your instrumentation and/or VXI mainframe to your PC or HP workstation. These GPIB interface cards and software make it easy for you to access and control instruments, exchange data, and create your own automated test applications. These GPIB products include:

- GPIB interface hardware and software for PCs
- GPIB interface hardware and software for HP-UX workstations
- LAN/GPIB Gateway for low-cost access to GPIB instrumentation over your LAN

HP also offers PC Automation Kits which provide the hardware, I/O software, and application software you need to automate your bench or lab at the best possible price.

GPIB Interface Products for PCs

- Plug-in interface cards for personal computers
- HP SICL/VISA support (VISA is not supported on the HP 82335B).
- HP VEE for Windows compatibility
- HP BASIC for Windows compatibility
- Easy access to test automation
- Wide range of performance and price options

GPIB Interface Products for PCs

Model	HP 82335B	HP 82341C	HP 82341D	HP 82350A
Description	Standard GPIB interface for PC	High-performance GPIB interface for PC	Plug and Play GPIB interface for PC	High-performance GPIB interface for PCI bus computers
Operating System	MS-DOS Windows 3.1 Windows 95 (16-bit mode only)	Windows 3.1 Windows 95 Windows NT	Windows 95	Windows 95 Windows NT
I/O Library	Command Library, SICL (available upon request)	SICL, VISA	SICL, VISA	SICL, VISA
Backplane	ISA/EISA	ISA/EISA	ISA/EISA	PCI
Max. Speed	335 KB/s	750 KB/s	750 KB/s	750 KB/s
Buffering	None	Built-in	Built-in	Built-in
Languages Supported	C/C++, Pascal, HP BASIC (16-bit mode only), HP VEE (16-bit mode only), Visual Basic (16-bit mode only)	C/C++, HP BASIC for Windows, HP VEE for Windows, Visual Basic	C/C++, HP BASIC for Windows,HP VEE for Windows, Visual Basic	C/C++, HP BASIC for Windows, HP VEE for Windows, Visual Basic
		*	*	*

*These products can be purchased online—visit **www.tmo.hp.com** and search on the product number.

PC Automation Kits

HP's PC Automation Kits provide the hardware, I/O software, and application software you need to automate your bench or lab at the best possible price. The software included is either HP VEE, HP's popular visual programming language, or HP BASIC, the world's most popular programming language for test and measurement applications.

PC Autokits provide hardware and software in a low-cost bundle

PC Automation Kits and Products

Model	HP 82345F	HP 82351F	HP 82346B	HP 82356B
GPIB Interface Card	HP 82341C GPIB card	HP 82350A GPIB PCI card	HP 82341C GPIB card	HP 82350A GPIB PCI card
GPIB Cable	HP 10833B 2 m cable	HP 10833B 2 m cable	HP 10833B 2 m cable	HP 10833B 2 m cable
Operating System	Windows 3.1 Windows 95 Windows NT	Windows 95 Windows NT	Windows 3.1 Windows 95 Windows NT	Windows 95 Windows NT
Software	HP VEE for Windows	HP VEE for Windows	HP BASIC for Windows	HP BASIC for Windows
			*	

*This product can be purchased online—**visit www.tmo.hp.com** and search on the product number.

HP-UX Workstation Interface Products

- High-performance GPIB interface cards
- Plug-in instrument control for UNIX workstations
- HP VISA and SICL support
- Easy access to test automation

Models	HP E2071C	HP E2071D	HP E2078A
Description	High-performance GPIB interface for HP Series 700	High-performance GPIB interface for HP Series 700	High-performance GPIB interface for PCI bus
Operating System	HP-UX 9.x, HP-UX 10.01	HP-UX 10.20	HP-UX 10.20
I/O Library	SICL, VISA	SICL, VISA	SICL, VISA
Backplane	EISA	EISA	PCI
Maximum Speed	Speed 750 KB/s	Speed 750 KB/s	Speed 750 KB/s
Buffering	Built-in	Built-in	Built-in
Languages Supported	ANSI C, HP BASIC/UX, HP VEE	ANSI C, HP BASIC/UX, HP VEE	C/C++, HP BASIC/UX, HP VEE

The HP E2071C/D and HP E2078A products include the interface card, I/O software, GPIB cable, GPIB connection extender, and documentation.

LAN/GPIB Gateway

The HP E2050A LAN/GPIB Gateway provides low-cost access to GPIB instrumentation over an existing LAN. It allows the use of SICL- or VISA-based applications designed for GPIB over the LAN without modifying the application beyond a simple address change.

The gateway is a combination of hardware and SICL/VISA software. It uses client/server technology to extend the standard remotely on the LAN. This gives you the opportunity to put your controller at an alternative, more convenient, or safer location. Therefore, you can go through the gateway instead of a GPIB interface card.

The HP E2050A LAN/GPIB Gateway is easy to use and low cost.

Ordering Information

HP E2050A LAN/GPIB Gateway (Cables not included)
Opt AG1 I/O software for HP-UX 9.x, 10.x operating system
Opt AG6 I/O software for Microsoft Windows 95/NT operating system
HP E2051A Rackmount Kit for LAN/GPIB Gateway (height is 1U)

Hewlett-Packard offers a wide range of products and solutions specifically tailored for the automotive and vehicle industry.

For more information, visit our automotive web site: **www.hp.com/auto**

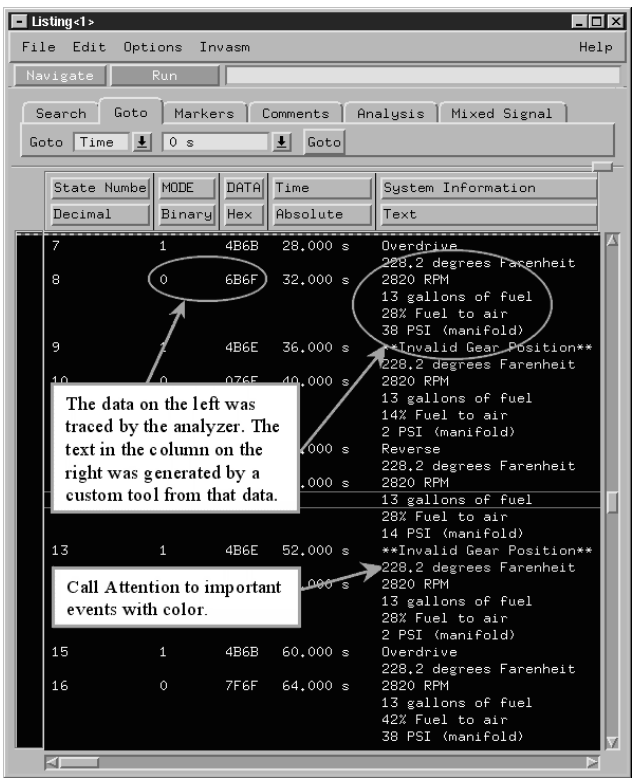
The Predator vehicle was designed by M&L Auto Specialists using HP UNIX and NT workstations. For more information, see: **www.mandlauto.com**

Design and Development

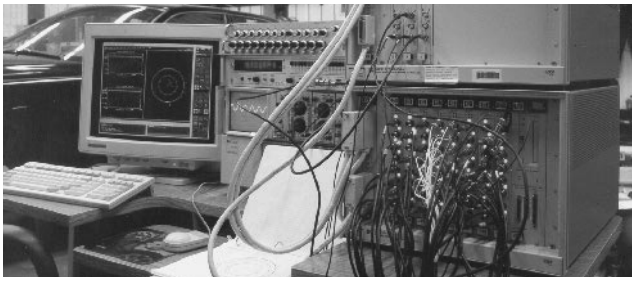
Logic Analysis and Emulation

HP offers a wide variety of logic analysis and emulation tools to support popular processors in the automotive industry. HP's solutions range from Motorola CPU-32 support to the lastest MPC 505/509/555.

Measurements can be customized to meet your unique, demanding requirements with HP's Tool Development Kit. HP's Premier Channel Partners and HP's application engineers provide custom hardware, software, and consulting services.



HP's Tool Development Kit allows custom views of measurement data tailored for automotive applications.



Noise, Vibration and Harshness (NVH)

If you could walk through the engineering and production facilities of the world's leading automotive companies you would see the same thing over and over again: physical measurement equipment from Hewlett-Packard.

Whether they're designing engines, analyzing structures or measuring vehicle performance, these innovators rely on HP for accurate results. These results include stress, temperature, noise, vibration, harshness and a variety of other product and process parameters—critical data that yield the information needed to create a comfortable, high quality vehicle.

These systems combine the security of industry-standard platforms with the performance advantages of test technologies available only from Hewlett-Packard. You get open systems such as the VXI measurement architecture, plus time-saving capabilities—integrated static and dynamic measurements—and solution enablers that bring high performance systems online faster.

To make sure you get the best solutions available we maintain close working relationships with innovative software developers known for their application expertise. These partnerships create tightly integrated solutions that give you an exceptional combination of hardware, software and technical expertise.

For more detailed product information please turn to section 17—Mechanical & Physical Test Instruments and Systems or visit our web site: **www.hp.com/go/data_acq**

The TS-5400 Series II Automotive Electronics Functional Test Platform. Shown is the E8785A family member with the optional express connect interface connector assembly (ICA).

Manufacturing Test

TS-5400 Series II Catalog

HP TS-5400 Series II Automotive Electronics Functional Test Platform

The TS-5400 Series II ships as a complete measurement-ready platform tuned for automotive electronics control module and smart sensor functional test. TS-5400 Series II delivers the scalability and flexibility requirements demanded by test and production managers and engineers. With the TS-5400 Series II Platform, test engineering delivers more productivity because up to 70% of the test system development process is completed by the platform.

The TS-5400 Series II eliminates the common task and process steps test engineering performs on all test systems: such as developing and documenting the hardware and racking and cabling, as well as developing the software infrastructure and common test procedures to support re-use. Other tasks, like ordering and taking delivery of individual pieces of software and hardware and then integrating these pieces are streamlined; the TS-5400 Series II is delivered with software, hardware and cabling integrated. A Test Executive with over 200 automotive routines is included.

Four Members to the TS-5400 Series II Family

E8770A/E8780A/E8785A/E8796A:

The four base platforms test the range of automotive electronic control modules (ECMs). From simple ECMs, like immobilizers and RKE (remote-keyless entry), to safety ECMs (airbag, ABS/TC) to complex ECMs (engine management systems), the TS-5400 Series II automotive functional test platforms meets the price/performance required to ensure that only quality products are shipped.

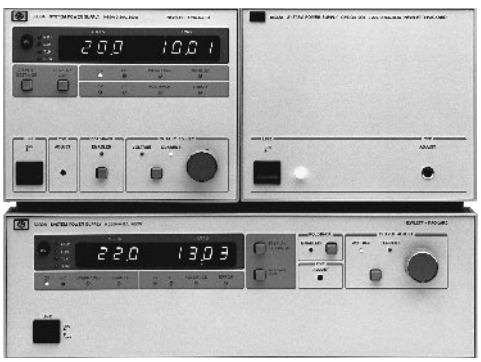
HP TS-5400 Series II Software Increases Productivity

All platforms utilized the enhanced version of Hewlett-Packard's TestExecSL Test Executive. This latest version of TestExecSL has been further tuned to supply faster testplan development, easier integration of message-based instruments, as well as support for Testplans from the TS-5400 Series I Automotive Electronics Functional Test Platform (HP TS-5430 and TS-5450). For customers desiring higher test asset utilization, the optional Throughput Multiplier allows for testing of multiple ECMs using one test platform. This feature, utilized on ECMs with long settling times, allows for overlap of instrument and ECM settling time and measurements. Multiple ECMs can be loaded into the test fixture and TestExecSL's unique architecture will sequence through setups and measurements for fastest throughput. To get more information on the TS-5400 Series II Automotive Electronics Functional Test Platform, please contact your Hewlett-Packard representative or check out our web site: **http://www.hp.com/go/ts-540**

3

Ordering Information

HP E8770A TS5400 Series II Platform for Simple Automotive Electronic Control Module Functional Test
HP E8780A TS5400 Series II Platform for Medium Complexity Electronic Control Module Functional Test
HP E8785A TS5400 Series II Platform for High Complexity Electronic Control Module Functional Test
HP E8786A TS5400 Series II Platform for Highest Performance Electronic Control Module Functional Test



Additional instrumentation and configuration choices must be added with system options.

System dc Power Supplies

Single-Output 500 W
HP 6650 Series 6651A, 6652A, 6653A, 6654A, 6655A

A primary application for this broad range of system power supplies is to provide power to the device in the production testing of sub-assemblies and systems in the automotive industry.

These models are 500 Watt, single output, series pass regulated power supplies, with an internal GPIB interface and SCPI programming. These models provide many talker/listener functions including remote programming of voltage and current with feedback of actual measured output values. Sixteen supplies can be connected to one GPIB interface via a serial link connection.

Single-Output

Autoranging: 200 W to 1,000W
A simpler way to test multiple operating points
HP 6030 Series
6030A, 6031A, 6032A, 6033A, 6035A, 6038A

The auto-ranging feature of these products provides a more efficient and convenient solution in which a wide variety of voltage and current combinations from a single test station are required.

HP's 6030 Series auto-ranging supplies are a flexible, convenient solution when you need to test a wide range of devices with a single supply or test devices with a variety of operating points. You can choose power ratings of 200 W or 1 kW, and all offer HP's one-box solution with built-in readback.

Test Software

HP BASIC for Windows
5964-0369E
HP BASIC Product Family
5962-7100E
HP VEE 5.0 Evaluation Kit
5966-4450E
HP VEE 5.0 Brochure
5966-3879EN/EUS
HP 35639A DataViewer Product Overview
5962-9499E
HP 37204A Multi-Point HP-IB Extender Technical Data Sheet
5962-6971E

VXIbus Products

Feeling Comfortable with VXI
5965-6497E
Test System and VXI Products Data Book
5966-2812E
Test System and VXI Products Catalog
5968-3698EN/EUS
Lowering the Cost of Test with HP VXI
5966-3283E

MMS Products

HP 71000 P-Series Spectrum Analyzers – Modular Spectrum Analyzers with PC Displays, Brochure
5965-5791E
HP 71910A Wide Bandwidth Receiver, Technical Specifications
5964-3895E

(PN 71612A) Extending High-Speed BER Testing to 20 Gb/s with the HP 71612A Error Performance Analyzer
5964-6133E
(PN 71612A) HP 71612A Error Location Analysis
5968-2811E
(PN 71612A) Testing 10-Gb/s SONET/SDH Equipment and Components
5968-2812E

System Switches

(PN 75000) HP IBASIC Product Note
5091-0805E
(PN 75000) Rigorous Stressing of SONET/SDH Alarms Using Programmable 3-Stage Sequences
5965-2742E
(PN 75000) Series 95-1 HP 75000 Series 95 SDH Tributary Test Solutions
5091-8060E
(PN 75000) Series 95-2 HP 75000 Series 95 SONET Tributary Test Solutions
5091-8174E

Interface Products

(PN) Introduction to HP Standard Instrument Control Library (SICL) (82341B)
5963-2228E

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00

Oscilloscopes Hewlett-Packard provides a wide selection of performance from general purpose and troubleshooting, to modular high bandwidth multiple channel instruments, with considerable built-in ease-of-use capabilities.

- Mixed Signal
- General Purpose
- Digitizing
- Infiniium

Oscilloscope Probes and Accessories Hewlett-Packard offers a wide selection of probes and accessories to fit your application, and maximize accuracy of signal reproduction.

- High Impedance Passive
- Surface Mount
- Differential
- Active
- High Voltage, Current

Electronic Counters Hewlett-Packard offers the industry's broadest line of electronic counters and counter timers, including Frequency Counters, Universal Counters, and Modulation Domain Analyzers. The breadth of the HP offering allows the best product to be selected for each application, and delivers the most cost effective solution.

- Modulation Domain and Time Interval Analyzers
- High Performance RF and Universal
- CW Microwave Counter with Power Measurement
- Pulse/CW Microwave

Digital Multimeters/Digital Voltmeters Hewlett-Packard offers a range of products from 3½ all the way to 8½ digits, with the right functionality and performance to get the job done.

- Low Cost 6½ Digital Multimeter
- Nanovolt/Micro-ohm Meter
- 8½ Digital Multimeter
- Handheld Digital Multimeter
- Accessories

Data Acquisition and Switching

- Low Cost Data Acquisition/Switch Unit
- Modules

Function Generators and Waveform Synthesizers Hewlett-Packard not only offers standard functions like sine, square and triangle waveforms, but in addition, HP instruments address needs such as multichannel signals, arbitrary waveforms, or even a mix of arbitrary and digital signals.

- 1 MHz to 21 MHz Synthesizers and Function/Sweep Generators
- Multi-functional Synthesizers
- Function Arbitrary Waveform Generator

dc Electronic Loads Hewlett-Packard electronic loads deliver precise control and the capabilities needed for analyzing dc power sources and devices.

- Single-Input Loads
- Modular Mainframes

dc Power Supplies Hewlett-Packard offers a broad line of system and general purpose power supplies. They include: single- and multiple-output, precision, mobile communications, autoranging, as well as solar array simulators.

- Modular Power System
- Mobile Communication dc Sources
- Precision Measurement Single-Output System
- Multiple-Output System
- Single-Output Systems
- Solar Array Simulators
- Autoranging
- Laboratory

ac Power Source/Analyzers Hewlett-Packard's ac power source/analyzers provide everything needed to generate, measure and analyze ac power.

- ac Power Source Analyzers
- Regulatory Test Solutions

10 Steps To Selecting The Right Oscilloscope

Since its introduction, the oscilloscope has been one of the most important and most used test and measurement tools. Its capabilities have grown and changed along with electronics technology, and today there are now a multitude of variations in performance and price. As a result, selecting the right one is an important task that can be time-consuming and confusing.

The steps outlined here are intended to speed your selection process and help you avoid possible pitfalls. Whether it's an HP scope or one from another vendor, following this process will help you make sure you end up with the right scope for your needs. For a more detailed version, look at the HP Infiniium scopes web site: **www.hp.com/go/10steps**.

1. Analog or Digital?
Analog scopes have familiar front panel controls and are often considered "easy to use." Digitizing oscilloscopes feature a wide range of functionality which cannot be obtained with an analog scope, and recent advances in user interfaces have greatly enhanced usability. As analog-to-digital converters get faster and less expensive with every passing year, the advantage balance continually tilts further toward the digitizing scope, with its increased measurement capabilities and virtually unlimited functionality. Like many T&M manufacturers, HP offers only digitizing scopes.

2. How Much Bandwidth?
Scope bandwidth is typically defined as the frequency above which a sine wave's amplitude is degraded by more than 3 dB. Trying to look at a signal that's too fast for a scope's bandwidth will introduce errors in amplitude and/or time-interval measurements.

There are two types of bandwidth: repetitive (or equivalent time) bandwidth, and real-time (or single-shot) bandwidth. Repetitive bandwidth applies only to repetitive signals, and the display is built up from samples taken during multiple signal acquisitions. Repetitive bandwidth should typically be at least three times greater than the bandwidth of the signals you want to measure. You can estimate non-sinusoidal bandwidth by the equation **BW=0.35/your signal's fastest rise-time.** Real-time bandwidth is the highest frequency a scope can capture in a single acquisition, and is critical when capturing events that occur infrequently. Real-time bandwidth is tied to sample rate, so if real-time bandwidth is important to you, look carefully at "Sample Rate" in Step 3.

Since more bandwidth usually means more money, you'll want to evaluate the frequency content of the signals you usually view against your budget.

3. How Much Sampling Speed ?
There are basically two types of signals you may want to view with a scope: those that occur repetitively and those that happen infrequently. For repetitive waveforms, a scope can either take all the samples in that occurrence (real-time sampling), or take a few samples each time the waveform occurs and combine the samples into a single picture (repetitive sampling). Infrequently occuring events require the scope to capture enough information on a single occurrence of the trigger to accurately represent the waveform. Here's a useful rule of thumb when comparing sample rate and signal bandwidth: if the scope you're looking at has interpolation (filtering to allow reconstruction between sample points), the sample rate to realtime bandwith ratio should be at least 4:1. Without interpolation, use a ratio of 10:1.

4. How Many Channels?
The number of channels you need depends on your application. Two channel scopes are popular for economical general-purpose troubleshooting. However, if you need to view the relationship of several analog signals you'll want a four channel instrument. Many engineers working on systems with both analog and digital signals also consider four channel scopes. Another newer option, called a mixed-signal oscilloscope, combines the channel count and triggering power of a logic analyzer with the greater resolution of an oscilloscope in a single instrument with a time-correlated display.

5. How Much Memory Depth?
Memory depth is a measure of how many samples the scope can store. If you need to capture a pulse train without interruption, you'll need a scope with enough memory to capture the whole thing. You can calculate the memory depth you need by dividing the length of time you want to capture by the sample rate needed to reproduce the signal accurately.

Effective triggering, so you capture your signal at the right place, can often reduce the amount of memory your scope really needs. It is also important to understand that deep memory digitizing oscilloscopes are typically more complex to operate. Hewlett-Packard has introduced a scope, HP 54645 A/D (see page 102) that combines ease-of-use and deep memory for many 100 MHz applications. For higher bandwidth measurements, you'll want to clearly understand possible trade-off between memory depth and ease-of-use.

Memory depth and sampling rate are intimately related. The memory depth you need depends on the overall time span you need to measure and the time resolution you require. Deep memory instruments are more complex to operate because the user must choose the memory depth that reduces "dead time" needed to fill up the extra memory, or display changing signals inaccurately.

6. What Kind of Triggering Do I Need?
Many general-purpose scope users get by using edge triggering alone. You may find it helpful in some applications, mainly in troubleshooting new designs, to have additional triggering power. Advanced triggering allows you to isolate events of interest to apply the sampling rate and memory depth most efficiently.

In digital applications, it is very helpful to trigger on a specific pattern across channels. In addition, state triggering allows you to sync up you pattern trigger to a clock edge. "Glitch" triggering allows you to trigger on a positive- or negative-going "glitch" or extremely narrow pulse. Other trigger capabilities are often available, and it is important to find out how easy they are to set up and use.

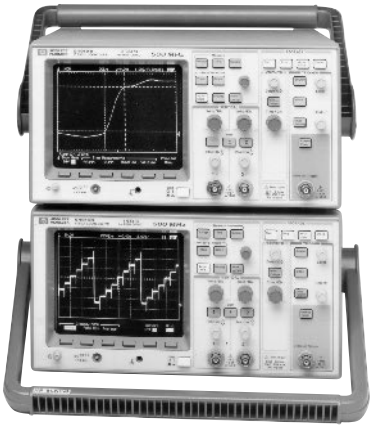
7. Can You Find Those Elusive Anomalies?
Three primary factors affect a scope's ability to display the unknown and complex signals that you encounter in your daily testing and debugging: screen update rate, peak detect, and triggering power (discussed in Step 6).

Update rate gives you an idea of how quickly your scope can respond to signal and control changes, while peak detect helps you capture fast signal peaks in slower signals. Your best bet is to see the scope performing on YOUR signals and view the update rate and peak detect in action, making sure these features aren't compromised by lack of flexibility in other areas.

8. Determine the Analysis Functions You Need
One of the greatest advantages of digitizing oscilloscopes is that they have the abiltiy to make measurements on acquired data and to perform various analysis functions at the touch of a button. The features available vary from vendor to vendor and model to model, but they typically include measurements like frequency, rise time, pulse width and more. Some digitizing oscilloscopes offer Fast Fourier Transform (FFT) capability as well, often at extra cost.

9. What About Probing?
It is easy to forget that the probe becomes part of the circuit as soon as it is attached. As a result it introduces resistive, capacitive, and inductive loading, that can cause to scope to show a different measurement than is actually occuring in the unit under test. The goal, therefore, is to have appropriate probes available for different applications and then choose one that will minimize the loading effects, and allows the most accurate replication of the signal.

10 Will This Scope Be Easy to Use?
It's pretty obvious—if you can't access the features, or spend too much time learning them, your scope becomes less valuable.

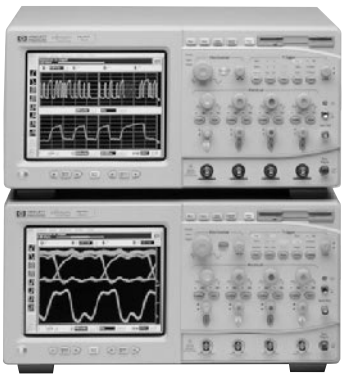


HP 54600-Series Oscilloscopes

- High-Value, General-Purpose Oscilloscopes
- 60 MHz to 500 MHz Bandwidth, up to 2 GSa/s Sample Rate
- Power of Digital with the Feel of Analog
- MegaZoom Deep Memory Technology
- Simultaneous Analog and Digital Capture and Display

	Bandwidth	No. of Chan.	Sample Rate	Memory Depth
HP 54645A	100 MHz	2	200 MSa/s	1M
HP 54645D	100 MHz	2 + 16	200 MSa/s	1M
HP 54603B	60 MHz	2	20 MSa/s	4k
HP 54600B	100 MHz	2	20 MSa/s	4k
HP 54602B	150 MHz	4(2 + 2)	20 MSa/s	4k
HP 54610B	500 MHz	2	20 MSa/s	4k
HP 54615B	500 MHz	2	1 GSa/s	5k
HP 54616B	500 MHz	2	2 GSa/s	5k
HP 54616C	500 MHz	2	2 GSa/s	5k

For more information on HP 54600-series troubleshooting scopes, see pages 102 to 110.



HP Infiniium Oscilloscopes

- High-Performance, Low-Frustration Oscilloscopes
- 500 MHz to 1.5 GHz Bandwidth with up to 8 GSa/s Sample Rate
- Analog-like Front Panel for Simple, Understandable Operation
- Easy Access to Advanced Features Through Windows 95® Based Graphical User Interface
- Built-in Information System and Measurement Expertise

Model	Bandwidth	No. of Chan.	Sample Rate	Memory Depth
HP 54810A	500 MHz	2	1 GSa/s	32K
HP 54815A	500 MHz	4	1 GSa/s	32K
HP 54820A	500 MHz	2	2 GSa/s	32K
HP 54825A	500 MHz	4	2 GSa/s	32K
HP 54835A	1 GHz	4	4 GSa/s (2 ch. mode) 2 GSa/s (4 ch. mode)	64K (2 ch. mode) 32K (4 ch. mode)
HP 54845A	1.5 GHz	4	8 GSa/s (2 ch. mode) 4 GSa/s (4 ch. mode)	64K (2 ch. mode) 32K (4 ch. mode)

For more information on the HP Infiniium family of scopes, see pages 111 to 114.

HP 54700-Series Oscilloscopes

- High-Bandwidth, High-Accuracy Oscilloscopes
- 12 to 50 GHz Bandwidth
- Rich Set of Features and Measurements
- Single Ended and Differential TDR

	Bandwidth	No. of Chan.	Sample Rate	Memory Depth
HP 54750A	12.5 GHz to 50 GHz	2 or 4	N/A	4 K

For more information on HP 54700-series scopes, see pages 115 to 117.

Oscilloscopes for Mixed Analog and Digital Debug

HP 54645D/A

- 2 channel or 2+16 channel 100 MHz oscilloscopes
- 1 Megabyte of MegaZoom deep memory per channel
- Flexible triggering
- Perfect for 8- or 16-bit MCU-based designs

HP 54645D Mixed Signal Oscilloscope

Oscilloscopes for Mixed Analog and Digital Debug

In today's world of A/Ds, D/As, DSPs and microcontrollers, designs now include both digital and analog components, and scopes need special capabilities to let you debug the problems in your designs. HP offers two products, the HP 54645A 2-channel scope and the HP 54645D 2+16 channel mixed signal oscilloscope, that focus on helping you verify and debug your mixed analog and digital designs. The HP 54645D is the only Mixed Signal oscilloscope with 2 analog and 16 timing channels that let you simultaneously view both analog and digital signals.

Both the HP 54645A and HP 54645D offer the 1 megabyte MegaZoom deep memory that lets you capture long time spans with a high sample rate so you can analyze fine details when dealing with slow analog and fast digital signals. And we added powerful flexible triggering power, such as glitch triggering, to give you the tools you need to solve your troubleshooting problems with easy-to-use controls.

HP 54645D: View Analog and Digital Signals Simultaneously

With the introduction of the HP 54645D mixed signal oscilloscope (MSO) to your lab, you will be able to easily view the complex relationships of your circuit's analog and digital operation. Seamless integration of scope and logic channels in the HP 54645D MSO allows you to view both the analog circuit operation on the two 100 MHz scope channels and the logic timing displayed on the 16 logic channels. Analog and digital events are aligned in time so that you can easily relate cause and effect in difficult mixed-signal troubleshooting situations, such as those encountered in debugging 8- or 16-bit micrcontroller systems.

The HP 54645D gives you an oscilloscope-like operation of both the scope and logic channels. For example, simply turn the time base knob to set the time/division for all scope and logic channels. Press Autoscale for the display of all active analog (scope) and digital (logic) channels. There is no scope-logic mode switch, just a seamless integration of logic channels into a scope.

HP 54645A: Dual Channel Testing Power

With the addition of the HP 54645A Oscilloscope to your lab, you will be able to easily view the full range of signals in your circuit, from its highest speed digital operation to its slowest analog transducer input. The HP 54645A's 100-MHz bandwidth, 2 ns/div sweep speed and 200 MSa/s acquisition give you the view of your critical digital control signals needed to ensure proper circuit operation. In addition, the HP 54645A's very deep memory and 50-second/div sweep speed allow you to capture transducer and analog signals at a higher sampling speed at long timebase settings.

HP 54645A and HP 54645D with MegaZoom Technology

HP MegaZoom, available on the HP 54645A and HP 54645D scopes, provides a unique approach to deep memory. It enables signal captures of up to 1 million samples on each channel, with higher sustained sample rates and responsive displays. You can find details buried in complex signals, discover anomalies leading up to trigger events and view both high- and low-speed signals at the same time. MegaZoom deep memory is not a special mode nor does it slow down your scope—you'll get all the power of deep memory without the drawbacks.

Often when trying to view analog and digital signals, the events of interest take place over a long time span or may be widely separated from the trigger event. With 1 million samples per channel, MegaZoom deep memory lets you capture these long time spans while maintaining the high sample rate you need to see the fine detail needed to solve elusive problems.

Before the introduction of the HP 54645D MSO and HP 54645A scope with MegaZoom, deep memory oscilloscopes were considered specialized tools because of their complex operation, non-responsive control panel, and excessive display dead time. These problems have been eliminated with the development of MegaZoom technology which uses multiple processors optimized for the task of waveform acquisition, storage and display.

Display update rates are up to 3 million points per second. Now you can have a deep memory scope in your lab that is also a scope you will use every day as it is a deep-memory scope that responds instantly to your control inputs, has a high speed, low dead time display and deep memory with easy-to-use pan-and-zoom.

Powerful Triggering

Both the HP 54645A and HP 54645D provide the triggering power you expect in your general purpose bench scope with easy-to-use controls. The familiar edge triggering mode is the one that will solve most of your problems as you can trigger on a rising or falling edge on any of the inputs. In the glitch trigger mode, the scopes will search for a glitch that is less than or greater than a specified width, allowing you to find abnormally narrow or wide pulses that indicate circuit failures. TV triggering may be specified as field 1, field 2, vertical interval, or line of a composite TV waveform.

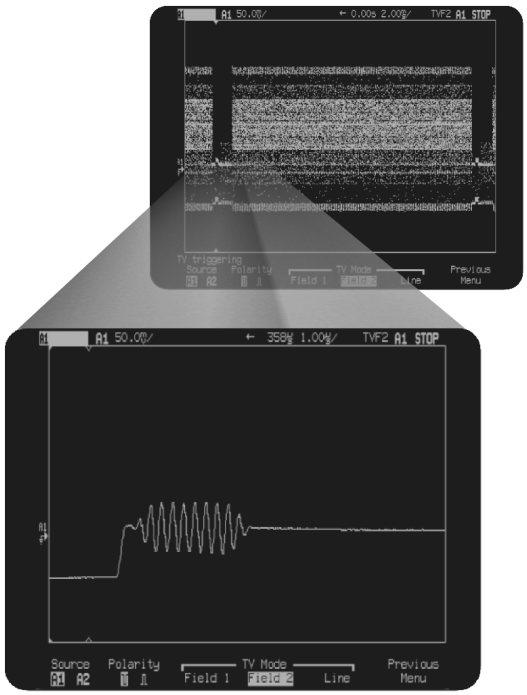
The HP 54645D MSO also offers pattern triggering that will allow you to set up a pattern of high, low, and don't-care levels across any or all of the MSO's 18 channels. In the advanced pattern, the MSO can use two trigger patterns or two edge terms which may be combined in one of several Boolean relations (AND, OR, and THEN). In addition you may establish trigger qualifiers such as entered, excited, or duration.

The HP 54600 Product Line

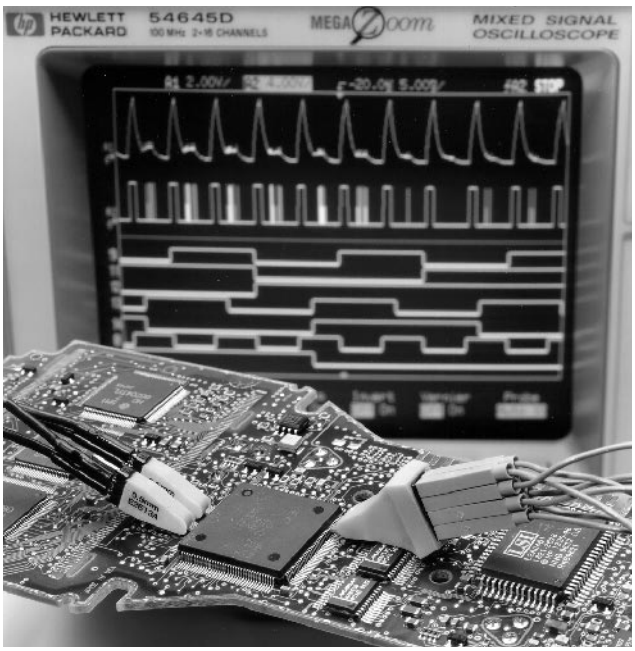
The HP 54645A and HP 54645D are members of the popular HP 54600 series of general purpose scopes that feature the power of digital and the feel of analog. As such, the scopes are rugged and built to the same environmental specifications with a 3 year standard warranty.

Both scopes use the same interface modules for connecting to printers and computers. And, when ordered with modules, they ship with BenchLink XL, a new free software package that allows for transfer of screen images, waveform data, and setups from the familiar environment of MS Excel or Word. The option BenchLink Scope software is a standalone software package with similar transfer capabilities from the scope to the PC.

For more information, visit out web site: **www.hp.com/go/bi**



With 1 megabyte of MegaZoom deep memory on each channel, the HP 54645A and 54645D scopes capture an extensive frame of a video signal and then the easy-to-use pan-and-zoom lets you explore the details of a color burst from a single line.



For accessories to help probe fine pitch ICs (0.5mm and 0.65mm) see page 122 for information about the new 3-, 8- or 16-signal HP Wedge. See pages 119–124 for other probing solutions.

Specifications for HP 54645A and HP 54645D

HP 54645A 2 Scope Channels
HP 54645D 2 Scope Channels + 16 Timing Channels

Vertical System

Scope Channels: Ch. 1 and Ch. 2
Bandwidth (3dB)**:** dc to100 MHz @ ≥ 10 mv/div (> 75 Mhz @ < 10 mv/div)
ac Coupled: 1.5 Hz to 100 MHz
Dynamic Input Range: ± 32 V or ± 8 div, whichever is less
Math Functions: Ch. 1 ± Ch. 2, invert
Input R&C: 1MΩ, ~13pF
Maximum Input: 400 V (dc + peak ac)
Range: 1 mV/div to 5 V/div
Vertical Gain Accuracy: ± 1.5% full scale
Single-Cursor Accuracy: ± 1.5% full scale; ± 1% full scale; ± 0.5% position value; ± 0.4% full scale;
Dual-Cursor Accuracy: ± 1.5% full scale; ± 0.8% full scale
BW Limit: Approx. 20 MHz
Coupling: ac, dc, GND

Logic Channels (HP 54645D only)

16 channels (0-15) in two pods of 8 channels each
Maximum Input Voltage: ± 40 volts peak
Input Dynamic Range: ± 10 volts about threshold
Minimum Input Voltage Overdrive: To meet the timing specifications, the threshold value must be within 20% of the 50% voltage point of the input signal
Minimum Input Voltage Swing: 500 mV peak-to-peak
Input R&C: 100 K Ω, ~ 8 pF
Pre-Defined Thresholds: TTL = 1.4 V, CMOS = 2.5 V, ECL = –1.3 V

Horizontal System, Scope and Logic Channels

Sweep Speeds: 50 s/div to 5 ns/div main and delayed
Accuracy: ± 0.01%
Vernier: Accuracy = ± 0.05%
Horizontal Resolution: 40 ps

Scope Cursor Accuracy

Single Channel: ± 0.01% reading ± 0.2% screen width ± 40 ps
Channel to Channel: ± 0.01% reading ± 0.2% screen width ± 80 ps

Logic Cursor Accuracy (HP 54645D only)

Single Channel: ± 0.01% reading ± 0.2% screen width ± 1 logic sample period
Channel to Channel ± 0.01% reading ± 0.2% screen width ± 1 logic sample period ± channel-to-channel skew
Delay Jitter: < 10 ppm

Delay Range

Pre-Trigger (negative delay)**:** At least 1 screen width or 2.5 msec
Post-Trigger (from trigger point to end of sweep)**:** 500 seconds

Delayed Sweep

Delayed timebase can be as fast as 5 nsec/div. but must be at least 2X the main timebase. Delayed sweep display is the same data acquisition as was the main.
HP MegaZoom Technology (post-acquisition pan and zoom)**:** The time/div and delay controls allow any part of the acquired waveform display to be expanded to the full extent of the memory available.

Trigger System

Modes: Auto, Autolevel, and Normal
Holdoff: ~200 ns to ~25 seconds
Edge Triggering: Rising or falling on any of the input channels
- **HP 54645A:** 2 channels and external trigger
- **HP 54645D:** Any of 18 channels

Glitch: Less than, greater than, or within specified range
- **Source:** Any of the 2 scope or 16 timing channels
- **Polarity:** Rising or falling
- **Minimum Pulse Width Setting:** 8 ns

TV: Available on scope channels only
TV Line and Field: 0.5 divisions of composite sync required for stable display
Pattern Triggering (HP 54645D only): A pattern of high, low, and don't-care levels and a rising or falling edge can be established across all 18 channels. The analog channel's high level is defined by that channel's trigger level.
Advanced Pattern (HP 54645D only): Up to two trigger terms (P1 and P2) and two edge terms (E1 and E2) may be established and these terms can be combined as follows: AND, OR, THEN, Entered, Exited, Duration <, Duration >, and Duration range
Advanced Triggering: Selectable as glitch, pattern, or TV

Oscilloscope Analog Triggering

Sensitivity	
< 10 mV/div, DC to 25 MHz	≤ 1 div or 2 mV
< 10 mV/div, 25 MHz to 100 MHz	≤ 1.5 div or 3 mV
> 10 mV/div, DC to 25 MHz	≤ 0.35 div or 3.5 mV
> 10 mV/div,25 MHz to 100 MHz	≤ 1 div or 10 mV

Sources: Ch. 1, Ch. 2, and line

Coupling

dc, ac, HF reject, LF reject, noise reject, HF reject and LF reject –3dB @ 50 kHz

External Trigger (HP 54645A only)

Range: ± 18V
Sensitivity
dc to 25 MHz: 50mv
25 MHz to 100 MHz: 100 MV
Coupling: dc, HF, reject, noise reject
Input R&C: 1MΩ, 13pF
Max Input Voltage: 400V (dc + peak ac)

XY

Bandwidth: 100 MHz
Phase Error @ 1 MHz: 1.8 degrees

Acquisition System

Maximum Display Rate: 3 million samples per second with sufficient trigger rate, and vectors off. 60 full screens per second, vectors on.
Average: Selectable as smoothing, 4, 8, 16, 32, 64, 128, and 256 averages
Roll Mode: At sweep speeds of 200 ms/div and slower, data moves across the display from right to left with no dead time

Oscilloscope Acquisition System

Maximum Sampling Rate: 200 MSa/s on each channel
Single-Shot Bandwidth: 50 MHz
Simultaneous capture on both channels
Vertical Resolution: 8 bits
Peak Detection: Can capture and display a pulse at least 5 nsec wide at any timebase setting
Maximum Memory Depth: 1 megabyte samples per channel

Logic Acquisition System (HD 54645D only)

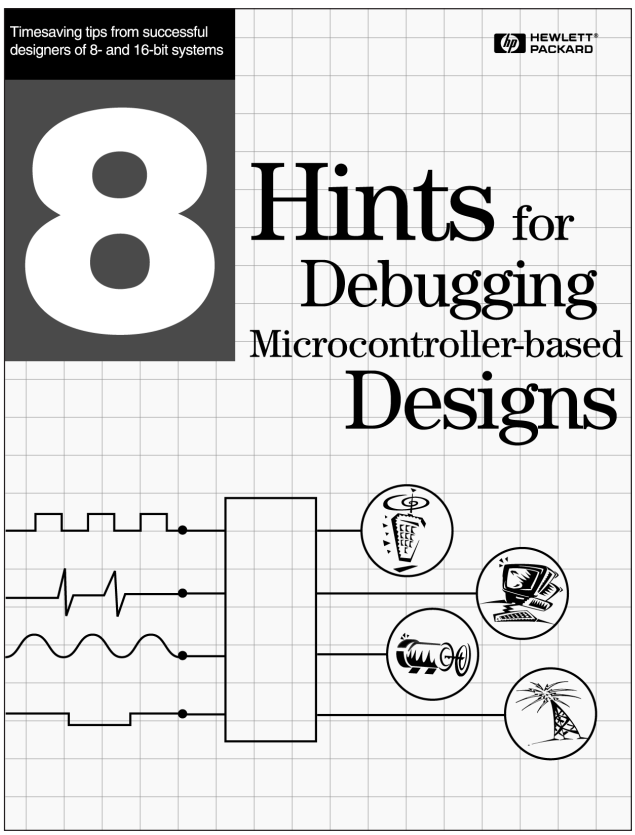
Vertical Resolution: 1 bit
Maximum Sampling Rate: 400 MSa/s on one pod, 200 MSa/s on two pods
Simultaneous capture on all channels
Peak Detection: Will capture and display a pulse at least 5 nsec wide at any time base setting
Maximum Memory Depth: 2 megabyte samples per channel on one pod, 1 megabytesamples when both pods are used

Advanced Features

Automatic measurements include
Voltage: V_{AVG} (dc), V_{RMS}, V_{PP}, V_{MIN}, V_{MAX}, V_{TOP}, V_{BASE}.
Time: Frequency, period, + pulse width, –pulse width, duty cycle, rise time and fall time (rise time and fall time are scope only)
Cursors: Manually or automatically-placed readout of time, 1/time, voltage.

Setup Functions

Autoscale: Finds and displays all active scope and logic channels, sets edge trigger mode on highest numbered channel.
Save/Recall (non-volatile)**:** 10 set-ups can be saved and recalled from non-volatile memory
Trace (pixel) **Memory:** 2 volatile; non-volitile with module



Ask for your free copy of time-saving tips from successful designers of 8- and 16-bit systems (p/n 5966-3688EUS).

Ordering Information

HP 54645A 2-Channel 100 MHz Scope
HP 54645D 2+16-Channel 100 MHz Mixed-Signal Oscilloscope
Accessories supplied: Two each HP10074A 10:1 divider probes with readout, HP 10089A16-channel logic input probe assembly (HP 54645D only), removable front panel ground connector, user's guide and service manual, power cord

- **Opt 001:** RS-03 Magnetic Interference shielding added to the CRT
- **Opt 002:** RE-02 Display Shield added to the CRT to reduce radiated interference
- **Opt 005:** Enhanced TV/Video Trigger for 54645A
- **Opt 101:** HP 10098A Front-panel Cover and Pouch Kit
- **Opt 103:** HP 54654A Customer Training Kit
- **Opt 104:** HP 1185A Carrying Case
- **Opt 106:** HP 34810B HP BenchLink Scope Software
- **Opt 1CM:** HP 1186A Rackmount Kit
- **Opt W50:** Additional two years of warranty

Accessories
HP 10074B: 10X Probe with Readout
HP 10070B: 1X Probe
HP 10085A: HP 16:16 logic cable and terminator
HP 10089A: HP 16:2 x 8 logic inputprobe assembly
HP 1183A: Testmobile Scope Cart
Optional modules needed for GPIB, RS232 or printer connection, see page 107.

See the MSO in Action

To see the HP 54645D mixed signal oscilloscope in action and for answers to any questions you might have, contact the HP Call Center in your region. Request a free copy of 8 Hints for Debugging Microcontroller-based Designs (5966-3688EN/EUS). The HP 54645D Data Sheet is also available–ask for publication number 5964-6364EN/EUS.

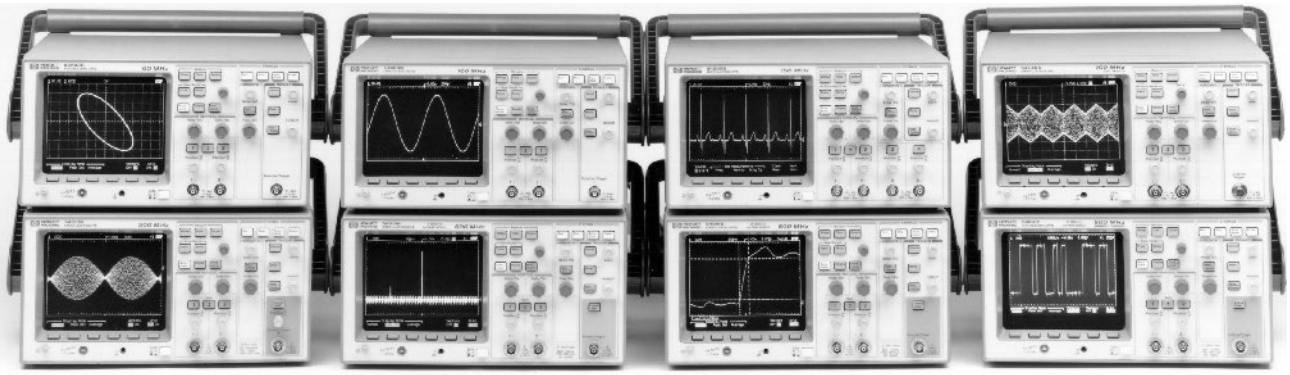
For more information, visit our web site: **http://www.hp.com/go/bi**

Indicates QuickShip availability.

General Purpose and Troubleshooting

HP 54600 Family

- Analog look and feel
- 1 Meg of memory (HP 54645A)
- Automatic and cursor-based measurements of frequency, time, and voltage
- Up to 2 GSa/s sample rates
- Glitch detection
- 60 to 500 MHz bandwidth
- Up to 1 ns peak detect
- Up to 3 million points per second update rate
- Color (54616C)
- Add-on interface and enhancement modules for hard copy, remote programming, and FFT



HP 54600 Family of Oscilloscopes

The HP 54600 family of oscilloscopes offers you the comfortable feel of analog scopes and the measurement power of digital scopes, all at a price you can afford. This family of oscilloscopes gives you the ability to view waveforms you can't see with your analog scope, and they provide the familiar controls and interactive displays you've grown accustomed to. To solve your most difficult test problems, these scopes provide powerful digital features, such as pre-trigger viewing, peak detect, waveform storage, and measurement automation.

This class of oscilloscopes, made possible through HP's advanced integrated circuit technology, presents this power in a small, lightweight package and at a price that fits your budget. The display update rate of up to three million points per second provides a display with unprecedented interactivity.

Eight Models: One Is Right for You

With eight models to choose from, you will be able to pick the oscilloscope that best meets your measurement and troubleshooting needs while meeting the constraints of your budget. The dual-channel 60 MHz HP 54603B is ideally suited for classroom use and other situations where budgets are tight. The HP 54600B offers dual-channel 100 MHz performance for field service and production test applications. With its 150 MHz bandwidth, 1 mV/division sensitivity, and triggering to 250 MHz, the HP 54602B is the "lab quality" general-purpose scope for your bench today, and in the years to come.

The HP 54610B may the lowest priced 500 MHz oscilloscope on the market, but it does not compromise on measurement quality. The HP 54615B boosts the sample rate to 1 GSa/s while preserving the intuitive analog feel and instantaneous response, common in all the members of the HP 54600 family. At the top of the HP 54600 line, the HP 54616B (monochrome) and the HP 54616C (color) provide 500 MHz bandwidth and 2 GSa/s sample rate. The HP 54645A, 100 MHz MegaZoom oscilloscope, brings deep memory to the family. MegaZoom technology makes using the one megabyte of memory effortless.

Model	Bandwidth	Chs	Sensitivity	Maximum Sample Rate
54603B	60 MHz	2	2 mV to 5 V/div	20 MSa/s
54600B	100 MHz	2	2 mV to 5 V/div	20 MSa/s
54645A	100 MHz	2	1 mV to 5 V/div	200 MSa/s
54602B	150 MHz	4 (2 + 2)	1 mV to 5 V/div	20 MSa/s
54610B	500 MHz	2	2 mV to 5 V/div	20 MSa/s
54615B	500 MHz	2	2 mV to 5 V/div	1 GSa/s
54616B/C	500 MHz	2	2 mV to 5 V/div	2 GSa/s

Powerful, Efficient and Compact

When you think about powerful digital scopes, the first thing that might come to mind is large and complicated. The HP 54600 family are neither, making them ideal troubleshooting and debugging oscilloscopes. These scopes are compact (can fit under a plane seat) and weigh under 15 pounds. They also retain some of the attributes that were valued in analog scopes. Knobs that allow direct access control of vertical and horizontal scaling and positioning are just one of the many features that make these scopes easy to use. High update rate and a real-time vector display respond instantly to changes in your waveform. This powerful combination will help you get answers fast.

Multiple-Processor Architecture

HP uses a multiple-processor architecture in the HP 54600 series of oscilloscopes. This is one of the ways in which HP delivers ease of use, with a responsive high update-rate oscilloscope. The parallel processing utilized in the HP 54600 series allows acquisition and display systems of the oscilloscope to function independent of the human interface and measurement systems. This makes for a general-purpose troubleshooting scope that is responsive to changes in your waveform, as well as responding to changes initiated from the front panel.

HP 54645A MegaZoom Oscilloscope

The HP 54645A oscilloscope makes deep memory highly usable. The HP 54645A is a dual channel 100 MHz oscilloscope with 200 MSa/s and a full 1 MB of memory behind each of its channels. Through the application of MegaZoom technology, this deep-memory oscilloscope has a high speed/low dead time display and a highly-responsive front panel.

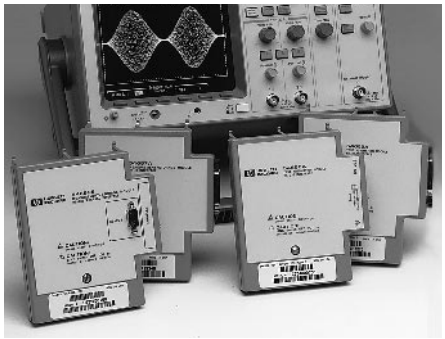
PC Connectivity Made Easy

Now receive the BenchLink XL 54600 Software free when you order either the RS232/Parallel or GPIB Interface modules for quick and easy connectivity. BenchLink XL transfers screen images, waveform data and setups directly into Microsoft Excel or Word with no programming.

Product Specific Performance Characteristics

Vertical system	HP 54603B	HP 54600B	HP 54602B	HP 54610B	HP 54615B/ HP 54616B/C	HP 54645A
Bandwidth (BW) Ch. 1 and 2	dc to 60 MHz	dc to 100 MHz	dc to 150 MHz ch3/4 dc to 250 MHz	dc to 500 MHz	dc to 500 MHz	dc to 100 MHz
Channels	2	2	4 (2+2)	2	2	2
Input R & C	1 MΩ, ~13 pF	1 MΩ, ~13 pF	1 MΩ, ~13 pF	1 MΩ, ~9 pF	1 MΩ, ~9pF	1 MΩ, ~13 pF
Dynamic range (from center screen)	± 8 divisions	± 8 divisions	± 8 divisions	± 12 divisions	± 12 divisions	± 8 divisions
Sensitivity (per division) Ch. 1 and 2	2 mV to 5 V	2 mV to 5 V	1 mV to 5 V	2 mV to 5 V	2 mV to 5 V	1 mV to 5 V
Accuracy	± 2%	± 1.5%	± 1.5%	± 2%	± 2%	± 1.5%
Maximum input dc + peak ac	400 V	400 V	400 V	250 V or 5 V RMS in 50 Ω mode	250 V or 5 V RMS in 50 Ω mode	400 V
Selectable BW limit	20 MHz	20 MHz	20 MHz	30 MHz	30 MHz	20 MHz
Horizontal system						
Accuracy	± 0.01%	± 0.01%	± 0.01%	± 0.01%	± 0.005%	± 0.01%
Resolution	100 ps	100 ps	100 ps	25 ps	20 ps	40 ps
Delay jitter	10 ppm	10 ppm	10 ppm	10 ppm	1 ppm	10 ppm
Sweep speed	5 s/div to 5 ns/div	5 s/div to 2 ns/div	5 s/div to 2 ns/div	5 s/div to 1 ns/div	5 s/div to 1 ns/div	50 s/div to 2 ns/div
Acquisition system						
Max. sample rate	20 MSa/s	20 MSa/s	20 MSa/s	20 MSa/s	1 GSa/s/2 GSa/s	200 MSa/s
Single shot BW	2 MHz	2 MHz	2 MHz	2 MHz	250 MHz/500 MHz	50 MHz
Peak detect	50 ns	50 ns	50 ns	50 ns	1 ns	5 ns
Record length (pts. vectors off/on)	4k/2k	4k/2k	4k/2k	4k/2k	5k/2k	1 Meg
Max. update rate vectors off	1.5 M pts/s	1.5 M pts/s	1.5 M pts/s	1.5 M pts/s	0.5 M pts/s	3 M pts/s
Trigger system						
Sensitivity Ch. 1 and 2	dc to 25 MHz, 0.35 div or 3.5 mV dc to 60 MHz, 1 div or 10 mV	dc to 25 MHz, 0.35 div or 3.5 mV dc to 100 MHz, 1 div or 10 mV	dc to 25 MHz, 0.35 div or 3.5 mV dc to 150 MHz, 1 div or 10 mV	dc to 25 MHz, 0.35 div or 3.5 mV dc to 500 MHz, 1 div or 10 mV	dc to 100 MHz, 0.5 div or 5.0 mV dc to 500 MHz, 1 div or 10 mV	dc to 25 MHz 0.35 div or 3.5 mV dc to 100 MHz, 1 div or 10 mV
External trigger range	± 18 V	± 18 V	N/A	± 18 V	± 2 V	± 18 V
External trigger input maximum input	400 V (dc + peak ac)	400 V (dc + peak ac)	N/A	250 V (dc + peak ac) or 5 V rms in 50 Ω	250 V (dc + peak ac) or 5 V rms in 50 Ω	400 V (dc + peak ac)
Measurements	Over 15 automatic measurements including Vpp, Vavg, Vrms, Frequency, Period, ± Pulse width, Rise/Fall time					
Math functions	+, –, invert, *, FFT, integrate, differentiate with optional measurement storage module					
Printer/computer support	with optional RS232/Parallel or GPIB modules; receive free BenchLink XL 54600 Software					

- Hard-copy output to printer or plotter
- Free BenchLink XL 54600 software for easy PC connectivity
- Remote instrument control
- Enhanced automatic measurements, FFT, mask testing



A Full Family of Add-On Interface and Enhancement Modules

The HP 54600 series scopes use a complete range of optional interface modules for hard-copy output, remote programmability, and custom test functionality. These modules plug into the back of most HP 54600 series scopes, adding advanced capability to your scope.

HP 54650A GPIB Interface Module

This module provides full remote control and hard-copy output to GPIB printers and plotters and computers in accordance with IEEE-488.2.

HP 54652B RS-232/Parallel Interface Module

This module provides computer interface via RS-232 and printing via parallel in one module. The RS-232 interface also can be configured for printing when not being used for remote programming.

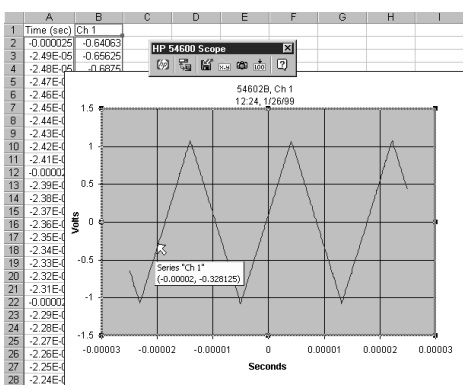
HP 54657A GPIB and 54659B RS-232/Parallel Measurement/Storage Modules

The HP 54657A and 54659B measurement/storage modules bring enhanced measurement and storage power to your HP 54600 scope. Added features include FFTs, mask testing and more measurements.

HP BenchLink XL 54600 Software (free)

PC Connectivity Made Easy

Receive HP BenchLink XL 54600 software FREE with the purchase of any RS232/Parallel or GPIB interface module. Use it to retrieve waveform images, waveform data—even automatic measurements—directly into MicroSoft Excel and Word without programming. Additionally, an ActiveX control simplifies programming in Visual Basic, VBA, Visual C++, HP VEE, and National Instruments LabVIEW.



HP 54600 Series Software and Accessories

HP 34810B BenchLink Scope Windows Software (Option 106)

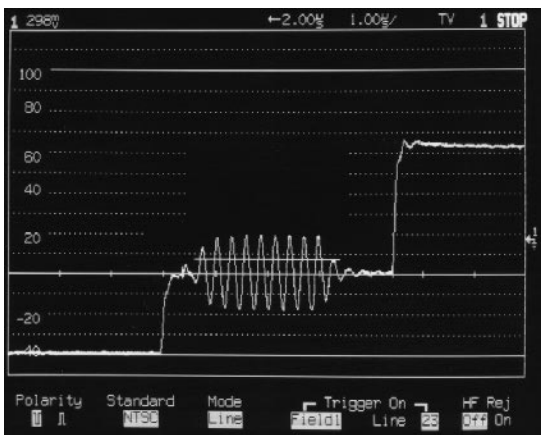
HP BenchLink Scope is a standalone optional software package that makes it easy to move important information from scope to PC. You'll be able to transfer:
Screen Images: You can transfer a bitmap picture of the scope screen to your PC for viewing, annotation, storage or printing TIF formats.
Waveform Data: HP BenchLink Scope transfers the actual waveforms on screen to your PC for further review and analysis.
Instrument Setups: The full front-panel setup of your scope can be saved in the PC for later use.

HP 54654A Operator's Training Kit (Option 103)

The operator's training kit consists of a training signal board and lab workbook. The signal board provides 12 scope signals and 20 logic analyzers that show various operating modes and features of an HP 54600 series oscilloscope. Nineteen logic analyzer test points are also provided to demonstrate the features of the HP 54600 series logic analyzers or mixed signal oscilloscope. After completing the labs, the user can operate the instrument and make measurements with no extra training. This kit is ideal for the educational environment and can also be an excellent tool for training new employees.

Enhanced Performance for Video Applications (Option 005)

With the addition of Option 005, enhanced TV/video triggering, to the HP 54602B, HP 54610B, HP 54615B, HP 54616B/C or HP 54645A oscilloscopes, you will be able to trigger on any specified line of video in either NTSC, PAL, PAL-M, SECAM or generic video formats. With this additional triggering, you will be able to easily view signals that are often very dim or invisible on most analog scopes. Once you have the signal of interest displayed, you can measure it with digital precision.



Live NTSC broadcast video with Opt 005.

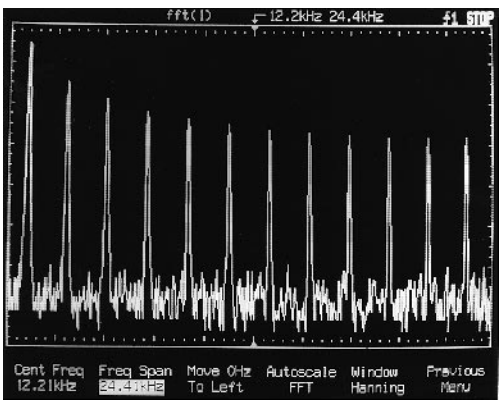
Product Specific Performance Characteristics

HP 54650A GPIB Interface Module

Provides full remote control and hard copy to GPIB printers and plotters. Programming is in accordance with IEEE-488.2. With the addition of this module, the scope's two pixel memories become non-volatile. An operating and programming manual and a programming examples disk are supplied.
Specifications: The interface capabilities of the HP 54600 series oscilloscope with this module installed are as defined by IEEE-488.1 as SH1, AH1, T5, L4, SR1, RL1, PP1, DC1, DT1, C0 and E2.
HP Printer/Plotter Supported: HP ThinkJet, HP QuietJet, HP PaintJet, HP DeskJet, and HP LaserJet; HP-GL compatible plotters.

HP 54652B RS-232/Parallel Interface Module

Provides full remote control via RS-232 and printing via parallel in one module. The RS-232 can also be configured for printing when not being used for remote control.
Specifications
Connector Type: 9 pin (m) DTE Port, works with HP 34398A RS-232 cable
Protocols: Xon/Xoff, hardwire
Data Bits: 8
Parity: None
Baud Rates: 1200, 2400, 9600, or 19200
HP Printer/Plotter Supported: HP ThinkJet, HP QuietJet, HP PaintJet, HP DeskJet, and HP LaserJet; HP-GL compatible plotters.
Connector Type: 25 pin (F) connector, works with HP C2950A parallel printer cable
Other Supported Printers: Epson FX-80 or HP PCL compatible printers



Add easy-to-use frequency domain FFTs to your HP 54600 with the Measurement Storage Module (HP 54657A or 54659B).

HP 54657A and 54659B Measurement/Storage Modules

With the the addition of either the HP 54657A module with GPIB interface or the HP 54659B module with RS-232 and parallel interface, the HP 54600 series oscilloscope will provide all of the following features:

19 Automatic Measurements consisting of:

Voltage: Vamp, Vavg, Vrms, Vpp, Vpre, Vovr, Vtop, Vbase, Vmin, and Vmax
Time: Delay, Duty Cycle, Frequency, Period, Phase Angle, Rise Time, Fall Time, + width, and –width
Thresholds: User selectable among 10%/90%, 20%/80%, or absolute voltage levels
Cursor Readout: Voltage or percentage
Modes: Time or phase angle

Waveform Math Functions

Function 1: Addition, subtraction, and multiplication
Function 2: Differentiation, integration, and FFT
FFT
Windows: Exponential, flat top, Hanning and rectangular
Samples: 1024 points

Storage

Trace Memory: Up to 100 nonvolatile memories
Memory Labeling: An onscreen text editor is provided for creating labels up to 20 characters.
Real-Time Clock: 24-hour format with battery back-up. Can be set from front panel.

Unattended Waveform Monitoring

Testing Method: Comparison to waveform mask
Number of Masks: 2
Mask Generation and Operation: Automask, controlled from the front panel, generates mask from displayed wave-form with selectable tolerance. Mask editor function allows pixel-by-pixel editing.
Hard Copy and Programmability Interface:
HP 54657A: GPIB (see specifications for 54650A)
HP 54659B: RS-232/Parallel (see specifications for 54652B)

HP 54600-Series Scope Interface and Enhancement Modules

Ordering Information Product		Description	GPIB	RS-232 and Parallel	FFT and Advanced Meas.	BenchLink XL Software (free)	BenchLink Scope Software
1.	**HP 54650A**	GPIB Interface Module	•			•	
	HP 54652B	RE-232 and Parallel Interface Module		•		•	
2.	**HP 54657A**	GPIB Measurement/Storage Module	•		•	•	
	HP 54659B	RS-232 Measurement/Storage Module		•	•	•	
3.	**HP E2657A**	Measurement/Connectivity Kit for GPIB	•		•	•	•
	HP E2659A	Measurement/Connectivity Kit for RS-232		•	•	•	•

Note: The HP 54620A logic analyzers can use any of these modules, but they use the modules for I/O only.

1. Basic Connectivity
If all you need is a PC interface, add GPIB with the HP 54650A or both RS-232 and parallel connections with the HP 54652B. BenchLink XL 546000 Software ships free with all modules.

2. Connectivity and Advanced Measurements
For high-performance tools usually found only in much more expensive scopes–including the FFT to view signals in the frequency domain–add the HP 54657A (GPIB) or HP 54659B (RS-232 and parallel) measurement/storage module.

3. Complete Connectivity, Including Software
Get the complete package, including HP BenchLink Scope stand-alone-software for documenting and analyzing measurement results.

Ordering Information

HP 54600B Two-Channel 100-MHz Oscilloscope
Includes two 1.5 m 10X probes (HP 10071A), operating and service guide, and line cord
HP 54602B Four-Channel 150-MHz Oscilloscope
Includes two 1.5 m 10X probes (HP 10071A), operating and service guide, and line cord
HP 54603B Two-Channel 60-MHz Oscilloscope
Includes two 1.5 m 10X probes (HP 10071A), operating and service guide, and line cord
HP 54610B Two-Channel 500-MHz Oscilloscope
Includes two 1.5 m 10X probes (HP 10073A), operating and service guide, and line cord
HP 54615B Two-Channel 500 MHz Oscilloscope
Includes two 1.5 m 10X probes (HP 10073A), operating and service guide, and line cord
HP 54616B Two-Channel 500 MHz Oscilloscope
Includes two 1.5m 10X probes (HP 10073A), operating and service guide, and line cord
HP 54616C Two-Channel 500 MHZ Color Oscilloscope
Includes two 1.5m 10X probes (HP 10073A), operating and service guide, and line cord
HP 54645A Two-Channel 100 MHz MegaZoom Oscilloscope
Includes two 1.5m 10X probes (HP 10074A), operating and service guide, and line cord
HP 54645D 2+16-Channel 100 MHz MSO
HP 54620A 16-Channel 500 MSa/s logic analyzer

Accessories
HP 54650A GPIB Interface Module*
HP 54652B RS-232 and Parallel Interface Module*
HP 54657A Measurement/Storage Module with GPIB Interface*
HP 54659B Measurement/Storage Module with RS-232 and Parallel*
*Modules ship with free BenchLink XL 54600 Software

HP 54654A Operator's Training Kit
HP 1146A Oscilloscope AC/DC Current Probe
HP 1183A Scope Cart (Testmobile)
HP 1185A Carrying Case (Hardshell)
HP 10070B 1.5 m 1X Probe
HP 10071B 1.5 m 10X 150 MHz Probe
HP 10072B SMT Probe Tip Kit for HP 10070A family of probes
HP 10073B 1.5 m 10X 500 MHz Probe
HP 10074B 1.5 m 10X 150 MHz Probe with Probe Sense
HP 10075A 0.5 mm SMT Probe Accessory Kit for the HP 10070A family of probes
HP 34397A DC to AC Inverter
HP 85901A AC Power Source

Options

Opt 001 Display EMI Shield (HP 54600-68703)
Provides extra shielding for the CRT, for MIL standards or harsh magnetic environments.
Opt 002 Display Filter
Provides additional reduction in radiated emissions, for MIL standards or measurement environments sensitive to radiated emissions.
Opt 005 Enhanced Video Trigger
(not available on HP 54600B, HP 54603B or HP 54645D)
Adds the ability to trigger on a specified line of NTSC, PAL, PAL-M,SECAM, or general format video. IRE graticule, IRE cursor readout, video autoscale, and rear-panel outputs for trigger and channel input are added with this option.
Opt 101 Accessory Pouch and Front-Panel Cover (HP 10098A)
Opt 102 Two Additional 10071A Probes (54602B only)
Opt 103 Operator's Training Kit (HP 54654A)
Consists of a training signal board and lab workbook. After completing these labs, an operator will be able to make measurements and operate the oscilloscope without any additional training.
Opt 104 Carrying Case (HP 1185A)
Designed to protect the oscilloscope for shipment or for checking as airline baggage
Opt 106 BenchLink Software (HP 34810B)
Windows software that interfaces the scope (with either GPIB or RS-232 module installed) to a PC for storage, analysis, or easy integration of waveform data into desktop publishing software
Opt 090 Delete Probes for HP 54600B, 54602B, 54603B
Opt 090 Delete Probes for HP 54610B, HP 54615B, HP 54616B/C
Opt 090 Delete Probes for HP 54645A
Opt 1CM Rackmount Kit (HP 1186A)
7-inch EIA standard rack
Opt W50 Additional Two-Year Warranty (for a total of five years)

For the Educators
These oscilloscopes are ideally suited for classroom use. Contact the HP Call Center in your region for details on specific education discount programs.

HP 54600 Interfacing and Hard Copy Output Information Compatibility Chart

Supported Devices	GPIB modules	RS-232/Parallel modules
Hewlett-Packard Printers (LaserJet, DeskJet)	N/A	Yes
Epson Printers (FX-80 or Compatible)	N/A	Yes
Computers	Yes	Yes
HP-PCL Printers	Yes	Yes
HP-GL Plotters	Yes	Yes

GPIB Cables for HP 59650A and HP 59657A
HP 10833A 1 m Cable
HP 10833B 2 m Cable
HP 10833C 4 m Cable
HP 10833D 0.5 m Cable
RS-232 Cables for HP 54652B and HP 54659B
For connection to PCs:
HP 34398A 2.5 m, 9 Pin (f) to 9 Pin (f)
HP 34399A Adapter Kit
Parallel Cable
HP C2950A 2 m, Parallel Printer Cable

Indicates QuickShip availability.

HP 54810A
HP 54815A
HP 54820A
HP 54825A
HP 54835A
HP 54845A

NEW

4

- 500-MHz, 1 GHz and 1.5-GHz bandwidth
- 2- or 4-channel models
- Up to 8 GSa/s sample rates
- Simple, analog-like front panel
- Windows 98-based graphical user interface
- Built-in information system
- Voice control option

Performance You Can Use

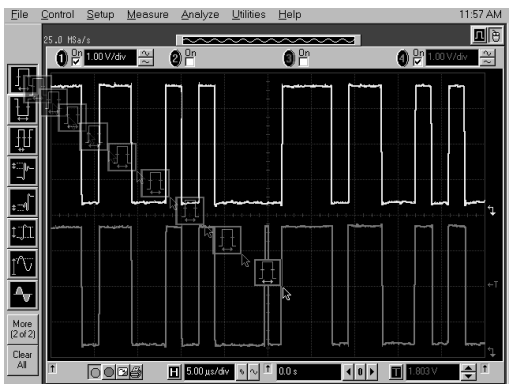
HP Infiniium oscilloscopes combine a simple, analog-like front panel, a familiar Windows 98 graphical user interface, and a built-in information system, to make high-performance scope features accessible and uncomplicated. We call it usable performance. We think you'll call it a significant improvement.

Simple Analog-like Front Panel

Dedicated scale and offset knobs for each vertical channel (see photo above), color coded with the waveform colors, provide intuitive scope operation. Backlit LEDs on the front panel tell you at a glance how the scope is set up. A single QuickMeas button gives you four of your favorite measurements with statistics at the push of a button.

Familiar Graphical User Interface

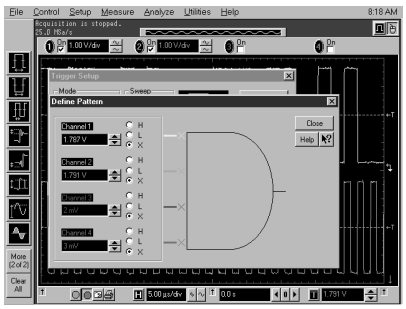
Infiniium oscilloscopes employ a graphical user interface based on Windows 98. Pull down menus give you easy access to advanced features. And many advanced features can be used without accessing the menus. For instance, drag-and-drop measurements (see photo), direct control of the waveforms, and zooming in on an area of interest can easily be performed using the standard mouse.



Just drag and drop an icon from the measurement toolbar onto the portion of the waveform you want to measure and the measurement appears instantly on screen.

Built-in Information System

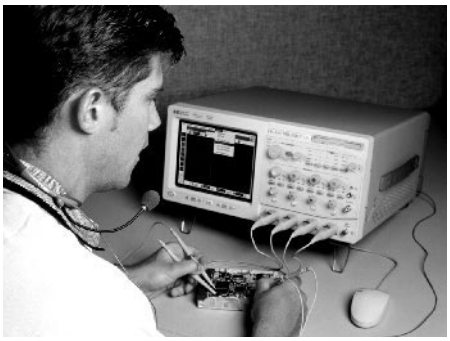
Infiniium's built-in information system puts measurement assistance at your fingertips. A Setup Guide walks you step-by-step through making 24 common complex measurements like jitter, runt triggering, etc. In addition, context-sensitive help is available to define all features available in the Windows 98 dialog boxes.



Graphical dialog boxes make it easy to set up HP Infiniium's powerful triggering capability

New Advanced Triggering

In addition to standard trigger modes such as edge, glitch, delay, logic, state and video, HP's violation trigger adds capabilities such as rise-time trigger, fall-time trigger, setup and hold-time trigger and runt trigger to capture these elusive violations. And Infiniium's graphical dialog boxes make it easy to set up advanced trigger conditions (see photo).



You can use both hands for probing when you control the scope's front-panel fuctions with your voice.

NEW Voice Control Option

Infiniium can now be controlled with Voice Control (option 200). Using the included microphone, users can now control front panel functions by speaking into a microphone, allowing hands-free operation of the scope. This is an extremely valuable option for users who need both hands to probe fine-pitch, surface mount parts.

LAN Connectivity

Infiniium makes it easy to document and share your results with others. Simply print out screen shots to high quality color printers connected to your network. You can also share screenshot files with other Infiniium users. Finally, you can mount Infiniium's hard disk drive to your PC over the network to easily transfer files for analysis or documentation.

Internal Hard and High Capacity Floppy Disk Drives

Use the internal 3.2 GB hard disk drive or the 3.5-inch LS-120 120 MB floppy disk drive (compatible with standard 1.44 MB floppies) to store instrument setups, waveforms, or screen images. Images can be stored as BMP, TIF, GIF, PCX, PS or EPS files for easy import over LAN or sneakernet into various documentation programs.

Easy Probing

A full line of compatible passive, active and differential probes are available for Infiniium. These probes contain the AutoProbe interface, which completely configures Infiniium for the proper attenuation ratio, input impedance, probe power and offset range, if needed. See the Infiniium Probes and Accessories datasheet for more information (5968-3832).

Clip-on Trackball Option

In addition to the standard mouse and keyboard supplied with Infiniium, a clip-on trackball is available if you don't have available bench space. The trackball clips onto the side of the instrument.

Internet URL **www.hp.com/go/tmc00**

Product & Order Info **See page 607**

HP 54810A
HP 54815A
HP 54820A
HP 54825A
HP 54835A
HP 54845A

General Specifications Chart for Infiniium Oscilloscopes

	HP 54810A, 54815A, 54820A, 54825A	HP 54835A	HP 54845A
Bandwidth	500 MHz	1 GHz	1.5 GHz
Channels	HP 54810A/820A: 2 HP 54815A/825A: 4	4	4
Sample rate	HP 54810A/820A: 1 GSa/s on each channel HP 54815A/825A: 2 GSa/s on each channel	2 channel mode: 4 GSa/s 4 channel mode: 2 GSa/s	2 channel mode: 8 GSa/s 4 channel mode: 4 GSa/s
Memory/channel	32K	2 channel mode: 64K 4 channel mode: 32K	
Vertical resolution	8 bits; 12 bits or greater with averaging	8 bits; 12 bits or greater with averaging	
Input voltage ranges	1 mV/div to 5 V/div	1 MΩ: 2 mV/div to 2 V/div 50Ω: 2 mV/div to 1 V/div	
Input Z, coupling	50Ω, 1 MΩ, dc, ac (1 MΩ), ground		
Trigger enhancements	Edge, glitch, pattern, state, delay by time, delay by events, violation (runt, setup/hold time, pulse width, transition), video, line		
Measurements	27 automatic waveform parameter measurements with statistics		
Math functions	4 functions, F1-F4. Select from add, subtract, multiply, divide, invert, magnify, Vs., min., max., integrate, differentiate, FFT magnitude		
Other analysis functions	Histograms (vertical/horizontal), automask capability, eye diagram measurements, variable persistence, dual density infinite persistence, color grade persistence waveforms		
Storage	Instrument setups, waveforms, screen images can be stored to either the 3.2 GB hard disk or the LS-120 120 MB high capacity floppy disk drive. 4 nonvolatile waveform memories.		
Display	Large 8.4-inch color active matrix LCD display		
Display annotation	Up to 12 labels, with up to 100 characters each, can be created with the standard keyboard and inserted into the waveform display area		
Waveform update rate	>2,000 waveforms/sec		
Printer support	Full support of HP DeskJet and LaserJet printers. LAN or Centronics interfaces.		
Price	HP 54810A: HP 54815A: HP 54820A: HP 54825A:		

For more detailed information, refer to the HP Infiniium Oscilloscopes technical datasheet (5968-2415).

HP 54810A
HP 54815A
HP 54820A
HP 54825A
HP 54835A
HP 54845A

NEW

4

- Over 20 industry standard ANSI T1.102, ITU-T G.703 and IEEE 802.3 communication masks
- Mask testing for positive and negative pulses
- Electrical communication adapters optimized for use with Infiniium oscilloscopes
- Automatic "isolated ones" triggering for all pulse masks
- One button alignment of mask to signal
- Single dialog box sets up the pass/fail test

The Option 100 kit includes a set of adapters to assure convenient, reliable and accurate connections to your DUT.

Option 100–Communication Mask Test Kit

Perform compliance testing to ANSI, ITU-T and IEEE standards with Infiniium's Communication Mask Library and electrical communication adapters.

For more detailed information on Option 100, refer to the datasheet (5968-3833).

Communication Mask Library

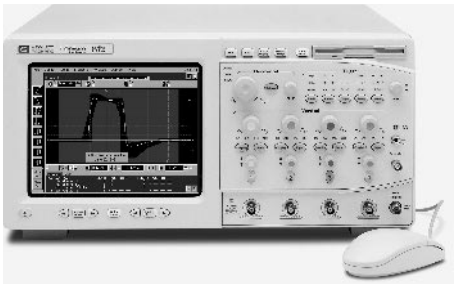
Standard	Mask	Standard	Mask
ANSI T1.102	DS1, DS1A, DS1C, DS2, DS3	ITU-T G.703	E1, E2, E3, E4
	STS1 (eye, pulse)		DS1, DS2, DS3
	DS4NA (eye)		STM1E
	STS3 (eye)		
		IEEE 802.3	10base-T

HP E2633A Infiniium Performance Upgrade—Hardware and Software Uprading by HP

For a nominal charge, HP will upgrade the hardware and software in your Infiniium oscilloscope to the latest factory configuration. The type of upgrade you need is determined by the serial number of your scope. Some upgrade items include:

- Updating the scope processor and installing additional RAM and a LAN card
- Installing a new LS-120 SuperDisk 120 MB floppy drive (reads and writes to 3.5" floppies)
- Installing the latest version of the Infiniium scope application software
- Performing other product adjustments and changes as needed, and calibrating the scope.

You'll end up with a better, faster Infiniium that makes it even easier to get your job done.



Ordering Information

HP 54810A 500 MHz (2 ch., 1 GSa/s)oscilloscope
HP 54815A 500 MHz (4 ch., 1 GSa/s) oscilloscope
HP 54820A 500 MHz (2 ch., 2 GSa/s) oscilloscope
HP 54825A 500 MHz (4 ch., 2 GSa/s) oscilloscope
HP 54835A 1 GHz (4ch., 2 GSa/s or 2 ch, 4 GSa/s) oscilloscope
HP 54845A 1.5 GHz (4 ch., 4 GSa/s or 2 ch., 8 GSa/s) oscilloscope
All of the above models include:
Mouse, Infiniium Mouse Pad, keyboard, protective front cover
2 1160A 10:1 10MΩ passive probes (54810A, 54820A)
4 1160A 10:1 10MΩ passive probes (54815A, 54825A)
4 1161A 10:1 10MΩ passive probes (54835A, 54845A)
1 User's Quick Start Guide, 1 Service Guide, 1 Programmer's Guide, 1 Programmer's Quick Reference Guide, Information System in English, French, German, Japanese, Korean, Chinese
1 Accessory Pouch, 1 US power cord, Three-year warranty

Options

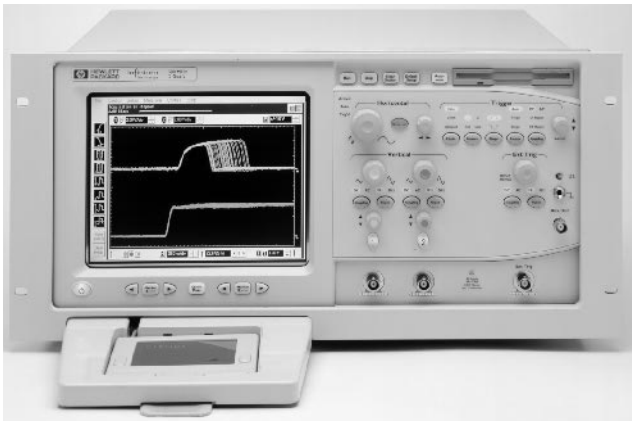
Opt 001 Provides additional standard probes
2 1160A probes for the 54810A/815A/820A/825A
2 1161A probes for the 54835A/845A
Opt 002 Add 1 1162A 1:1 passive probe
Opt 003 Add 1 1163A 10:1 500Ω, low C passive probe
Opt 006 Add 1 1152A 2.5 GHz, 0.6 pF active probe (54835A/845A)
Opt 008 Add 1 1153A 200 MHz differential probe
Opt 090 Deletes standard probes
2 1160A probes for the 54810A/820A
4 1160A probes for the 54815A/825A
4 1161A probes for the 54835A/845A
Opt 100 Communication Mask Test Kit
Opt 200 Voice Control for Infiniium oscilloscopes
Opt 1BP Mil Std 45662A and ANSI/NCSL Z-540 calibration with test data
Opt 1CM Add 1 rackmount kit (E2609A)–includes TouchPad
Opt UL5 Add 1 TouchPad pointing device (E2612A)
Opt UL6 Add 1 Clip-on track ball pointing device (E2611A)

HP E2633A HP Infiniium Oscilloscope Performance Upgrade
The upgrade price is determined by the serial number prefix (the 4 numbers that follow the letters "U.S.") in the serial number of your Infiniium. You can find your scope's serial number by using your mouse to click on Help/About Infiniium or by looking on the back of your scope.

Opt 001 Serial number prefixes beginning with US3825
This option includes: All Opt 003 features, upgrading processor from 133 MHz to 300 MHz, increasing RAM to 64MB, adding a LAN card (if not already installed)
Opt 002 Serial number prefixes from US3805 to US3844
This option includes: All Opt 003 features, upgrading processor from 200 MHz to 300 MHz
Opt 003 Serial number prefixes beginning with US3825
This option includes: Upgrading your scope to Windows 98 and version A.03.00 of the Infiniium application software, replacing the 1.44MB floppy drive with LS-120 SuperDisk 120MBfloppy, other hardware adjustments and updates, scope calibration

Once your order has been received, HP will provide instructions on how to return your Infiniium to the nearest HP service center for the upgrade. The scope will be upgraded and returned to you within 3 weeks after receipt at HP.

HP E2609A
HP E2611A
HP E2612A
HP E2617A

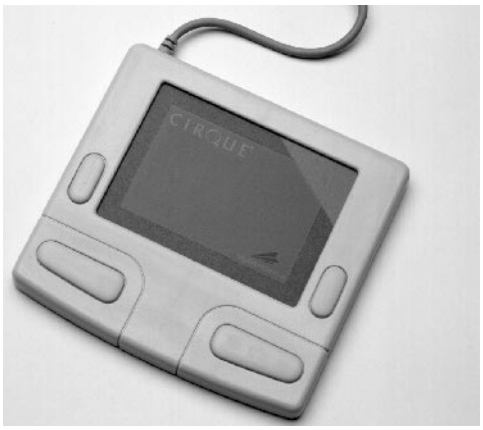


HP E2609A Rackmount Kit

The rackmount kit provides a support shelf and hardware for mounting HP Infiniium oscilloscopes into EIA standard 19-in (487 mm) rack cabinets. When installed, the instrument occupies 5 vertical increments [8.75 in (222 mm)]. Each kit includes a support shelf, 2 rackmounts rails, 1 TouchPad (E2612A), 2 brackets, hardware, and a user's reference.

HP E2611A Clip-on Trackball

If you don't have the bench space for a standard mouse, a clip-on track-ball is available for Infiniium oscilloscopes. The trackball clips into holes on the instrument. The driver for the clip-on trackball is pre-installed in the Infiniium oscilloscope.



HP E2612A Touchpad

The HP E2612A Touchpad has a touch surface that gives you complete control of your scope with just the tip of your finger. The driver for the Touchpad is pre-installed in the Infiniium oscilloscope.

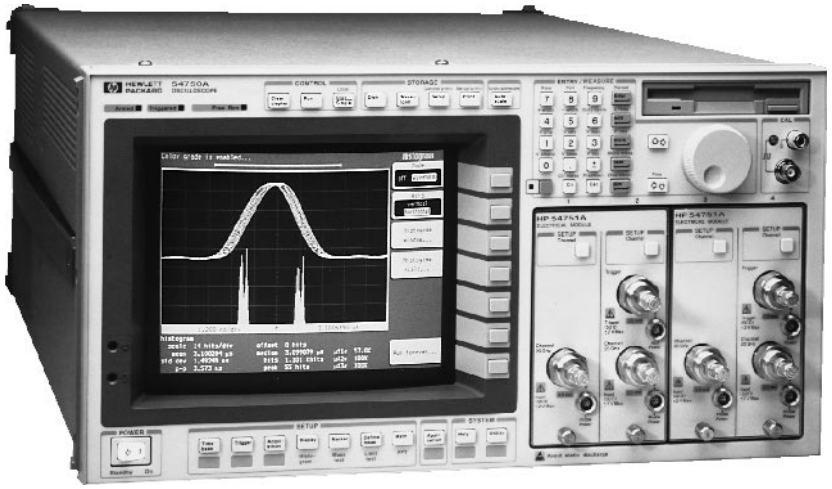
HP E2617A Infiniium Oscilloscope Transit Case

Heavy-duty hard cover carrying case is constructed from rugged A.B.S and has a rubber-grip, steel handles and steels latches. Moving the instrument is easy with the pull out handle and wheels. The case can be padlocked.

Ordering Information

HPE2609A Rackmount kit
HPE2611A Clip-on Trackball
HPR2612A Touchpad
HP E2617A Infiinium Transit Case

- 50 GHz bandwidth
- < 62.5 fs timing resolution
- 8 ps time interval accuracy
- Differential TDR
- Fast data acquisition and throughput
- Modular system design
- 2.5 GHz edge trigger
- Floppy drive
- TDR normalization
- Excess L/C



HP 54750A

HP 54750A Series High-Bandwidth Digitizing Oscilloscope

The HP 54750A provides up to four low-noise high-bandwidth channels coupled with the best measurement feature set in the industry. The exceptionally stable timebase and 2.5 GHz trigger circuits give highly repeatable and accurate results as needed by today's engineers for circuit or device characterization and modeling.

Key Contributions

The 54750A series oscilloscope offers:
- DC to 20 GHz bandwidth (HP 54751A), 17.5 ps rise time
- DC to 50 GHz bandwidth (HP 54752A/B)
- Single-ended TDR (HP 54753A)
- Differential and single-ended TDR (HP 54754A)
- 8 ps time interval accuracy
- 62.5 fs horizontal resolution
- 2.5 GHz or 12 GHz edge triggering
- 500 MHz to 18 GHz triggering with the HP 54118A
- 15 bits vertical resolution with averaging
- < 0.5 mVrms noise (12.4 GHz)
- 1 mV per division to 100 mV per division vertical scaling
- HP-IB programmable
- Support for both HP and Epson (Centronics) printers
- Up to 4 channels
- Modularity for future expansion
- 50 built-in automatic measurements including: FFT, Color-Graded Display, Histograms, Limit Testing, Mask Testing, full parametrics on both single and multi-valued signals
- 4K point memory depth per channel
- Test high-speed circuits remotely with the HP 11898A module extender

Signal Measurements

The HP 54750A offers a very rich feature set giving quick repeatable measurement results so engineering productivity is maximized. A broad range of measurement capability is provided with FFTs, Color-Graded Display, Histograms, Parametric Limit Testing, and Mask Template Testing. These measurements can be used independently or in concert.

An internal database stores acquired data for use with the Color-Graded Display, Histograms, and multi-valued parametric testing. Additional new measurements can be taken without re-acquiring the signal. This database can be stored to the internal MS-DOS compatible disk or internal memory for later analysis.

Data Stream Measurements

Full parametric measurements on multi-valued signals (eye diagrams), found in digital buses and memory circuits, can be taken without the need for an external controller. In addition to the normal parametric measurements such as rise time, fall time, etc., five new measurements have been added specifically to characterize digital data: Eye Height, Crossing Percent, Eye Width, RMS Jitter, and Peak-to-Peak Jitter. Characterizing and evaluating the dynamics of digital data has never been easier.

HP 83480K Digital Communications Option

The HP 83480K is an optional software package that provides the capabilities of the HP 83480A digital communications analyzer/oscilloscope. This option provides the firmware necessary to support the 8348X series of optical to electrical plug-ins. It also adds the communications measurements provided by the HP 83480A digital communications analyzer.

Ordering Information

HP 54750A Digitizing Oscilloscope Mainframe
HP 54751A 2-Channel 20 GHz Plug-in
HP 54752A Dual-Channel 50 GHz
HP 54752B Single-Channel 50 GHz
HP 54753A 2-Channel 20 GHz w/single-ended TDR
HP 54754A 2-Channel 18 GHz w/differential TDR
HP 54755A TDR S/W for the HP 83480A
HP 83480K Communications S/W for HP 54750A
HP 11898A Module Extender

HP 54750A with plug-in modules

HP 54751A Plug-in

The HP 54751A plug-in offers two 20 GHz bandwidth channels. The two-wide configuration allows up to four channels in the HP 54750A mainframe. The bandwidth of each channel may be selected independently from the channel menu as either 20 GHz or 12.4 GHz. The bandwidth of the channel is altered by changing the bias on the sampling bridge.

The low-noise characteristic of the plug-in gives an RMS noise level of < 1.0 mV in the high-bandwidth mode and < 0.5 mV in the low-bandwidth mode. With exceptionally low noise and a minimum sensitivity of 1 mV/div, the HP 54751A is ideally suited for evaluation of low-level signals.

The plug-in provides a single external trigger input of 2.5 GHz or 12 GHz bandwidth. Triggering to 18 GHz is possible by using the HP 54118A.

HP 54752A/B Plug-ins

The HP 54752A has two 50 GHz bandwidth channels and the HP 54752B provides a single cost-effective channel. Both plug-ins use 2.4 mm connectors to provide the highest fidelity from the DUT.

These plug-ins also feature a dual bandwidth scheme which can be selected independently from the mainframe. The low-bandwidth mode bandlimits the signal to 26.5 GHz. The high-bandwidth mode RMS noise performance is < 1.5 mV and the low-bandwidth mode is < 0.75 mV.

HP 54753A TDR/TDT Module

The HP 54753A is a two-channel vertical plug-in with a TDR step generator built into channel one. The bandwidth of the TDR/vertical channel is 18 GHz. The bandwidth of channel two is 20 GHz.

The step generator provides a 200 mV TDR step with a system rise time of < 45 ps. The system has the ability to normalize the TDR by applying a digital filter. Normalization removes errors caused by loss or imperfect launchers or cables.

The rise time of the normalization filter may be varied to allow you to simulate the edge speeds found in your system. You may also push the rise time up to 20 ps. The normalization filter when activated processes every acquisition so you see changes as the DUT is adjusted.

The HP 54753A provides support for external step generators, such as the PicoSecond Pulse Labs 4015C.

HP 54754A Differential TDR/TDT Module

The HP 54754A has two independent vertical channels and two step generators. The bandwidth of both channels is 18 GHz. The step generators may be operated singly, simultaneously but independently, differentially, or as common-mode stimulus. The TDR results may be viewed as common mode or differentially and displayed simultaneously. Once selected, the display mode is computed automatically, freeing the user from setting up mathematical functions.

Each step may be skewed separately in time. Coupled with the ability to skew the vertical channels, it is possible to accurately perform differential TDR when the launch cables are not the same electrical length.

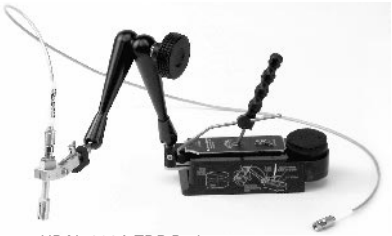
HP 54750A System Specifications

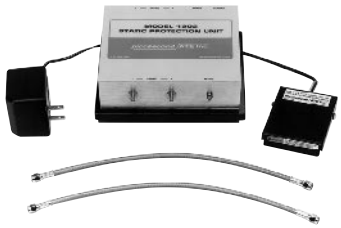
Vertical	54751A	54752A/B	54753A	54754A
DC-coupled bandwidth (–3dB)				
High bandwidth				
Channel 1	20 GHz	50 GHz	18 GHz	18 GHz
Channel 2	20 GHz	50 GHz	20 GHz	18 GHz
Low bandwidth				
Channel 1	12.4 GHz	26.5 GHz	12.4 GHz	12.4 GHz
Channel 2	12.4 GHz	26.5 GHz	12.4 GHz	12.4 GHz
Rise time (calculated)				
High bandwidth				
Channel 1	≤ 17.5 ps	≤ 7.0 ps	≤ 19.4 ps	≤ 19.4 ps
Channel 2	≤ 17.5 ps	≤ 7.0 ps	≤ 17.5 ps	≤ 19.4 ps
Low bandwidth				
Channel 1	≤ 28.2 ps	≤ 13.2 ps	≤ 28.2 ps	≤ 28.2 ps
Channel 2	≤ 28.2 ps	≤ 13.2 ps	≤ 28.2 ps	≤ 28.2 ps
Noise (RMS)				
High bw	≤ 1 mV	≤ 1.5 mV	≤ 1 mV	≤ 1 mV
Low bw	≤ 0.5 mV	≤ 0.75 mV	≤ 0.5 mV	≤ 0.5 mV
DC accuracy (single voltage marker)	0.4% of full-scale or marker reading (whichever is greater) ± 2 mV ± 1.2% of (reading-channel offset)			
Dynamic range	± 400 mV relative to channel offset			
Connectors	3.5 mm	2.4 mm	3.5 mm	3.5 mm

TDR System	Oscilloscope/TDR performance	Normalized characteristics
Rise time	≤ 45 ps	Adjustable from larger of 10 ps or 0.08 x time/div Maximum: 5 x time/div
Flatness	≤ ± 1% after 1 ns from edge; ≤ + 5%, –3% 1 ns from edge	< 0.1%
Low level	0.00 V ± 2 mV	0.00 V ± 2 mV
High level	200 mV ± 2 mV	200 mV ± 2 mV

External Trigger Input (Standard Configuration)	
Sensitivity	40 mVp-p dc to 100 MHz increasingly linearly to 200 mVp-p at 2.5 GHz
Pulse width	200 ps > 200 mV
High frequency reject	Trigger bandwidth reduced to 100 MHz
Jitter (trigger and time base combined)	≤ 2.5 ps + 5E-5 x delay setting


HP 54118A 18 GHz Trigger


HP N1020A TDR Probe


PicoSecond ATE Static Protection Unit


HP 54008A 20 GHz Delay Line


HP 54007A RF Accessory Kit


PicoSecond Pulse Labs Model 4015C

HP 54118A, 500 MHz to 18 GHz Trigger

Simple, Stable Triggering at Microwave Frequencies

For applications requiring more than 2.5 GHz trigger bandwidth, use the HP 54118A 18 GHz trigger. The HP 54118A gives your HP 54750 series oscilloscope true event triggering from 500 MHz to 18 GHz, with less than 1.7 ps of rms jitter at 18 GHz. This powerful and versatile accessory extends the oscilloscope's measurement capabilities to applications in lightwave communications, pulsed RF, gigabit logic, pseudo-random bit-stream eye patterns, and other microwave signals.

HP 83440 Series Unamplified Lightwave Converters and HP 11982A Amplified Lightwave Converter

These products are wide-range optical-to-electrical converters for characterizing SONET/SDH optical waveforms. See page 462 for more information.

HP N1020A TDR Probe

The HP N1020A TDR Probe is a useful accessory when making time domain reflectometry measurements on printed circuit boards. If no convenient method of connection is available, such as an SMA launch, then probing is the only viable solution. While most test engineers are very creative in designing and building the appropriate test fixture for each individual application, the TDR Probe is an off-the-shelf-solution.

When used in conjunction with the HP TDR Oscilloscope Family (HP 54750 or HP 83480), it provides X, Y and Z positioning in one fluid motion. Its unique 3-D joystick has a 3:1 motion reduction with a fully articulating arm which allows simple positioning in anything from card cages to microstrip-line. If your test tasks get you into some tight spots, the TDR probe gives you a hands-free solution.

Launching and Probing Solutions from Inter-Continental Microwave (ICM)

ICM offers both fixed- and variable-spacing 50-Ω TDR/TDT probe assemblies for launching a TDR pulse into transmission systems under test, such as in a PC board trace. These probes can be handheld or placed in a manipulator. ICM also offers a universal test platform (UTP-3000) with accessories for component and package measurements.In North America contact Werner Schuerch at ICM, 1515 Wyatt Dr., Santa Clara, CA 95054-1524; (408)727-1596.

Static Protection Unit from picosecond ATE Inc.

The picosecond ATE Inc. Static Protection Unit model 1202 offers static damage protection for TDR measurements. A foot switch or TTL signal allows connection of the device under test after static charge is removed. Risetime is <40 ps. In North America contact Stu McNaughton at picosecond ATE Inc. (503) 641-3295.

HP 54008A 22 ns Delay Line

Viewing the Trigger Signal

The HP 54008A delay line provides 22 ns of delay with a useable frequency response of 20 GHz. By adding this accessory to your HP 54750 oscilloscope system, you will be able to view the trigger event. The HP 54008A has enough delay to view the trigger event with the HP 54118A trigger installed in the trigger path also.

HP 54007A Accessory Kit

Low-Loss Measurements for HP 54750A Oscilloscope Systems

The HP 54007A accessory kit provides an assortment of parts with 3.5-mm connectors. This kit is highly recommended for low-loss reflection and transmission measurements. It also includes semi-rigid coax, formed for use with the HP 11667B power splitter.

Contents of the HP 54007A Accessory Kit

- 17-in (43.18 cm) cable, APC-3.5 (f-f)
- Coaxial short, APC-3.5
- 50 Ω termination, APC-3.5 (m)
- 7.5-cm "airline", APC-3.5 (m-f)
- 6-cm semi-rigid "L", SMA (m-m)
- 6 dB attenuator, APC-3.5 (m-f)
- Adapter, APC-3.5 mm (m-m)
- 17-in (43.18 cm) cable, APC-3.5 (m-f)
- Coaxial short, APC-3.5 mm (m)
- 50 Ω termination, APC-3.5 (f)
- Power splitter, APC-3.5 mm (f)
- 3-cm semi-rigid "L", SMA (m-m)
- 40 dB attenuator, APC-3.5 (m-f)

PicoSecond Pulse Labs 4015C

15-ps, 9 V External TDR or TDT Source

The PicoSecond Pulse Labs model 4015C pulse generator extends the TDR/TDT performance of the HP 54750 series oscilloscopes. The pulse generator produces a 15-ps fall time with an amplitude of 9 V, which can be triggered by any HP 54750 series TDR step generator. The HP 1167C power splitter is not included. In North America contact Dr. Jim Andrews at PSPL, P.O. Box 44, Boulder, CO 80306; (303)443-1249.

Oscilloscope Probes & Accessories

Choosing the Right Probe, High Impedance Passive Probes

Oscilloscope/Probe Compatibility

	General Purpose Passive Probes								
Oscilloscope	**10:1**	**100:1**	**1:1**	**Low Mass 10:1**	**Low Mass 20:1**	**Low Z**	**50 Ohm**	**Active**	**Differential**
HP Infiniium Oscilloscopes HP 54810/15/20/25A	1160A 1164A	10440B[2]	1162A	1170A	1172A	1163A	10437B	1152A, 1155A	1153A[2]
HP 54835A and HP 54845A Infiniium Oscilloscopes	1161A	10440B[2]	1162A	1171A	1173A	1163A 10020A	10437B 10020A	1152A[2], 1155A[2]	1153A[2]
HP 54751/52A/B	–	–	–	–	–	54006A	–	54701A[2,4]	1141A[2,3]
HP 54711/12/21/22A	–	–	–	–	–	54006A	–	54701A[4]	1141A[2,3]
HP 54714/15A/13B	10441B	10444B[2]	10439B	1170A[1]	1172A[1]	10442B	10437B	1144A[3], 1145A[3], 54701A[4]	1141A[2,3]
HP 54645A/D	10074B	10440B	10070B	1171A[1]	1173A[1]	–	–	1144A[3], 1145A[3] w 50 Ohm term	1141A[3] w 50 Ohm term
HP 54615/16B	10073B	10440B	10070B 10439B	1170A[1]	1172A[1]	1163A[1] 10442B	10437B	1144A, 1145A	1141A[3]
HP 54610A/B	10073B	10440B	10070B 10439B	1170A[1]	1172A[1]	1163A[1] 10442B	10437B	1144A[3], 1145A[3]	1141A[2,3]
HP 54600/01/02/03A/B	10071B	10440B	10070B 10439B	1171A[1]	1173A[1]	–	–	1144A[3], 1145A[3] w 50 Ohm term	1141A[3] w 50 Ohm term
HP 54520/22/40/42A/C	10441B	10440B[2]	10439B	1170A[1]	1172A[1]	10442B	10437B	1144A, 1145A	1141A
HP 54502/03/04/10A/05/06/10/12B	10441B	10440B[2]	10439B	1170A[1]	1172A[1]	10442B	10437B	1144A[3], 1145A[3]	1141A[3]
HP 54501A	10433B	10440B	10439B	–	–	–	–	1144A[3], 1145A[3] w 50 Ohm term	1141A[3] w 50 Ohm term
HP 54201A/D	10433B	10440B	10439B	1170A[1]	1172A[1]	10442B	10437B	–	1141A[3]
HP 54200A/D	10433B	10440B	10439B	1170A[1]	1172A[1]	–	–	–	1141A[3] w 50 Ohm term
HP 54121/22/23/24T	–	–	–	–	–	54006A	10020A	54701A[2,4]	1141A[3]
HP 54111/112D	10441B	10440B	10439B	1170A[1]	1172A[1]	10442B	10437B	1144A[3], 1145A[3]	1141A[3]
HP 1980, 1950AA/B	10433B	10440B	10439B	–	–	10442B	10437B	–	–
HP 1740/41/42/43/44/45/46A	10436B		10439B	–	–	10442B	10437B	1144A[3], 1145A[3]	1141A[3]
HP 1715/22/25/26/27	10433B	10440B	10439B	–	–	10442B	10437B	1144A[3], 1145A[3]	1141A[3]

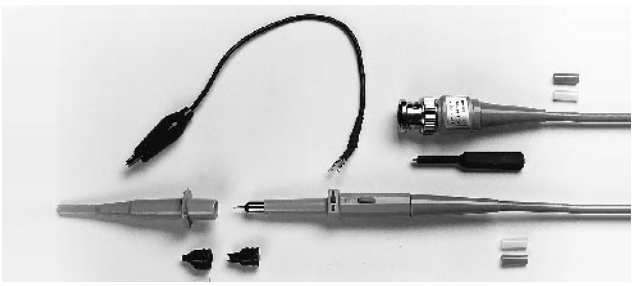
[1]Must remove pogo pin and configure scope for probe manually
[2]Not commensurate with oscilloscope bandwidth
[3]Requires the HP 1142A probe power supply
[4]Requires the HP 1143A probe offset and power module

HP 10070 Passive Divider Probe Family

The HP 10070B family of rugged, general purpose probes are designed to operate with the HP 54600 family of oscilloscopes. This family provides a range of high-quality probing solutions at very reasonable prices.

These reliable probes come with one retractable hook tip, eight color identification tags, one ground bayonet, one IC Tip, one adjustment tool, and one ground lead.

See page 122 for compatible SMT probing kit.



HP 10070B Passive Divider Probe Series

Model	Length	Division ratio	Circuit loading (1 MΩ scope input)	Typical scope bandwidth	Compensates oscilloscope input
10070B	1.5 m	1:1	1 MΩ; 70 pF	20 MHz	High Impedance
10071B	1.5 m	10:1	10 MΩ; 15 pF	150 MHz	1 MΩ; 9 to 17 pF
10073B	1.5 m	10:1	2.2 MΩ; 12 pF	500 MHz	1 MΩ; 6 to 15 pF
10074B[3]	1.5 m	10:1	10 MΩ; 15 pF	150 MHz	1 MΩ; 9 to 17 pF

[3] Probe ID pin

Other HP 10070 Series Probe Accessories

Accessory	HP p/n
Probe tip to BNC (m) adapter	5081-7705
Replacement parts accessory kit	5081-7690
SMT probe accessory kit	10072A
Retractable hook tip, qty 2	N2769A
Alligator ground lead, qty 2	N2769A

Other Accessories

Accessory	HP p/n
BNC 50 Ω feedthrough	10100C
BNC 75 Ω feedthrough	11094B
BNC AC blocking capacitor	10240B

HP 10400B Passive Divider Probe Family

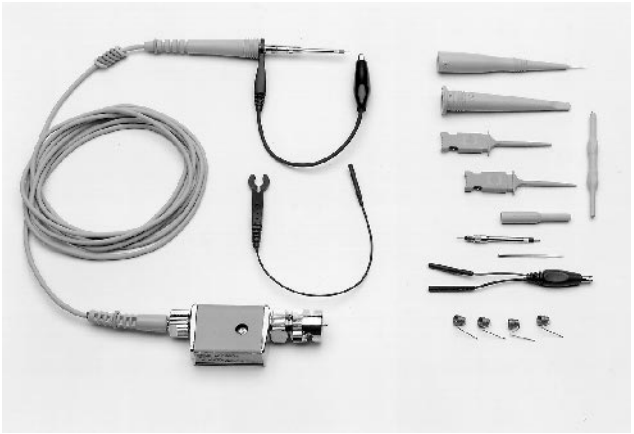
The HP 10400B probe family are reliable general-purpose high performance passive probes that replace the 10400A family of probes. These probes include a no-slip browser. The crown point of the browser digs in to solder and won't slip while the pogo pin allows small hand movements without losing contact.

The 10400B family of probes also comes complete with a range of accessories. For grounding, there's an alligator ground lead for general-purpose probing, 4 spring grounds for high frequency measurements and a socketed ground lead. The accessories also include 2 IC clips for probing 50 mil SMDs and a dual-lead adapter so that both the probe tip and ground can easily be connected to surface mount devices.

The miniature probe has a narrow, sharp tip that is good for probing SMDs. The handle of the probe can be unscrewed and pulled back on the cable to reduce the probe's mass and size. This makes attaching to fine pitch ICs and small devices easier. For connection to fine pitch ICs order the HP Wedge probe adapter or the 0.5 mm IC clips.

The HP 10400 family of probes are built and tested for high reliability. The cable has a Kevlar strengthener for added pull strength and the general purpose retractable hook tip is made from durable music wire. The probe tips are replaceable.

See page 122 for compatible SMT probing solutions.



HP 10400B Passive Divider Probe Series

Model	Length	Division ratio	Circuit loading	Typical scope bandwidth	Compensates oscilloscope input	
10437B	2 m	1:1	50 Ohm	–	50 Ohm	
10439B[1]	1.5 m	1:1	65 pF	–	High Z	
10433B	2 m	10:1	10 MOhm; 10 pF	300 MHz	1MOhm; 10 – 16 pF	
10436B	2 m	10:1	10 MOhm; 11 pF	100 MHz	1MOhm; 18 – 22 pF	
10441B	1.8 m	10:1	10 MOhm; 9 pF	500 MHz	1M; 6 – 9 pF	
10442B	2 m	10:1	500 Ohm; 1.2 pF	1 GHz	50 Ohm	
10440B	2 m	100:1	10M; 2.5 pF	300 MHz	1M; 6 – 14 pF	

[1]This probe can be used with many oscilloscopes, but because of the relatively high capacitance, there will be bandwidth degradation

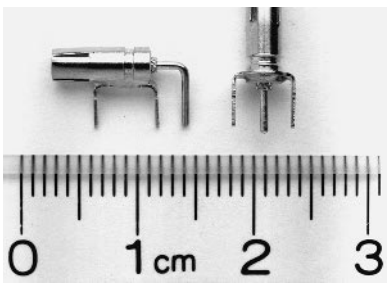
HP 10400B Family Replacement Parts

HP p/n	Description	Qty	
5063-2115	Browser	1	
5063-2120	Socketed ground lead	1	
5063-2135	General-purpose retractable hook tip	2	
5063-2140	Aligator ground lead	2	
5063-2147	Dual lead adapter	1	
5063-2149	SMD INC clips	5	
01160-68701	Accessory Kit: spring grounds browser pogo pins barrel insulators screwdriver	 4 4 4 1	
5063-2167	HP 10433B probe tip	5	
5063-2168	HP 10436B probe tip	5	
5063-2138	HP10437B probe tip	5	
5063-2138	HP 10439B probe tip	5	
5063-2171	HP 10440B probe tip	5	
5063-2172	HP 10441B probe tip	5	
5063-2139	HP 10442B probe tip	5	

Fine Pitch IC Probing Accessories

HP p/n	Description	Qty	
E2613B	HP Wedge probe adapter, 0.5 mm, 3-signal	2	
E2614A	HP Wedge probe adapter, 0.5 mm, 8-signal	1	
E2615B	HP Wedge probe adapter, 0.65 mm, 3-signal	2	
E2616A	HP Wedge probe adapter, 0.65 mm, 8-signal	1	
10467-68701	0.5mm IC clips for surface SMT parts with lead spacings of 0.5 mm (.020 in) to 0.8mm (0.32 in)	4	

HP PC Board Mini-Probe Sockets

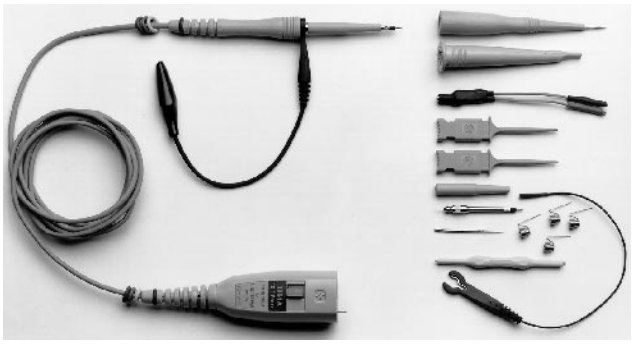


The HP PC board mini-probe sockets are ideal for reliable, stable, and convenient connection between the 10400 family probe tip and the circuit under test. The HP 1250-2427 horizontal PC board mini-probe replaces HP 1250-1737. The HP 1250-2428 vertical PC board mini-probe socket replaces HP 1250-1918.

Ordering Information

HP N2765A Horizontal Mini-Probe Socket, qty 5
HP N2766A Horizontal Mini-Probe Socket, qty 25
HP N2767A Vertical Mini-Probe Socket, qty 5
HP N2768A Vertical Mini-Probe Socket, qty 25

HP 1160A Family Miniature Passive Probes



The HP 1160 family of miniature probes are reliable general-purpose probes for use with Infiniium Oscilloscopes (HP 54800 series). The HP 1160 family probes include a no-slip browser with a crown point that digs in to solder, and won't slip. The pogo pin allows hand movement without losing contact.

A variety of grounding accessories are included. An alligator ground lead for general-purpose probing, 4 spring grounds for high frequency measurements, a socketed ground lead and 2 SMD IC clips for probing 50 mil SMD. Also included is a dual lead adapter so that both the probe tip and ground can be connected to SMD devices. For connection to 0.5 mm–0.8 mm devices, order the 10467-68701 0.5 mm IC clips.

The HP 1160 family probes are built and tested for high reliability. The cable has a kevlar strengthener for added pull strength. The general-purpose retractable hook tip has a durable music wire hook. And probe tips are replaceable.

The miniature probe has a narrow, sharp tip that is good for probing SMD. To fully miniaturize the probe, unscrew the handle and pull it back on the cable.The HP 1160 family probes are compatible with the AutoProbe Interface, which completely configures the Infiniium Oscilloscope for the probe.

Model	Type of probe	Length	Division ratio	Circuit loading	System bandwidth (scope and probe)	Oscilloscope input	
HP 1160A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 9pF	500 MHz[1]	1 MOhm, 6-9 pF	
HP 1161A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 10 pF	500 MHz[2]	1 MOhm,12-14 pF	
HP 1162A	High Impedance, Passive	1.5 m	1:1	1 MOhm, 50 pF +scope input	25 MHz[3]	1 MOhm	
HP 1163A	500 Ohm Resistive Divider	1.5 m	10:1	500 Ohm, 1.5 pF	1.5 GHz[2]	50 Ohm	
HP 1164A	High Impedance, Passive	2.0 m	10:1	10 MOhm, 10pF	500 Mhz[1]	1 MOhm, 6-9 pF	

[1] System bandwidth with 54810A/15A/20A/25A
[2] System bandwidth with 54845A
[3] System bandwidth with all Infiniium scopes

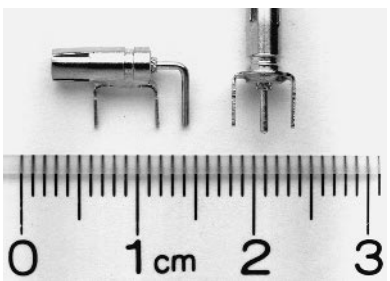
HP 1160 Family Replacement Parts

HP p/n	Description	Qty
5063-2115	Browser	1
5063-2120	Socketed ground lead	1
5063-2135	General-purpose retractable hook tip	2
5063-2140	Alligator ground lead	2
5063-2147	Dual lead adapter	1
5063-2149	SMD IC clips	5
01160-68701	Accessory kit: Spring grounds Browser pogo pins Barrel insulators Screwdriver	 4 4 4 1
5063-2136	HP 1160A probe tip	5
5063-2137	HP 1161A probe tip	5
5063-2138	HP 1162A probe tip	5
5063-2139	HP 1163A probe tip	5

Fine Pitch IC Probing Accessories

HP p/n	Description	Qty	
E2613B	HP Wedge probe adapter, 0.5 mm, 3-signal	2	
E2614A	HP Wedge probe adapter, 0.5 mm, 8-signal	1	
E2615B	HP Wedge probe adapter, 0.65 mm, 3-signal	2	
E2616A	HP Wedge probe adapter, 0.65 mm, 8-signal	1	
E2643A	HP Wedge probe adapter, 0.5 mm, 16-signal	1	
E2444A	HP Wedge probe adapter, 0.65 mm, 16-signal	1	
10467-68701	0.5mm IC clips for surface SMT parts with lead spacings of 0.5 mm (.020 in) to 0.8mm (0.32 in)	4	

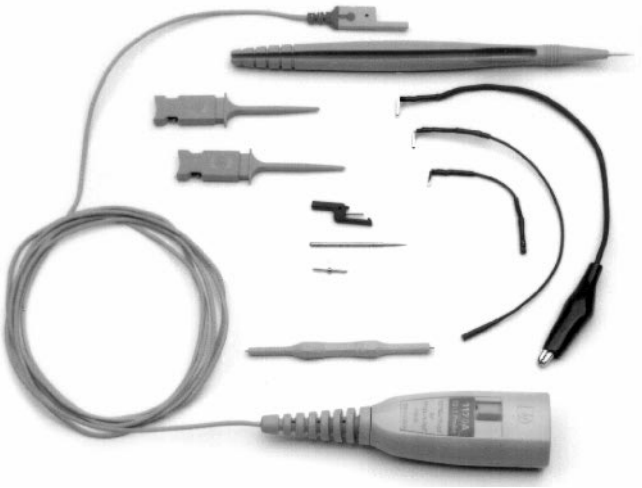
HP PC Board Mini-Probe Sockets



The HP PC board mini-probe sockets are ideal for reliable, stable, and convenient connection between the 10400 family probe tip and the circuit under test. The HP 1250-2427 horizontal PC board mini-probe replaces HP 1250-1737. The HP 1250-2428 vertical PC board mini-probe socket replaces HP 1250-1918.

Ordering Information

HP N2765A Horizontal Mini-Probe Socket, qty 5
HP N2766A Horizontal Mini-Probe Socket, qty 25
HP N2767A Vertical Mini-Probe Socket, qty 5
HP N2768A Vertical Mini-Probe Socket, qty 25

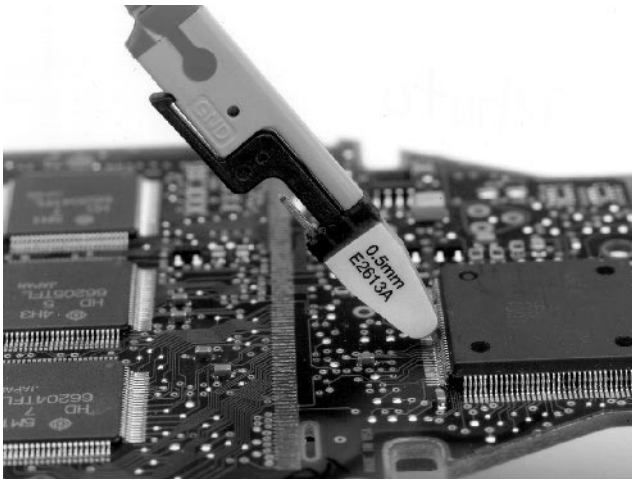


The HP 1170A Low Mass Passive Probe

The HP 1170 family of low mass high performance passive probes for the HP Infinium Oscilloscopes are designed specifically to make the probing of fine pitch ICs and dense circuit boards easier. The probe tip is exceptionally small and light, weighing less than 1 gram, so it is easier to attach to those small devices and surface mount ICs. Even though small and light, these probes are designed for high performance and the ruggedness required for general purpose use. The cable is reenforced with Kevlar for added pull strength.

The probe also includes a no-slip browser for precise and safe browsing. The crown point of the browser digs in to solder and wont slip and the pogo pin allows small movements without loosing contact.

The HP 1170A family of probes will connect directly to the HP Wedge probe adapter for an easy hands-free solution for probing 0.5 and 0.65 mm IC packages. See pages 122 for more information



Easy hands-free connection to fine pitch ICs using the HP Wedge and 1170A probe.

All probes come complete with a range of accessories for both general purpose probing and the probing of fine pitch ICs and dense circuit boards.

The HP 1170A family of probes are compatible with the AutoProbe Interface, which completely configures the Infinium Oscilloscope for the probe.

Model	Length	Division Ratio	Circuit Loading	System Bandwidth (scope and probe)	Oscilloscope Input
1170A	1.5m	10:1	10 MOhm; 9 pF	500 MHz	1 MOhm; 6–9 pF
1171A	1.4m	10:1	10 MOhm; 10 pF	500 MHz	1 MOhm; 12–14 pF
1172A	1.3m	20:1	10 MOhm; <5 pF	500 MHz	1 MOhm; 6–9 pF
1173A	1.2m	20:1	10 MOhm; <5 pF	500 MHz	1 MOhm; 12–14 pF

HP 10467–68701
HP 10075A
E2613A
E2613B
E2614A
E2615A
E2615B
E2616A

4

HP 1170A Family Replacement Parts

Ordering Information

HP E2642A Accessory replacement kit.
Includes the following:

- 2 probe pogo pins
- 4 probe pins
- 2 ground extenders
- 2 SMD IC clips
- 1 browser pogo pin
- 1 screw driver
- 1 alligator ground lead
- 2 socketed ground lead
- 1 walking stick ground

Fine Pitch IC Probing Accessories
E2613A HP Wedge probe adapter, 0.5 mm, 3-signal, qty1
E2613B HP Wedge probe adapter, 0.5 mm, 3-signal, qty2
E2614A HP Wedge probe adapter, 0.5 mm, 8-signal, qty1
E2615A HP Wedge probe adapter, 0.65 mm, 3-signal qty1
E2615B HP Wedge probe adapter, 0.65 mm, 3-signal, qty2
E2616A HP Wedge probe adapter, 0.65 mm, 8-signal, qty1
E2643A HP Wedge probe adapter, 0.5 mm, 16-signal, qty1
E2644A HP Wedge probe adapter, 0.65 mm, 16-signal, qty1
10467-68701 0.5mm IC clips for surface SMT parts with leg spacing of 0.5 mm (.020 in) to 0.8mm (0.32 in), qty 4

Other Accessories
HP E9638A Probe tip to BNC adapter

Fine-Pitch Probing Kits

A complete solution at a bargain price!

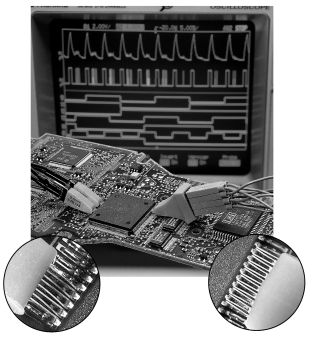
These fine-pitch probing kits take the 1170A family of probes and add the most useful accessories to give you a versatile and complete probing solution. Each kit includes 2 HP 1170A-family probes (20:1 models) and its' accessories, 2 of the 0.5 mm HP Wedge probe adapter, 4 of our 0.5 mm IC clips and 10 standard IC clips. All for a price substantially less the individual parts.

Ordering Informmation

HP E2652A Fine-pitch probing kit for the HP 54810/15/20/25A Infiniium Oscilloscopes
HP E2653A Fine-pitch probing kit for HP 54835A and HP 54845A Infiniium Oscilloscopes

HP 10467–68701
HP 10075A
E2613A
E2613B
E2614A
E2615A
E2615B
E2616A

- Easy connection to 0.5mm, 0.65 mm TQFP and PQFP packages
- Reliable contact with little chance of shorting to adjacent pins
- Mechanically noninvasive
- Can be inserted while the board is active
- 3, 8, and 16-signal versions



At one end, Wedge conductor segments are inserted into the space between IC pins; at the other end, they easily connect to scopes and logic analyzers.

HP Wedge Probe Adapter

NEW

Precise problem-free probing

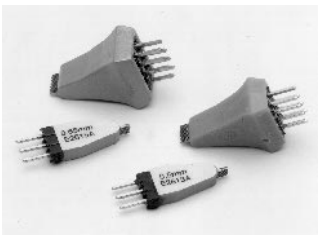
The HP Wedge probe adapter solves the problem of connecting your scope or logic analyzer to fine pitch thin quad flat pack (TQFP) and plastic quad flat pack (PQFP) surface mount ICs. It provides accurate, mechanically noninvasive and reliable electrical contact to 0.5 and 0.65 mm IC packages, with little chance of shorting. It is available in 3-, 8-, and 16-signal versions.

Easy to insert, then stays put

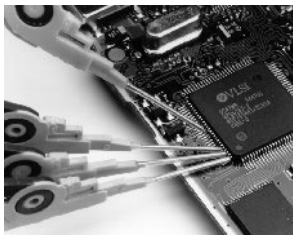
It works by inserting compressible dual conductors between adjacent IC pins. The flexible conductors conform to the size and shape of each leg to ensure tight contact. It's then a simple matter to connect your scope or logic analyzer to the HP Wedge.

Electrical reliability

The HP Wedge's unique design delivers secure redundant contact on each pin, with little chance of shorting to adjacent pins. The redundant physical connection created by two contact points on each pin of the IC and its short electrical length dramatically increases the reliability of the electrical connection. Since the HP Wedge doesn't latch directly onto the IC and doesn't require expansion beforehand (as a clip does), it can be inserted while the board is active. Plus, its mechanically noninvasive so it won't damage your device under test.



3- and 8-signal versions for 0.5 and 0.65 mm IC Packages



10467-68701 0.5 mm IC Clips

0.5 mm IC Clips

These IC clips are the smallest in the industry to date and are suitable for connecting to PQFP and SOIC SMT packages from 0.5 – 0.8 mm pitch. The thin body allows clips to be mounted side by side for probing adjacent IC pins. They are suitable for use with all HP oscilloscope probes and logic analyzers and have a maximum input voltage of ± 40V (dc + peak ac)

HP 10075A 0.5 mm IC Clip Accessory Kit

HP 10467A 0.5 mm IC Clip Accessory Kit

HP 10075A and HP 10467A 0.5 mm IC Clip Accessory Kit

These kits includes four 0.5mm IC clips (10467-69701) and two dual-lead adapters for use with the HP passive probes. Plug the probe tip into one end of the adapter and connect the IC clips to the other end.

The HP 10075A is compatible with the 10070 family of probes. The HP 10467A is compatible with the HP 10400A family of passive probes. The 1160A and 10400B family of probes include a dual-lead adapter as a standard accessory. For these probes the accessory kit is not required. Order the IC clips 10467-68701.

Ordering Information

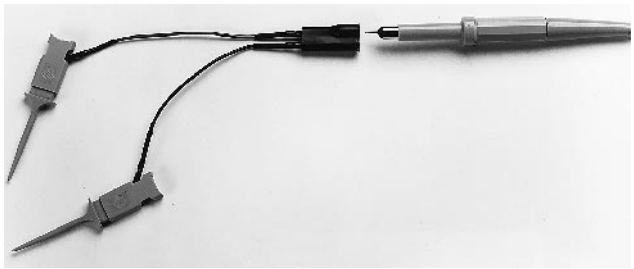
E2613A HP Wedge probe adapter, 0.5 mm 3-signal, qty 1
E2613B HP Wedge probe adapter, 0.5 mm 3-signal, qty 2
E2614A HP Wedge probe adapter, 0.5 mm 8-signal, qty 1
E2615A HP Wedge probe adapter, 0.65 mm 3-signal, qty1
E2615B HP Wedge probe adapter, 0.65 mm 3-signal, qty 2
E2616A HP Wedge probe adapter, 0.65 mm 8-signal, qty 1
E2643A HP Wedge probe adapter, 16-signal, qty 1
E2644A HP Wedge probe adapter, 16-signal, qty 1
10467-68701 0.5 mm IC Clips, qty 4
HP 10075A 0.5 mm IC Clip Accessory Kit
HP 10467A 0.5 mm IC Clip Accessory Kit
HP 10450A SMT probe accessory kit
HP 10072A SMT probe accessory kit

HP 10450A SMT Probe Accessory Kit

Assorted accessories include 10 SMT lead IC clips that interface the HP 10400A series miniature probes to the fine-pitch circuitry.

HP 10072A SMT Probe Accessory Kit

The HP 10072A includes 10 SMT lead clips which adapt the 10070A family of low-cost probes to fine-pitch devices.



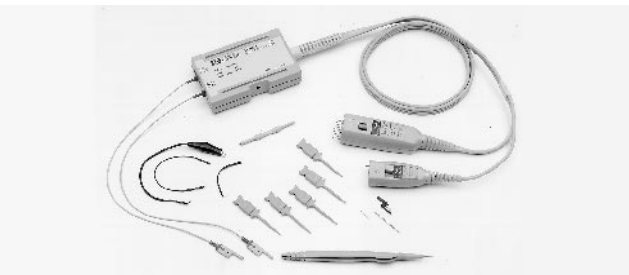
HP 1141A Differential Probe with HP 1142A Power Supply

The HP 1141A is a 1X FET differential probe with 200 MHz bandwidth and a 3000:1 CMRR (Common Mode Rejection Ratio). The probe has a high-input resistance and low-input capacitance of 7pF to minimize circuit loading. The 1141A must be used with the 1142A probe control and power module which controls input coupling modes dc, dc with variable offset, and dc reject. Two attenuators, 10X and 100X are provided to expand the linear differential input range to ± 30V.

HP 1153A 200 MHz Differential Probe

The HP 1153A is a 200 MHz Differential Probe for use with HP Infiniium Oscilloscopes. It is a 1X FET differential probe with 200 MHz bandwidth and 3000:1 CMRR (Common Mode Rejection Ratio). The probe has high-input resistance of 1 MOhm and low-input capacitance of 7 pF to minimize circuit loading. The 1153A is compatible with the AutoProbe Interface which provides power and completely configures the Infiniium Oscilloscope for the probe.

Input coupling modes include dc, dc with variable offset, and lf reject. Two attenuators, 10X and 100X, are provided to expand the linear differential input range to ± 30V.



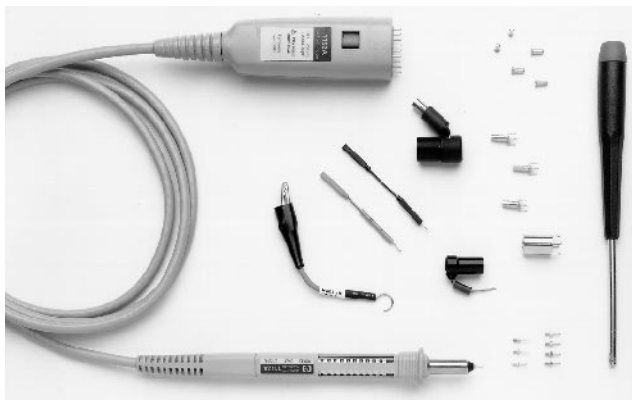
HP 1155A Low Mass Active Probe for Surface-Mount Devices

The two-channel HP 1155A low mass active probe for Infiniium oscilloscopes has a probe tip that weighs less than 1 gram making it ideal for attaching to fine pitch ICs and probing surface mount components. The probe combines high bandwidth (750 MHz), low input capacitance (2 pF) and high input resistance (1 Mohm). A versatile set of accessories are provided, including an HP browser with a crown point that digs deep in to solder and a spring loaded tip that helps absorb small movements. When used in conjunction with the HP Wedge, the 1155A provides a hands-free solution for probing 0.5mm and 0.65mm IC packages. See page 122 for more information.

HP 1145A Low Mass Active Probe for Surface-Mount Devices

The two-channel HP 1155A low mass active probe has a probe tip that weighs less than 1 gram making it ideal for attaching to fine pitch ICs and probing surface mount components. The probe combines high bandwidth (750 MHz), low input capacitance (2 pF) and high input resistance (1 Mohm). A versatile set of accessories are provided and when used in conjunction with the HP Wedge, the 1145A provides a hands-free solution for probing 0.5mm and 0.65mm IC packages. See page 132 for more information.

This probe can access power directly from the HP 54520/40 series and 54615/16B oscilloscopes. The HP 1142A power supply is required for all other instruments. This configuration requires 50 Ohm inputs.



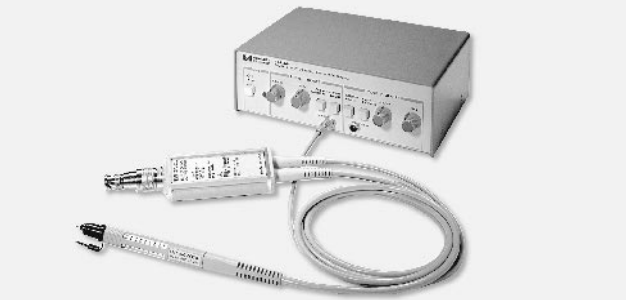
HP 1152A 2.5 GHz, 0.6 pF Active Probe

The HP 1152A's 0.6pF, 100Kohm input provides ultra low loading of the device-under-test, making it an ideal companion for the HP 54845A 1.5 GHz and HP 54835A 1 GHz Infiniium Oscilloscope. Its 40Vac maximum input voltage, ± 15 KV ESD tolerance and replaceable probe tips make the HP 1152A extremely reliable. The 1152A is compatible with the AutoProbe Interface which provides power and completely configures the Infiniium Oscilloscope for the probe.

Ordering Information

HP 1141A 200 MHz Differential Probe
HP 1142A Power Supply
HP 1145A 2 Channel, 750 MHz, Active Probe
HP 1152A 2.5 GHz, 0.6 pF Active Probe
HP 1153A 200 MHz Differential Probe
HP 1155A Low Mass Active Probe

HP 1143A
HP 1144A
HP 1146A
HP 10020A
HP 54006A
HP 54701A



HP 54701A 2.5 GHz, 0.6 pF Active Probe with HP 1143 Power Supply

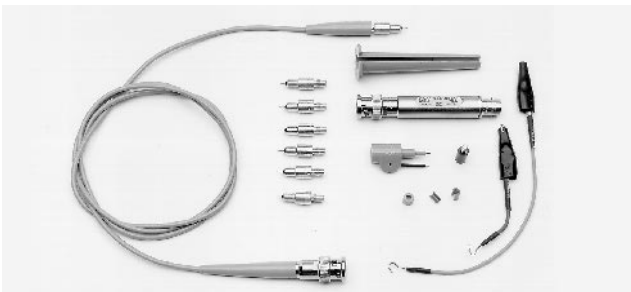
4

The HP 54701A 2.5 GHz, 10:1 active probe provides ultra-low loading of the device-under-test because of its low 0.6 pF capacitive loading and its high 100 KOhm resistive loading. Its 40Vac maximum input voltage, ± 15 KV ESD tolerance and replaceable probe tips make the probe extremely reliable.

The HP 1143A probe offset and power module provides power for 2 HP 54701A probes with any instrument with 50 Ohm input impedance. The power supply is not required if the probe is used with the HP 54700 series oscilloscopes.

HP 1144A 800 MHz Active Probe

The HP 1144A features 800-MHz bandwidth, 1 MΩ input resistance, 2 pF input capacitance, 10:1 attenuation, and ±40 Vdc + peak ac maximum-input voltage. The HP 1144A can access power directly from the HP 54520 and HP 54540 series and the HP 54615B and HP 54616B oscilloscopes. These oscilloscopes provide power for two channels of active probing. If four channels of probing are needed, a special one-input, two-output adapter is available (p/n 01144-61604). Two adapters are needed for four channels of probing. If the HP 1144A is used with any scope not listed above, then the HP 1142A power supply is required. The HP 01144-61604 adapter can be used with this power supply to provide power for two channels of active probing



HP 10020A Resistive Divider Probe Kit

The HP 10020A Resistive Divider Probe Kit is for measuring fast transition signals in high-impedence systems. It is designed for use with oscilloscopes with 50 Ohm inputs but may be used with other than 50 Ohm systems if a 50 Ohm feedthrough termination is used. The kit includes 6 resistive dividers ranging from 1:1, 50 Ohm to 100:1, 5 KOhm and has an input capacitance of less than 0.7 pF.

HP 54006A 6-GHz Passive Divider Probe

The low 0.25 pF input capacitance and sophisticated ground design of the HP 54006A probe lets you probe multi-GHz systems with minimal loading of the circuit-under-test. The small size of this probe also allows you to access very small components. The HP 54006A is supplied with 10:1, 500 Ω, and 20:1, 1 k Ω resistive dividers.

HP 1146A Oscilloscope AC/DC Current Probe

This AC/DC current probe expands oscilloscope applications into industrial, automotive or power environments, and is ideal for analysis and measurement of distorted current waveforms and harmonics. This probe permits accurate display and measurement of currents from 100 mA to 100 A rms, dc to 100 kHz without breaking into the circuit. The 1146A uses Hall-effect technology to measure ac and dc signals. Compatible with any scope or voltage measuring instrument with BNC input, 0.2 to 0.5 V/div, and a minimum input impedance of 1 MOhm. 1 mV/100 mA Range; Output Signal: 10 mV/A ac/dc. 1mV/10mA Range; Output Signal: 100 mV/A ac/dc. Working Voltage: 660 V max., Battery: 9 V alkaline.

Ordering Information

HP 1143A Probe Offset and Power Module
HP 1144A 800 MHz Active Probe
HP 01144-61604 Adapter (1144A)
HP 1146A Oscilloscope AC/DC Current Probe
HP 10020A Resistive Divider Probe Kit
HP 54006A 6-GHz Passive Divider Probe
HP 54701A 2.5 GHz, 0.6 pF Active Probe

Modulation Domain Analysis: A New View of Complex Signals

As a pioneer of counter/timer technology, Hewlett-Packard recognized a need to expand traditional frequency and time measurement techniques. With modulation domain analyzers, HP offers a unique method for viewing complex signals that is both intuitive and insightful.

Oscilloscopes display amplitude (voltage) versus time: the time domain. Spectrum analyzers show amplitude versus frequency: the frequency domain. The HP 53310A, E1725C and E1740A bring a new dimension to frequency and time interval analysis with views of the modulation domain:

- Frequency versus time
- Phase versus time
- Time interval versus time

Improved Measurement Analysis

A wide range of applications benefit from modulation domain analysis. Jitter measurements in digital communication systems, disk and tape drives, and mechanical systems are dramatically improved. Identify the sources of jitter—the first step in improving system performance.

Modulation domain analyzers simplify the study of step response for voltage-controlled oscillators. They easily characterize the frequency-hopping performance of an agile transmitter. Chirp linearity and phase switching in radar systems are easily understood from displays of frequency or phase versus time.

Modulation Domain Analyzer Products

HP modulation domain analyzers provide a range of features and performance. Analysis features include views of frequency and phase versus time, with built-in statistics and histograms. GPIB programmability lets you control these analyzers remotely, or use the front panel measurement and display options for quick on-the-spot measurements.

The HP 53310A combines modulation domain analysis in a low-cost offering. Single-button functions and automated setup and measurement capabilities make the HP 53310A the easiest to operate of the modulation domain analyzers. The HP 53310A Option 031 includes features that further simplify the analysis steps for RF mobile communications designers, and Option 305 provides software for complete phase analysis.

HP 53310A: Affordable, easy-to-use modulation domain analyzer

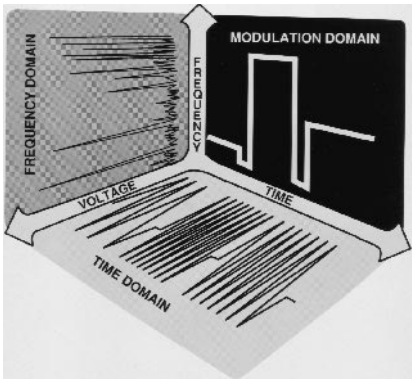
Time Interval Analyzer Products

HP's expertise with modulation domain analyzer technology has resulted in a family of time interval analyzer (TIA) products tuned for specific applications. Choose from preconfigured instruments, or design your own solution using the basic TIA module and selecting from a range of software offerings.

The HP E1725C TIA is based on the HP E1740A TIA module, a VXI card that can be plugged into a VXI cardcage. The on-card functionality includes basic arming and measurement control and a large 512K memory for storing results. Histograms are also executed in hardware on the HP E1740A for accelerated analysis operations.

The HP E1725C instruments combine the HP E1740A in a VXI cardcage with a portable computer. The computer's Microsoft Windows interface and optional HP software packages simplify measurements and offer powerful display and analysis capabilities for viewing and interpreting measurement results.

HP E1740A: Two-slot VXI module
HP E1725C: Highest performance time interval analyzer with configurable personalities



The Modulation Domain adds a third dimension of frequency vs. time

Application Solutions

With a range of add-on software packages, the HP E1725C TIAs can be tailored as complete solutions for specific applications. The current family of HP E174XA software products provide full-function and easy-to-use platforms for these complex measurement situations:

Data storage: Evaluate designs and troubleshoot problems for today's high-speed digital storage solutions.
Clock jitter: Study and solve jitter problems in clock distribution networks.
SONET/SDH networks: Evaluate existing equipment for use with new high-speed technologies.
Network Synchronization Determine compliance with today's industry standards.
HP E1741A/E1747A: Data storage test analysis
HP E1742A: SONET/SDH tributary jitter analysis
HP E1743A: Clock jitter analysis
HP E1748A: Multiple-channel network sychronization measurement

Modulation Domain Analyzer Selection Guide

Model	Key selection criteria	Feature highlights
HP 53310A	Low-cost, easy to use	Auto set-up RF transmitter characterization features Fast histograms
HP E1725C	Highest performance analyzer	80 MHz sample rate Microsoft Windows user interface with custom analysis software
HP E1740A	2-slot VXI module	High performance histograms, window margin analysis, statistics 512K on-card memory

Modulation Domain Analyzer Applications

The application examples on this page and the next illustrate some of the many situations that benefit from HP modulation domain analyzers. For complete product specifications or to arrange a product demonstration, contact the HP Call Center in your region.

Modulation Analysis for Mobile Communications

The HP 53310A's Option 031 "Digital RF Communications Analysis/High Resolution 2.5 GHz Input" provides automatic measurements of synthesizer settling time, Frequency Shift Keyed (FSK) center frequency, and FSK peak deviation on DECT, CT2 and CT3 radios. Features for optimizing RF designs include:

- High resolution measurements—built-in downconversion provides superior frequency resolution for RF signals.
- RF envelope trigger—simplifies measurement setup by automatically triggering on a detected TDMA burst.
- Automatic measurements—synthesizer settling time, Frequency Shift Keyed (FSK) center frequency, and FSK deviation.

Option 305 phase analysis software adds the power of phase analysis to your HP 53310A. Direct phase analysis lets you measure digital communication systems and extract data, including phase settling time, phase noise (phase spectrum), phase deviation, and phase trajectory. When used in combination, Options 031 and 305 allow direct profiles of both wide- and narrowband modulations up to a 500 KHz modulation rate and eliminate the need for external downconversion.

Data Storage Analysis

The HP E1725C Option 141 instrument is tailored for the specific requirements of data storage analysis. High-speed measurements and large 512K on-board memory allow you to measure a full track on high density hard disk drives and several types of optical disks. Complete acquisition control allows measuring of data edges in the presence of servo or header fields. The Option 141 TIA software can be combined with the Option 147 timing pattern analysis software to provide powerful display and analysis capabilities:

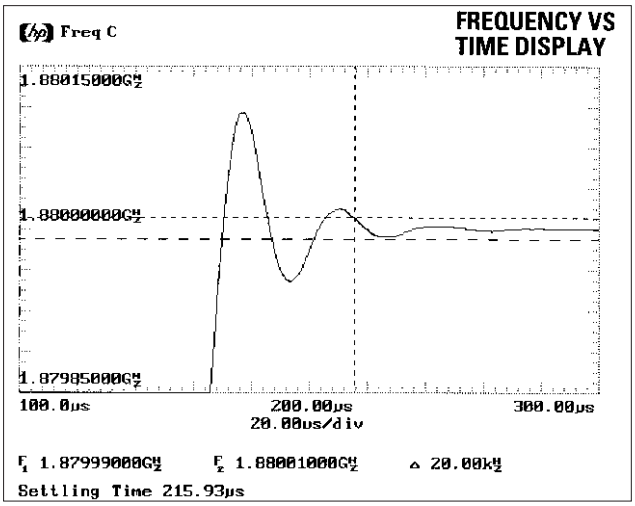
- Window margin analysis and histograms for understanding drive timing (view peak shift, jitter, worst-case data patterns).
- Flexible measurement setup for measuring the edges of your choice, specifying trigger delays and measurement duration, and pacing measurements.
- Sequential displays for characterizing PLL dynamics, viewing spindle speed variations, or verifying correctly written data patterns.
- Computed clock for measuring to an ideal reference.
- Timing pattern analysis for studying worst-case data patterns or viewing problematic data patterns and the surrounding code spacings.
- Online Help for quick answers to operation questions.
- Data export capability for transferring results to another analysis package or to spreadsheet or wordprocessor packages.

Characterization and Reduction of Clock Jitter

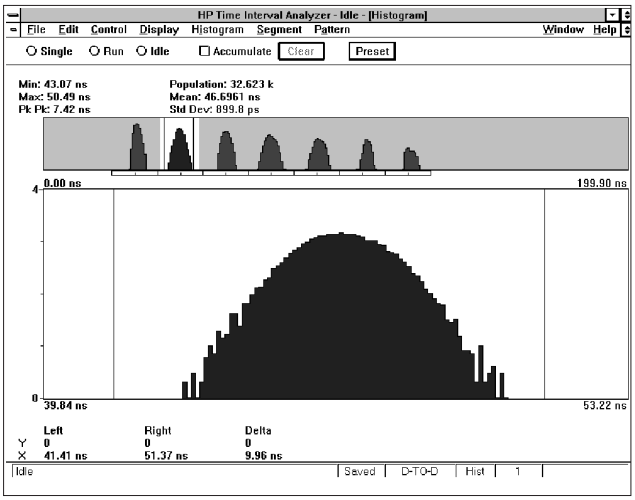
The HP E1725C Option 243 TIA and clock jitter analyzer software provides digital designers with a powerful tool for understanding and reducing clock jitter. High-speed clock distribution networks are critical for high performance digital systems. The clock buffers found in these networks—PLLs, frequency dividers, fanout and translation ICs—are also affected by jitter.

The HP E1725C Option 243 includes powerful jitter measurement and display capabilities:

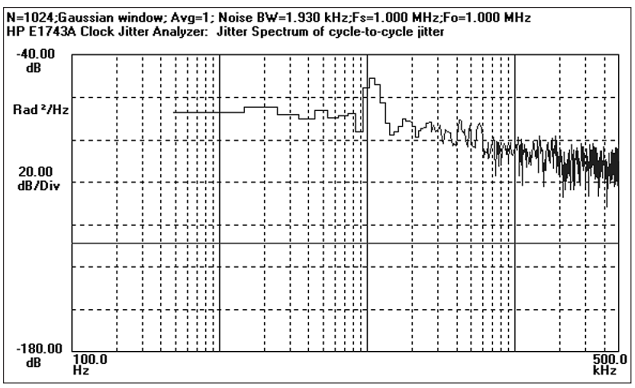
- Capture every clock cycle up to 80 MHz, continuously for a trillion cycles using fast histogram or 256K cycles using a vs. time display.
- Understand true peak-to-peak and cycle-to-cycle jitter using a complete range of statistics.
- Display jitter spectrum (using a built-in FFT) to determine the root causes of jitter.
- View the phase power spectral density display to see phase noise as noise power offset from the carrier.
- Use the Allan variance display to understand the type and level of noise (white phase, flicker phase, random walk phase, flicker FM, random walk FM, and white FM).
- Export data to another analysis package or to spreadsheet or wordprocessor packages.



Settling time is displayed automatically on this direct measurement of the synthesizer step.



The HP E1741A features extensive statistical, histogram, and window margin analysis features to simplify jitter characterization in data storage products.



The HP E1743A phase power spectrum feature allows you to examine jitter spectrum, in this case of cycle-to-cycle jitter on a clock signal. A jitter component near 10 kHz can be easily identified.

SONET/SDH Tributary Jitter Analysis

When integrating new SONET/SDH technologies with existing telecommunications equipment, network equipment designers use the HP E1725C TIA Option 242 tributary jitter analyzer software to make sure that new designs conform to evolving standards. HP's unique software clock extraction scheme and software filters provide consistent, repeatable results when measuring jitter. The display screens make it easy to examine mapping jitter, pointer-induced jitter, and waiting time jitter.

After a measurement is performed, the HP E1742A software (included in Option 242) extracts the clock signal and performs a variety of analysis functions:

- Phase deviation display shows the cumulative phase difference of a signal relative to the extracted clock.
- Jitter display uses a built-in 10 Hz high pass filter to simultaneously display peak-to-peak jitter, positive peak, negative peak, mapping jitter, and other jitter components.
- Power spectrum display shows the frequency components which contribute to the jitter and gives a better understanding of the jitter sources.
- Frequency deviation display explains the effect of a pointer hit on the desynchronizer phase lock loop inside a network element.
- Allan variance, TVAR, and FFT functions enhance further study and analysis of the tributary jitter. Each measurement can be stored for future analysis. Graphic and numeric results can be transferred to other Windows applications for inclusion in documents or spreadsheets.

Ensure Compliance with Network Synchronization Standards

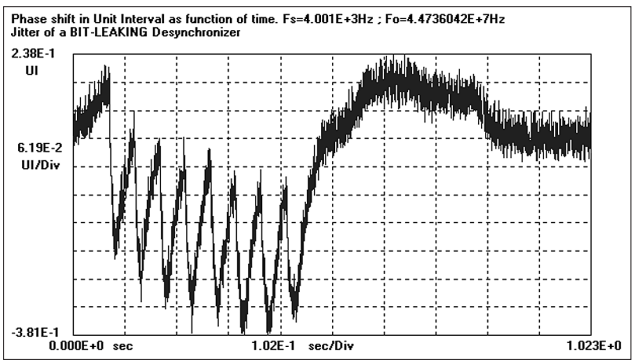
Network synchronization problems can lead to slips and degrading voice, fax and video services. The HP E1748A network synchronization measurement software, available as Option 248 with the HP E1725C TIA, gives network managers a powerful tool for evaluating network synchronization and ensuring compliance with industry standards.

All measurements adhere to ITU (CCITT) 0.171, Bellcore and ANSI requirements. On an operational network, MTIE and TDEV are measured and plotted against proposed ITU, ANSI, and ETSI masks for fast reviewing of results. With these measurements, network managers can characterize SSUs and SDH switches. MTIE can be measured over long times, sampling at the ITU-specified rate of 80 samples per second. A unique software clock extraction scheme and software filters result in consistent, repeatable results. Measurement times can be extended even further utilizing concatenation available with the HP E1748A software. As industry standards evolve, the masks, sample rates, and filters used by the HP E1748A software package can be updated.

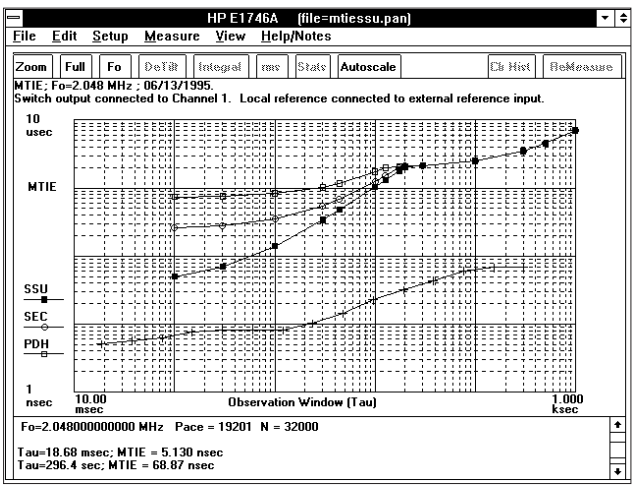
Jitter levels are accurately measured with the HP E1748A and the HP E1725C TIA. Its unsurpassed timing resolution of 100 ps rms, combined with the power of its Phase Power Spectral Density plot, deliver enough detail to determine which network components are improving or degrading incoming signals.

The HP E1748A multiple-channel network synchronization measurement software shortens measurement time on multiple channels with simultaneous recording of channels. Overlay displays offer quick visual comparison of data obtained from multiple MTIE or TDEV measurements.

A scrolling text window below the data display automatically records every action the instrument takes and records every result. This includes marker clicks and other actions performed in order to read, examine, or interpret results. Custom notes can be intermixed in this file to record important information such as type/length of cable, number of PHYs, pass/fail, and so forth. The file can be saved and used in reports or other documents to provide a complete record of the test.



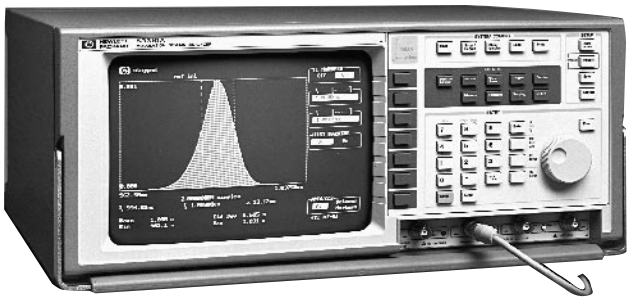
This HP E1742A display shows the peak-to-peak jitter during an 8 UI phase transient. The phase transient is being leaked out to the tributary over 0.5 seconds one bit at a time.



Typical MTIE measurements made with HP E1748A multiple channel network synchronization measurement software show sufficient margin compared to ETSI draft DE/TM 3017 masks. The four simultaneous measurements show, however, degradation from cascading timing signals.

HP 53310A
HP E1725C
HP E1740A
HP E1741A
HP E1742A
HP E1743A
HP E1747A
HP E1748A

- 200 ps rms single-shot resolution, 1 ps with averaging
- DECT, CT2, CT3 mobile communications measurements
- Easy to use



HP 53310A

HP 53310A Modulation Domain Analyzer

Affordability and Ease of Use

The most affordable modulation domain analyzer, the HP 53310A, includes many innovations for ease of use. Characterization of modulation and jitter is easy with built-in analysis. Parameters such as peak-to-peak deviation, carrier frequency, and modulation rate are all quickly and automatically displayed. Jitter analysis is simplified with automated mean, standard deviation, and probability functions. Key features of this frequency and time interval analysis product include:
Automated setup: A single button can set up the HP 53310A for measurement. Signals are automatically evaluated.
Single-touch measurements: Peak-to-peak deviation, carrier frequency, and modulation rate are easily and quickly measured for quantifying modulation. The Save/Recall function stores up to 10 measurement steps for fast repeat operations.
Built-in statistics: Mean, standard deviation, and probability function buttons simplify jitter analysis.
Softkey-driven menus: Measurement parameters and analysis functions are easily selected while viewing measurement data.
Large display: The expanded screen displays measurement results clearly and aids analysis.
Low cost: The HP 53310A is priced to fit budget-constrained projects and departments.

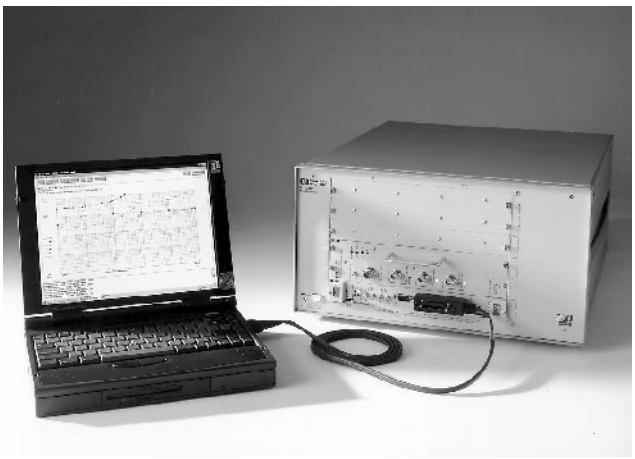
Product Features

The HP 53310A offers powerful analyzer features:
Dual timebases: Main timebase and window timebase allow data capture while viewing measurement details in the window.
Auto or triggered operation: Select auto triggering, edge triggering (rising or falling), or a unique feature: measurement value triggering (frequency or time interval). Value triggering can eliminate the need for and expense of external sync signal generation, shortening project time and lowering costs.
Display vs. time or histogram: Select appropriate views.
Fast histograms: Up to 16 million measurements per acquisition.
Automated measurements: Autoscale selects appropriate setup parameters; built-in analysis functions eliminate calculations.

Specifications and Ordering Information

See page 129 for key specifications and ordering details.

- Highest performance HP TIA
- Fast histograms, statistics, and window margin analysis
- Analyze data storage devices
- Study and identify clock jitter
- Analyze jitter in SONET/SDH networks



HP E1725C

HP E1725C Time Interval Analyzer

The HP E1725C time interval analyzer (TIA) combines a fast measurement sampling rate with a large memory and advanced analysis capabilities. Optional software packages, purchased separately or as options with the HP E1725C system, tailor the instrument to meet a variety of demanding application areas.

Configured with the HP E1741A time interval analyzer software, the HP E1725C is tailored for the characterization of high-speed data storage devices. HP offers several options to address other applications involving jitter analysis.

Versatile Design and Operation

Tailored for benchtop use, the HP E1725C system integrates a high performance time interval analyzer with an external portable computer based on the Intel Pentium processor. The MS® -Windows interface streamlines setup and offers complete control of measurement and analysis parameters. Measurements are carried out and stored in the instrument's 512K of memory. Built-in histograms, window margin analysis, and statistics functions speed access to many results.

For customers who desire a VXI solution, HP offers the HP E1740A time interval analyzer card. The HP E1725C benchtop instrument and HP E1740A VXI TIA card offer equivalent measurement capabilities, and the software packages that run on the HP E1725C can be purchased as add-on products for the HP E1740A.

Advanced Analysis Software

The current HP E174XA software solutions address four application areas described in the two previous pages of this catalog. These applications and corresponding software include:
- Data storage and test: HP E1741A and HP E1747A
- SONET/SDH tributary jitter analysis: HP E1742A
- Clock jitter analysis: HP E1743A
- Multiple-channel network synchronization measurement: HP E1748A

Specifications and Ordering Information

See page 129 for key specifications and ordering details.

Modulation Domain Analyzer Specification Highlights

Model	Frequency range (extension)	Single-shot freq. res. (1s gate)	Time interval resolution (single-shot/ averaging)	Maximum continuous meas. rate (meas/s)	Memory size	Output meas/s	Analysis and display
HP 53310A	200 MHz (2.5 GHz)	10 digits	200 ps/1ps	2.5 M	8000 (32,000 w/Option 001)	GPIB: to 7,500	Frequency and time vs. time; auto-scale (setup); large display; jitter analysis; simple triggering; digital RF communications (Option 031)
HP E1740A HP E 1725C	150 MHz	10 digits	100 ps/1ps	80 M	512K	6,500; VXI shared memory available	Frequency, time interval, time stamps, histogram, statistics, and window margin analysis. Additional analysis and display capability available using the HP E174xA software.

Ordering Information

HP 53310A Modulation Domain Analyzer
- **Opt 001** Extended Measurement Memory (4 x)
- **Opt 010** High Stability Oven Timebase
- **Opt 030** 2.5 GHz Channel C
- **Opt 031** Digital RF Communications Analysis/ High Resolution 2.5 GHz Input
- **Opt 305** Phase Analysis Software
- **Opt W30** 3-Year Extended Repair Service (see page 70)
- **Opt W32** 3-Year Calibration Service (see page 70)
- **Opt W34** 3-Year Standards Compliant Cal Service
- **Opt W50** 5-Year Return Repair Service
- **Opt W52** 5-Year Return Calibration Service
- **Opt W54** 5-Year Standards Compliant Cal Service

Available Separately
HP 53305A Phase Analysis Software

HP E1725C Time Interval Analyzer
Includes HP E1740A TIA module, HP E1406A Command Module, HP OmniBook portable computer, MS-Windows 98 MS-DOS 6.22, National Instruments PCMCIA-GPIB kit, and 4 oscilloscope probes.
- **Opt 002** Replace 6-slot card cage with HP E1401A 13-slot mainframe
- **Opt 141** Time Interval Analyzer Software
- **Opt 147** Timing Pattern Analysis Software
- **Opt 242** SONET/SDH Tributary Jitter Analyzer Software
- **Opt 243** Clock Jitter Analyzer Software
- **Opt 248** Multiple-channel Network Synchronization Software
- **Opt W32** 3-Year Service
- **Opt W50** 5-Year Return Repair Service
- **Opt W52** 5-Year Return Calibration Service

Available Separately
HP E1740A Time Interval Analyzer Module
- **Opt W32** 3-Year Return Calibration Service (see page 70)
- **Opt W50** 5-Year Return Repair Service
- **Opt W52** 5-Year Return Calibration Service

HP E1741A Time Interval Analyzer Software
HP E1742A SONET/SDH Tributary Jitter Analyzer Software
HP E1743A Clock Jitter Analyzer Software
HP E1747A Timing Pattern Analysis Software
HP E1748A Multiple-channel Network Synchronization Software

Electronic Counters

Hewlett-Packard offers the industry's broadest line of electronic counters and counter/timers. Starting with the first frequency-measurement projects in the 1940s, HP has pioneered the major technologies enabling today's electronic counters and modulation-domain analyzers.

Electronic counter/timers are used throughout most technical industries for measuring and analyzing frequency, phase, and time-interval signal characteristics. The breadth of the HP offering allows the best product to be selected for each application. An ideal functional and performance fit delivers the greatest value: the best and most cost-effective solution.

HP counter/timers offer:

- High-measurement accuracy
- Fast system throughput/HP-IB capability
- Low cost of ownership
- Ease of use
- Data reduction on many models
- Triggering simplicity

New Measurement Technology

Modulation domain products feature "continuous count" technology. Unlike traditional counters, these products do not stop between measurements to process data. Rather, they measure continuously and process results on the fly. As a result, new kinds of measurements are made possible.

Modulation domain products include:

HP 53310A: Combines affordability and ease of use

HP E1725C: Highest performance time-interval analyzer

HP E1740A: 150 MHz time-interval analyzer; high-performance analysis for VXI systems

For more information on modulation domain products, see the section starting on page 125.

Counter Products

RF Frequency Counter

The HP 53181A RF counter offers outstanding measurement performance in a low-cost, easy-to-use package.

The HP 53181A leads off Hewlett-Packard's newest line of frequency counters. The HP 53181A RF counter employs continuous measurement technology to provide superior performance at a very low price. Frequency and period measurements are provided over the range of 0.1 Hz to 225 MHz with exceptional resolution of 10 digits in one second. An optional second channel increases the frequency range to 1.5 GHz, 3 GHz, 5 GHz, or 12.4 GHz, making it easy to cover your exact RF measurement needs. Other features of the HP 53181A include HP-IB, automatic limit testing, analog display mode, single-button recall, extensive in-box statistical and math analysis, and more.

The HP 53181A RF counter is designed for systems and bench applications where high-precision frequency measurements are required in an easy-to-use, small and rugged package.

HP 53181A: The low-cost RF counter for systems and bench use

High-Performance Universal Counters

The HP 53131A universal counter offers high performance for system or bench.

The HP universal counter/timers incorporate frequency measurements, just like the HP 53181A, and additional capabilities for time-interval measurements. Specifically, these HP counters measure precise timing between two trigger events. The high-performance universal products also provide complete, automatic characterization of rise time, pulse width, and other signal parameters. Options are available (frequency extensions, high-performance time bases) to customize the products.

The current HP universal counter offering includes two high-performance universal counters: the HP 53131A and HP 53132A.

The HP 53131A is designed for manufacturing test, troubleshooting, and service. This counter allows you to easily make highly reliable frequency and timing measurements. Featured are extensive in-box analysis, automatic limit testing, analog display mode, single button recall, and more. The HP 53131A's half-rack size and light weight make it well suited for both benchtop and rackmounting.

The HP 53132A is designed for high-performance ATE systems. It combines the functionality of the HP 53131A with improved frequency and time interval resolution.

HP 53131A: High-performance system and bench counter (10 digits/sec. and 500 ps LSD)

HP 53132A: Highest resolution universal counter for system applications (12 digits/sec. and 150 ps LSD)

Microwave and Millimeter-Wave Frequency Counters

These products provide fundamental high-performance frequency measurements, dc to 46 GHz. Many enhancements—power measurement, battery operation, systems interface (GPIB), and high-accuracy time bases—are available standard or as options.

Pulse counters add the capability to automatically measure and profile burst or pulsed microwave or millimeter-wave signals.

HP 53150A/53151A/53152A: Portable CW microwave counters with power measurement for telecommunications service

HP 53147A/53148A/53149A: Portable CW microwave counter plus true power meter for improved power accuracy

HP 5361B: Profiles pulsed/CW microwave frequencies

High-Precision Oscillators

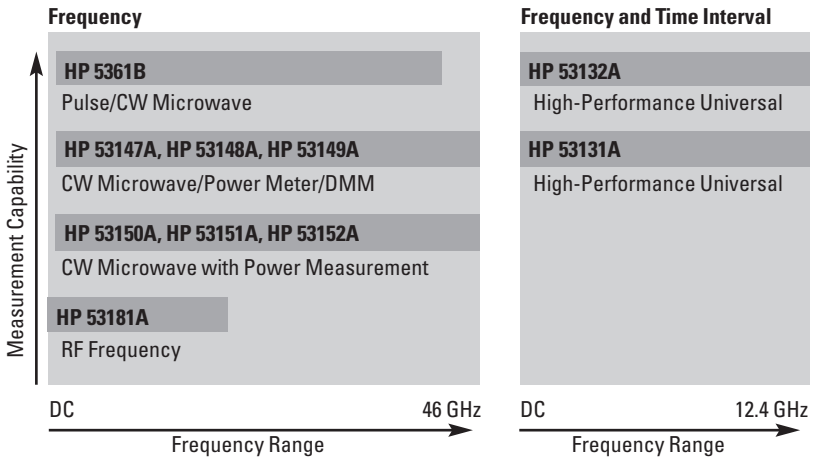
The accuracy of frequency and time-interval measurements is vitally dependent on the time base or reference element selected. HP has pioneered the field of high-precision crystal oscillators. The current counter product line benefits from HP's leadership in quality and precision oscillator technology. Three oscillator varieties are standard or optional with HP counters and counter/timers:

RTXO: Room-temperature crystal oscillators are designed for minimum frequency change over a change in temperature

TCXO: Temperature-compensated oscillators use external components to offset temperature effects. TCXO time bases have temperature characteristics which are typically five times better than an RTXO, or $<5 \times 10^{-7}$ for a 0° to 50° C change.

Oven Time Base: This alternative places the crystal and temperature-sensitive elements within a temperature-controlled environment. A heating element maintains a consistent temperature. The best stability is achieved when the operating point is 15° to 20° C above the highest temperature to which the unit will be exposed. After warm-up, the frequency remains very stable, typically $<7 \times 10^{-9}$ over a 0° to 50° C variation.

For more information, please request Application Note 200-2, "Fundamentals of Quartz Oscillators" from the HP Call Center in your region.



Counter Selection Guide

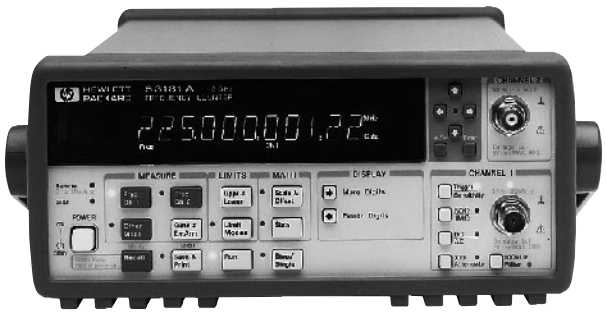
Model	Frequency range (extension)	Freq. resolution (1 s gate time)	Best sensitivity	Time-interval res. (single-shot LSD)	Additional features	Page	
High-Performance Universal Counters							
HP 53131A	225 MHz (3, 5, 12.4 GHz)	10 digits	20 mV	500 ps	GPIB standard, full math, statistics, limit testing, auto pulse characterization	132	
HP 53132A	225 MHz (3, 5, 12.4 GHz)	12 digits	20 mV	150 ps	GPIB standard, full math, statistics, limit testing, auto pulse characterization	132	
RF Frequency Counter							
HP 53181A	225 MHz (1.5, 3, 5, 12.4 GHz)	10 digits	20 mV	—	GPIB standard, full math, statistics, limit testing	132	
CW Microwave Counters with Power Measurement							
HP 53150A	20 GHz	1 Hz	–30 dBm	—	GPIB standard, battery optional, simultaneous power measurement	134	
HP 53151A	26.5 GHz	1 Hz	–30 dBm	—	GPIB standard, battery optional, simultaneous power measurement	134	
HP 53152A	46 GHz	1 Hz	–30 dBm	—	GPIB standard, battery optional, simultaneous power measurement	134	
CW Microwave Counter/Power Meters/DMM							
HP 53147A	20 GHz	1 Hz	–30 dBm	—	GPIB standard, battery and DMM optional, –70 dBm to +20 dBm true power meter	136	
HP 53148A	26.5 GHz	1 Hz	–30 dBm	—	GPIB standard, battery and DMM optional –70 dBm to +20 dBm true power meter	136	
HP 53149A	46 GHz	1 Hz	–30 dBm	—	GPIB standard, battery and DMM optional –70 dBm to +20 dBm true power meter	136	
Pulse/CW Microwave Counter							
HP 5361B	20 GHz (26.5 GHz) (40 GHz)	1 Hz	–28 dBm	—	GPIB standard, full microwave pulse measurements, automatic pulse profiling	137	

Indicates QuickShip availability.

Additionally, Hewlett-Packard offers electronic counters and counter/timers in an industry standard platform: VXIbus. With VXIbus counters from Hewlett-Packard, you can rely on the same exceptional performance that you have always had from Hewlett-Packard's high-performance rack-and-stack universal counters. All B-size instruments can be adapted to fit into the C-size VXIbus mainframes. Please request the 1999 *HP Test System and VXI Data Book*, p/n 5968-3698E, for additional configuration and product ordering information. Also, see the *VXIbus Products, HP 75000 VXIbus Family* section in this catalog.

HP 53131A
HP 53132A
HP 53181A

- High-accuracy frequency measurements to 225 MHz (optional 1.5, 3.0, 5.0 or 12.4 GHz)
- High-accuracy time-interval measurements with HP 53131A and HP53132A
- Intuitive user interface with shallow menu structure
- GPIB standard with data transfer rate of up to 200 fully-formatted measurements/second; talk-only RS-232
- Limit test capability
- HP 53181A: 10-digits/s
- HP 53131A: 10-digit/s and 500 psec resolution
- HP 53132A: 12-digit/s and 150 psec resolution



HP 53181A RF Counter

HP 53131A and 53132A Universal Counters

A Full Family of High-Performance RF and Universal Counters

Within Budget, Without Compromise

The HP 53131A/132A/181A high-performance counters offer exceptional price and performance in a rugged, lightweight package with a unique combination of ease of use, complete measurement set, extensive analysis capability, reliability, and high measurement and data transfer speed.

These instruments use real-time digital signal processing technology to analyze data while simultaneously taking new readings, speeding measurement throughput. The technology, developed for HP's high-end line of modulation-domain analyzers, allows the counters to gather more data for each measurement so you get the high-resolution measurements in a fraction of the time it takes a conventional reciprocal counter.

Powerful Analysis Capability

The HP 53131A/132A/181A counters offer built-in statistics and math functions so you can scale measurements and simultaneously measure and track average, min./max. and standard deviation. Automated limit testing lets you set upper and lower limits for any measurement. When a measurement falls outside those limits, the counters log the out-of-limit conditions, notify the operator and generate an output signal to trigger external devices or stop the test. An analog display mode carries limit testing one step further, letting you see at a glance whether a measurement falls within pass/fail limits.

Analog display mode uses an asterisk to represent the current measurement relative to user-defined upper and lower limits. The colon on the left represents the lower limit and the colon on the right represents the upper limit.

High-Speed Automated Test Capability

For computer-controlled systems applications, each counter includes a standard GPIB interface with a data transfer rate of up to 200 fully-formatted measurements per second. The counters use the Standard Commands for Programmable Instruments (SCPI) protocol, letting you leverage your programming investment across your measurement system. The standard RS-232 talk-only interface provides printer support or data transfer to a computer through a terminal-emulation program.

HP 53181A RF Counter

Optimized for RF applications, the single-channel HP 53181A gives you frequency, period, and peak-voltage measurements with up to 10 digits/sec frequency resolution. The low-cost HP 53181A counter is ideal for benchtop, system RF and analog applications.

A digit-blanking function lets you easily eliminate unnecessary digits when you want to read measurements quickly. For higher-frequency measurements, an optional second channel provides 1.5, 3, 5 or 12.4 GHz bandwidth.

HP 53131A and 53132A Universal Counters

The two-channel HP 53131A counter offers 10 digits per second of frequency resolution at up to 225 MHz. Single-shot time-interval resolution is specified at 500 ps and averaging can reduce this even further. Measurements include frequency, time interval, ratio, period, phase angle, totalize, peak voltage, pulse parameters and more. For quick access to frequently used tests, a single keystroke recalls up to 20 different stored front-panel set-ups. Choose the HP 53131A for general bench or system test where you need excellent performance at an unbeatable price.

For applications requiring higher resolution, the HP 53132A offers the same features and functions as the HP 53131A with up to 12 digits/s frequency resolution. Single-shot time-interval resolution is specified at 150 ps. Choose the HP 53132A when you need the very best in accuracy and resolution, or when speed in an automated system is critical. With the HP 53132A, expanded external arming features can be used to control the start of measurements using an external signal.

Whichever counter you choose, you'll have an accurate, reliable counter that will serve you for years to come. We back that claim with a standard three-year warranty that can be extended an additional two years.

Options Increase Versatility

The HP 53131A/132A/181A counters can be ordered with an optional RF-input channel to provide frequency measurements up to 3 GHz (Option 030), 5 GHz (Option 050) or 12.4 GHz (Option 124). (See table on page 133)

A choice of optional timebases is available for the HP 53131A/132A/181A counters to increase your measurement accuracy. Option 010 provides a high-stability oven timebase with aging of less than 5×10^{-10} per day. Option 012 provides an ultra-high-stability oven timebase with aging of less than 1×10^{-10} per day. (See table on page 133)

BenchLink Meter, HP 34812A optional software turns your PC and counter into a powerful, easy-to-use measurement system. HP BenchLink Meter lets you easily configure and run tests from your Windows-based PC, making data gathering more convenient. HP BenchLink software helps you get more information from your data by providing a variety of basic display formats and analysis tools that let you manipulate and understand your data quickly and easily.

Abridged Measurement Specification & Characteristics

	HP 53131A	HP 53132A	HP 53181A
Measurements	Frequency, frequency ratio, time interval, period, rise/fall time, positive/negative pulse width, duty cycle,phase (CH 1 to CH 2), totalize, peak voltage, time interval average, time interval delay		Frequency, frequency ratio (with optional CH 2), period, peak voltage
Analysis	Automatic limit testing, math (scale and offset), statistics (minimum, maximum, mean, standard deviation). Statistics available on all measurements or only measurements that fall within limits.		
Measurement characteristic			
Frequency range	CH 1 & 2: dc–225 MHz	CH 1 & 2: dc–225 MHz	CH 1: dc–225 MHz
Frequency resolution:	10 digits/s	12 digits/s	10 digits/s
Time interval resolution (LSD)	500 ps	150 ps	NA
Measurement speed:	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB
Voltage range & Sensitivity (Sinusoid)			
DC to 100 MHz:	20 mVrms to ±5 Vac + dc	20 mVrms to ±5 Vac + dc	20 mVrms to ±5 Vac + dc
100 MHz to 200 MHz:	30 mVrms to ±5 Vac + dc	30 mVrms to ±5 Vac + dc	30 mVrms to ±5 Vac + dc
200 to 225 MHz:	40 mVrms to ±5 Vac + dc	40 mVrms to ±5 Vac + dc	40 mVrms to ±5 Vac + dc
Input conditioning	(Independently selectable on CH 1 & 2)	(Independently selectable on CH 1 & 2)	(Selectable on CH 1)
Impedance, coupling	1 MΩ or 50 Ω, ac or dc	1 MΩ or 50 Ω, ac or dc	1 MΩ or 50 Ω, ac or dc
Low pass filter	100 kHz, switchable	100 kHz, switchable	100 kHz, switchable
Attenuation	x1 or x10	x1 or x10	x1 or x10
External timebase reference input	1, 5, 10 MHz	10 MHz	1, 5, 10 MHz
Trigger	CH 1 & 2	CH 1 & 2	CH 1
	Trigger on rising/falling edge; set level by percent of signal level or absolute voltage; set sensit		ity to LOW, MED, or HIGH
Gating and arming	Auto, manual (set gate time or number of digits of resolution); external, delay		
Interfaces	Standard GPIB (IEEE 488.1 and 488.2) with SCPI-compatible language; talk only RS-232		
Power	100 to 120 VAC ± 10% –50, 60 or 400 Hz ± 10% 220 to 240 VAC ± 10% –50 or 60 Hz ± 10%	AC line voltage selection is automatic	
Net weight/size	3 kg (6.5 lbs), 212.6mm W x 88.5mm H x 348.3mm D		

For full specifications, request data sheet, pn 5967-6039EUS/EN, or visit our web site: **www.hp.com/go/bi**

Standard and Optional High-Stability Timebases

	Standard (0° to 50° C)	Medium Stability Oven (Option 001)	High Stability Oven (Option 010)	Ultra High Stability Oven (Option 012, 53132A only)
Temperature Stability: (referenced to 25° C)	$< 5 \times 10^{-6}$	$< 2 \times 10^{-7}$	$< 2.5 \times 10^{-9}$	$< 2.5 \times 10^{-9}$
Aging Rate (after 30 days) **Per Day:**	$< 3 \times 10^{-7}$	$< 4 \times 10^{-8}$	$< 5 \times 10^{-10}$	$< 1 \times 10^{-10}$
Per Month:		$< 2 \times 10^{-7}$	$< 1.5 \times 10^{-8}$	$< 3 \times 10^{-9}$
Per Year:				$< 2 \times 10^{-8}$
Turn-on stability vs. time: (in 30 minutes)		$< 2 \times 10^{-7}$ (referenced to 2 hours)	$< 5 \times 10^{-9}$ (referenced to 24 hours)	$< 5 \times 10^{-9}$ (referenced to 24 hours)
Calibration:	Manual Adjust	Electronic	Electronic	Electronic

Note that power to the time base is maintained when the counter is placed in standby via the front panel switch. The internal fan will continue to operate under this condition to maintain long-term instrument reliability.

Optional High-Frequency Channels

	Frequency range	Coupling	Power range and sensitivity	Damage level
Option 015[1] 1.5 GHz channel	100 MHz to 1.5 GHz	ac	–27 dBm to +19 dBm	5 Vrms
Option 030 3.0 GHz channel	100 MHz to 3.0 GHz	ac	–27 dBm to +19 dBm (100 MHz to 2.7 GHz) –21 dBm to +13 dBm (2.7 GHz to 3 GHz)	5 Vrms
Option 050 5.0 GHz channel	200 MHz to 5.0 GHz	ac	–23 dBm to +13 dBm	25 dBm
Option 124 12.4 GHz channel	200 MHz to 12.4 GHz	ac	–23 dBm to +13 dBm	25 dBm

[1] Option 015 is available only for HP 53181A counters.

Ordering Information

HP 53131A Universal Counter
HP 53132A Universal Counter
HP 53181A RF Counter
- **Opt 001** Medium-Stability Timebase
- **Opt 002** DC Power Input
- **Opt 010** High-Stability Timebase
- **Opt 012** High-Stability Timebase (HP53132A Only)
- **Opt 015** 1.5 GHz Ch. w/BNC Connector (HP 53181A only)
- **Opt 030** 3 GHz Channel with BNC Connector
- **Opt 050** 5 GHz Channel with Type-N Connector
- **Opt 124** 12.4 GHz Channel with Type-N Connector
- **Opt 060** Rear-Panel Connectors
- **Opt 1BP** MIL-STD-45662 Calibration w/ Data
- **Opt 1CM** Rackmount Kit

HP 34812A HP BenchLink Meter Software
HP 34161A Accessory Pouch
HP 34131A Hard Transit Case
HP 34397A DC to AC Inverter

Indicates QuickShip availability.

HP 53150A
HP 53151A
HP 53152A

- Ultra wide range, single input (from 50 MHz up to 46 GHz)
- Simultaneous frequency and power measurement with analog peaking indicator
- Fully programmable via GPIB and RS-232 standard
- Lightweight with optional battery

HP 53152A

HP 53150A, 53151A, 53152A Microwave Counters

The HP 53150 series represent a total re-thinking of microwave counters: innovative designs that offer no-compromise performance and quality while attaining true portability. The HP 53150A, 53151A, and 53152A measure both frequency and power over the frequency ranges of 20 GHz, 26.5 GHz, and 46 GHz, respectively, and feature a single, extremely wideband microwave input (50 MHz up to 46 GHz).

No Compromise Performance

Utilizing a unique single board design with low phase noise PLL circuitry, the HP 53150 series offers exceptional sensitivity, excellent power measurement accuracy and repeatability as well as fast acquisition times and full programmability. Performance equals or surpasses the industry standard HP 5350 series in virtually every aspect in a package that is less than half the weight and size.

Frequency and Power Measurements with a Single Connection

The heart of the HP 53150 series is an advanced sampler design that integrates a separate zero bias Schottky diode for the accurate measurement of input power. This allows the convenient measurement of both frequency and power with a single connection. The unique cable-loss-compensation feature (power correction) yields accuracies and repeatabilities that rival power meters with diode sensors. Best of all, since the frequency of the test signal is measured simultaneously, the diode's frequency response is automatically adjusted for. And like the latest in diode sensors, deviation from square law is also compensated for.

Functionality Without Clutter

The HP 53150 series offers a clean, uncluttered front panel with with a minimum of push buttons. Despite their simple appearance, these counters retain all the powerful functions one expects in precision instrumentation, with such useful functions as: measurement averaging, arbitrary as well as nulling offsets for both frequency and power, display of power in either dBm or Watts and full control of resolution, sampling rate, and GPIB address plus extensive self-diagnostics.

Field Tough but Ready for Benchtop or ATE Applications

The HP 53150 series is as comfortable in the field as in the laboratory. The rugged case with an integrated tilting handle can tolerate the vibration and shock expected in field use. For easy transportation, a soft carrying case is also available. The "see anywhere" backlit LCD display ensures visibility in all environments, from dark to full sunlight. And in situations where AC is unavailable, the internal, replaceable camcorder batteries provide over 2.5 hours of continuous operation. Alternatively, the unit can be powered from an external 11-18 VDC source.

For benchtop and ATE applications, the HP 53150 series delivers full functionality and high measurement speed along with fully programmable RS-232 interface and high speed GPIB (SCPI compliant) as standard. In addition, these counters are compatible with standard HP rackmount hardware.

HP 53150 Series Abridged Measurement Specifications and Characteristics

All measurement specifications are over the full signal ranges of channels 1 and 2. For full specifications, please call your HP representative and request a Product Overview for the HP 53150 series microwave counters.

Input Characteristics

	Input 1 (1 MΩ)	Input 2 (50 Ω)	
Frequency Range			
53150A	10 Hz to125 MHz	.05–20 GHz	
53151A	10 Hz to125 MHz	.05–26.5 GHz	
53152A	10 Hz to125 MHz	.05–46 GHz	
Sensitivity		**53150/51**	**53152**
<30 Hz	40 mV	—	—
to 125 MHz	25 mV	—	—
<250 MHz	—	–20 dBm	–20 dBm
to 12.4 GHz	—	–33 dBm	–33 dBm
to 18 GHz	—	–33 dBm	–30 dBm
to 20 GHz	—	–29 dBm	–27 dBm
to 26.5 GHz	—	–25 dBm (151)	–27 dBm
to 40 GHz	—	—	–23 dBm
to 46 GHz	—	—	–17 dBm
Maximum Input	2 V_{rms}	+5 dBm, < 2 GHz +13 dBm, > 2 GHz	
Damage Level	5 V_{rms} to120 Vp	+27 dBm	
Coupling	AC	AC	

Channel 1

Resolution: Selectable 1 Hz to 1 MHz
Connector: BNC female
Low Pass Filter: 50 kHz, selectable

Channel 2

Resolution: Selectable 1 Hz to 1 MHz
Acquisition Time: 100 ms to 140 ms
Gate Time: 1/Resolution
FM Tolerance: 20 MHz p-p max. @ 10 MHz rate to 26.5 GHz; 12 MHz p-p max. @ 10 MHz rate to 46 GHz
AM Tolerance: Any depth/rate within dynamic range of input
Amplitude Discrimination (above 250 MHz)**:** 20 dB typ. for greater than 75 MHz separation; 10 dB typ. for less than 75 MHz separation
Connector: 3.5 mm SMA compatible (HP 53150A/53151A); 2.92 mm Planar Crown (HP 53152A)

Power Measurement
Range: Counter sensitivity to +7 dBm
Units: dBm or milliwatts/microwatts
Resolution: 0.01 dB

Accuracy* (0 to –20 dBm)**:**

	53150/51	53152
< 12.4 GHz	±1.5 dB	±1.0 dB
to 20 GHz	±1.5 dB	±1.5 dB
to 26.5 GHz	±2.0 dB (151)	±1.5 dB
to 46 GHz	—	±2.0 dB

*At chanel two input connector

General

Display: Backlit LCD
Sample Rate: User-selectable Fast, Medium, Slow or Hold
Programming: HP-IB and RS-232C, SCPI compatible
Math Functions
Offset: Last reading and/or entered offset to reading for either power or frequency
Averaging: 1 to 99 measurement running average
Power Correction (Cable Loss Compensation): Offsets power reading via linear interpolation of up to 10 user-entered frequency attenuations
Save and Recall: Up to 9 complete instrument setups may be saved and later recalled
Sleep Mode (battery option only)**:** Automatically activated if no input is present for 5 minutes
Power Requirements
75 VA max. (25 W typ.)
90– 132 VAC; 50, 60, 400 Hz
216– 264 VAC; 50, 60 Hz
11–18 VDC: 2A max.: battery option only
Battery (option)**:**
Type: VHS camcorder, sealed lead acid (2 each)
Charge Time: 8 hours in unit
Capacity: 2.5 hours minimum at 25° C
Timebase:

	TCXO (std)	Option 001
Aging Rate	1 x 10^{-7}/mo	5 x 10^{-10}/day
Short Term (1 sec. avg.)	1 x 10^{-9}	2 x 10^{-10}
Temperature (0—55°C)	<1 x 10^{-6}	<3 x 10^{-9}

Accessories Furnished: Power cord and operating, programming, and service manuals
Size: 213 mm W x 88.5 mm H x 300 mm D
Weight: 4 kg without battery option; 6.4 kg with battery option

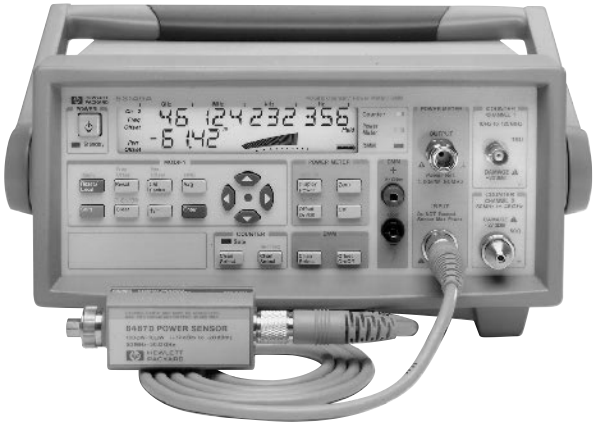
Ordering Information

HP 53150A 20 GHz Counter
HP 53151A 26.5 GHz Counter
HP 53152A 46 GHz Counter
Options
Opt 001 Oven Timebase
Opt 002 Battery/DC Input
Opt 007 Soft Carrying Case
Opt 1CM Rack Mounting Kit
Opt W30 3-Yr. Return Repair Service
Opt W50 5-Yr. Return Repair Service

Microwave Counter/Power Meter/DMM

HP 53147A
HP 53148A
HP 53149A

- Three frequency ranges up to 46 GHz
- True power meter with HP 8480 series sensors
- DMM and battery optional
- Fully programmable GPIB and RS-232 standard



HP 53149A with DMM option

HP 53147A, 53148A, 53149A Microwave Counter/ Power Meter/DMMs

The HP 53140 series microwave counter/power meters with optional digital multimeter have all the fundamental measurements required to install and maintain today's digital microwave radio links. Rugged field portability and a battery option complete the ensemble. These instruments are also at home in ATE applications with HP-IB and RS-232 fully programmable I/O ports as standard features. For those demanding R&D application, the HP 53140 series offer the laboratory-level performance and accuracy you've come to expect from HP.

HP 53140 Series Abridged Measurement

Specifications and Characteristics

For full specifications, please call your HP representative and request a Product Overview for the HP 53140 series microwave counters.

Counter Specifications

Input Characteristics

	Input 1 (1 M Ω)	Input 2 (50 Ω)	
Frequency Range			
53147A	10 Hz to 125 MHz	.05-20 GHz	
53148A	10 Hz to 125 MHz	.05-26.5 GHz	
53149A	10 Hz to 125 MHz	.05-46 GHz	
Sensitivity		**53147A/48A**	**53149A**
< 30 GHz	40 mV	—	—
to 125 MHz	25 mV	—	—
< 250GHz	—	–20 dBm	–20 dBm
to 12.4 GHz	—	–33 dBm	–33 dBm
to 18 GHz	—	–33 dBm	–30 dBm
to 20 GHz	—	–29 dBm	–27 dBm
to 26.5 GHz	—	–25 dBm (148)	–27 dBm
to 40 GHz	—	—	–23 dBm
to 46 GHz	—	—	–17 dBm
Damage Level	5 Vrms to 120 Vp	+27 dBm	

Channel 1

Resolution: Selectable 1 Hz to 1 MHz
Low Pass Filter: 50 kHz, selectable

Channel 2

Resolution: Selectable 1 Hz to 1 MHz
Acquisition Time: 100 ms to 140 ms
Gate Time: 1/Resolution
FM Tolerance: 20 MHz p-p max. @ 10 MHz rate to 26.5 GHz;
12 MHz p-p max. @ 10 MHz rate to 46 GHz
Amplitude Discrimination (above 250 MHz): 20 dB typ. for greater than 75 MHz separation; 10 dB typ. For less than 75 MHz separation
Connector: 3.5 mm SMA compatible (HP 53147A/53148A)
2.92 mm Planar Crown (HP 53149A)

Power Meter Specifications

Frequency Range: 10 MHz to 50 GHz, sensor-dependent
Power Range: –70 dBm to +20 dBm, sensor-dependent
Power Sensors: HP 8480 series
Display Units: Watts, dBm
Resolution: 0.01 dB in log mode, 0.1% of full scale in linear mode
Accuracy
Instrumentation: +/- 0.02 dB or +/- 0.5%
Power Reference
Power Output: 1.00 mW. Factory set to +/- 0.7%, traceable to U.S. National Institute of Standards and Technology.
DMM Specifications (option)
Function: AC and DC volts, Ohms

General

Display: Backlit LCD
Programming: HP-IB and RS-232C, SCPI compatible
Math Functions
Offset: Last reading and/or entered offset to reading for either power of frequency
Averaging: 1 to 99 measurement running average
Save and Recall: Up to 9 complete instrument setups may be saved and later recalled
Power Requirements:
90 – 132 VAC; 50, 60, 400 Hz
216 – 264 VAC; 50, 60 Hz
11 – 18 VDC: battery option only
Battery (option):
Type: VHS camcorder, sealed lead acid (2 each)
Charge Time: 8 hours in unit
Capacity: 2 hours typical

Timebase:

	TXCO (std)	Oven (opt)
Aging Rate	1×10^{-7}/mo	5×10^{-10}/day
Short Term (1 sec. avg.)	1×10^{-9}	2×10^{-10}
Temperature (0–55° C)	$<1 \times 10^{-6}$	$<3 \times 10^{-9}$

Accessories Furnished: Power cord, 1.5 m power sensor cable (HP 11730A), operating, programming and service manuals

Ordering Information

HP 53147A 20 GHz Counter/Power Meter	Available Spring 2000
HP 53148A 26.5 GHz Counter/Power Meter	Available Spring 2000
HP 53149A 46 GHz Counter/Power Meter	Available Spring 2000
Options	
DMM	Available Summer 2000
Oven Timebase	Available Spring 2000
Battery/DC Input	Available Spring 2000

- Frequency extensions to 26.5 GHz, 40 GHz
- Measure frequency (pulsed or CW), PRI, PRF, pulse width, off-time, and frequency profiles directly

HP 5361B

HP 5361B Pulse/CW Microwave Counter

The HP 5361B offers both high-precision pulse and CW performance. With built-in frequency modulation profiling, the HP 5361B characterizes radar, EW, and communications systems or components. This counter lowers your equipment costs by eliminating the need for a separate CW counter, pulse generator, and computer.

Key features include:

Pulse measurements: Frequency, PRF, PRI, pulse width, and off-time.
Frequency profiling: Characterize frequency transients, modulation (such as chirp), and linearity using the PROFILE function. No external gate is required.
Fast track: Measure a signal that is sweeping at up to 800 MHz/s.
Low FM rate: Measure signals that vary slowly in frequency.
Simplified operation: To offload the operator, built-in automatic functions include calibration, signal assessment (pulsed or CW), signal acquisition, gate width calculation and setting, gate positioning, PRF mode, tracking of sweeping signals, pulse averaging for desired resolution and measurement display.
Scope-View: Set up externally gated measurements by viewing the down-converted pulse with a dc offset.

The HP 5361B is a cost-effective choice for manufacturing and service. High-speed throughput saves operator time and lowers cost. Periodic maintenance is limited to time-base calibration.

For radars, VCOs, and DTOs, the HP 5631B makes frequency, timing, and profiling measurements at the touch of a button. The counter makes more complex measurements for the carrier frequency of agile signals, staggered PRIs, or the frequency transients in a pulsed or CW signal. With one instrument you can characterize radar pulses or test a Stable Local Oscillator (STALO). Functions for measuring step response, post-tuning drift, and settling time facilitate accurate and easy testing of VCOs and DTOs.

Summary Specifications

Input Characteristics

	Input 1 (50 Ω)	Input 2 (1M Ω)	Input 2 (50 Ω)
Frequency range	500 MHz to 20, 26.5, 40 GHz	10 Hz to 80 MHz	10 MHz to 525 MHz
Sensitivity		25 mV rms	25 mV rms
0.5 to 12.4 GHz	–28 dBm		
12.4 to 20 GHz	–23 dBm		
0.5 to 26.5 GHz (Option 026, 040)	–20 dBm		
26.5 to 40 GHz (Option 040)	0.37 x f (in GHz) –29.8 dBm		

Frequency (Input 1)

Automatic and Manual Acquisition: 500 MHz to 20 GHz; 500 MHz to 26.5 GHz (Option 026); 500 MHz to 40 GHz (Option 040)
Least Significant Digit: 1 MHz to 1 Hz for frequency, 0.001 Hz for PRF
Pulse Frequency Measurements
- **Pulse Width** (minimum)**:** Manual mode, 60 ns; auto mode, 100 Ns
- **Pulse Rep. Freq.:** Minimum 1 Hz; maximum 2 MHz
- **Measurement Time, Resolution, Accuracy:** See data sheet

CW Frequency Measurements
- **FM Tolerance:** 55 MHz peak-to-peak
- **Tracking Speed** (fast acquisition)**:** 800 MHz/s
- **Acquisition Time:** Manual mode, <40 ms; automatic mode, fast acq., <100 ms
- **Gate Times** (1 Hz resolution)**:** 200 to 1000 ms
- **Measurement Time:** ≥ 8.5 ms (in Dump Mode)

Accuracy: See data sheet

Pulse Parameters (Input 1)

	Pulse width	PRI	Offtime	PRF
Min./Max.	60 ns/10 ms	500 ns/1 s	400 ns/1 s	1 Hz/2 MHz to 0.001 Hz
LSD	(PW < 1 ms) 1 ns; (PW≥ 1 ms) 100 ns			
Accuracy (100 Avg.)	± (20 ns + timebase uncertainty x measurement ± LSD			± (20 ns) x (PRF)^2 ± LSD ± timebase uncertainty

Profile (Input 1)

Frequency Range (min./max. for Y axis)**:** 500 MHz/40 GHz
FM Chirp Tolerance (max. span for Y axis)**:** 50 MHz peak-to-peak
Time Range (min./max. for span x axis)**:** 100 ns/10 ms
Time Resolution: 1 ns
Internal Gate Width: Minimum: 11 to 23 ns; typical minimum: 14 ns
External Gate Width: Minimum: manual acquisition 20 ns; auto-acquisition 60 ns
Number of Data Points: Up to 100
Profile Frequency Measurements
- **Printers Supported:** HP 2225A, HP 2227B, HP 3630A Option 002
- **Profile Phase Measurements:** See Application Note 377-4 for details. Computer required.

Frequency (Input 2)

Range: 10 Hz to 525 MHz
Accuracy: 0.001 to 1 Hz
Resolution / LSD: 0.001 to 1 Hz

Options

Option 001 Oven Timebase: Aging rate < 5 x 10^{-10} / day
Option 006, Increased Damage Level: Pulsed, + 50 dBm (100 W) peak; CW, +39 dBm (8 W)
Option 010 High-Stability Oven Timebase: Aging rate < 7 x 10^{-10} /week (Standard timebase: Aging rate < 1 x 10^{-7} /month)
Option 026: Frequency extensions for input 1 to 26.5 GHz
Option 040: Frequency extensions for input 1 to 40 GHz

Ordering Information

HP 5361B Pulsed/CW Microwave Counter
- **Opt 001** Oven Timebase
- **Opt 006** Microwave Limiter
- **Opt 010** High-Stability Timebase
- **Opt 026** 26.5 GHz Frequency Extension
- **Opt 040** 40 GHz Frequency Extension
- **Opt 908** Rackmount Kit for Use with Front Handles Removed
- **Opt 910** Additional Operating and Programming Manual
- **Opt 913** Rackmount Kit for Use With Supplied Front Handles
- **Opt 915** Service Manual
- **Opt W30** Extended Repair Service (see page 71)
- **Opt W32** Calibration Service (see page 71)

Digital Multimeters

Overview

HP offers a full line of digital multimeters.

Find Your Fit in the HP Family

From a toolbox to a test rack to a VXIbus system, there's a HP digital multimeter (DMM) that's right for the job:

HP 3458A Multimeter
Up to 8 ½ digits and up to 100,000 readings per second. Test engineers, R&D engineers, and metrologists worldwide rely on its accuracy and speed.

HP 34420A Nanovolt/Micro-ohmeter
With 7 ½ digits of resolution, 8 nVpp noise, and built-in resistance and SPRT functions, the (HP 34420A) can handle your most demanding low-level measurements.

HP 34401A Multimeter
The world's best-selling benchtop/system DMM delivers 6 ½-digit performance at a 5 ½-digit DMM price.

HP 970 Series Handheld DMMs
Carry benchtop capabilities wherever your job takes you. Choose from resolution as high as 4 ½ digits and a variety of useful features, from temperature to ac+dc to dB/dBm.

HP VXIbus DMMs
Five B- and C-size multimeters to choose from. Perfect for data acquisition and computer-aided test applications. Refer to the VXIbus section of this catalog for more information.

HP Digital Multimeters/Digital Voltmeters

	HP 34401A	HP 34420A	HP 3458A	HP 970 series	HP E1312A HP E1412A HP VXIbus DMMs
Digits	6 ½	7 ½	8 ½	3 ½ to 4 ½	6 ½
DC voltage					
Basic 1 yr. accuracy	35 ppm	30 ppm	8 ppm (4 ppm opt.)	0.3% to 0.05%	35 ppm
Sensitivity	100 nV	0.1 nV	10 nV	100 μV to 10 μV	100 nV
Maximum reading rate	1,000 rdg/s	250 rdg/s	100,000 rdg/s	2 rdg/s	1,000 rdg/s
Maximum range	1,000 V	100 V	1,000 V	1,000 V	300 V
Resistance					
Basic 1 yr. accuracy	0.01%	0.006%	0.001%	0.5% to 0.06%	0.01%
Sensitivity	100 μΩ	0.1 μΩ	10 μΩ	0.1 Ω to 0.01 Ω	100 μΩ
AC voltage					
Basic 1 yr. accuracy	0.06%	NA	0.014%	1% to 0.5%	0.06%
Bandwidth	3 Hz to 300 kHz	NA	1 Hz to 10 MHz	up to 100 kHz	3 Hz to 300 kHz
Functions	dc and ac V dc and ac I 2- and 4-wire Ω Diode test Frequency Period Continuity Reading hold dB, dBm Null, min/max, pass/fail, ratio 512 reading storage GPIB, RS-232	dc V 2-channel voltage input 2- and 4-wire Ω Offset-compensated Ω Low power Ω Voltage clamped Ω Temperature (including SPRT) Analog and digital filter Chart recorder analog output 1,024 reading storage GPIB, RS-232	dc and ac V dc and ac I 2- and 4-wire Ω Offset-compensated Ω Frequency Period Math Ratio Internal Basic 20 KB reading memory Digitizing GPIB	dc and ac V dc and ac I 2-wire Ω Diode test Frequency Capacitance Data hold Continuity Temperature Min/max/avg Bargraph Dual digital display Relative/percent Current shutter	dc and ac V dc and ac I 2- and 4-wire Ω Frequency Period Temperature dB, dBm Null, limit, min/max 1000 reading storage
More information in this catalog	page 139	page 141	page 143	page 145	page 84 VXIbus products

- 12 measurement functions
- 1000 V maximum input
- 15 ppm basic dcV accuracy (24-hour)
- 1000 readings per second direct to GPIB
- GPIB and RS-232 standard
- 512-reading memory
- SCPI commands standard

HP 34401A with optional accessory pouch

HP 34401A Digital Multimeter

The HP 34401A digital multimeter establishes a new price/performance standard by offering such features as 6½ digits of resolution, 1000 readings per second, and 15 ppm basic dc accuracy at a surprisingly affordable price. The HP 34401A has been designed for superior performance while providing the flexibility to meet both your present and future needs.

Great Bench Performance

The clear, logical front panel of the HP 34401A allows you to easily select all primary measurement functions. Traditional "bench" functions, such as continuity and diode test, are included. Math functions, such as NULL, dB, dBm, limit test, and min/max/avg are easily selected. A simple menu scheme gives you access to powerful advanced features, such as the ability to store up to 512 readings in internal memory. Measurement results are displayed on a bright, high-visibility readout. A rugged case ensures survival even under the toughest conditions, and the optional accessory pouch makes it easy to pack up and go with the HP 34401A.

Superior Performance in Your System

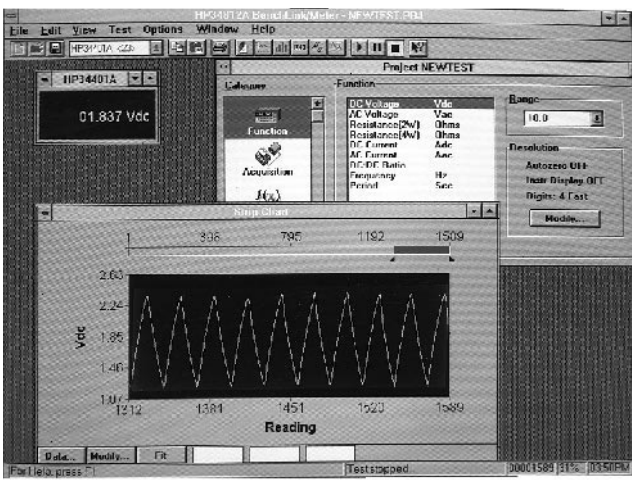
The HP 34401A can take up to 1000 readings per second, including GPIB bus transfer in ASCII format. Both GPIB and RS-232 are standard, letting you select the interface that best meets your needs. The HP 34401A responds to three different command languages. It accepts SCPI commands (Standard Commands for Programmable Instruments), which ensures present and future compatibility. It also responds to commands for the HP 3478A and the Fluke 8840A, thereby protecting your software investment with backward compatibility. Drivers are also available for both National Instruments Labview and Hewlett-Packard's VEE software.

Turn Your HP 34401A into a Measurement System with HP 34812A BenchLink Meter Software

The HP 34401A is an exceptional digital multimeter, and you can make it even more valuable with the HP 34812A BenchLink Meter software solution. HP BenchLink Meter turns your PC and DMM into a powerful, easy-to-use single-channel data acquisition system.

One of the HP BenchLink family of PC/basic instrument connectivity solutions, HP BenchLink Meter lets you combine your Windows-based PC and the HP 34401A DMM to easily configure, capture, and display measurement data. HP BenchLink lets you structure your entire test—measurement, acquisition parameters, time of test start, test limits, and more—from the PC, so you create the test environment you need. You'll have a variety of display and analysis formats available, including a strip chart mode, statistics, histograms, and an analysis window to let you zoom in on specific data points for a closer look. In addition, it's easy to transfer captured data to other Windows programs for more detailed analysis.

HP BenchLink Meter supports both GPIB and RS-232 transfers, and runs on Windows 3.1, Windows 95, Windows 98, and Windows NT 4.0.



HP 34401A

Abbreviated Technical Specifications

DC Voltage

Input Characteristics

Range	Maximum reading (6½ digits)	Resolution in digits 6½	5½	4½	Input resistance
100 mV	120.0000	100 nV	1 μV	10 μV	10 MΩ or > 10 GΩ
1 V	1.200000	1 μV	10 μV	100 μV	10 MΩ or > 10 GΩ
10 V	12.00000	10 μV	100 μV	1 mV	10 MΩ or >10 GΩ
100 V	120.0000	100 μV	1 mV	10 mV	10 MΩ
1000 V	1050.000	1 mV	10 mV	100 mV	10 MΩ

Input Protection: >1000 V on all ranges
Measurement Accuracy: ±(% of reading + % of range)

Range	24-Hour 23° C ±1° C	90-Day 23° C ±5° C	1-Year 23° C ±5° C
100 mV	0.0030 + 0.0030	0.0040 + 0.0035	0.0050 + 0.0035
1 V	0.0020 + 0.0006	0.0030 + 0.0007	0.0040 + 0.0007
10 V	0.0015 + 0.0004	0.0020 + 0.0005	0.0035 + 0.0005
100 V	0.0020 + 0.0006	0.0035 + 0.0006	0.0045 + 0.0006
1000 V	0.0020 + 0.0006	0.0035 + 0.0010	0.0045 + 0.0010

Noise Rejection: (50 or 60 Hz, 1 kΩ unbalance in LO lead)
DC CMRR: 140 dB
AC CMRR: 70 dB
Normal mode rejection (60 Hz/50 Hz)± 0.1%:
100 PLC (1.67 s/2.00 s): 60 dB
10 PLC (167 ms/200 ms): 60 dB
1 PLC (16.7 ms/20.0 ms): 60 dB
<1 PLC (3 ms or 800 μs): 0 dB
Maximum Reading Rate: (readings/s)

Power line frequency	Resolution in digits 6½	5½	4½
60 Hz	6	300	1000
50 Hz	5	300	1000

AC Voltage (true rms)

Measurement Accuracy: ± (% of reading + % of range); 1 year, 23° C ± 5° C

Frequency	Ranges 100 mV	Ranges 1, 10, 100, 750 V
3 to 5 Hz	1.00 + 0.04	1.00 + 0.03
5 to 10 Hz	0.35 + 0.04	0.35 + 0.03
10 Hz to 20 kHz	0.06 + 0.04	0.06 + 0.03
20 to 50 kHz	0.12 + 0.04	0.12 + 0.05
50 to 100 kHz	0.60 + 0.08	0.60 + 0.08
100 to 300 kHz	4.00 + 0.50	4.00 + 0.50

Note: –3 dB frequency typically >1 MHz

Input Resistance: 1 MΩ ±2%, in parallel with 100 pF
Input Protection: >750 V rms on all ranges
Maximum Volt–Hz Product: 8 x 10^7
Crest Factor: Maximum of 5:1 at full scale
Maximum Reading Rate: 10 readings/s (50 readings/s with default delays defeated)

Frequency and Period
Range: 3 Hz to 300 kHz (333 ms to 3.33 μs)
1-Year Accuracy: 0.01% (40 Hz to 300 kHz); 0.05% (3 to 40 Hz)
Resolution: 10 μHz to 1 Hz

Other Measurement Functions: Continuity, Diode Test, Ratio dc:dc, Limit Test
Math Functions: NULL, Min/Max/Avg, dB, dBm, Limit Test
Memory: 512-reading internal storage
Standard Programming Languages: SCPI, HP 3478A and Fluke 8840A/42A
Computer Interface: GPIB and RS-232C standard
Accessories Included: Test lead kit, operators manual, service manual, test report, and power cord
Warranty: 3 years standard

Resistance: (2-wire Ω, 4-wire Ω)

Input Characteristics

Range	Maximum reading (6½ digits)	Resolution in digits 6½	5½	4½
100 Ω	120.0000	100 μΩ	1 mΩ	10 mΩ
1 kΩ	1.200000	1 mΩ	10 mΩ	100 mΩ
10 kΩ	12.00000	10 mΩ	100 mΩ	1 Ω
100 kΩ	120.0000	100 mΩ	1 Ω	10 Ω
1 MΩ	1.200000	1 Ω	10 Ω	100 Ω
10 MΩ	12.00000	10 Ω	100 Ω	1 kΩ
100 MΩ	120.0000	100 Ω	1 kΩ	10 kΩ

Input Protection: >1000 V on all ranges
Measurement Accuracy: ±(% of reading + % of range)
Specs are for 4-wire Ω or 2-wire Ω using Math Null

Range	24-Hour 23° C ±1° C	90-Day 23° C ±5° C	1-Year 23° C ±5° C	Current source
100 Ω	0.0030 + 0.0030	0.008 + 0.004	0.010 + 0.004	1 mA
1 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	1 mA
10 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	100 μA
100 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	10 μA
1 MΩ	0.002 + 0.001	0.008 + 0.001	0.010 + 0.001	5.0 μA
10 MΩ	0.015 + 0.001	0.020 + 0.001	0.040 + 0.001	500 nA
100 MΩ	0.300 + 0.010	0.800 + 0.010	0.800 + 0.010	500 nA*

* Measurement is computed from 10 M Ω in parallel with input.

Maximum Reading Rate: Same as dcV

DC Current

Measurement Accuracy: ±(% of reading + % of range)

Range	24-Hour 23° C ±1° C	90-Day 23° C ±5° C	1-Year 23° C ±5° C	Shunt resistance
10 mA	0.005 + 0.010	0.030 + 0.020	0.050 + 0.020	5.0 Ω
100 mA	0.010 + 0.004	0.030 + 0.005	0.050 + 0.005	5.0 Ω
1 A	0.050 + 0.006	0.080 + 0.010	0.100 + 0.010	0.1 Ω
3 A	0.100 + 0.020	0.120 + 0.020	0.120 + 0.020	0.1 Ω

Burden Voltage: <2 V for 3 A input; <0.1 V for 10 mA input
Input Protection: Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse
Maximum Reading Rate: Same as dcV

AC Current (true rms)

Measurement Accuracy: ±(% of reading + % of range); 1 year, 23° C ± 5° C

Frequency	Ranges 1 A	Ranges 3 A
3 to 5 Hz	1.00 + 0.04	1.10 + 0.06
5 to 10 Hz	0.30 + 0.04	0.35 + 0.06
10 Hz to 5 kHz	0.10 + 0.04	0.15 + 0.06

Burden Voltage: <1.5 V rms for 3 A input
Input Protection: Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse
Maximum Reading Rate: Same as acV

General Specifications

Power: 100/120/220/240V, ±10%
Power Line Frequency: 45 to 66 Hz, 360 to 440 Hz
Power Consumption: 25 VA peak (10 W average)
Operating Environment: 0° to 55° C, full accuracy to 80% RH, 40° C
Storage Environment: –40° C to 75° C
Size: 212.6 mm W x 88.5 mm H x 348.3 mm D (8.5 in x 4 in x 14 in)
Weight: Net, 3.6 kg (8.0 lb); shipping, 5.9 kg (13 lb)
Safety: Designed to UL-1244, IEC-348, CSA

Ordering Information

HP 34401A Multimeter
Opt 908 Rackmount Kit
Opt 1BP MIL-STD-45662A Certificate of Calibration with Data
HP 34397A DC to AC Power Inverter
HP 34812A BenchLink/Meter Software
HP 34161A Accessory Pouch
HP 34171A Input Terminal Connector (sold in pairs)
HP 34172A Input Calibration Short (sold in pairs)

Indicates QuickShip availability.

- 1.3 nV rms noise/8 nVp-p
- 100 pV, 100 nΩ sensitivity
- Two-channel programmable voltage input; difference and ratio functions
- 7½ digit resolution
- 1 mV to 100 V ranges
- SCPI and Keithley 181 languages
- Direct SPRT, RTD, Thermistor, and thermocouple temperature measurements

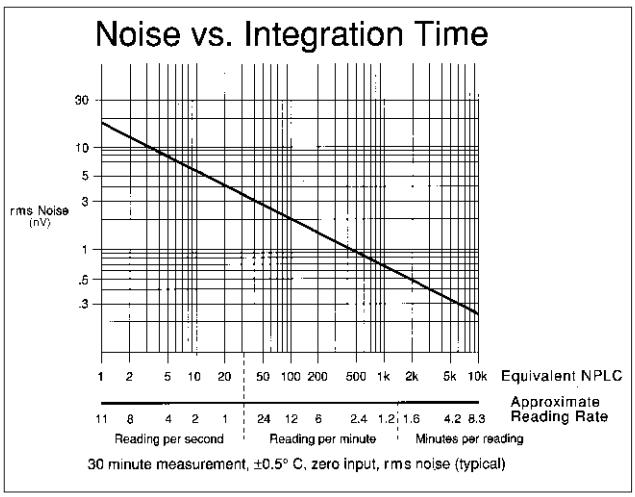
HP 34420A

HP 34420A Nanovolt/Micro-ohm Meter

The HP 34420A sets a price/performance standard in low-level measurement capability. The noise performance of the HP 34420A nanovolt/micro-ohm meter is more than an order of magnitude better than that previously available from Hewlett-Packard.

Accurate, Repeatable Low-Level Measurements

A shielded copper pin screw-down connector, a 7½-digit A/D converter, 2 ppm basic dc accuracy, and a new measurement algorithm that gives 100 dB normal mode rejection without front-end filtering result in measurement capability you can depend on to make accurate and repeatable low-level measurements. Low noise input amplifiers and a highly-tuned input protection scheme bring reading noise down to 8 nVp-p. Longer integration times improve noise performance even further.



Unprecedented Functionality

Two input channels allow voltage measurements to be made independently, or they can be mathematically combined to make difference and ratio measurements. Ohms measurements combine the low-noise input circuits with a highly-stable current source to provide outstanding low-resistance measurements. Offset compensation is employed to eliminate the effects of stray thermal EMFs that would otherwise result in measurement error. Low power ohms and a low-voltage resistance measurement capability allow repeatable measurements to be made where a low voltage (20 mV) is required to avoid oxidation punch-through. A wide range of temperature measurement capabilities are also built in, providing support for SPRT, thermocouple, RTD, and thermistor temperature sensors.

Math Functions Enhance Capabilities

Math functions such as NULL, STATS, and SCALE ease the capture of minimum and maximum readings, provide averages and standard deviation, scale your measurement results, and ultimately makes it easier for you to characterize your input signal. The HP 34420A can also store up to 1024 readings in internal memory.

Built-in Versatility

You will find that the HP 34420A will fit equally well into your bench or your system applications. Designed with the bench user in mind, operation of the HP 34420A from the front panel is straightforward and intuitive. For system applications, the HP 34420A includes both HP-IB and RS-232 interfaces standard, and uses Standard Commands for Programmable Instrumentation (SCPI). This ensures both present and future compatibility. The HP 34420A also responds to commands for the Keithley 181 nanovoltmeter.

Abbreviated Technical Specifications

Accuracy Specifications: ± (% of reading + % of range)

DC Voltage[1] – 7½ digits resolution all ranges

Range	24-Hour 23°C ±1°C	90-Day 23°C ±5°C	1-Year 23°C ±5°C
1 mV	0.0025 + .0020	0.0040 + .0020	0.0050 + .0020
10 mV	0.0025 + .0002	0.0040 + .0002	0.0050 + .0003
100 mV	0.0015 + .0003	0.0030 + .0004	0.0040 + .0004
1 V	0.0010 + .0003	0.0025 + .0004	0.0035 + .0004
10 V	0.0002 + .0001	0.0020 + .0004	0.0030 + .0004
100 V	0.0010 + .0004	0.0025 + .0005	0.0035 + .0005

DCV1/DCV2 (ratio)**:** Ratio error in % = channel 1 accuracy in % + channel 2 accuracy in %
DCV1-2 (difference)**:** Difference error = channel 1 (% reading + % range) + channel 2 (% reading + % range)

DC Voltage Noise Specifications[2]

Range	2-Minute rms noise	2-Minute p-p noise	24-Hour p-p noise
1 mV	1.3 nV RMS	8 nV p-p	12 nV p-p
10 mV	1.5 nV RMS	10 nV p-p	14 nV p-p
100 mV	10 nV RMS	65 nV p-p	80 nV p-p
1 V	100 nV RMS	650 nV p-p	800 nV p-p
10 V	450 nV RMS	3 µV p-p	3.7µV p-p
100 V	11 µV RMS	75 µV p-p	90 µV p-p

DC Voltage
Input Resistance:
10 MΩ ±1% (100 V range)
>10 GΩ (1 mV through 10 V range)
Input Protection:
150 V peak to Channel 1 LO

Resistance[3] – 7½ digits resolution all ranges

Range	Test current	24-Hour 23°C ±1°C	90-Day 23°C ±5°C	1-Year 23°C ±5°C
1Ω	10 mA	0.0015 + .0002	0.0050 + .0002	0.0070 + .0002
10 Ω	10 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002
100 Ω	10 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002
1 kΩ	1 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002
10 kΩ	100 µA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002
100 kΩ	10 µA	0.0015 + .0003	0.0040 + .0004	0.0060 + .0004
1 MΩ	5 µA	0.0020 + .0003	0.0050 + .0004	0.0070 + .0004

Low Power Resistance[3]

Range	Test current	24-Hour 23°C ±1°C	90-Day 23°C ±5°C	1-Year 23°C ±5°C
1 Ω	10 mA	0.0015 + .0002	0.0050 + .0002	0.0070 + .0002
10 Ω	10 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002
100 Ω	1 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002
1 kΩ	100 µA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002
10 kΩ	10 µA	0.0015 + .0004	0.0040 + .0004	0.0060 + .0004
100 kΩ	5 µA	0.0015 + .0012	0.0040 + .0015	0.0060 + .0015
1 MΩ	5 µA	0.0020 + .0003	0.0050 + .0004	0.0070 + .0004

Voltage Limited Resistance[3]
Voltage limit selectable: 20 mV, 100 mV, or 500 mV

Range	Test current	24-Hour 23°C ±1°C	90-Day 23°C ±5°C	1-Year 23°C ±5°C
10 Ω	1 mA	0.0020 + .0002	0.0050 + .0002	0.0070 + .0002
100 Ω	100 µA	0.0025 + .0002	0.0050 + .0002	0.0070 + .0002

Temperature – 0.001°C Resolution

Probe type	Accuracy
SPRT[4]	SPRT probe accuracy + 0.003°C
RTD	RTD probe accuracy + 0.05°C
Thermistor	Thermistor probe accuracy + 0.1°C
Thermocouple[5]	Thermocouple probe accuracy + 0.2°C

Temperature
SPRT: ITS-90 calibrated temperature within the range of –190°C to +660°C
RTD: Type α =.00385 and α =.00392. R_0 from 4.9 Ω to 2.1 KΩ. ITS-90 (IEC 751) Callendar - Van Dusen conversion.
Thermistor: 5 KΩ
Thermocouple: ITS-90 conversions of type B, E, J, K, N, R, S, T

Chart Out (Analog Out)
Resolution: 16 bits
Maximum Output: ±3 V
Span and Offset: Adjustable

Filter (Analog or Digital or Both)
Analog: Low pass 2 pole @ 13 Hz, available for dcV on 1 mV, 10 mV, 100 mV ranges
Digital: Moving average filter. 10 (fast), 50 (medium) or 100 (slow) reading averages.

Math Functions
NULL (Channel 1 dcV, Channel 2 dcV, Difference, Resistance, Temperature)
STATS (Min/max/avg, peak-peak, standard deviation, number of readings)
SCALE (Allows linear scaling as Y=MX + B)
CHART NULL (Establishes zero for rear-panel output)

General Specifications

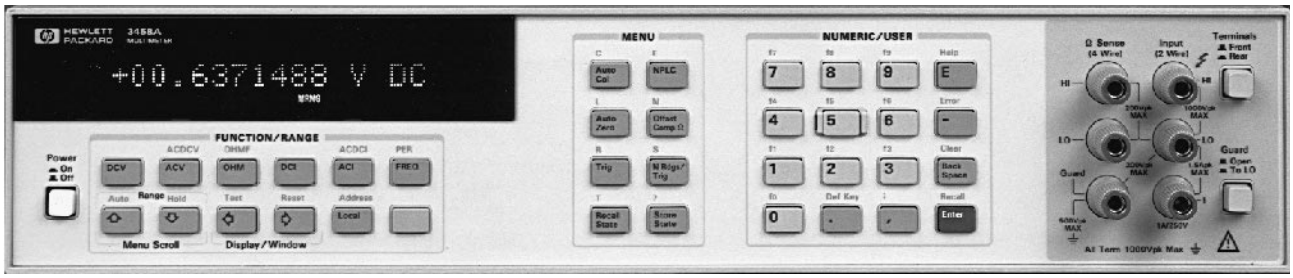
Front-Panel Connection: Shielded, low-thermal, copper contacts
Interface: HP-IB and RS-232 standard
Languages: SCPI-1994 (IEEE-488.2), Keithley 181
Warranty: 3 years standard

Ordering Information

HP 34420A Nanovolt/Micro-Ohm Meter
Includes low-thermal input cable (HP 34102A), low-thermal shorting plug (HP 34103A), operating and service manuals, quick reference guide, test report with calibration sticker, 2.3 ml bottle of contact cleaner, and power cord.
Opt 1CM Rackmount Kit

Accessories
HP 34102A Low-Thermal Input Cable (four-conductor with copper spade lugs)
HP 34103A Low-Thermal Shorting Plug
HP 34104A Low-Thermal Input Connector
HP 34161A Accessory Pouch

[1] Specifications are for channel 1 or channel 2 (100 V range on channel 1 only), after 2-hour warm-up, resolution at 7.5 digits (100 NPLC), with filters off.
[2] After a 2-hour warm-up ± 1° C, 6.5 digits (10 NPLC) with analog filter off digital filter medium (50 readings). 2 minute rms and 24-hour noise typical.
[3] All resistance specifications are for channel 1 only, after 2-hour warm-up, resolution at 7.5 digits (100 NPLC) with filters off, for 4-wire Ω or 2-wire Ω using Null.
[4] For 25 Ω SPRT with triple-point of water check within last 4 hours. With no triple-point of water check, add 0.013° C for 24-hour, 0.035° C for 90-day, and 0.055° C for 1-year specifications.
[5] For fixed reference junction. Add 0.3° C for external reference junction, add 2.0° C for internal reference junction.



HP 3458A

HP 3458A Multimeter

The HP 3458A multimeter shatters long-standing performance barriers of speed and accuracy on the production test floor, in research and development, and in the calibration lab. The HP 3458A is the fastest, most flexible, and most accurate multimeter offered by Hewlett-Packard. In your system or on the bench, the HP 3458A saves you time and money with unprecedented test-system throughput and accuracy, seven-function measurement flexibility, and low cost of ownership.

Select a rate of 100,000 reading per second for maximal test throughput. Or achieve highest levels of precision with up to 8½ digits of measurement resolution and 0.1 part per million transfer accuracy. Add to this the HP 3458A's simplicity of operation, and you have the ideal multimeter for your most demanding applications.

High-Test System Throughput

Faster Testing
- Up to 100,000 readings/s
- Internal test setups > 340/s
- Programmable integration times from 500 ns to 1 s

Greater Test Yield
- More accuracy for tighter test margins
- Up to 8½ digits resolution

Longer Uptime
- Two-source (10 V, 10 kΩ) calibration, including ac
- Self-adjusting, self-verifying auto-calibration for all functions and ranges, including ac

High-Resolution Digitizing

Greater Waveform Resolution and Accuracy
- 16 to 24-bits resolution
- 100,000 to 0.2 sample/s
- 12 MHz bandwidth
- Timing resolution to 10 ns
- Less than 100 ps time jitter
- Over 75,000 reading internal memory

Calibration Lab Precision

Superb Transfer Measurements
- 8½ digits resolution
- 0.1 ppm dc volts linearity
- 0.1 ppm dc volts transfer capability
- 0.01 ppm rms internal noise

Extraordinary Accuracy
- 0.6 ppm for 24 hours in dc volts
- 2.2 ppm for 24 hours in Ω
- 100 ppm mid-band ac volts
- 8 ppm (4 ppm optional) per year voltage reference stability

HP 3458A Multimeter Performance Features

DC Volts
- 5 ranges: 0.1 V to 1000 V
- 8½ to 4½ digits resolution
- Up to 100,000 readings/s (4½ digits)
- Maximum sensitivity: 10 nV
- 0.6 ppm 24-hour accuracy
- 8 ppm (4 ppm optional)/year voltage reference stability

Resistance
- 9 ranges: 10 Ω to 1 GΩ
- 2-wire and 4-wire Ω with offset compensation
- Up to 50,000 readings/second (5½ digits)
- Maximum sensitivity: 10 μΩ
- 2.2 ppm 24-hour accuracy

AC Volts
- 6 ranges: 10 mV to 1000 V
- 1 Hz to 10 MHz bandwidth
- Up to 50 readings/s with all readings to specified accuracy
- Choice of sampling or analog true rms techniques
- 100 ppm best accuracy

DC Current
- 8 ranges: 100 nA to 1 A
- Up to 1,350 readings/s (5½ digits)
- Maximum sensitivity: 1 pA
- 14 ppm 24-hour accuracy

AC Current
- 5 ranges: 100 μA to 1 A
- 10 Hz to 100 kHz bandwidth
- Up to 50 readings/second
- 500 ppm 24-hour accuracy

Frequency and Period
- Voltage or current ranges
- Frequency: 1 Hz to 10 MHz
- Period: 100 ns to 1 second
- 0.01% accuracy
- AC or dc coupled

Throughput

Maximum Reading Rates
- 100,000 readings/s at 4½ digits (16 bits)
- 50,000 readings/s at 5½ digits
- 6,000 readings/s at 6½ digits
- 60 readings/s at 7½ digits
- 6 readings/s at 8½ digits

Measurement System Speed
- 100,000 readings/s over GPIB or with internal memory
- 110 autoranges/s
- 340 function or range changes/s
- Postprocessed math from internal memory

Abbreviated Technical Specifications

DC Voltage

Range	Full scale	Maximum resolution	1-Year* accuracy	Transfer accuracy 10 min., tref ±0.5° C	Input impedance
			ppm of reading + ppm of range		
100 mV	120.00000	10 nV	9(5) + 3	0.5 + 0.5	>10 GΩ
1 V	1.20000000	10 nV	8(4) + 0.3	0.3 + 0.1	>10 GΩ
10 V	12.0000000	100 nV	8(4) + 0.05	0.05 + 0.05	>10 GΩ
100 V	120.000000	1 µV	10(6) + 0.3	0.5 + 0.1	10 MΩ ±1%
1000 V	1050.00000	10 µV	10(6) + 0.1	1.5 + 0.05	10 MΩ ±1%

One-year specifications for NPLC 100 within 24 hours and ±1° C of last ACAL, Tcal ±5° C, MATH NULL, fixed range. Add 2 ppm of reading additional error for HP factory traceability of 10 V dc to US NIST. Traceability error is the absolute error relative to National Standards associated with the source of last external calibration. Transfer specifications for NPLC 100, following 4-hour warm-up. Full scale to 10% of full scale. Measurements on the 1000 V range are within 5% of the initial measurement value and following measurement settling. Tref is the starting ambient temperature. Measurements are made on a fixed range using accepted metrology practices.
*High stability (Option 002) ppm of reading in parentheses.

Noise Rejection (dB)[1]

	AC NMR[2]	AC ECMR	DC ECMR
NPLC < 1	0	90	140
NPLC ≥ 1	60	150	140
NPLC ≥ 10	60	150	140
NPLC ≥ 100	60	160	140
NPLC = 1000	75	170	140

[1] Applies for 1 kΩ unbalance in the LO lead and ±0.1% of the line frequency currently set for LFREQ.
[2] For line frequency ±1%, ACNMR is 40 dB for NPLC ≥ 1, or 55 dB for NPLC ≥ 100. For line frequency ±5%, ACNMR is 30 dB for NPLC ≥ 100.

Maximum Input

	Rated input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±350 V pk
Guard to earth	±500 V pk	±1000 V pk
HI or LO to earth	±1000 V pk	±1200 V pk

True rms AC Voltage
(Synchronous Subsampled Mode)

Range	Full scale	Maximum resolution	Accuracy* 24 hour–2 year 40 Hz to 1 kHz % of reading + % of range	Input impedance
10 mV	12.00000	10 nV	0.02 + 0.011	1 MΩ ±15% with <140 pf
100 mV	120.00000	10 nV	0.007 + 0.002	1 MΩ ±15% with <140 pf
1 V	1.2000000	100 nV	0.007 + 0.002	1 MΩ ±15% with <140 pf
10 V	12.000000	1 µV	0.007 + 0.002	1 MΩ ±2% with <140 pf
100 V	120.00000	10 µV	0.02 + 0.002	1 MΩ ±2% with <140 pf
1000 V	700.0000	100 µV	0.04 + 0.002	1 MΩ ±2% with <140 pf

*Specifications apply for full scale to 10% of full scale, dc <10% of ac, sine-wave input, crest factor of 1.4. Within 24 hours and ± 1° C of last ACAL. Peak (ac+dc) input limited to 5 x full scale for all ranges. Add 2 ppm of reading additional error for HP factory traceability of 10 Vdc to US NIST.

Maximum Input

	Rated input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±350 V pk
Guard to earth	±500 V pk	±1000 V pk
HI or LO to earth	±1000 V pk	±1200 V pk
Volt-Hz product	1 x 10[8]	—

Resistance

Range	Full scale	Maximum resolution	Current through unknown	1-Year Accuracy* (4-wire Ω) ppm of rdg+ppm of range
10 Ω	12.00000	10 µΩ	10 mA	15 + 5
100 Ω	120.00000	10 µΩ	1 mA	12 + 5
1 kΩ	1.2000000	100 µΩ	1 mA	10 + 0.5
10 kΩ	12.000000	1 mΩ	100 µA	10 + 0.5
100 kΩ	120.00000	10 m Ω	50 µA	10 + 0.5
1 MΩ	1.2000000	100 m Ω	5 µA	15 + 2
10 MΩ	12.000000	1 Ω	500 nA	50 + 10
100 MΩ	120.00000	10 Ω	500 nA	500 + 10
1 GΩ	1.2000000	100 Ω	500 nA	0.5% + 10

*Specifications for 100 NPLC, offset compensation on, within 24 hours and ± 1° C of last ACAL, Tcal ±5° C. Add 3 ppm of reading additional error for HP factory traceability of 10 kΩ to US NIST.

Memory

	Standard Readings	Bytes	Option 001 Readings	Bytes
Reading storage (16 bit)	10,240	20 k	+65,536	+128 k
Non-volatile, for subprograms and/or state storage	—	14 k	—	—

Math Functions
The HP 3458A performs the following math functions on measurements: NULL, SCALE, OFFSET, RMS FILTER, SINGLE POLE FILTER, THERMISTOR LINEARIZATION, DB, DBM, % ERROR, PASS/FAIL LIMIT TESTING, and STATISTICS. Two math functions may be used at one time.

General Specifications

Operating Temperature: 0° to 55° C
Warmup Time: Four hours to all specifications except where noted
Humidity Range: 95% RH, 0° to 40° C
Storage Temperature: –40° to +75° C
Power: 100/120 V, 220/240 V ± 10%, 48 to 66 Hz, 360 to 420 Hz automatically sensed. Fused at 1.5 A @ 115 V or 0.5 A @ 230 V. <30 W, < 80 VA (peak).
Size: 425.5 mm W x 88.9 mm H x 502.9 mm D (16.75 in x 3.5 in x 19.8 in)
Weight: Net, 12 kg (26.5 lb); shipping, 14.8 kg (32.5 lb)

Ordering Information

HP 3458A Multimeter (with HP-IB, 20 KB reading memory, and 8 ppm stability)
Opt 001 Extended Reading Memory (expands total to 148 KB)
Opt 002 High-Stability (4 ppm/year) Reference
Opt 1BP MIL-STD-45662A Certificate of Calibration with Data
Opt W30 Two Additional Years Return-to-HP Hardware Support
Opt W32 Three-year Customer Return Calibration Coverage
Opt 907 Front-handle Kit
Opt 908 Rack Flange Kit
Opt 909 Rack Flange Kit (with handles)

- Sophisticated math functions
- 3½, 4½ digits
- Temperature
- Safety shutter
- Dual display


Handheld Multimeters

These handheld multimeters are ideal for portable measurements requiring basic accuracy from 0.7% to 0.05%, 3½ digits, or 4½ digits.

HP E2373A

This basic multimeter measures dc and ac voltage/current, resistance, diode test and audible continuity. It provides a large 0.85 inch (22 mm) high display as well as an analog bar graph in a compact size.

HP 970 Series Features

These meters come with sophisticated math functions that allow relative (difference) or percent readings for checking tolerances, min./max. with time stamp to monitor all types of measurements including temperature, Hold and Auto Hold for saving a reading manually or automatically and average to quiet noisy measurements. Auto-diode reverses the leads for you to check semiconductor junctions, a secondary digital display shows the range of the function or elapsed time in min./max. and autopower off turns off the meter after 30 minutes of inactivity, or defeats it for extended measurements. The innovative terminal shutter prevents inadvertent use of the current terminals by requiring two operations by the user to connect the terminals.

Description

All meters come with ac/dc volts, ac/dc current, ohms, continuity, diode test, auto-diode test, frequency, and °F and °C high-resolution temperature (using optional temperature probe).

HP 971A
The sophisticated math functions and the extra rugged and bright yellow design make this an ideal meter for general-purpose measurements.

HP 972A
40 mV ac/dc range, 20 kHz bandwidth, capacitance and a dual display distinguishes this meter. The dual display allows the simultaneous reading of voltage and frequency.

HP 973A
For demanding applications this meter has basic dc accuracy of 0.1%, 20 kHz true rms, ac+dc, and dB/dBm for ac. This meter has features and functions for maximum flexibility. You get a dual digital display, frequency, current, capacitance, and thermocouple temperature as added features.

HP 974A
When extra precision is required, so is the HP 974A. 4½ digits, dc accuracy of 0.05%, 100 kHz BW true rms, ac+dc, and dB/dBm with 0.01 dB resolution make this the best value for high precision.

	E2373A	971A	972A	973A	974A
Display count	3200	4000	4000	4000	49999
Basic accuracy					
dc volts	0.7%	0.3%	0.2%	0.1%	0.05%
ac volts	1.2%	1%	0.5%	0.7%	0.5%
ohms	0.7%	0.5%	0.2%	0.2%	0.06%
capacitance	—	—	1.2%	1.2%	—
Frequency response					
ac volts	500 Hz	1 kHz	20 kHz	20 kHz	100 kHz
Resolution/ maximum reading					
dcV	100 µV 1000 V	100 µV 1000 V	10 µV 1000 V	10 µV 1000 V	10 µV 1000 V
acV	1 mV 750 V	100 µV 1000 V	10 µV 1000 V	10µV 1000 V	10µV 750 V
ohms	0.1 Ω 30 MΩ	0.1 Ω 40 MΩ	0.1 Ω 40 MΩ	0.1 Ω 40 MΩ	0.01 Ω 50 MΩ
current	10 µA 10 A	100 nA 10 A	100 nA 10 A	100 nA 10 A	10 nA 10 A
elapsed time	—	1 min. 1999 min.	1 min. 1999 min.	1 min. 1999 min.	1 sec 9999 min.
frequency	—	1 Hz 100 kHz	0.01 Hz 200 kHz	0.01 Hz 200 kHz	0.01 Hz 200 kHz
Battery life (typical hours)	2,500	1000	600	600	120
Current shutter		•	•	•	•
Bargraph	•	•	•	•	
Thermistor temperature		•	•	•	•
Thermocouple temperature				•	
Dual digital display			•	•	
True rms ac response				•	•
dBm/dB				•	•
Warranty (years)	3	3	3	3	3

HP E2373A
Standard accessories include pair of test leads, installed batteries, spare fuse and manual.
Size: 76 mm W x 164 mm H x 33 mm D (3 in x 6.5 in x 1.3 in)
Weight: 240 g (.53 lb)

970 Series
Standard accessories include a pair of test leads, manual, certificate of calibration, spare fuse, rubber boot, and two installed AA batteries.
Size: 87 mm W x 190 mm H x 39 mm D (3.4 in x 7.5 in x 1.5 in)
Weight: 440 g (1 lb) approx.

Digital Multimeter Accessory Compatibility Chart and Products

Accessory	HP 34401A	HP 3458A	HP E2373/ HP 970 series	HP34420A[1]
34132A Deluxe Test Lead Kit	Yes	No	Yes	No
34132B Deluxe Test Lead Kit	Yes	Yes	Yes	No
34132C Deluxe Test Lead Kit	Yes	No	Yes	No
11059A Kelvin Probe Set	Yes	Yes	No	No
11062A Kelvin Clip Set	Yes	Yes	No	Yes
34133A Precision Electronic Probe	Yes	No	Yes	No
11060A Surface-Mount Device Probe	Yes	Yes	Yes	No
34171A DMM Terminal Connector	Yes	No	No	No
34172A DMM Calibration Short	Yes	No	No	No
11053A Lug-Lug Jumper Set	No	Yes	No	No
11174A Lug-Banana Jumper Set	Yes	Yes	Yes	No
11058A Banana-Banana Jumper Set	Yes	Yes	Yes	No
E2305A Spare Test Leads	No	No	Yes	No
E2301A Surface Type-K Thermocouple Probe **E2303A** SMP-Dual Banana Adapter	Yes[2]	No[3]	973A	No
E2307A Type-K Thermocouple Bead Temperature Probe	Yes[2]	No[3]	973A	No
E2308A Thermistor Temp Probe	Yes[2]	Yes	Yes, except E2373	No
40653B Thermistor Surface Sensor Assembly	Yes[2]	Yes	Yes, except E2373	No
34134A AC/DC Current Probe	Yes	No	Yes	No
34135A AC/DC Current Probe	Yes	No	Yes	No
34330A 30 A Current Shunt	Yes	Yes	Yes	No
34397A 12 Vdc to 115V ac inverter	Yes	Yes	N/A	Yes
34131A Basic Instrument Transit Case	Yes	No	No	Yes
34161A Accessory Pouch	Yes	No	No	Yes
E2304A Handheld Multimeter Carrying Case	No	No	Yes	No

[1] Many accessories are listed as incompatible with HP 34420A because of the specialized termination. Many of these accessories may be rewired onto the low thermal input connector 34104A.

[2] Need HP 34812A BenchLink Meter or an external program to do temperature measurements.

[3] Compatible with voltmeter inputs, however an external program would be needed for temperature calculations.

HP 34132A

HP 34133A

HP 11060A

HP 11059A

Test Leads

HP 34132A/B/C Deluxe Test Lead Kits

The test leads in these kit feature a 1.4 m flexible cable and a soft Sanoprene over mold for a comfortable grip. They are rated at 1000V CAT III. Each kit contains red and black test leads, needle point and alligator test lead tips and red and black retractable hook test leads. Supplied in a reusable nylon pouch.

The kits are available with the following banana plug configurations:

HP Model	Description
HP 34132A	Deluxe test lead kit with straight fixed sheath banana plugs
HP 34132B	Deluxe test lead kit with straight retractable sheath banana plugs
HP 34132C	Deluxe test lead kit with right angle fixed sheath banana plugs

HP 34133A Precision Electronic Test Leads

These precision electronic test leads are designed specifically for working with small components and in dense circuit boards. The test leads are small and light. The spring-loaded tip helps absorb those small movements and the crown point digs into solder. The test leads have a 1.2 m flexible cable, terminated in right angle shrouded banana plugs and have a Sanoprene over-mold for a comfortable grip. Each kit includes one black and one red test lead.

HP 11060A Surface Mount Device Tweezers

The gold plated beryllium copper tweezer design provides an easy method to access and accurately measure SMD resistive networks. Length 1.2 m.

Kelvin Probe and Clips

HP 11059A Kelvin Probe Set

This high quality Kelvin probe set is complete and ready to use for making 4-wire Ohm measurements. The 4 color coded banana jacks and Kelvin clips are both gold plated for maximum conductivity and resistance to corrosion. The probe assembly also includes a ground to guard connector to help remove any ground related errors for the ultimate in high accuracy measurement, ideal for use with the HP 3458A 8½ digit DMM. The wires are encased in a woven shroud for ease of use and to protect the cables.

HP 11062A Kelvin Clip Set

These silver plated Kelvin clips are ideal for constructing your own Kelvin Probe set for 4-wire Ohm measurements. Each set contains 2 clips.


HP 34134A


HP 34135A


HP E2301A with HP 2302A

HP 34330A


HP 34397A


HP 34161A


HP 34131A


HP E2304A

Low Thermal Cables

These cables are used to minimize error in low voltage measurements. Each kit contains one red and one black cable. Length 1.2 m

- HP 11053A Low Thermal Lug to Lug Cable
- HP 11174A Low Thermal Lug to Banana Cable
- HP 11058A Low Thermal Banana to Banana Cable

Current Measurement

HP 34134A DC Coupled Current Probe

A clamp on probe for a wide range of applications such as measuring ground currents, powers ripple or current distribution in systems. Output signals: 1 V/A (1 mV/mA) and 10 mV/A. Frequency range: DC to 2 kHz.

HP 34135A DC Coupled Current Probe

A clamp on probe idea for measuring high current electrical systems. Measurement range 1 to 600A (Peak) AC and 1 to 600A DC. Output signal: 1mV/A, Frequency range: DC to 10 KHz

HP 34330A 30 A Current Shunt

This current shunt can be used to extend the current measurement range. Precision 0.001 Ohm resistor. Output is 1 mV per amp of current passing through the shunt. 15 A continuous; 30A for 15 min continuous.

Temperature Measurement

HP 40653B Thermistor Surface Assembly

10,000 Ohm thermistor with fast response gives real time measurements. Temperature range: –10° C to 100° C. Accuracy: ±1° C. termination: bare wire.

HP E2301A Surface Type-K Thermocouple Probe

Designed for measuring surface temperatures on PC boards, this probe has a narrow tip and quick response to temperature change. Accuracy ±2.2° C or 0.75%, whichever is greater. Temperature range: –130° C to 260° C. Length 0.9m Must be used with the HP E2303A thermocouple probe adapter.

E2307A Type-K Thermocouple Bead Temperature Probe

General-purpose thermocouple temperature probe. Accuracy: -260° C to 110° C, ±2% of reading. Length: 0.9m. Terminated in dual banana plug.

E2308A Thermistor Temperature Probe

General purpose temperature probe. 5KOhm @ 25° C, encapsulated in a stainless steel case. Temperature range: -80° C to 150° C. Accuracy: 0 to 70° C, ±2%. Time constant: 3 seconds typical

Miscellaneous DMM Accessories

HP 34171A DMM Terminal Connector

Provides a convenient and reliable method to connect wires to all five input terminals on the HP 34401A. Qty 2.

HP 34172A DMM Calibration Short

Provides a convenient and secure method to apply a short to the input connectors of the HP 34401A for calibration purposes. Qty 2.

HP 34397A 12 Vdc to 115 Vac Inverter

Hit the road and power your instruments from a cigarette lighter with this dc-to-ac inverter. Accepts inputs from 10.5 to 15 V and provides 100 W max. power at 115 Vac.

HP 34161A Accessory Pouch

Cordura pouch fits on top of the HP 34401A and HP 34420A voltmeters as well as the HP 54131/32/81A counter and the HP 33120A function/arb generator.

HP 34131A Basic Instrument Transit Case

Heavy-duty hard-cover carrying case is constructed from rugged A.B.S. and has rubber-grip steel handles and steel latches. The case can be padlocked. For use with HP 34401A and HP 34420A voltmeters as well as the HP 53131/32/81A counter and the HP 33120A function/arb generator.

HP E2304A Handheld Multimeter Carrying Case

Padded case with dual zipper and snap-on belt strap. For use with HP 970 series handhelds.

Low-Cost Data Acquisition/Switch Unit

HP 34970A

- 3-slot data acquisition and switching mainframe
- 6½-digit (22 bit) internal DMM
- 11 built-in measurement functions
- 8 switch and control plug-in modules
- HP BenchLink data logger software included

HP 34970A (Front Panel)

HP 34970A (Back Panel)

HP 34970A Data Acquisition/Switch Unit

The HP 34970A is a high performance, low-cost data acquisition and switching mainframe ideal for data logging, data acquisition, and general-purpose switching and control applications. It consists of a half-rack mainframe with an internal 6½-digit (22 bit) digital multimeter. Three module slots are built into the rear of the unit to accept a combination of switch and control modules. Whether you need a few channels of simple data logging or a hundred channels of ATE performance, the HP 34970A meets your data acquisition needs at a price that meets your budget.

Measurements You Can Trust

The HP 34970A incorporates the measurement engine from our best-selling benchtop digital multimeter (DMM). You get the benefit of proven HP performance, universal inputs with built-in signal conditioning, and modular flexibility, all in a low-cost, compact data acquisition package. The HP 34970A features 6½ digits (22 bits) of resolution, 0.004% basic dcV accuracy, and ultra-low reading noise. Combine that with scan rates of up to 250 channels/sec, and you've got the speed and accuracy you need to get the job done.

Powerful Flexibility

The HP 34970A's unique design allows per-channel configurability for maximum flexibility and quick, easy setup. The internal autoranging DMM measures 11 different functions directly, eliminating the need for expensive external signal conditioning. Temperature conversion routines are built-in to display raw thermocouple, RTD, or thermistor inputs in degrees C, F, or Kelvin. Use Mx+B scaling to convert linear transducer outputs directly into engineering units. You can even set high/low alarm limits to warn you of out-of-tolerance conditions.

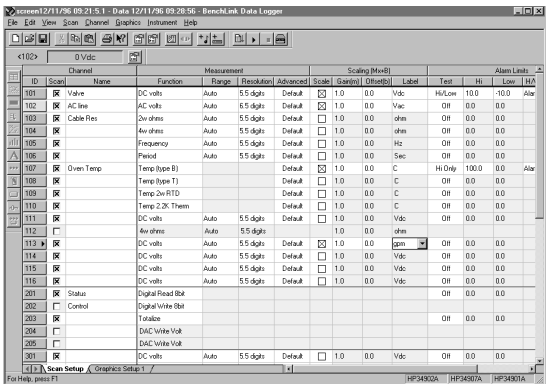
Custom Configurations That Grow With You

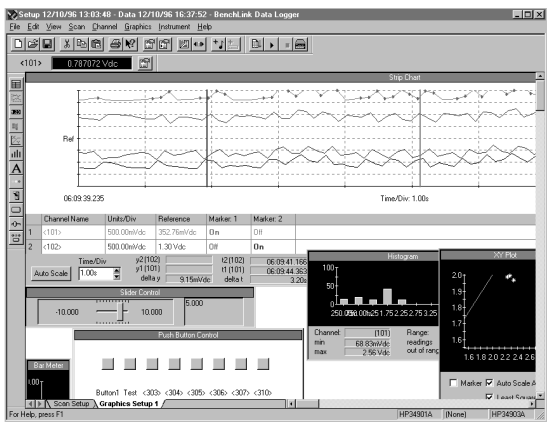
Three module slots and eight switch and control modules allow you to customize the HP 34970A to meet your unique requirements. Buy only what you need, and add more modules later as your application grows. Measure up to 120 inputs with a single half-rack unit.

Free HP BenchLink Software Simplifies Your Data Gathering

If you want PC-based data logging capabilities, but don't want to spend hours programming, HP BenchLink Data Logger is the answer. Use it to set up your test, acquire and archive measurement data, and perform real-time display and analysis of the incoming measurements.

A familiar spreadsheet environment makes it easy to configure and control your tests. A rich set of colorful graphics provides many options for displaying your data—all with point-and-click ease. Set up multiple graphics using strip charts, histograms, X-Y scatter charts, alarm lights and more. Also use HP BenchLink Data Logger to easily move data to other applications for further analysis, or for inclusion in your presentations and reports.





Free HP BenchLink Data Logger makes PC-based setup and analysis easy.

Applications

Data Logging

Configured with the HP 34901A 20-channel relay multiplexer, the HP 34970A becomes a rugged, low-cost data logger that's ideal for quick tests in the lab or in the field. An intuitive front panel with self-guiding menus and a bright, easy-to-read vacuum flourescent display make standalone set-up fast and easy. All readings are automatically time stamped and stored in a 50,000 reading memory — enough memory to hold a week's worth of data (20 channels scanned every five minutes). The non-volatile memory holds your data even after power is removed, so you can use the HP 34970A to collect data at a remote location for later uploading to a PC. The system configuration is also held in non-volatile memory, so in the event of a power failure the unit automatically resumes scanning when power is returned. And for PC-based testing, HP BenchLink Data Logger software is included to simplify your test configurations, data analysis and data managament.

Automated Testing

For automated test and benchtop automation applications, the HP 34970A's three slots and choice of eight plug-in switch and control modules allow easy customization. The 6½-digit internal DMM brings you the power and performance of a world-class standalone DMM, but in a fraction of the space and at a fraction of the cost. Software drivers that support HP VEE and National Instruments LabVIEW are available to make an easy integration of the HP 34970A into your test sytem. Standard RS-232 and GPIB interfaces and SCPI programming language make integration even easier. A three-year warranty is also standard, as is our proprietary relay maintenance system which automatically counts and stores every individual switch closure to help you predict relay end-of-life and avoid costly production line downtime.

Switching

For test applications that don't require the built-in measurements of the HP 34970A, the unit can be ordered without the internal DMM. This provides an ultra low-cost solution for routing test signals to and from your device-under-test and assorted instruments, including external DMMs, scopes, counters and power supplies. Plus, you can add the DMM later if your needs change.

Module Overview

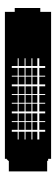
Up to three modules, in any combination, can be inserted into a single mainframe. The HP 34970A's internal DMM connections are accessible only through the HP 34901A, HP 34902A, and HP 34908A multiplexers. The HP 34970A accuracy specifications already include the switching offset and reference junction errors shown in the table below; these errors are listed separately for determining system error with external measurement devices.

The **HP 34901A** 20-channel multiplexer is the most versatile module for general-purpose scanning. It combines dense, multifunction switching with 60 channel/second scan rates to address a broad spectrum of data acquisition applications.

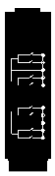
The **HP 34902A** 16-channel high-speed multiplexer employs reed relays to achieve scan rates of up to 250 channels-per-second. This module is ideal for high-throughput automated test applications, as well as high-speed data logging and monitoring tasks.

Use the **HP 34908A** 40-channel single-ended multiplexer for the greatest density in common-low applications, such as battery test, component characterization, and benchtop testing.

Use the **HP 34903A** 20-channel general-purpose switch module to cycle power to products-under-test, control indicator and status lights, actuate external relays requiring large drive signals, and to build custom switch configurations.



The **HP 34904A** is a two-wire, 4x8 full cross-point matrix that gives you the most flexible connection path between your device-under-test and your test equipment, allowing different instruments to be connected to multiple points on your DUT at the same time.



The **HP 34905A** and **HP 34906A** RF multiplexers offer broadband switching capabilities for high-frequency and pulsed signals to 2 GHz. Use them to route test signals between your device-under-test and your signal generator, oscilloscope, spectrum analyzer, video amplifier, or receiver.

The **HP 34907A** multifunction module allows great flexibility for a variety of sense and control applications. It combines two 8-bit ports of digital input and output, a 100 kHz gated totalizer, and two ±12 V analog outputs—all on a single module.

Module Specifications

Module Description	Type	Connects to internal DMM	Speed (ch./sec.)	Maximum Input Voltage	Current	Power	Offset Voltage	Bandwidth	Comments
HP 34901A 20-ch. Multiplexer	2-wire armature (4-wire selectable)	yes	60	300 V	1 A	50 W	< 3 µV	10 MHz	2 current channels (22 ch. total) Built-in cold junction reference
HP 34902A 16-ch. Multiplexer	2-wire reed (4-wire selectable)	yes	250	300 V	50 mA	2 W	< 6 µV	10 MHz	Built-in cold junction reference
HP 34903A 20-ch. Actuator/GP Switch	SPDT / form C	no	120	300 V	1 A	50 W	< 3 µV	10 MHz	—
HP 34904A 4 x 8 Matrix	2-wire armature	no	120	300 V	1 A	50 W	< 3 µV	10 MHz	Full crosspoint
HP 34905A Dual 1: 4 RF Mux, 50 Ω	Common Low (unterminated)	no	60	42 V	0.7 A	20 W	< 6 µV	2 GHz	1 GHz through provided BNC-to-SMB adapter cables
HP 34906A Dual 1: 4 RF Mux, 75 Ω	Common Low (unterminated)	no	60	42 V	0.7 A	20 W	< 6 µV	2 GHz	1 GHz through provided BNC-to-SMB adapter cables
HP 34907A Multifunction Module	Two 8-bit digital I/O ports 26-bit Event Counter Two Analog Outputs	no no no	— — —	42 V 42 V ± 12 V	400 mA — 10 mA	— — —	— — —	— 100 kHz dc	Open drain Gated; selectable input threshold 16-bit, earth referenced
HP 34908A 40-ch. single-ended Mux	1-wire armature (common low)	yes	60	300 V	1 A	50 W	< 3 µV	10 MHz	No 4-wire measurements

These are abbreviated specifications. For more detailed information on the HP 34970A, refer to HP publication number 5965-5290.

Accuracy Specifications ± (% of reading + % of range)[1]

Includes measurement error, switching error and transducer conversion error

Function	Range[2]	Frequency, etc.	1 Year 23° C ±5° C
DC Voltage	100.0000 mV		0.0050 + 0.0040
	1.000000 V		0.0040 + 0.0007
	10.00000 V		0.0035 + 0.0005
	100.0000 V		0.0045 + 0.0006
	300.000 V		0.0045 + 0.0030
True RMS AC Voltage[3]	100.0000 mV to 100.0000 V	3 Hz–5 Hz	1.00 + 0.04
		5 Hz–10 Hz	0.35 + 0.04
		10 Hz–20 kHz	0.06 + 0.04
		20 kHz–50 kHz	0.12 + 0.05
		50 kHz–100 kHz	0.60 + 0.08
		100 kHz–300 kHz[4]	4.00 + 0.50
	300.0000 V	3 Hz–5 Hz	1.00 + 0.08
		5 Hz–10 Hz	0.35 + 0.08
		10 Hz–20 kHz	0.06 + 0.08
		20 kHz–50 kHz	0.12 + 0.12
		50 kHz–100 kHz	0.60 + 0.20
		100 kHz–300 kHz[4]	4.00 + 1.25
Resistance[5]	100.0000 Ω	1 mA current source	0.010 + 0.004
	1.000000 kΩ	1 mA	0.010 + 0.001
	10.00000 kΩ	100 µA	0.010 + 0.001
	100.0000 kΩ	10 µA	0.010 + 0.001
	1.000000 MΩ	5.0 µA	0.010 + 0.001
	10.00000 MΩ	500 nA	0.040 + 0.001
	100.0000 MΩ	500 nA || 10 MΩ	0.800 + 0.010
Frequency and Period[6]	100 mV to 300 V	3 Hz–5 Hz	0.10
		5 Hz–10 Hz	0.05
		10 Hz–40 Hz	0.03
		40 Hz–300 kHz	0.01
DC Current (HP 34901A only)	10.00000 mA	<0.1 V burden	0.050 + 0.020
	100.0000 mA	<0.6 V	0.050 + 0.005
	1.000000 A	<2 V	0.100 + 0.010
True RMS AC Current (HP 34901A only)	10.00000 mA and[3] 1.00000 A	3 Hz–5 Hz	1.00 + 0.04
		5 Hz–10 Hz	0.30 + 0.04
		10 Hz–5 kHz	0.10 + 0.04
	100.0000 mA[7]	3 Hz–5 Hz	1.00 + 0.5
		5 Hz–10 Hz	0.30 + 0.5
		10 Hz–5 kHz	0.10 + 0.5

Temperature	Type	Best Range Accuracy[8]	
Thermocouple	B	1100° C to 1820° C	1.2° C
	E	–150° C to 1000° C	1.0° C
	J	–150° C to 1200° C	1.0° C
	K	–100° C to 1200° C	1.0° C
	N	–100° C to 1300° C	1.0° C
	R	300° C to 1760° C	1.2° C
	S	400° C to 1760° C	1.2° C
	T	–100° C o 400° C	1.0° C
RTD	R_0 from 49 Ω to 2.1 kΩ	–200° C to 600° C	0.06° C
Thermistor	2.2 k, 5 k and 10 k	–80° C to 150° C	0.08° C

Measurement Characteristics[9]

DC Voltage	
Measurement Method	Continuously integrating multi-slope III A–D Converter
A–D Linearity	0.0002% of reading + 0.0001% of range
Input Resistance	
100 mV, 1 V, 10 V ranges	Selectable 10 MΩ or > 10,000 MΩ
100 V, 300 V ranges	10 MΩ ± 1%
Input Bias Current	< 30 pA at 25° C
Input Protection	300 V all ranges
True RMS AC Voltage	
Measurement Method	AC coupled True RMS—measures the AC component of the input with up to 300 Vdc of bias on any range
Crest Factor	Maximum of 5:1 at full scale
Additional Crest Factor Errors (non-sinewave)	Crest Factor 1–2 0.05 % of reading Crest Factor 2–3 0.15 % of reading Crest Factor 3–4 0.30 % of reading Crest Factor 4–5 0.40 % of reading
Input Impedance	1 MΩ ± 2% in parallel with 150 pF
Input Protection	300 Vrms all ranges
Resistance	
Measurement Method	Selectable 4-wire or 2-wire Ohms. Current source referenced to LO input.
Offset Compensation	Selectable on 100 Ω, 1k Ω, 10k Ω ranges
Maximum Lead Resistance	10% of range per lead for 100 Ω and 1 k Ω ranges. 1 kΩ on all other ranges.
Input Protection	300 V on all ranges
Frequency and Period	
Measurement Method	Reciprocal counting technique
Voltage Ranges	Same as AC voltage function
Gate Time	1s, 100 ms, or 10 ms
Measurement Timeout	Selectable 3 Hz, 20 Hz, 200 Hz LF limit
DC Current	
Shunt Resistance	5 Ω for 10 mA, 100 mA; 0.1 Ω for 1 A
Input Protection	1A 250 V fuse on HP 34901A module
True RMS AC Current	
Measurement Method	Direct coupled to the fuse and shunt. AC coupled True RMS measurement (measures the ac component only).
Shunt Resistance	5 Ω for 10 mA; 0.1 Ω for 100 mA, 1 A
Input Protection	1A 250 V fuse on HP 34901A module
Thermocouple	
Conversion Conformity	ITS-90 based software routines
Reference Junction Type	Internal, Fixed, or External
Open Thermocouple Check	Selectable per channel. Open >5k Ω.
RTD	Type α = .00385 (DIN) and α = .00392
Thermistor	44004, 44007, 44006 series
Measurement Noise Rejection 60 (50) Hz[10]	
dc CMRR	140 dB
ac CMRR	70 dB
Integration Time	**Normal Mode Rejection**[11]
200 plc / 3.33s (4s)	110 dB[12]
100 plc / 1.67s (2s)	105 dB[12]
20 plc / 334 ms (400 ms)	100 dB[12]
10 plc / 167 ms (200 ms)	95 dB
2 plc / 33.3 ms (40 ms)	90 dB
1 plc / 16.7 ms (20 ms)	60 dB
< 1 plc	0 dB

[1] Specifications are for 1-hour warm-up and 6½ digits, slow ac filter
[2] 20% over range on all ranges except 300 Vdc and ac ranges and 1 A dc and ac current ranges
[3] For sinewave input > 5% of range. For inputs from 1% to 5% of range and < 50 kHz, add 0.1% of range additional error.
[4] Typically 30% of reading error at 1 MHz, limited to 1 x 108 V Hz
[5] Specifications are for 4-wire ohms function or 2-wire ohms using scaling to remove the offset. Without scaling, add 1 Ω additional error in 2-wire ohms function.
[6] Input > 100 mV. For 10 mV inputs, multipy % of reading error x 10.
[7] Specified only for inputs >10 mA
[8] 1 year accuracy. For total measurement accuracy, add temperature probe error.
[9] 300 Vdc, ac rms isolation voltage (ch-ch, ch-Earth)
[10] For 1 KΩ unbalance in LO lead
[11] For power line frequency ±0.1%
[12] For power line frequency ±1%, use 40 dB or ±3% use 30 dB

Operating Characteristics[1]

Single Channel Measurement Rates[2]

Function	Resolution	Reading/s
dcV, 2-wire resistance	6½ digits (10 plc) 5½ digits (1 plc) 4½ digits (0.02 plc)	6 (5) 57 (47) 600
Thermocouple	0.1° C (1 plc) (0.02 plc)	57 (47) 220
RTD, Thermistor	0.01° C (10 plc) 0.1° C (1 plc) 1° C (0.02 plc)	6 (5) 57 (47) 220
acV	6½ Slow (3 Hz) 6½ Med (20 Hz) 6½ Fast (200 Hz) 6½[3]	0.14 1 8 100
Frequency, Period	6½ digits (1s gate) 5½ digits (100 ms) 4½ digits (10 ms)	1 9 70

System Speeds[4]	Channel/s
INTO Memory	
Single channel dcV	600
34902A scanning dcV	250
34907A scanning digital in	250
34902A scanning dcV with scaling and 1 alarm fail	220
34907A scanning totalize	170
34902A scanning temperature	160
34902A scanning acV[3]	100
34902A scanning dcV/Ohms on alternate channels	90
34901A/34908A scanning dcV	60
INTO and OUT of memory to HP-IB or RS-232 (init/fetch)	
34902A scanning dcV	180
34902A scanning dcV with timestamp	150
OUT of memory to HP-IB	
Readings	800
Readings with timestamp	450
Readings with all format options ON	310
OUT of memory to RS-232	
Readings	600
Readings with timestamp	320
Readings with all format options ON	230
DIRECT to HP-IB or RS-232	
Single channel dcV	440
34902A scanning dcV	200
Single channel MEAS DCV10/MEAS DCV 1	25
Single channel MEAS DCV/ MEAS OHMS	12
HP BenchLink Performance	
Scan and save to disk with 2 strip-charts displayed	100

System Characteristics

Scanning Inputs	
Analog	HP 34901A, 34902A, and 34908A multiplexer channels
Digital	HP 34907A digital in and totalize
Scan list	Scans channels in ascending order
Triggering	
Source	Interval, external, button press, software, or on monitor channel alarm
Scan count	1 to 50,000 or continuous
Scan interval	0 to 99 hours; 1 ms step size
Channel delay	0 to 60 seconds per channel; 1 ms step size
External trig delay	< 2 ms. With monitor on < 200 ms.
External trig jitter	< 2 ms
Alarms	
Analog inputs	Hi, Lo, or Hi + Lo evaluated each scan
Digital inputs	34907A digital in: maskable pattern match or state change 34907A totalize: Hi limit only
Monitor channel	Alarm evaluated each reading
Alarm outputs	4 TTL compatible; selectable TTL logic Hi or Lo on fail
Latency	5 ms (typical)

Memory (Battery backed, 4 year typical life[5])	
Readings	50,000 with timestamp Readable during scan
States	5 instrument states with user label
Alarm queue	Up to 20 events with channel number, reading, and timestamp
System Features	
Per-channel math	Individual Mx + B scaling and Min/Max/Average calculated real time
Power fail recovery	Resumes scanning automatically
Relay maintenance	Counts each relay closure and stores on module. User resettable.
Real time clock	Battery-backed, 4 year typical life[5]

HP BenchLink Data Logger software (not included with Option 001)	
System Requirements[6]	
PC Hardware	486, 66 MHz, 16 MB RAM, 12 MB disk space
Operating Systems	Windows 3.1/95/98, Windows NT 4.0
Computer Interfaces[7]	
HP-IB	HP 82335B, 82340A/B/C, 82341A/B/C/D National Instruments AT-GPIB/TNT, PCI-GPIB
LAN -to- GPIB	HP E2050A (Windows 95 and NT only)
RS-232 (Serial Port)	PC COM 1-4

[1] Reading speeds for 60 Hz and (50 Hz) operation
[2] For fixed range and function, readings to memory, scaling and alarms off, autozero off
[3] Maximum limit with default settling delays defeated
[4] Speeds are for 4 ½ digits, delay 0, display off, autozero off. Using 115 kB RS-232 setting.
[5] Storage at temperatures above 40° C will decrease battery life
[6] Software provided on CD-ROM and includes utility to create floppy disks for installation
[7] Interface and driver must be purchased separately

General

Power Supply: 100 V/120 V/220 V/240 V ±10%
Power Line Frequency: 45 Hz to 66 Hz automatically sensed
Power Consumption: 12 W (25 VA peak)
Operating Environment:
Full accuracy for 0° C to 55° C
Full accuracy to 80% R.H. at 40° C
Storage Environment: –40° C to 70° C
Weight: Net: 3.6 kg (8.0 lbs)
Safety: Conforms to CSA, UL-1244, IEC 1010 Cat I
RFI and ESD: CISPR 11, IEC 801/2/3/4
Warranty: 3 years

Ordering Information

HP 34970A Data Acquisition/Switch Unit
Includes internal 6½ digit DMM, operating and service manuals, test report, power cord, and Quick Start package (includes HP Benchlink Data Logger software, RS-232 cable, thermo-couple, and screwdriver). Modules are purchased seperately and are required to operate.
Opt 001 Delete Internal DMM
Same as above but deletes DMM and quick start package. Order 34970-80010 to retrofit DMM at a later time.
Opt 1CM Rackmount Kit
Opt 0B0 Delete Manual Set
HP 34901A 20-Channel Armature Multiplexer
HP 34902A 16-Channel Reed Multiplexer
HP 34903A 20-Channel Actuator/General Purpose Switch
HP 34904A 4 x 8 Two-Wire Matrix Switch
HP 34905A Dual 4-Channel RF Multiplexer, 50 Ohms
Includes (10) SMB-to-BNC(f) 50 Ω adapter cables
HP 34906A Dual 4-Channel RF Multiplexer, 75 Ohms
Includes (10) SMB-to-BNC(f) 75 Ω adapter cables
HP 34907A Multifunction Module
HP 34908A 40-Channel Single-Ended Multiplexer
Accessories
HP 34161A Accessory Pouch
HP 34131A Hard Carrying Case
HP 34397A dc-to-ac Inverter
HP E2050A LAN/HP-IB Gateway
34970-80010 DMM Field Installation Kit
Fully calibrated with Test Report and Quick Start Kit

For more information on high-performance data acquisition products from Hewlett-Packard, refer to the Data Acquisition Systems section of this catalog starting on page 530.

HP 33120A's functions and arbitrary waveforms are accurate and convenient to set up. Also, available software makes it easy to download modeled or captured waveforms.

Find Your Fit in the HP Family

Besides producing sine waves accurate in frequency and amplitude, function generators and waveform synthesizers are versatile signal sources that can produce some or all of the following waveforms: square, triangle, ramp and pulse. Tuning is continuous over wide bands, and many models can modulate these waveforms and sweep them across a range of frequencies. Some function generators and all waveform synthesizers use frequency synthesis techniques to generate their outputs. Applications for these general purpose signal sources are diverse. Examples include speed sensor characterization, communications receiver design and test, and earthquake testing.

Some waveform synthesizers can also produce arbitrary waveforms, programmable at the front panel or on a PC and downloaded. This capability allows creating signals that mimic noise, vibration, control pulses, whatever signal is needed for realistic tests. A typical use for arbitrary waveforms is to simulate specific ECG waveforms to verify that an electronic hospital patient monitor responds in the proper manner.

From complex signals to simple waveforms, there is an HP generator that is right for the job. See the table and the individual product pages for more detail.

HP 33120A

The HP 33120A uses the latest direct digital synthesis techniques to bring you a full-featured 15 MHz function generator that also has arbitrary waveform capability built in. The HP 33120A offers both linear and log sweep, internal AM, FM, FSK, and burst modulation, and a 12-bit, 40 MSa/s, 16,000 point deep arb generator. Option 001 phase lock/timebase increases the HP 33120A frequency stability and allows multiple HP 33120A's to produce precise phase-offset signals. Fully programmable, the HP 33120A includes both GPIB and RS-232 interfaces standard. An optional software package, the HP 34811A BenchLink/Arb, facilitates creating, modifying, and downloading arbitrary waveform to the HP 33120A.

HP 3325B

The HP 3325B offers true synthesizer performance for demanding applications. Frequency range of the sinewave output is 1µHz to 20.999 MHz with resolution of 1µHz. A sync/Trigger output provides TTL-compatible signals with µHz resolution from DC to 60 MHz. Sinewave distortion is better than -65 dBc to 50 kHz.

The HP 3325B is also a high-performance function generator, providing a variety of waveforms with synthesizer accuracy and precision. Squarewaves are available to 10.999 MHz, with 20 ns rise and fall times. Triangles and positive and negative ramps are provided with 0.05% linearity up to 10.999 kHz. All waveforms can be DC and phase offset to match the requirements of the circuit under test.

The HP 3325B is fully programmable through GPIB and RS-232, making it a natural choice for automated test systems. Both interfaces and all inputs and outputs are floating (isolated from chassis ground) to minimize ground loops and offer maximum flexibility in configuring a solution to your measurement needs.

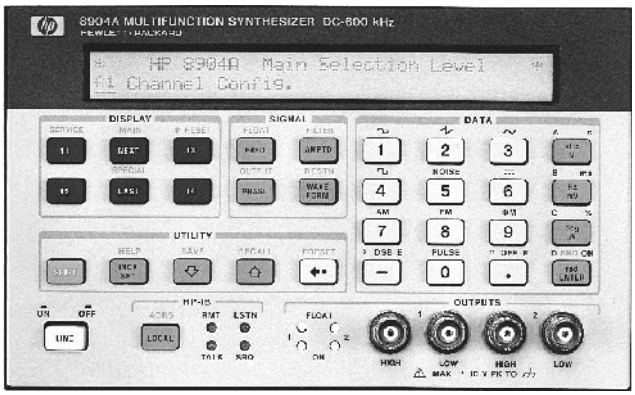
HP 8904A

The HP 8904A creates complex signals from six simple waveforms. The instrument offers standard functions, dc, and noise. Option 001 adds three more internal sources (total of four) which can be digitally summed together. Option 001 also adds AM, FM, PM, DSBSC, and pulse modulation using these three internal sources. In addition, Option 001 adds sequencing capabilities. These features address VOR, FM Stereo, and communications signaling applications. Option 002 adds a second independent synthesizer output. Option 005 allows multiple units to be phase synchronized to create complex waveforms with high timing accuracy.

Function and Arbitrary Waveform Generator Specifications

	HP 33120A	HP 3325B	HP 8904A
Sine wave			
Min. frequency	dc	1 µHz	dc
Max. frequency	15 MHz	21 MHz	600 kHz
Waveforms			
Square	100 µHz to 15 MHz	1 µHz to 11 Mhz	0.1 Hz to 50 kHz
Triangle	100 µHz to 100 kHz	1 µHz to 11 kHz	0.1 Hz to 50 kHz
Ramp	100 µHz to 100 kHz	1 µHz to 11 kHz	0.1 Hz to 50 kHz
Arbitrary	16,000 points	--	--
Modes			
Trigger	int./ext.		Creates signals from six
Gate	int./ext.		basic waveforms
Counted burst	1 to 50,000 or ∞		
Modulation			
AM	int./ext., and Arbitrary	int./ext.	int.
FM	int., including Arbitrary	--	int.
PM	--	int./ext.	int.
Sweep			
Lin.	int.	int.	int.
Log.	int.	int.	none
VCO	--	int.	int.
Output (into 50 Ω)			
Amplitude (p-p)	10 V	10 V	10 V
DC offset (±)	5 V	5 V	5 V
Output Impedance Ω	50	50	50
Programmability	GPIB and RS-232	GPIB	GPIB
Notes	12 bit, 40 MSa/s ARB, also has FSK, SCPI commands, 3-year warranty	Also has PWM. Modulation source can be used separately	4 internal channels; one is modulated or sequenced
Catalog page	155		153

- Sine to 600 kHz, square, ramp, triangle to 50 kHz
- 12-bit direct digital synthesis
- Tone, DTMF, digital, Hop Ram sequence modes
- One or two outputs
- One to four internal channels
- AM, FM, ØM, DSBSC, and pulse modulation
- Unit-to-unit phase synchronization
- Optional 600 Ω high power, balanced output



HP 8904A

HP 8904A Function Synthesizer

The standard HP 8904A multi-function synthesizer generates accurate sine waves from 0 Hz to 600 kHz with 0.1 Hz resolution. The HP 8904A also has five other standard functions: square, triangle, ramp, from 0 Hz to 50 kHz plus dc, and Gaussian white noise. All waveform values in the HP 8904A are digitally calculated in real time by Hewlett-Packard's Digital Waveform Synthesis IC yielding 12-bit digital accuracy. Full HP-IB programmability is also included standard on the HP 8904A.

Two Outputs

Option 002 adds a second, identical synthesizer and floating 50 Ω output section to the HP 8904A. Frequency, amplitude, waveform, and phase can be independently set for the two sources. Either synthesizer can be precisely varied in phase relative to each other from 0 degrees to 359.9 degrees with a resolution of 0.1 degree.

Complex Signal Generation

Option 001 adds internal synthesizers (for a total of four) which can modulate channel A or be summed to give complex waveform generating capabilities to the HP 8904A. All four synthesizers are independent with precise phase offset capabilities. These synthesizers can be digitally summed before being output. In addition to summing, Option 001 allows channels B, C, and D to modulate channel A with AM, FM, ØM, DSBSC, or pulse modulation.

FM Stereo Composite Mode

Option 001 also includes a mode for generating FM stereo composite signals. Test signals in this mode include Left = Right, Left = – Right, Left Only, and Right Only. Single keystrokes select test-tone frequency, composite level, test signal mode, and pilot tone level. Stereo separation is typically greater than 65 dB.

Communication Signaling

Option 001 also adds four sequence modes to the HP 8904A: tone, DTMF, digital, and Hop Ram sequence modes. These modes make the HP 8904A a powerful tool for use in communications signaling. Tone and DTMF modes allow creation of single or dual tone sequences up to 750 states in length. Digital sequence mode can generate bit streams up to 3000 bits in length with 100 μs resolution. Hop Ram sequence mode allows sequencing of 16 tones, each with an associated amplitude, frequency, and phase value.

Fast Hop

Option 003 adds the ability to externally hop channel A in frequency, phase, or amplitude. Up to 16 frequency/phase/amplitude states can be entered into the Hop Ram memory. To hop, an external device must address the four-bit wide, TTL-level address bus provided on the rear panel. Phase continuous switching can be done in as little as 20 μs.

Unit-to-Unit Phase Synchronization

With Option 005, multiple HP 8904As can be phase synchronized to provide more than two phase-related outputs. In the synchronous mode, one unit is specified to be the master clock unit and all others are designated slaves. Two signals are then routed from the clock master unit to all slave units through external low-loss power splitters. To synchronize the units, a phase reset command is given to the master HP 8904A via HP-IB or from the front panel. The total phase error between units will be the larger of ± 0.1 degree or 60 ns for frequencies from 0.1 Hz to 100 kHz. Up to eight HP 8904As may be synchronized.

600 Ω Balanced Output

Option 006 changes output 1 from a 50 Ω electronically-floating output to a transformer-coupled, 600 Ω -balanced output. Option 006 provides high power, balanced signals into 600 Ω loads. Maximum output is 10 volts rms into 600 Ω. The Option 006 output restricts the frequency range of output 1 to 30 Hz to 100 kHz. In addition, complex wave forms such as square, ramp, and triangle waveforms are degraded and dc cannot be passed through the Option 006 output. In many applications, however, the HP 8904A Option 006 is a direct replacement for the HP 200CD wide range oscillator.

HP 8904A Specifications (for 50 Ω output only)

Frequency
Range: Sine wave: 0 Hz to 600 kHz
Square, triangle, ramp: 0 Hz to 50 kHz
Resolution: 0.1 Hz
Accuracy (internal 10 MHz timebase): 50 ppm

AC Amplitude (sine wave only)
Range: 0 to 10 V p-p into a 50 Ω load
Accuracy (> 40 mV p-p into open circuit):
1%, 0.1 Hz to 100 kHz; 3%, 100 kHz to 600 kHz
Flatness (> 630 mV p-p into 50 Ω):
± 0.1% (± 0.009 dB), 0.1 Hz to 100 kHz

DC Amplitude
Range: 0 to ±10 V p-p open circuit
Accuracy: Larger of ± 20 mV or ± 2.1%

Spectral Purity (sine wave only)
THD + N (including spurs, amplitude > 50 mV rms into 50 Ω):
– 63 dBc rms (0.07%), 20 Hz to 7.5 kHz, 30 kHz BW
– 63 dBc rms (0.07%), 7.5 kHz to 20 kHz, 80 kHz BW

Gaussian Noise
Spectral Characteristic: Equal energy per unit bandwidth ("white")
Time-Domain Characteristic: Gaussian distribution
Flatness (>100 mV p-p): Typically ±0.5 dB, 0.1 Hz to 100 kHz

Option 001 Specifications

Modulation is for channel A only, and specified for sine-wave carrier and modulation. External modulation is NOT possible.

Modulation

Amplitude
- **Rate:** 0 to 600 kHz
- **Depth Range:** 0% to 100 % of carrier amplitude

Frequency
- **Rate:** 0 to 600 kHz
- **Deviation Range:** 0 to 600 kHz

Phase
- **Rate:** 0 to 600 kHz
- **Deviation Range:** 0° to 179.9°/channel

Pulse or DSBSC
- **Rate:** 0 Hz to 50 kHz (up to 600 kHz for DSBSC)

Summation

Two, three, or four channels may be summed.
Channel to Channel Phase Accuracy (equal amplitude sine waves): Larger of ± 0.1° or 30 ns, 0.1 Hz to 100 kHz

Modes

FM Stereo Composite
- **Test Modes:** Left = Right, Left = –Right, Left Only, Right Only
- **Composite Signal Level:** Up to 10 V_{p-p} into 50 Ω
- **Pre-Emphasis Modes:** Off, 25 μs, 50 μs, and 75 μs
- **Channel Separation:** Typically > 65 dB, 20 Hz to 15 kHz rates

Tone Sequence
- **Number of Frequencies:** 16 tones each with user-definable frequency, on-time and off-time
- **On/Off Time Duration Range:** 0 ms, 0.80 ms to 655.35 ms
- **Timing Accuracy:** ± 0.02 ms (± 20 μs)
- **Sequence Length:** 750 steps, user-definable

DTMF Sequence
- **Number of Tone Pairs:** 16 standard DTMF tone pairs (0-9, A-D, #, *) with user-definable on-time and off-time
- **On/Off Time Duration Range:** 0 ms, 1.00 ms to 655.35 ms
- **Timing Accuracy:** ± 0.02 ms (± 20 μs)
- **Sequence Length:** 750 steps, user-definable

Digital Sequence
- **User Definable:** On level, off level, and bit period
- **Bit Period Duration Range:** 0.10 ms to 655.35 ms
- **Timing Accuracy:** ± 0.02 ms (± 20 μs)
- **Sequence Length:** Up to 3000 bits, user-definable

Hop Ram Sequence
- **Number of Frequencies:** 16 tones each with user-definable frequency, phase, and amplitude
- **Sequence Clock Frequency Range:** 0.1 Hz to 10 kHz
- **Sequence Length:** 750 steps (all 16 tones used) or 3000 steps (tones 0 and 1 used), user-definable

Option 002 Specifications (50 Ω outputs)

Output 1 to Output 2 Phase Accuracy (sine waves at the same frequency): ± 0.1° or 30 ns, 0.1 Hz to 100 kHz, whichever is greater

Option 003 Specifications (Fast Hop)

Direct Hopping of Channel A: 16 phase-frequency-amplitude states may be addressed with four TTL-compatible inputs
Switching Speed (via digital port): Typically < 20 μs

Option 005 Specifications (50 Ω outputs)

Unit-to-Unit Phase Accuracy (sine waves only): Larger of ± 0.1° or 60 ns, 0.1 Hz to 100 kHz
Maximum Number of Synchronized Units: 8 units

Option 006 Specifications (sine wave)

All specifications for the standard 50 Ω output HP 8904A are degraded by the accuracy, flatness, and distortion specifications of the Option 006, 600 Ω transformer coupled output.

Output Type: Fully floating/balanced transformer-coupled output
Usable Frequency Range: Typically 30 Hz to 200 kHz
AC Amplitude Range: 0 to 10 Vrms into 600 Ω
AC Amplitude Accuracy (> 40 mVrms into a balanced 600 Ω load): 6% (0.5 dB), 30 Hz to 20 kHz; 12% (1.0 dB), 30 Hz to 100 kHz
Flatness (> 40 mVrms into a balanced 600 Ω load): + 0.15 dB, – 0.75 dB, 30 Hz to 100 kHz
THD + Noise (including spurs, > 140 mVrms into a balanced 600 Ω load): – 63 dB (0.07%), 7.5 kHz to 20 kHz, 80 kHz BW

General

Store Recall: 35 non-volatile registers
Output Type (standard unit): 50 Ω electronic floating or grounded output, HP-IB programmable
Maximum Float Voltage (50 Ω output, signal + float): 10 V peak maximum from high or low output to chassis ground
External Timebase Input: 10 MHz accepted at a nominal level of 0.1 to 5 V peak, automatic switching
Operating Temperature Range: 0° to 50° C
Storage Temperature Range: – 20° to 70° C
Remote Operation: HP-IB
Size: 213 mm W x 133 mm H x 513 mm D (8.36 in x 5.25 in x 20.2 in)
Weight: Net, 5.9 kg (12.8 lb); shipping, 13 kg (28.6 lb)

Key Literature

HP 8904A Technical Specifications, p/n 5965-9456E
HP 8904A Brochure, p/n 5965-9457E

Ordering Information

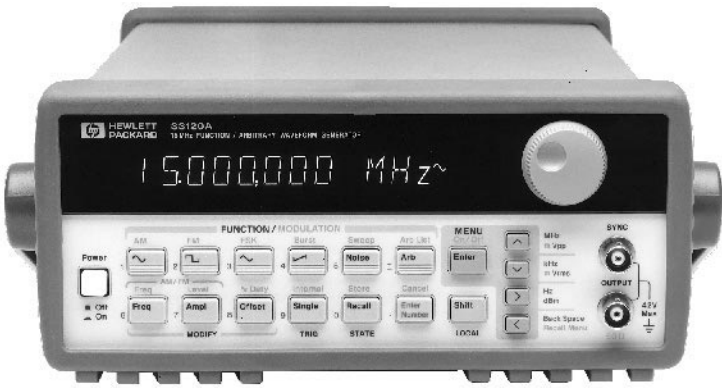
HP 8904A Multifunction Synthesizer[1]
- **Opt 001** Adds three (two when ordered with Option 002) internal channels, Channel A modulation, summation, FM stereo mode, and sequence capability
- **Opt 002** Adds second internal synthesizer and output
- **Opt 003** Adds fast hop and digital modulation
- **Opt 004** Connectors on rear panel only (not available with Option 005 or 006)
- **Opt 005** Adds unit-to-unit phase synchronization
- **Opt 006** Changes output 1 from a 50 Ω output to a transformer-coupled, 600 Ω balanced output
- **Opt 910** Provides an additional operation and calibration manual (08904-90007) and two service manuals (08904-90008)
- **Opt 915** Adds Service Manual (08904-90008)
- **Opt W30** Extended Repair Service
- **Opt W32** Calibration Service
- **08904-61024** Rackmount Kit for a single HP 8904A
- **08904-61025** Rackmount Kit for mounting two HP 8904A's side by side

HP 8904A Retrofit Kits (customer retrofittable)
HP 11816A Retrofit Kit for Option 001
HP 11817A Retrofit Kit for Option 002
HP 11818A Retrofit Kit for Option 003
HP 11827A Retrofit Kit for Option 005[2]
HP 11837A Retrofit Kit for Option 006[2]

[1] GPIB cables not included.
[2] Not available for units with serial prefix less than 2948A.

Indicates QuickShip availability.

- 15 MHz sine- and square-wave outputs
- Sine, triangle, square, ramp, noise, and more
- 12-bit, 40 MSa/s, 16,000 point deep arbitrary waveforms
- Direct digital synthesis for excellent stability
- Linear and log sweeps built-in
- AM, FM, FSK, and burst modulation built-in
- GPIB and RS-232 interfaces both standard
- Optional BenchLink Arb software



HP 33120A

HP 33120A Function/Arbitrary Waveform Generator

The HP 33120A is a high-performance, full-function 15 MHz synthesized function generator. It features sine, triangle, square, ramp, and noise waveforms, a 12-bit, 40 MSa/s, 16,000 point deep arbitrary waveform generator, and both internal sweep and modulation capabilities. The HP 33120A is ideal for both bench and system applications. Both GPIB and RS-232 interfaces are standard, as is a full three-year warranty. All this is available for a surprisingly affordable price.

Unprecedented Functionality

The HP 33120A will fill all your basic signal source needs by giving you a full complement of standard functions. But this source goes beyond the basics. You get both linear and log sweeps to 15 MHz, plus full-modulation capabilities. AM, FM, FSK, and burst modulation are just a button push away. You can internally modulate with any of the standard waveforms as well as Arb. You can even use an external source for AM, FSK, and burst modulation, if desired. Finally, you get near-infinite custom waveform capability with the inclusion of a 12-bit, 40 MSa/s, 16,000 point deep arbitrary waveform generator.

Superb Performance

The performance of the HP 33120A was designed in, not left out. This means that you get clean, low-distortion sine waves, fast rise- and fall-time squarewaves, and linear triangle and ramp waveforms. Further, due to the latest direct digital synthesis techniques utilized in the HP 33120A, you can get down to 10 μHz frequency resolution.

Built-In Versatility

You will find that the HP 33120A will fit equally well into your bench or your system applications. Designed with the bench user in mind, operation of the HP 33120A from the front panel is straightforward and intuitive. The inclusion of a knob makes adjusting frequency, amplitude, and offset extremely convenient. Or enter these values directly. You can even enter amplitude values directly in V peak-to-peak, V rms, or dBm. For system applications, the HP 33120A includes both GPIB and RS-232 interfaces standard, and uses commands that are in total compliance with the Standard Commands for Programmable Instrumentation (SCPI).

Quality and Reliability

Not only does the HP 33120A offer you performance and features unheard of at this price, you also get the advantages of owning Hewlett-Packard. A full three-year warranty is standard with the HP 33120A. The rugged construction and conservative design of the HP 33120A ensures many years of trouble-free operation. Just as price was designed out of the HP 33120A, quality and reliability were designed in.

Option 001 Phase Lock Loop

Option 001 adds a high-stability timebase, the ability to lock to an external timebase, and the ability to phase lock two or more HP 33120As together. This option is especially useful if your application requires higher-frequency stability and accuracy, if you need to lock to an external-frequency standard, or if you need two or more phase-locked outputs.

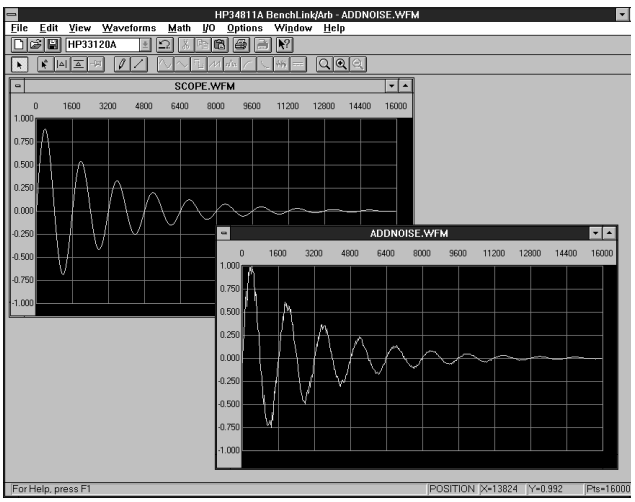
HP BenchLink Arb Software Helps the 33120A Work for You

HP BenchLink Arb lets you use your Windows-based PC (3.1, 95, 98, NT 4.0) to easily create and edit arbitrary waveforms for output on the HP 33120A.

HP BenchLink Arb software application lets you create waveforms in a variety of ways:

- Select and edit a standard waveform from the HP BenchLink Arb library, and change its amplitude and frequency characteristics as desired.
- Use HP BenchLink Arb's drawing tools to draw and edit your own custom waveform.
- Bring in and edit a waveform captured or created elsewhere.

HP BenchLink Arb accepts time/voltage pairs in ASCII format, or you can use waveforms captured with HP BenchLink Scope and an HP oscilloscope. Once your waveform is ready, downloading to the HP 33120A generator is simple. Make your arbitrary waveforms quickly and easily with HP BenchLink Arb.



HP 34811A BenchLink Arb lets you take control of arbitrary waveforms on the HP 33120A function/arbitrary waveform generator.

Abbreviated Technical Specifications

Waveforms
Standard: Sine, square, triangle, ramp, noise, sin(x)/x, exponential rise, exponential fall, heartbeat, dc volts
Arbitrary
- **Waveform Length:** 8 to 16,000 points
- **Amplitude Resolution:** 12 bits (including sign)
- **Sample Rate:** 40 MSa/s
- **Non-Volatile Memory:** Four (4) 16,000 point waveforms

Frequency Characteristics
Sine: 100 μHz to 15 MHz
Square: 100 μHz to 15 MHz
Triangle: 100 μHz to 100 kHz
Ramp: 100 μHz to 100 kHz
Noise (Gaussian): 10 MHz bandwidth
Resolution: 10 μHz or 10 digits
Accuracy: 10 ppm in 90 days, 20 ppm in 1 year, 18° C to 28° C
- **Temp. Co-eff.:** <2 ppm/ °C
- **Aging:** <10 ppm/yr.

Sine-wave Spectral Purity
Harmonic Distortion:
DC to 20 kHz: – 70 dBc
20 kHz to 100 kHz: – 60 dBc
100 kHz to 1 MHz: – 45 dBc
1 MHz to 15 MHz: – 35 dBc
Spurious (non-harmonic):
DC to 1 MHz: < – 65 dBc
1 MHz to 15 MHz: < – 65 dBc + 6 dB/octave
Total Harmonic Distortion: < 0.04% (dc to 20 kHz)
Phase Noise: < – 55 dBc in a 30 kHz band

Signal Characteristics
Squarewave
- **Rise/Fall Time:** < 20 ns
- **Overshoot:** < 4%
- **Asymmetry:** <1% + 5 ns
- **Duty Cycle:**
  20% to 80% (to 5 MHz)
  40% to 60% (to 15 MHz)

Triangle, Ramp, Arb
- **Rise/Fall Time:** 40 ns (typical)
- **Linearity:** <0.1% of peak output
- **Settling Time:** < 250 ns to 0.5% of final value
- **Jitter:** < 25 ns

Output Characteristics
Amplitude (into 50 Ω): 50 mV p-p to 10 V p-p
- **Accuracy** (at 1 kHz): 1% of specified output

Flatness	(sine wave relative to 1 kHz)
<100 kHz	±1% (0.1 dB)
100 kHz to 1 MHz	±1.5% (0.15 dB)
1 MHz to 15 MHz	±2% (0.2 dB) Ampl ≥3 Vrms ±3.5% (0.3 dB) Ampl <3 Vrms

Output Impedance: 50 Ω (fixed)
Offset (into 50 Ω): ± 5 Vpk ac + dc
- **Accuracy:** ± 2% of setting + 2 mV

Resolution: 3 digits, amplitude and offset
Units: V p-p, V rms, dBm
Isolation: 42 Vpk maximum to earth
Protection: Short circuit protected, ±15 Vpk overdrive <1 minute

HP 33120A Option 001

Modulation
AM
- **Carrier 3dB Freq.:** 10 MHz (typical)
- **Modulation:** Any internal waveform including Arb
- **Frequency:** 10 mHz to 20 kHz
- **Depth:** 0% to 120%
- **Source:** Internal/external

FM
- **Modulation:** Any internal waveform including Arb
- **Frequency:** 10 mHz to 10 kHz
- **Peak Deviation:** 10 mHz to 15 MHz
- **Source:** Internal only

FSK
- **Internal Rate:** 10 mHz to 50 kHz
- **Frequency Range:** 10 mHz to 15 MHz
- **Source:** Internal or external (1 MHz max)

Burst
- **Carrier Freq.:** 5 MHz max.
- **Count:** 1 to 50,000 cycles or infinite
- **Start Phase:** –360° to + 360°
- **Internal Rate:** 10 mHz to 50 kHz ±1%
- **Gate Source:** Internal or external gate
- **Trigger Source:** Single, external, or internal rate

Sweep
Type: Linear or logarithmic
Direction: Up or down
Start F/Stop F: 10 mHz to 15 MHz
Speed: 1 ms to 500 s ± 0.1%
Trigger: Internal, external, single

Rear Panel Inputs
Ext. AM Modulation: ± 5 Vpk =100% modulation, 5 kΩ input resistance
External Trigger/FSK/Burst Gate: TTL low true

General Specifications

State Storage Memory: Power off state automatically saved. 3 user-configurable stored states.
Interface: IEEE-488 and RS-232 standard
Language: SCPI–1991
Warranty: 3 years standard

Option 001 Phase Lock/TCXO Timebase

Stability: ±1 ppm, 0° to 50°C
Aging: < 2 ppm in first 30 days (continuous operation); 0.1 ppm/month (after first 30 days)
Ext. Reference Input Lock Range: 10 MHz ± 50 Hz
Int. Reference Output Frequency: 10 MHz
Phase Offset: –360° to + 360°, 0.001° resolution

Ordering Information

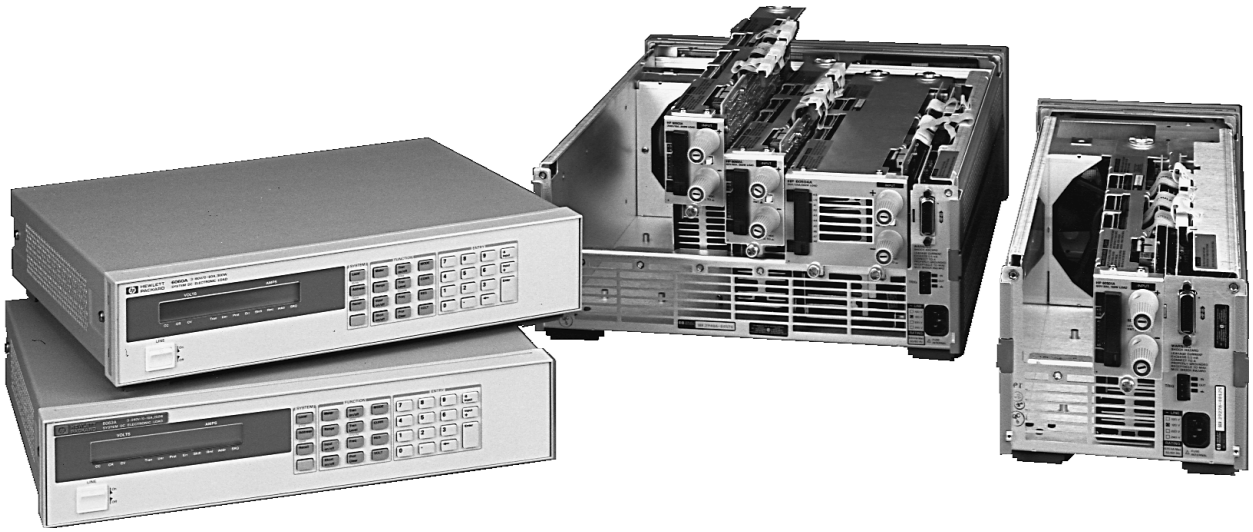
HP 33120A Function Generator
- **Opt 001** Phase Lock Loop
- **Opt 106** BenchLink/Arb Software
- **Opt 1CM** Rackmount Kit

HP 34811A BenchLink/Arb Software
HP 34161A Accessory Pouch
HP 34397A DC to AC Power Inverter

Indicates QuickShip availability.

- Programmable control of current, voltage, and resistance
- Accurate readback of current, voltage, and power
- Built-in waveform generation for transient simulation
- Continuous and pulse loading operation
- Full protection features
- Trigger input for external synchronization
- Parallel operation for higher power
- Up to 240 V loads available
- Single-input or multiple-input mainframes available
- Three-year standard warranty

HP 6050A
HP 6051A
HP 6060B
HP 6063B
HP 60501B
to 60507B



HP 6060B and 6063B

HP 6050A with
HP 60500 Series Modules

HP 6051A with
HP 60500 Series Module

HP dc Electronic Loads

HP dc electronic loads are ideal for testing and evaluating dc power sources, power components, and battery capacity testing.

Everything You Need in an HP One-Box Solution

HP dc electronic loads feature an integrated HP-IB programmer, pulse generator, current shunt, and DMM. The HP one-box solution saves space, cost and time while making HP dc electronic loads easy to integrate into automated test systems.

Performance and Ease-of Use

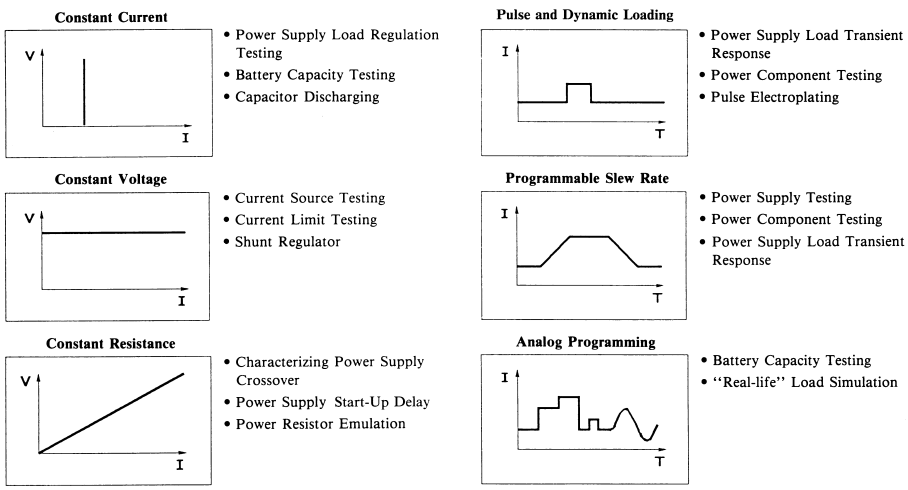
HP dc electronic loads are optimized for a broad range of dynamic loading applications. They offer high stability for applications where fast transients are applied to the load inputs, such as during dc power supply startup characterization or transient response testing. Dynamic load performance can be further tailored to specific application needs with programmable amplitudes, frequency, duty cycle, and slew rate.

Programmable Capabilities

HP-IB and analog programmable interfaces are standard features. HP dc electronic loads are fully compatible with industry-standard SCPI command set. The HP-IB interface allows complete control of all load functions as well as measurement readback of input voltage, current, power and detailed operating status. HP dc electronic loads also include analog voltage inputs for real life simulation of load current.

Versatile Solutions

HP dc electronic loads are equally suitable for manual use on the bench. The front-panel LCD meters indicate voltage, current and power readings. The full function keypad allows easy, repeatable and reliable control of the load. User-definable power-up state and six volatile states allow you to easily save settings for later recall.



DC Electronic Load Applications

DC Electronic Loads

Electronic Load Family

Single-Input Products

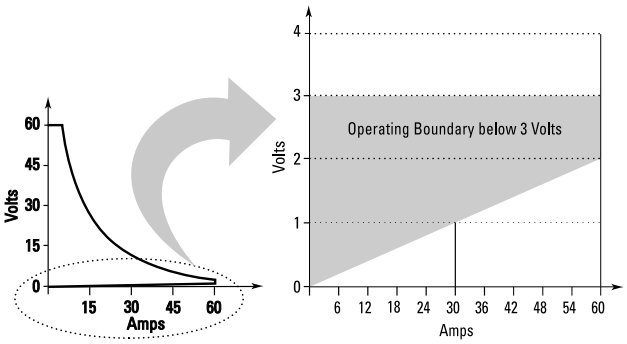
HP 6060B and HP 6063B are single-input dc electronic loads. HP 6060B is a 300W, 60V, 60A load and HP 6063B is a 250W, 240V, 10A load.

Mainframe Products

HP 6050A 1,800W and HP 6051A 600W electronic loads accept the user-installable HP load modules for easy system configuration. The HP 6050A holds up to six HP 60501B, 60502B, and 60503B load modules, or three HP 60504B, HP 60507B load modules. The HP 6051A holds up to two load modules.

Operating Below the Minimum Input Voltage

HP electronic loads meet all specifications when operated above 3V; however, the dc operating characteristics also extend below this minimum-input voltage for static tests. The figure below shows the operating range of a typical HP dc electronic load. Low voltage operation, down to zero volts, is possible at correspondingly-reduced current levels, depending on the minimum resistance of the load. HP electronic loads, therefore, can be used in many applications that previously required zero-volt loads.



Example of HP 60502B Input Characteristics

Battery Testing

HP 6050A option J10, HP 6051A option J10 and HP 6060B option J10 electronic loads are modified for battery testing. These products provide tri-level pulse loading to simulate accurate conditions on batteries. They also feature a programmable minimum battery voltage threshold. If the voltage of the battery under test falls below this threshold, the load will automatically turn off.

Key Literature

1999/00 HP Power Products Catalog, p/n 5968-2199

For more information, visit our web site: **http://www.hp.com/go/loads**

Ordering Information

HP 6050A Six-slot, 1800 W dc Electronic Load Mainframe
- **Opt 908** Rackmount kit (p/n 5062-3978)
- **Opt 909** Rackmount kit with handles (p/n 5062-3984)

HP 6051A Two-slot, 600W dc Electronic Load mainframe
- **Opt 800** Rackmount kit for two units mounted side-by-side (p/n 5061-9694 and 5062-3978)
- **Opt 908** Rackmount kit (p/n 5062-3960)

HP 6060B Single-input, 300 W dc Electronic Load

HP 6063B Single-input, 250 W dc Electronic Load
- **Opt 020** Front panel inputs
- **Opt 908** Rackmount kit (p/n 5062-3974)
- **Opt 909** Rackmount kit with handles (p/n 5062-3975)

HP 60501B 150 W dc Electronic Load Module

HP 60502B 300 W dc Electronic Load Module

HP 60503B 250 W dc Electronic Load Module

HP 60504B 600 W dc Electronic Load Module

HP 60507B 500 W dc Electronic Load Module

Standard Options
- **Opt 100** 87 to 106 Vac, 47 to 66 Hz (for Japan only)
- **Opt 220** 191 to 233 Vac, 47 to 66 Hz
- **Opt 240** 209 to 250 Vac, 47 to 66 Hz
- **Opt 910** Extra manual set for HP 6050A, 6051A For HP 6060B, 6063B, 60501-60507

Abbreviated Technical Specifications and Characteristics

Hewlett-Packard Model	HP 6060B, 60502B	HP 6063B, 60503B	HP 60501B	HP 60504B	HP 60507B
Amperes	0 to 60 A	0 to 10 A	0 to 30 A	0 to 120 A	0 to 60 A
Volts	3 to 60 V	3 to 240 V	3 to 60 V	3 to 60 V	3 to 150 V
Maximum power (at 40° C)	300 W	250 W	150 W	600 W	500 W
Constant current mode Ranges Accuracy Regulation	 0 to 6 A, 0 to 60 A 0.1% ±75 mA 10 mA	 0 to 1 A, 0 to 10 A 0.15% ±10 mA 8 mA	 0 to 3 A, 0 to 30 A 0.1% ±40 mA 10 mA	 0 to 12 A, 0 to 120 A 0.12% ±130 mA 10 mA	 0 to 6 A, 0 to 60 A 0.1% ±80 mA 10 mA (w/≥3 V at the point)
Constant voltage mode Accuracy Regulation (w/remote sense)	 0.1% ±50 mV 10 mV	 0.12% ±120 mV 10 mV	 0.1% ±50 mV 5 mV	 0.1% ±50 mV 20 mV	 0.1% ±125 mV 10 mV
Constant resistance mode Ranges	0.033 to 1.0 Ω 1 to 1,000 Ω 10 to 10,000 Ω	0.20 to 24.0 Ω 24 to 10,000 Ω 240 to 50,000 Ω	0.067 to 2 Ω 2 to 2,000 Ω 20 to 10,000 Ω	0.017 to 0.5 Ω 0.5 to 500 Ω 5 to 5,000 Ω	0.033 to 2.5 Ω 2.5 to 2,500 Ω 25 to 10,000 Ω
Accuracy (with ≥10% of rated current at input)	1 Ω: 0.8% ±8 mΩ 1 KΩ: 0.3% ±8 mS 10 KΩ: 0.3% ±8 mS	24 Ω: 0.8% ±200 mΩ 10 KΩ: 0.3% ±0.3 mS 50 KΩ: 0.3% ±0.3 mS	2 Ω: 0.8%, ±16 mΩ 2 KΩ: 0.3% ±5 mS 10 KΩ: 0.3% ±5 mS	0.5 Ω: 0.8% ±5 mΩ 500 Ω: 0.3% ±18 mS 5 KΩ: 0.3% ±18 mS	2.5 Ω: 0.8% ±16 mΩ 2.5 KΩ: 0.3% ±5 mS 10 KΩ: 0.3% ±5 mS
Transient generator Frequency range Accuracy	 0.25 Hz to 10 kHz 3%	 0.25 Hz to 10 kHz 3%	 0.25 Hz to 10 kHz 3%	 0.25 Hz to 10 kHz 3%	 0.25 Hz to 10 kHz 3%
Duty cycle range Accuracy	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz) 6% of setting ±2%	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz) 6% of setting ±2%	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz) 6% of setting ±2%	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz) 6% of setting ±2%	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz) 6% of setting ±2%
Readback measurement Current accuracy Voltage accuracy	 ± (0.05% ±65 mA) ± (0.05% +45 mV)	 ± (0.12% ±10 mA) ± (0.1% +150 mV)	 ± (0.06% ±40 mA) ± (0.5% +45 mV)	 ± (0.1% ±110 mA) ± (0.1% +45 mV)	 ± (0.1% ±65 mA) ± (0.1% +90 mV)
Display resolution	20 mV	100 mV	20 mV	20 mV	100 mV
Ripple and noise **(20-Hz to 10-MHz noise)** Current Voltage	 4 mA rms/40 mA p-p 6 mV rms	 1 mA rms/10 mA p-p 6 mV rms	 2 mA rms/20 mA p-p 5 mV rms	 6 mA rms/60 mA p-p 8 mV rms	 4 mA rms/40 mA p-p 10 mV rms
Constant current mode Resolution	60-A range: 16 mA 6-A range: 1.6 mA	10-A range: 2.6 mA 1-A range: 0.26 mA	30-A range: 8 mA 3-A range: 0.8 mA	120-A range: 32 mA 12-A range: 3.2 mA	60-A range: 16 mA 6-A range: 1.6 mA
Constant voltage mode Resolution	16 mV	64 mV	16 mV	16 mV	40 mV
Constant resistance mode Resolution	1 Ω: 0.27 mΩ 1 KΩ: 0.27 mS 10 KΩ: 0.027 mS	24 Ω: 6 mΩ 10 KΩ: 0.011 mS 50 KΩ: 0.001 mS	2 Ω: 0.54 mΩ 2 KΩ: 0.14 mS 10 KΩ: 0.014 mS	0.5 Ω: 0.14 mΩ 500 Ω: 0.54 mS 5 KΩ: 0.054 mS	2.5 Ω: 0.67 mΩ 2.5 KΩ: 0.10 mS 10 KΩ: 0.01 mS
Transient generator Frequency range Resolution	 0.25 Hz to 10 kHz 4% or less	 0.25 Hz to 10 kHz 4% or less	 0.25 Hz to 10 kHz 4% or less	 0.25 Hz to 10 kHz 4% or less	 0.25 Hz to 10 kHz 4% or less
Duty cycle range	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz)
Analog programming bandwidth	10 kHz (–3 dB frequency)	10 kHz (–3 dB frequency)	10 kHz (–3 dB frequency)	10 kHz (–3 dB frequency)	10 kHz (–3 dB frequency)
Analog programming accuracy Current (low range) Current (high range)	 4.5% ±75 mA 4.5% ±250 mA	 3% ±8 mA 3% ±20 mA	 4.5% ±40 mA 4.5% ±130 mA	 4% ±200 mA 4% ±400 mA	 4.5% ±75 mA 4.5% ±200 mA
Voltage	0.8% ±200 mV	0.5% ±150 mV	0.8% ±200 mV	0.8% ±200 mV	0.8% ±375 mV
Analog programming voltage	0 to 10 V	0 to 10 V	0 to 10 V	0 to 10 V	0 to 10 V
Analog monitor accuracy Current monitor (0 to 10 V out)	 4% ±85 mA	 3% ±10 mA	 4% ±40 mA	 4% ±170 mA	 3% ±85 mA
Voltage monitor (0 to 10 V out)	0.25% ±40 mV	0.4% ±240 mV	0.25% ±40 mV	0.4% ±60 mV	0.4% ±120 mV
Remote sensing	5-Vdc maximum between sense and load input				
Minimum operating voltage	2 volts (1.2 V typical)	2 volts (1.2 V typical)	2 volts (1.2 V typical)	2 volts (1.4 V typical)	2 volts (1.4 V typical)
Programmable short	0.033 Ω (0.020 Ω typical)	0.20 Ω (0.10 Ω typical)	0.066 Ω (0.040 Ω typical)	0.017 Ω (0.012 Ω typical)	0.033 Ω (0.025 Ω typical)
Programmable open (typical)	20 kΩ	80 kΩ	20 kΩ	20 kΩ	20 kΩ
dc isolation voltage	±240 Vdc, between any input and chassis ground				

Notes:
1. Operating temperature range is 0° to 55° C. All specifications apply for 25° C ±5° C, except as noted.
2. Maximum continuous power available is derated linearly from 40° C to 75% of maximum at 55° C.
3. DC current accuracy specifications apply 30 seconds after input is applied.

Regulatory Compliance: Listed to UL-1244, certified to CSA 556B, complies with EN 61010-1
RFI Suppression: CISPR-11, Group 1, Class B

Weight
HP 6050A: 9.5 kg (21 lb)
HP 6051A: 5.5 kg (12 lb)
HP 6060B, 6063B: 6.12 kg (13.5 lb)
HP 60501B, 60502B, 60503B: 3.2 kg (7 lb)
HP 60504B, 60507B: 5.4 kg (13 lb)

GPIB System Power Supplies

Single Output

Max. volts (dc)	Max. amps (dc)	Max. watts	Output Operating Boundary	HP Model Number	Page
5	875	4400	Rectangular	6680A	174
6.7	30	200	Autoranging	6033A	175
7	120	1000	Autoranging	6031A	175
8	5	40	Rectangular	6611C	168
8	10	80	Rectangular	6631B	170
8	20	160	Rectangular	6641A	171
8	50	400	Rectangular	6651A	172
8	220	1760	Rectangular	6671A	173
8	580	4600	Rectangular	6681A	174
15	3	45	Rectangular	66111A	164
15	3	45	Rectangular	66311B/D	164
15/12	3/1.5	45/18	Rectangular	66309B/D	164
20	2	40	Rectangular	6612B	168
20	2	40	Rectangular	66312A	167
20	5	100	Rectangular	6632B	170
20	5	100	Rectangular	66332A	167
20	10	200	Autoranging	6033A	175
20	10	200	Autoranging	6038A	175
20	10	200	Rectangular	6642A	171
20/8	1.5/3	30/24	Rectangular	E3640A	177
20/8	2.5/5	50/40	Rectangular	E3642A	177
20/8	4/8	80/64	Rectangular	E3644A	177
20/8	10/20	200/160	Rectangular	E3633A	178
20	25	500	Rectangular	6652A	172
20	50	1000	Autoranging	6031A	175
20	50	1200	Autoranging	6032A	175
20	100	2000	Rectangular	6672A	173
21	240	5000	Rectangular	6682A	174
30/15	4/7	120/105	Rectangular	E3632A	178
32	160	5100	Rectangular	6683A	174
35	6	210	Rectangular	6643A	171
35	15	525	Rectangular	6653A	172
35	60	2100	Rectangular	6673A	173
40	128	5100	Rectangular	6684A	174
50	1	50	Rectangular	6613C	168
50	2	100	Rectangular	6633B	170
50/25	4/7	200/175	Rectangular	E3634A	178
60/35	0.5/0.8	30/28	Rectangular	E3641A	177
60	3.3	200	Autoranging	6038A	175
60	3.5	210	Rectangular	6644A	171
60	9	540	Rectangular	6654A	172
60	17	1200	Autoranging	6030A	175
60	17.5	1200	Autoranging	6032A	175
60	30	150	Rectangular	60501B	157
60	35	2100	Rectangular	6674A	173
60	60	300	Rectangular	6060B	157
60	60	300	Rectangular	60502B	157
60	120	600	Rectangular	60504B	157
65	8	480	Rectangular	E4350B	166
80	30	2100	Rectangular	E4356A	157
100	0.5	50	Rectangular	6614C	168
100	1	100	Rectangular	6634B	170
120	1.5	180	Rectangular	6645A	171
120	4	540	Rectangular	6655A	172
120	18	2160	Rectangular	6675A	173
130	4	480	Rectangular	E4351B	166
150	60	500	Rectangular	60507B	157
200	5	1000	Autoranging	6035A	175
200	5	1200	Autoranging	6030A	175
240	10	250	Rectangular	6063B	157
240	10	250	Rectangular	60503B	157
500	2	1000	Autoranging	6035A	175

Available on Special Order

Single Output 100 to 5000 watts per output

Max. volts (dc)	Max. amps (dc)	Max. watts	Output Operating Boundary	HP Model Number
4	1000	4000	Rectangular	6680A-J03
5	250	1000	Rectangular	6671A-J14
6	60	360	Rectangular	6651A-J03
8	250	2000	Rectangular	6671A-J05
10	50	500	Rectangular	6651A-J01
10	200	2000	Rectangular	6671A-J04
14	150	2000	Rectangular	6671A-J03
15	30	450	Rectangular	6651A-J05
15	120	1800	Rectangular	6671A-J17
18	280	5000	Rectangular	6682A-J01
24	85	2000	Rectangular	6672A-J04
30	3.3	100	Rectangular	66332A-J01
30	17.5	500	Rectangular	6653A-J17
30	65	2000	Rectangular	6673A-J09
32	16	500	Rectangular	6653A-J16
36	15	500	Rectangular	6653A-J09
36	55	2000	Rectangular	6673A-J04
37.5	45	1700	Rectangular	6673A-J03
38	55	2000	Rectangular	6673A-J07
40	5	200	Rectangular	6643A-J11
40	12.5	500	Rectangular	6653A-J04
40	50	2000	Rectangular	6673A-J08
45	12	500	Rectangular	6654A-J29
50	10	500	Rectangular	6654A-J05
50	42	2000	Rectangular	6674A-J07
50	100	5000	Rectangular	6684A-V50
55	38	2000	Rectangular	6674A-J03
70	3	200	Rectangular	6644A-J09
70	7.5	500	Rectangular	6654A-J04
70	30	2000	Rectangular	6674A-J06
80	6	500	Rectangular	6654A-J12
80	26	2000	Rectangular	6674A-J05[1]
100	22	2000	Rectangular	6675A-J08
110	20	2000	Rectangular	6675A-J09
135	16	2000	Rectangular	6675A-J06
150	1.2	150	Rectangular	6645A-J05
150	3.2	500	Rectangular	6655A-J05
150	15	2000	Rectangular	6675A-J11
156	3	500	Rectangular	6655A-J10
160	13	2000	Rectangular	6675A-J04
200	11	2000	Rectangular	6675A-J07

[1]Order standard product E4356A

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-2199

For more information, visit our web site:
http://www.hp.com/go/power

Multiple Output

Range 1		Range 2			Outputs for each HP model number									
Max. volts (dc)	Max. amps (dc)	Max. volts (dc)	Max. amps (dc)	Max. watts per output	6621A page 169	6622A page 169	6623A page 169	6624A page 169	6625A page 169	6626A page 169	6627A page 169	6628A page 169	6629A page 169	E3631A page 178
6	5	—	—	—	—	—	—	—	—	—	—	—	—	Output 3
7	0.015	50	0.5	25	—	—	—	—	Output 1	Outputs 1–2	—	—	—	—
7	5	20	2	40		—	Output 1	Outputs 1–2	—	—	—	—	—	—
7	10	20	4	80	Outputs 1–2	—	Output 3	—	—	—	—	—	—	—
8	20	20	10	200	—	—	—	—	—	—	—	—	—	—
15	7	30	4	120	—	—	—	—	—	—	—	—		
16	0.2	16	2	50	—	—	—	—	Output 2	Outputs 3–4	—	Outputs 1–2	Outputs 1-4	—
16	0.2	50	1	50	—	—	—	—	Output 2	Outputs 3–4	—	Outputs 1–2	Outputs 1-4	—
20	2	50	0.8	40	—		Output 2	Outputs 3–4	—	—	Outputs 1-4	—	—	—
20	4	50	2	100	—	Outputs 1–2	—	—	—	—	—	—	—	—
±25	1			25	—	—	—	—	—	—	—	—		Outputs 1–2
Output Operating Boundary					Rectangular									

Manually-Controlled and Analog-Programmable Power Supplies

Single Output

Max. volts (dc)	Max. amps (dc)	Max. watts	Type	Manually controlled analog-prog	HP Model Number	Page
6.7	30	200	Autoranging	MC/AP	6023A	175
7	120	840	Autoranging	MC/AP	6011A	175
8	6	48	Rectangular	MC/AP	E3614A	180
8	20	160	Rectangular	MC/AP	6541A	171
8	50	400	Rectangular	MC/AP	6551A	172
8	220	1760	Rectangular	MC/AP	6571A	173
15/8	2/3	30/24	Dual-range	MC	E3610A	180
20	3	60	Rectangular	MC/AP	E3615A	180
20	10	200	Autoranging	MC/AP	6023A	175
20	10	200	Autoranging	MC/AP	6024A	175
20	10	200	Rectangular	MC/AP	6542A	171
20	25	500	Rectangular	MC/AP	6552A	172
20	50	1000	Autoranging	MC/AP	6011A	175
20	50	1000	Autoranging	MC/AP	6012B	175
20	100	2000	Rectangular	MC/AP	6572A	173
35/20	0.85/1.5	30	Dual-range	MC	E3611A	180
35	1.7	60	Rectangular	MC/AP	E3616A	180
35	6	210	Rectangular	MC/AP	6543A	171
35	15	525	Rectangular	MC/AP	6553A	172
35	60	2100	Rectangular	MC/AP	6573A	173
40	5.7	228	Autoranging	MC/AP	6028A	175
40	30	1200	Autoranging	MC/AP	6012B	175
60	1	60	Rectangular	MC/AP	E3617A	180
60	3.3	200	Autoranging	MC/AP	6028A	175
60	3.5	210	Rectangular	MC/AP	6544A	171
60	9	540	Rectangular	MC/AP	6554A	172
60	17	1020	Autoranging	MC/AP	6010A	175
60	17.5	1050	Autoranging	MC/AP	6012B	175
60	35	2100	Rectangular	MC/AP	6574A	173
120/60	0.25/0.5	30	Dual-range	MC	E3612A	180
120	1.5	180	Rectangular	MC/AP	6545A	171
120	4.5	540	Rectangular	MC/AP	6555A	172
120	18	2160	Rectangular	MC/AP	6575A	173
200	5	1000	Autoranging	MC/AP	6010A	175
200	5	1000	Autoranging	MC/AP	6015A	175
500	2	1000	Autoranging	MC/AP	6015A	175

Modules for HP 66000 Modular Power System

Up to 8 per mainframe

Max. volts (dc)	Max. amps (dc)	Max. watts	HP Model Number	Page
8	16	128	66101A	162
20	7.5	150	66102A	162
35	4.5	150	66103A	162
60	2.5	150	66104A	162
120	1.25	150	66105A	162
200	0.75	150	66106A	162

Available on Special Order

Max. volts (dc)	Max. amps (dc)	Max. watts	HP Model Number
5.7	20	100	66101A-J03
12	12	150	66101A-J03
15	10	150	66102A-J05
24	6	100	66103A-J12
28	5	1400	66103A-J09
35	1.25	40	66105A-J01
37	4	150	66103A-J01
40	3.6	100	66103A-J02

Multiple Output

Max. volts (dc)	Max. amps (dc)	Max. watts per output	Outputs for each HP model number: E3620A MC Page 179	Outputs for each HP model number: E3630A MC Page 179
6	2.5	15		Output 1
±20	0.5	10		Outputs 2 & 3
25	1	25	Outputs 1 & 2	

*MC=Manually controlled. AP=Analog programmable.

Single Output

Available on Special Order

Max. volts (dc)	Max. amps (dc)	Max. watts	Output Operating Boundry	Manually controlled analog-prog	HP Model Number
10	200	2000	Rectangular	MC/AP	6571A-J04
13	15.3	200	Rectangular	MC/AP	6541A-J04
14	150	2000	Rectangular	MC/AP	6571A-J03
30	65	2000	Rectangular	MC/AP	6573A-J09
35	8	280	Rectangular	MC/AP	6553A-J21
36	55	2000	Rectangular	MC/AP	6573A-J04
37.5	45	1500	Rectangular	MC/AP	6573A-J03
40	50	2000	Rectangular	MC/AP	6673A-J08
40	5	200	Rectangular	MC/AP	6543A-J11
50	42	2000	Rectangular	MC/AP	6574A-J07
55	38	2000	Rectangular	MC/AP	6574A-J03
70	7.5	500	Rectangular	MC/AP	6554A-J04
70	30	2000	Rectangular	MC/AP	6574A-J06
100	22	2000	Rectangular	MC/AP	6575A-J08
110	20	2000	Rectangular	MC/AP	6675A-J09
135	16	2000	Rectangular	MC/AP	6575A-J06
150	1.2	150	Rectangular	MC/AP	6545A-J05
150	3	500	Rectangular	MC/AP	6555A-J10
160	13	2000	Rectangular	MC/AP	6675A-J04
200	11	2000	Rectangular	MC/AP	6575A-J07

For more information, visit our web site:
http://www.hp.com/go/power

Modular Power System

HP 66000A
HP 66001A
HP 66101A
to 66106A

- High density 1200W mainframe in 7 inches of rack space
- 8-slot modular power system
- Stable, low ripple and noise power source
- High-accuracy readback of voltage and current
- Advanced programmable voltage and current control
- Sequence up to 20 voltage and current setting per output
- Optional isolation and polarity-reversal relays
- Three-year standard warranty

HP 66000 Modular Power System

HP 66000 Modular Power System is ideal for automated testing environments for supplying bias power and stimulus to subassemblies and final products.

Key Features

- GPIB programmable voltage and current
- Series and parallel operation
- Programmable over-voltage and over-current protection
- Self-test initiated at power-up or from GPIB command
- Electronic calibration over GPIB or from keyboard
- Over-temperature protection
- Discrete fault indicator/remote inhibit (DFI/RI)
- Five nonvolatile store-recall states per output
- User-definable power-on state

4

Abbreviated Specification and Characteristics

		HP 66101A	HP 66102A	HP 66103A	HP 66104A	HP 66105A	HP 66106A
Output ratings (at 40° C)	Output Voltage Output Current Output Power	0 to 8 V 0 to 16 A 128 W	0 to 20 V 0 to 7.5 A 150 W	0 to 35 V 0 to 4.5 A 150 W	0 to 60 V 0 to 2.5 A 150 W	0 to 120 V 0 to 1.25 A 150 W	0 to 200 V 0 to 0.75 A 150 W
Programming accuracy (at 25° C ±5° C)	Voltage 0.03%+ Current 0.03%+	3 mV 6 mA	8 mV 3 mA	13 mV 2 mA	27 mV 1.2 mA	54 mV 0.6 mA	90 mV 0.4 mA
Readback accuracy (via HP-IB or keyboard display at 25° C ±5° C)	Voltage 0.02%+ Current 0.02%+	2 mV 6 mA	5 mV 3 mA	8 mV 2 mA	16 mV 1 mA	32 mV 0.6 mA	54 mV 0.3 mA
Ripple and noise (20 Hz to 20 MHz)	Constant voltage rms peak to peak Constant current rms	2 mV 5 mV 8 mA	3 mV 7 mV 4 mA	5 mV 10 mV 2 mA	9 mV 15 mV 1 mA	18 mV 25 mV 1 mA	30 mV 50 mV 1 mA
Line Regulation	Voltage Current	0.5 mV 0.75 mA	0.5 mV 0.5 mA	1 mV 0.3 mA	2 mV 0.1 mA	3 mV 50 µA	5 mV 30 µA
Load Regulation	Voltage Current	1 mV 0.5 mA	1 mV 0.2 mA	1 mV 0.2 mA	2 mV 0.1 mA	4 mV 50 µA	7 mV 10 µA
Transient Response Time: Less than 1 ms for the output voltage to recover within 100 mV of its previous level following any step change in load current up to 10 percent of rated current							
Average resolution	Voltage Current Output voltage programming (OVP)	2.4 mV 4.6 mA 50 mV	5.9 mV 2.3 mA 120 mV	10.4 mV 1.4 mA 200 mV	18.0 mV 0.75 mA 375 mV	36.0 mV 0.39 mA 750 mV	60.0 mV 0.23 mA 1.25 V
OVP accuracy		250 mV	500 mV	800 mV	1 V	1.5 V	2.5 V

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped across each load lead. Add 2 mV to the voltage load regulation specification for each 1–V change in the negative output lead caused by a load current change.

Command Processing Time: The average time for the output voltage to change after getting an HP-IB command is 20 ms

Output Programming Response Time (with full resistive load)**:** The rise time (10/90%) of the output voltage is less than 20 ms. The fall time (90/10%) of the output voltage is less than 20 ms (66101A–66103A) or 50 ms for (HP 66104A–66105A). The output voltage change settles within 1 LSB (0.025% x rated voltage) of the final value in less than 120 ms.

Down Programming: An active down-programmer sinks approximately 10% of the rated output current

Calibration Interval: One year

ac Input of System Mainframe

Voltage	100 Vac	120 Vac	200 Vac	220 Vac	230 Vac	240 Vac
Maximum current	29 A	25 A	16 A	16 A	16 A	15 A

Input Power of System Mainframe: 3200 VA (max.), 1800 W (max.), 1600 W (typ.)

Regulatory Compliance: Listed to UL-1244; certified to CSA 22.2 No. 231; complies with EN61010-1, carries the CE mark

RFI Suppression: Complies with CISPR-11, Group 1, Class A

Weight:

Net: HP 66000A, 15 kg (33 lb); HP 66001A, 1.05 kg (2.3 lb); HP 66101–66106A, 2.7 kg (6 lb).

Shipping: HP 66000A, 19 kg (41 lb); HP 66001A, 1.34 kg (2.95 lb); HP 66101–66106A, 4.1 kg (9 lb).

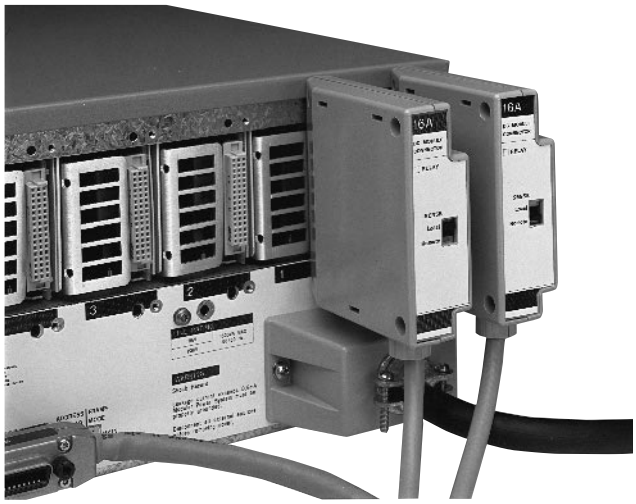
Size: HP 66000A: 425.7 mm W x 184.94 mm H x 677.93 mm D (16.76 in x 7.28 in x 26.69 in), including feet and rear connectors

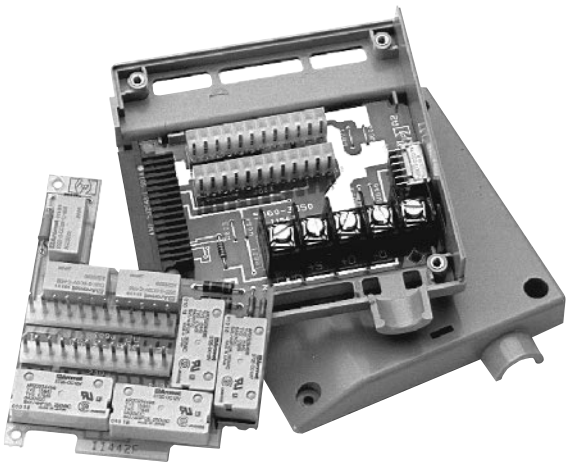
Warranty Period: Three years

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-2199

For more information, visit our web site:
http://www.hp.com/go/modularPS





Isolation and polarity reversal relays are available as an option to the modules. The relay assembly fits into the module connector and can be fully controlled and sensed over the GPIB.

Simple Way to Integrate Multiple Power Sources

A single HP 66000A mainframe can hold up to eight modules. Six modules are available with voltage ranges up to 200 V and current ranges up to 16 A. The built-in HP serial link feature can control up to 16 outputs at one GPIB address by connecting an auxiliary mainframe.

System assembly is simplified thanks to a quick-disconnect connector assembly on each module. Once your wires are connected to the load, the connector design permits the modules to be removed from the front of the mainframe without disconnecting cabling or removing the mainframe from the rack. One connector assembly is shipped with each module.

No Compromise Performance with Modular Convenience

HP 66000 MPS offers high performance and reliability and the advantages of modularity. The HP 66000 MPS offers high stability for applications that need precise output control, accurate readback measurements, and low output noise.

Advanced Programmable Control

HP 66000 MPS features a powerful output capability, precise control of voltage and current, programmable protection features, user-definable power-on state and five non-volatile store-recall states per output. An optional keyboard offers full control of all programmable features. GPIB interface is a standard feature fully compatible with the industry-standard SCPI command set.

Increase test throughput by using the output sequencing feature of the HP 66000 MPS. This powerful feature allows you to download up to 20 voltage, current, and dwell-time parameter sets per output. This sequence can be paced by the programmed dwell times. As an alternative, triggers can be used to step through the output list. The output sequences can be executed without controller intervention, thereby increasing overall test system throughput.

Ordering Information

HP 66000A MPS Mainframe
- **Opt 908** Rackmount Kit (HP p/n 5062-3978)
- **Opt 909** Rackmount Kit with Handles (HP p/n 5062-3984)
- **Note: Options 908 and 909** require cabinet rails or a slide kit (HP p/n 1494-0059) to support the loaded mainframe's weight.
- **Opt 910** Extra Manual Set (Standard unit is shipped with Installation Guide only.)

HP 66001A MPS Keyboard includes 2m (6 ft) cables (Order HP66002A to rackmount)
HP 66002A (Rack Kit for HP 66001A keyboard)
Module Options
HP 66101A dc Power Module 8 V, 16 A
HP 66102A dc Power Module 20 V, 7.5 A
HP 66103A dc Power Module 35 V, 4.5 A
HP 66104A dc Power Module 60 V, 2.5 A
HP 66105A dc Power Module 120 V, 1.25 A
HP 66106A dc Power Module 200 V, 0.75 A
- **Opt 760** Open/Close and Polarity Reversal Relays
- **Opt 910** Extra Manual Set: User's Guide, Programming Guide and Service Manual (Standard unit is shipped with Installation Guide only.)

Accessories
HP p/n 5060-3351 Field-Installable Relay Kit
HP p/n 5060-3386 Standard Connector Assembly
HP p/n 5060-3387 Standard Connector Assembly with installed relays (Option 760)
HP p/n 66000-90001 Mainframe Installation Guide
HP p/n 5959-3360 dc Power Module User's Guide
HP p/n 5959-3362 dc Power Module Programming Guide
HP p/n 66000-90003 Mainframe Service Manual
HP p/n 5959-3364 dc Power Module Service Manual
HP p/n 1252-1488 4-Pin FLT/Inhibit Connector
Line Cord Options
A line cord option must be specified. For details, refer to page 176.

164 Telecommunication dc Source

HP 66111A
HP 66309B
HP 66309D
HP 66311B
HP 66311D
HP E4356A

NEW

- 5A peak current
- Single and dual output models
- Fast transient voltage response
- Precision uA measurement
- Dynamic current pulse measurement
- Exceptional sourcing and current sinking
- Automatic detection of open sense connections
- VXI plug&play drivers

HP 66309B

- Low ripple and noise
- Fast up—and down—programming
- SCPI (Standard Commands for Programmable Instruments)
- Complete front-panel control, calibration and display
- Remote programming and sensing
- Fan-speed control to minimize acoustic noise
- Over-voltage and over-current protection
- VXIplug&play drivers
- Also suitable for non-telecom applications

HP E4356A

New Solutions for Testing Battery-Powered Devices

The HP mobile communications dc sources are a family of 45 watt power supplies that functions as a power-source alternative to batteries and charger for testing mobile phones and portable devices. They offer up to 5 A peak current sourcing with improved output stability and superior voltage transient response, HP Fast Response Power Technology, that prevents device shutdowns due to significant voltage drops in the test wiring.

A rack's worth of capability in a single box

From the dual output HP 66309D with built-in DVM to the low-cost HP 66111A, this family of solutions offers many features/capability in a single, ½ rack box. They eliminate the cost and hassle of integrating and using oscilloscope or high-speed digital voltmeter, shunts, relays and multiplexers to make voltage and current measurements. Now you can catch and characterize those critical pulses using only power supply.

In addition to dynamic measurements, the HP mobile communications dc source solutions feature output programming response as fast as 400us and command processing times of less than 4ms; the reduced cycle times will boost your test throughput, too.

Maintaining Value

With a full set of device protection features and three-year warranties, the HP mobile communications dc source solutions will keep delivering superb results year after year. A new HP-developed technology that automatically detects open sense connections helps ensure you deliver quality products to your customers.

Ordering Information

Standard: 104 to 127 Vac 47 to 63 Hz
Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 230 207 to 253 Vac, 47 to 63 Hz
Opt 052 Device Characterization Software HP 14565A (HP 66309B/D and HP 66311B/D Only)
Opt 1CM Rack-mount Kit HP p/n 5062-3972
Opt AXS Rack-mount Kit for side-by-side mounting, Locking Kit HP p/n 5061-9494; Flange Kit HP p/n 5062-3974
Opt OBN Service Manual, extra User's Guide and Programming Guide

Accessories
HP 14575A Multiplexing Remote Front Panel

HP E4356A Telecom dc Power Supply

The E4356A telecom dc power supply is a one-box solution that delivers the reliable capabilities of an integrated system. This power supply provides power at up to 80 Vdc and up to 30 A in two ranges. When programmed to operate between 0 V and 70 V, the E4356A is automatically placed in the low output range, offering its full 30 A maximum current and 2100 W. When programmed between 70 V and 80 V, the E4356A switches into the high output range, where it is able to provide up to 26 A and 2100 W. Thus, the E4356A's automatic ranging means that you get the most power possible, whether you are operating at 70 V or 80 V.

Since noise elimination is critical for telecom applications, the telecom dc power supply offers low noise output, so that power supply noise does not interfere with testing of telecom devices.

The E4356A is ideal for manufacturing and R&D engineers who build equipment for the telecom industry that operates from a 48 V or higher dc rail. This telecom equipment includes: base stations, switches, public and private telephone network equipment, PBX systems, and dc/dc power supplies that provide power to this equipment.

Although targeted at the telecom industry where 80V is a common requirement, the E4356A can also be used for other applications requiring 80 Vdc. The E4356A has all of the features found on our general purpose system dc power supplies, such as the HP 6670 Series of 2000 W system dc power supplies. Therefore is it well suited for both R&D and ATE applications where the features and performance of a one-box solution provide a complete test solution at the price of a single instrument.

Key Literature

1999/00 HP Power Products Catalog, p/n 5968-2199

For more information, visit our web site : **www.hp.com/go/power**

Ordering Information

Standard: 191 to 250 Vac, 47 to 63 Hz
Opt 200 174 to 220 Vac, 47 to 63 Hz (Japan only)
Opt 908 Rack-mount Kit (HP p/n 5062-3977)
Opt 909 Rack-mount Kit w/Handles (HP p/n 5062-3983)

Accessories
HP p/n 1494-0059 Accsessory Slide Kit
HP p/n 1252-3698 7-pin Analog Plug
HP p/n 1252-1488 4-pin Digital Plug
HP p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)

HP 66111A
HP 66309B
HP 66309D
HP 66311B
HP 66311D
HP E4356A

NEW

4

Abbreviated Specifications and Characteristics

Model		HP 66111A	HP 66311B HP 66311D	HP 66309B HP 66309D		HP E4356A
Number of Outputs		1	1	2		1
Output Ratings				**Output 1**	**Output 2**	
	Voltage Current	0 to 15 V 0 to 3 A 5A[1]	0 to 15 V 0 to 3 A 5A[1]	0 to 15 V 0 to 3 A 5A[1]	0 to 12 V 0 to 1.5 A 3A[2]	0 to 70 V/0 to 80 V 0 to 30 A/0 to 26 A
Programming accuracy At 25° C ±5° C				**Output 1**	**Output 2**	
	Voltage Current	0.05% + 10 mV 0.05% + 1.33 mA	0.05% + 10 mV 0.05% + 1.33 mA	0.05% + 10 mV 0.05% + 1.33 mA	0.2% + 40 mV 0.2% + 4.5 mA	0.04% +80 mV 0.1% + 25 mA
Ripple and Noise (20 Hz to 20 mHz)						
	Voltage (rms/p-p) Current (rms)	1 mV/ 6 mV[3] 2 mA	1 mV/ 6 mV[3] 2 mA	1 mV/ 6 mV[3] 2 mA	1 mV/ 6 mV[3] 2 mA	2 mV/16 mV 25 mA
Dc Measurement Accuracy (via GPIB or front panel meters with respect to actual output at 25° C ±5° C)	Voltage Current High Current Range +20 mA to + rated I –20 ma to – rated I Low Current Range –20 mA to + 20 mA	0.03% + 5 mV see below 0.2% + 9 mA 0.2% + 9 mA –	0.03% + 5 mV see below 0.2% + 0.5 mA[4] 0.2% + 1.1 mA 0.1% + 2.5 uA	0.03% + 5 mV see below 0.2% + 0.5 mA[4] 0.2% + 1.1 mA 0.1% + 2.5 uA	0.02% + 15 mV 0.2% + 3 mA – – –	0.05% + 120 mV 0.1% + 35 mA – – –
Transient Response Time		<35 us[5]	<35 us[5]	<35 us[5]	<400 us[6]	< 900 us [7]
Price			66311B 66311D	66309B 66309D		

1 Peak current for up to a 7 ms time period. Average current cannot exceed 3 A
2 Peak current for up to a 1 ms time period. Average current cannot exceed 1.5 A
3 For phone capacitance higher than 6 uF
4 Applies with current detector set to dc
5 Time for the output voltage to recover to within 20 mV of its final value following a 0.1 A to 1.5 A load change in the High Mode compensation range
6 Time for the output voltage to recover to within 20 mV of its final value following a 0.75 A to 1.5 A load change
7 Time for the output voltage to recover 100 mV following a change in load from 100% to 50% to 100% of the output current rating of the supply

Voltmeter Input (HP 66311D and HP 66309D only)

Input Range	N/A	Max differential voltage between input terminals ±25V	N/A
Dc Readback Accuracy At 25 deg C +/- 5 deg C	N/A	0.04% + 5 mV	
(ac + dc) rms Readback Accuracy @25° C ± 5° C with dc plus a sinewave input >25 mV rms	N/A	1% + 5 mV at 10 K HZ sinewave 60 Hz to 10 KHz: 1% + 5 mV[1] 45-60 Hz and 10-20 KHz: 4% + 5 mV[1]	
Common Mode Voltage Range (from either DVM input with respect to the negative output terminal of Output #1	N/A	–4.5 V pk to 25 V pk	

[1] 1+15 mV for dc plus sinewave input <25 mV rms

dc Floating Voltage: Output terminals can be floated up to 50 Vdc maximum from chassis ground ± 240 vdc for E4356A.
Remote Sensing: For 66111A, 66309B/D, 66311 B/D, up to 4 V can be dropped across each load lead (add 2 mV to the voltage load regulation specification for each 1 V change in the positive output lead due to load current change). For E4356A, up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.
Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB. (Display disabled.) (20 ms for the E4356A.)
Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 200 ms (66111A, 66311B/D) (20 ms for the E4356A). The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in 2 ms (less than 60 ms for the E4356A).
Measurement Time: 66111A, 66309B/D, 66311B/D only. Average time to process query, calculate measurement parameter and return data is 50 ms (includes the default tie of 30 ms for acquiring data, and a 20 ms data processing overhead.)

Modulation: E4356A only (Analog programming of output voltage and current).
Input signal: 0 to –4 V for voltage, 0 to 7 V for current
Input impedance: 30k Ohm or greater
Input power: 3,800 VA 2,600 W at full load, 170 W at no load.
GPIB Interface Capabilities: For 6111A, 66309B/D, 66311 B/D only. IEEE-488.2, SCPI command set, and 6630A series programming capability. For E4356A only: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, E1 and C0. IEE-448.2 and SCPI-compatible command set.
Input (full load): 1.4 A, (66111A, 66309B, 66311B/D only)
Regulatory Compliance For 66111A, 66309B/D, 66311 B/D only : Listing pending to UL 3111-1; complies with EMC directive 89/336/EEC (ISM 1B). For E4356A only: Listed to UL 1244; certified to CSA556B, conforms to EN61010.
Warranty Period: 3 years.
Size: HP 66111A, 66309 B/D, 66311 B/D: 212.8 mm W x 88.1 mm H x 435 mm D (8.4 in x 3.5 in x 17.125 in); HP E4356A: 425.5 mm W x 132.6 mm H x 640 mm D (16.75 in. x 5.22 in. x 25.2 in.)
Weight: HP 66111A, 66309 B/D, 66311 B/D, 9.07 kg (20 lb) net, 11.1 kg (24.5 lb) shipping; HP E4356A: 28.2 kg (62 lb) net, 31.8 kg (70lb) shipping

HP E4350B
HP E4351B

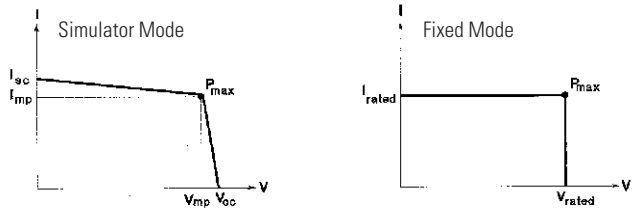
The E4350B/E4351B simulates the output characteristic of a satellite's solar panels as it moves from darkness to light.

HP Solar Array Simulator

The HP one-box Solar Array Simulator (SAS) is a dc power source that simulates the output characteristics of a solar array. The HP SAS is primarily a current source with very low output capacitance and is capable of simulating the I-V curve of different arrays under different conditions (i.e., temperature, age, etc.). The I-V curve is programmable over the IEEE-488.2 bus and is conveniently generated within the HP SAS.

The HP SAS provides three current operating modes:

1. Simulator Mode: An internal algorithm is used to approximate a SAS I-V curve. Four input parameters: Voc (open circuit voltage), Isc (short circuit current), Imp and Vmp (current and voltage at the peak power point on the curve) are needed to establish a curve in this mode.



2. Table Mode: For a fast and accurate I-V simulation, the HP SAS provides a table mode. The I-V curve is set by a user-defined table of points. A table can have any length up to 4000 points (a point corresponds to a specific value of I and V). As many as 60 tables may be stored in the HP SAS built-in volatile and non-volatile memory.

Non-volatile memory can store a maximum of 3500 points. The tables (I-V curves) are easily stored and recalled with an IEEE-488.2 command. The table(s) stored in this memory will be retained when the power is turned off.

Volatile memory greatly increases the flexibility by saving up to 30,000 points. Multiple tables are easily accessed with IEEE-488.2 command. These tables will be erased after power is removed.

In Table Mode, current and voltage offsets can be applied to the selected table to simulate a change in the operating conditions of the solar array.

3. Fixed Mode: This is the default mode when the unit is powered on. The unit has the rectangular I-V characteristics of a standard power supply, when an output capacitor is added in this mode.

Specifications

	HP E4350B	HP E4351B
For simulator and table modes		
Max. Power	480 W	480 W
Voc, Max.*	65 V	130 V
Isc, Max.*	8 A	4 A
For fixed mode		
Max. Power	480 W	480 W
V rated*	0–60 V	0–120 V
I rated*	0–8 A	0–4 A

*Other voltage/current combinations may be configured to meet your unique requirements.

Programming Accuracy: at 25°C + 5°C (SAS and Table Mode)
Voltage: (Fixed Mode)
0.075% + 10 mV (E4350B)
0.075% + 20 mV (E4351B)
Current: (Simulator and Fixed Mode)
0.2% + 20 mA (E4350B)
0.2% + 10 mA (E4351B)
Ripple and Noise: (20 Hz to 20 MHz) with outputs ungrounded or with either terminal grounded (Simulator and Table Mode)
Voltage: RMS: 16 mV (E4350B)
24 mV (E4351B)
P-P: 125 mV (E4350B)
195 mV (E4315B)
Current: 4 mA
Load Switching Recovery Time: < 5μs when switched from short circuit to variable load to within 1.5 A of an operating point on the I-V curve.
Load/Line Regulation: Change in output voltage or current for any load or line change within ratings (Fixed Mode)
Voltage: 2 mV
Current: 1 mA

ac Input: 104 to 127 Vac

Voltage	100 Vac	120 Vac	220 Vac	240 Vac
Current	12 A	10 A	5.7 A	5.3 A

Supplemental Characteristics

Supplemental characteristics are intended to provide information useful in applying the HP SAS by describing nonwarranted performance that has been determined by design or type testing.

Remote Sensing: Up to 2 V+ (Voc–Vmp). Add 3 mV to the voltage load regulation specification for each 1 volt change in the positive output lead due to load current change.
Analog Programming of Output Current
Input Signal: 0 to –4 V
Input Impedance: 20 k Ohms nominal
Shunt Regulation: Switching frequency up to 50 kHz
Series Regulation: Switching frequency up to 50 kHz
OVP and OCP: Overvoltage and overcurrent protection triggers in <100 μs
Capacitive Load: In fixed mode, the maximum load capacitance (without causing instability) is 2000μF. In simulator and table mode, it is unconditionally stable at all capacitive loads.
Inductive Load: The maximum load capacitance (without causing instability) is 200μH
Regulatory Compliance: Listed to UL3101, certified to CSA 22.2 NO. 1010.1, complies with EN 61010-1
RFI Suppression: Complies with CISPR-II, GROUP1, Class A
Size: 425.5 mm W x 132.6 mm H x 497.8 mm D (16.75 in x 5.25 in x 19.6 in)
Weight: Net, 25 kg (54 lb): shipping, 28 kg (61 lb)
Warranty: Three years

Key Literature

1999/00 HP Power Products Catalog, p/n 5968-2199

For more information, visit our web site:
http://www.hp.com/go/solarsimulator

Ordering Information

Simulators can be ordered as individual modules or as a fully customized system.
Opt 0BN Service Manual and extra Operating Guide
Opt 0BO Delete Manual
Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 240 209 to 250 Vac, 47 to 63 Hz
Opt 908 Rackmount Kit, HP p/n 5062-3977
Opt 909 Rackmount Kit with Handles, HP p/n 5062-3983

Accessories
HP p/n 1252-3698 7-pin Analog Plug
HP p/n 1252-1488 4-pin Digital Plug
HP p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
HP p/n 1494-0059 Accessory Slide Kit

- Ideal for portable product test
- Dynamic pulse measurement
- Precision low current measurement
- Low-output noise
- High-speed programming
- SCPI (Standard Commands for Programmable Instruments)
- GPIB and RS-232 interface
- HP VXI *plug&play* drivers

HP 66312A, top; HP 66332A, bottom

Abbreviated Specifications and Characteristics

			HP 66312A	HP 66332A
Output ratings	Voltage/Current		0 to 20 V/0 to 2 A	0 to 20 V/0 to 5 A
Programming accuracy at 25° C ±5° C	Voltage/+Current	0.05%+	10 mV/1mA	10 mV/2 mA
Ripple and noise (20 Hz to 20 MHz, with outputs ungrounded or with other terminal grounded)	Voltage normal mode Voltage fast mode Current (rms)	(rms/p-p) (rms/p-p)	0.5 mV/3 mV NA 1 mA	0.3 mV/3 mV 1 mV/10 mV 2 mA
DC measurement accuracy via GPIB or front-panel meters with respect to actual output at 25°C ± 5°C	Voltage	0.03% +	3 mV	3 mV
	Low current range –20 mA to +20 mA	0.1% +	2.5 μA	2.5 μA
	High current range +20 mA to + rated I –20 mA to – rated I	 0.2% + 0.2% +	 0.25 mA 0.85 mA	 0.5 mA 1.1 mA
Load regulation	Voltage/Current		2 mV/0.5 mA	2 mV/1 mA
Line regulation	Voltage/Current		0.5 mV/0.5 mA	0.5 mV/0.5 mA
Transient Response Time: Less than 100 μs (50 μs in the fast mode HP 66332A) for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply), following any step change in load current of up to 50% of the output current rating of the supply				
Average programming resolution	Voltage/Current		5 mV/0.5 mA	5 mV/1.25 mA
OVP accuracy		2.4% +	240 mV	240 mV
Sink current*	—		1.2 A	5 A

*For the HP 66332A, the sink current tracks the programmed current to within 2 mA for programmed currents greater than 5 mA. Below 5 mA, the sink current remains at 5 mA. The sink current does not track the programmed current for the 66312A.

Dynamic Measurements: Accuracy of the instantaneous voltage measurement is 0.03% +5 mV. Accuracy of the instantaneous current measurement is 0.6% +1 mA (2 mA for HP 66332A). The dc, rms, maximum, minimum, high-level and low-level voltage and current measurements are calculated from the instantaneous voltage and current readings. Up to 4096 data points can be acquired. The sampling interval can be varied from 15.6 μs to 31,200 s. The instantaneous data points can also be read back from the storage buffer. Dynamic measurements on current waveforms with frequency content up to 10 kHz can be made on the low- or high-current range. Above 10 kHz, accurate current measurements can only be made in the high range.
dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground (50 volts for HP 66312A)
Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead (positive output lead for the HP 66312A) due to load current change.
Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB.(Display disabled.)
Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms (400 μs for the HP 66332A in the fast mode). The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms (2 ms in the fast mode).
Measurement Time: Average time to process query, calculate measurement parameter and return data is 50 ms. (Includes the default tie of 30 ms for acquiring data, and a 20 ms data processing overhead)
Input Power (full load): HP 66312A: 160 VA, 100 W;
HP 66332A: 350 VA, 250 W
Regulatory Compliance: Listed to UL-3111-1; certified to CSA 22.2. No. 1010-1, complies with EN61010-1, complies with EMC directive 89/336/EEC (ISM Group 1, Class B)
Warranty Period: Three years

Size: HP 66312A: 212.8 mm W x 88.1 mm H x 444.4 mm D
(8.4 in x 3.5 in x 17.5 in);
HP 66332A: 425.5 mm W x 88.1 mm H x 364.4 mm D
(16.75 in x 3.5 in x 14.3 in)
Weight: HP 66312A: 8.85 kg (19.5 lb) net; 11.1 kg (24.5 lb) shipping;
HP 66332A: 12.7 kg (28 lb) net, 15.0 kg (33 lb) shipping

Key Literature

1999/00 HP Power Products Catalog, p/n 5968-2199

For more information, visit our web site: **http://www.hp.com/go/dynamicPS**

Ordering Information

Standard: 104 to 127 Vac, 47 to 63 Hz
Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 230 207 to 253 Vac, 47 to 63 Hz
Opt 020 Front-panel Binding Posts (HP 66332A only)
Opt 760 Isolation and Reversal Relays (HP 66332A only)
Opt 8ZJ Delete instrument feet
Opt 1CM Rackmount Kit,
HP 66312A: HP p/n 5060-3972
HP 66332A: HP p/n 5062-3974
Opt 1CP Rackmount Kit with Handles,
HP p/n 5062-3975 (HP 66332A only)
Opt AXS Rackmount Kit for side-by-side mounting (66312A only), Locking Kit HP p/n 5061-9694;
Flange Kit HP p/n 5062-3974
Opt 0BN Service Manual and extra Operating Guide (Standard unit is shipped with operating guide and programming guide only.)
Accessories
HP p/n 1494-0060 Rack Slide Kit (HP 66332A only)

Precision Measurement Single-Output System: 40 W and 50 W

HP 6611C
HP 6612C
HP 6613C
HP 6614C

- Precision low current measurement
- Low-output noise
- High-speed programming
- GPIB and RS-232 interface
- SCPI (Standard Commands for Programmable Instruments)
- HP VXI plug&play drivers

Abbreviated Specifications and Characteristics

			HP 6611C	HP 6612C	HP 6613C	HP 6614C
Output ratings	Voltage/Current		0 to 8 V/0 to 5 A	0 to 20 V/0 to 2 A	0 to 50 V/0 to 1 A	0 to 100 V/0 to 0.5 A
Programming accuracy at 25° C ±5° C	Voltage/+ Current	0.05% +	5 mV/2 mA	10 mV/1 mA	20 mV/0.75 mA	50 mV/0.5 mA
Ripple and noise (20 Hz to 20 MHz, with outputs ungrounded or with either terminal grounded)	Voltage (rms/p-p) Current (rms)		0.5 mV/3 mV 2 mA	0.5 mV/3 mV 1 mA	0.5 mV/4 mV 1 mA	0.5 mV/5 mV 1 mA
DC measurement accuracy: via GPIB or front-panel meters with respect to actual output at 25° C ±5° C	Voltage	0.03% +	2 mV	3 mV	6 mV	12 mV
	Low current range –20 mA to +20 mA	0.1% +	2.5 μA	2.5 μA	2.5 μA	2.5 μA
	High current range +20 mA to + rated I –20 mA to –rated I	 0.2% + 0.2% +	 0.5 mA 1.1 mA	 0.25 mA 0.85 mA	 0.2 mA 0.8 mA	 0.1 mA 0.7 mA
Load regulation	Voltage/Current		2 mV/1 mA	2 mV/0.5 mA	4 mV/0.5 mA	5 mV/0.5 mA
Line regulation	Voltage/Current		0.5 mV/0.5 mA	0.5 mV/0.5 mA	1 mV/0.25 mA	1 mV/0.25 mA
Transient Response Time: Less than 100 μs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of the output current rating of the supply						
Average programming resolution	Voltage/Current		2 mV/1.25 mA	5 mV/0.5 mA	12.5 mV/0.25 mA	25 mV/0.125 mA
Sink current (does not track the programmed current)			3 A	1.2 A	0.6 A	0.3 A

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground
Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead due to load current change.
Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB.
Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms.
Measurement Time: Average time to make a voltage or current measurement is 50 ms.
Input Power (full load)**:** 160 VA, 100 W
Regulatory Compliance: Listed to UL 3111-1; certified to CSA 22.2 No. 1010.1; complies with EN61010-1; complies with EMC directive 89/336/EEC (ISM Group 1, Class B)
Warranty Period: Three years
Size: 212.8 mm W x 88.1 mm H x 368.3 mm D (8.4 in x 3.5 in x 14.5 in)
Weight: 8.2 kg (18.16 lb) net; 10.6 kg (23.5 lb) shipping

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-2199

For more information, visit our web site:
http://www.hp.com/go/singlePS

Ordering Information

Standard: 104 to 127 Vac, 47 to 63 Hz
Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 230 207 to 253 Vac, 47 to 63 Hz
Opt 760 Isolation and Reversal Relays
Opt 8ZJ Delete instrument feet
Opt ICM Rackmount Kit, HP p/n 5062-3972
Opt 0BN Service Manual and extra Operating Guide (Standard unit is shipped with operating guide and programming guide only.)

- Multiple sources in an integrated one-box solution
- 2, 3 or 4 independent isolated outputs
- Precision models available, 14-bit programming and readback
- Stable, low ripple and noise power source
- Faster testing with fast up-and down- programming
- Full protection features
- Three-year standard warranty

HP multiple-output power supplies are an ideal solution for automated testing environments that require multiple voltage sources.

HP 6621A
HP 6622A
HP 6623A
HP 6624A
HP 6625A
HP 6626A
HP 6627A
HP 6628A
HP 6629A

4

Abbreviated Specifications and Characteristics

		25-watt output	40-watt output	40-watt output	50-watt output	80-watt output	80-watt output
Output Power	Low-range volts, amps High range volts, amps	0 to 7 V, 0 to 15 mA 0 to 50 V, 0 to 500 mA	0 to 7 V, 0 to 5 A 0 to 20 V, 0 to 2 A	0 to 20 V, 0 to 2 A 0 to 50 V, 0 to 0.8 A	0 to 16 V, 0 to 200 mA 0 to 50 V, 0 to 1 A or 0 to 16 V, 0 to 2 A	0 to 7 V, 0 to 10 A 0 to 20 V, 0 to 4 A	0 to 20 V, 0 to 4 A 0 to 50 V, 0 to 2 A
Output combinations for each HP model (total number of outputs)	HP 6621A (2)	—	—	—	—	2	—
	HP 6622A (2)	—	—	—	—	—	2
	HP 6623A (3)	—	1	1	—	1	—
	HP 6624A (4)	—	2	2	—	—	—
	HP 6625A (2) Precision	1	—	—	1	—	—
	HP 6626A (4) Precision	2	—	—	2	—	—
	HP 6627A (4)	—	—	4	—	—	—
	HP 6628A (2) Precision	—	—	—	2	—	—
	HP 6629A (4) Precision	—	—	—	4	—	—
Programming accuracy (at 25° C ±5° C)	Voltage	1.5 mV + 0.016% (low) 10 mV + 0.016% (high)	19 mV + 0.06%	50 mV + 0.06%	3 mV + 0.016% (low) 10 mV + 0.016% (high)	19 mV + 0.06%	50 mV + 0.06%
	Current	15 μA + 0.04% (low) 100 μA + 0.04% (high)	50 mA + 0.16%	20 mA + 0.16%	185 μA + 0.04% (low) 500 μA + 0.04% (high)	100 mA + 0.16%	40 mA + 0.16%
Ripple and noise (peak-to-peak, 20 Hz to 20 MHz; rms, 20 Hz to 10 MHz)	Constant voltage rms	500 μV	500 μV	500 μV	500 μV	500 μV	500 μV
	peak-to-peak	3 mV	3 mV	3 mV	3 mV	3 mV	3 mV
	Constant current rms	0.1 mA	1 mA	1 mA	0.1 mA	1 mA	1 mA
Load regulation	Voltage	0.5 mV	2 mV	2 mV	0.5 mV	2 mV	2 mV
	Current	0.005 mA	1 mA	0.5 mA	0.01 mA	2 mA	1 mA
Load cross regulation	Voltage	0.25 mV	1 mV	2.5 mV	0.25 mV	1 mV	2.5 mV
	Current	0.005 mA	1 mA	0.5 mA	0.01 mA	2 mA	1 mA
Line regulation	Voltage	0.5 mV	0.01% + 1 mV	0.01% + 1 mV	0.5 mV	0.01% + 1 mV	0.01% + 1 mV
	Current	0.005 mA	0.06% + 1 mA	0.06% + 1 mA	0.01 mA	0.06% + 1 mA	0.06% + 1 mA
Transient Response Time: Less than 75 μs for the output to recover to within 75 mV of nominal value following a load change within specfications							
Average programming resolution	Voltage	460 μV (low)/ 3.2 mV (high)	6 mV	15 mV	1 mV (low)/ 3.2 mV (high)	6 mV	15 mV
	Current	1 μA (low)/ 33 μA (high)	25 mA	10 mA	13 μA (low)/ 131 μA (high)	50 mA	20 mA
	OVP	230 mV	100 mV	250 mV	230 mV	100 mV	250 mV
Output setting time		6 ms	2 ms	6 ms	6 ms	2 ms	6 ms

dc Floating Voltage: All outputs can be floated up to ±240 Vdc from chassis ground
Remote Sensing: Up to 1 V (HP 6621–24A, 6627A); up to 10 V (HP 6625A, 6626A, 6628A, 6629A) drop per load lead.
Command Processing Time: 7 ms typical
Down Programming: Current sink approximately 110% of the rated output current for operating voltage above 2.5 V (HP 6621A, 6622A, 6623A, 6624A, 6627A)
Input Power: 550 W max., 720 VA max.
Regulatory Compliance: Listed to UL-1244; certified to CSA 556B; complies with EN61010-1; carries the CE mark
RFI Suppression: Complies with CISPR-11, Group 1, Class B
Size: 425.5 mm W x 132.6 mm H x 497.8 mm D (16.75 in x 5.22 in x 19.6 in)
Weight:
HP 6621A–24A, 6626A, 6627A, 6629A
Net: 17.4 kg (38 lb); Shipping: 22.7 kg (50 lb)
HP 6625A, 6628A
Net: 15.5 kg (34 lb); Shipping: 20.8 kg (46 lb)

Key Literature

1999/00 HP Power Products Catalog, p/n 5968-2199

For more information, visit our web site:
http://www.hp.com/go/multiple PS

Ordering Information

HP 6621A Dual-Output System Power Supply
HP 6622A Dual-Output System Power Supply
HP 6623A Triple-Output System Power Supply
HP 6624A Quad-Output System Power Supply
HP 6625A Precision Dual-Output System Power Supply
HP 6626A Precision Quad-Output System Power Supply
HP 6627A Quad-Output System Power Supply
HP 6628A Precision Dual-Output System Power Supply
HP 6629A Precision Quad-Output System Power Supply
Standard: 104 to 127 Vac, 47 to 66 Hz, 5.4 A
Opt 100 87 to 106 Vac, 47 to 66 Hz Input, 6.3 A (Japan only)
Opt 220 191 to 233 Vac, 47 to 66 Hz, 3.0 A
Opt 240 209 to 250 Vac, 47 to 66 Hz, 3.0 A
Opt 750 Relay Control and DFI/RI
Opt 908 Rackmount Kit (HP p/n 5062-3977)
Opt 909 Rackmount Kit w/Handles (HP p/n 5062-3983)
Opt 910 Service Manual and extra Operating Guide
Opt 0B0 Delete Manual
Accessories
Rack Slide Kit (HP p/n 1494-0059)
14852A Bias Cable to connect either the HP 6626A or 6629A to a 3-terminal device test fixture

Precision Measurement Single-Output System: 100 W

HP 6631B
HP 6632B
HP 6633B
HP 6634B

- Precision low current measurement
- Low-output noise
- High-speed programming
- GPIB and RS-232 interface
- SCPI (Standard Commands for Programmable Instruments)
- HP VXI *plug&play* drivers

Abbreviated Specifications and Characteristics

			HP 6631B	HP 6632B	HP 6633B	HP 6634B
Output ratings	Voltage/Current		0 to 8 V/0 to 10 A	0 to 20 V/0 to 5 A	0 to 50 V/0 to 2 A	0 to 100 V/0 to 1 A
Programming accuracy at 25° C ±5° C	Voltage/+ Current	0.05% +	5 mV/4 mA	10 mV/2 mA	20 mV/1 mA	50 mV/0.5 mA
Ripple and noise (20 Hz to 20 MHz, with outputs ungrounded or with either terminal grounded)	Voltage Normal mode (rms/p-p)		0.3 mV/3 mV	0.3 mV/3 mV	0.5 mV/3 mV	0.5 mV/3 mV
	Voltage Fast mode rms/p-p)		1 mV/10 mV	1 mV/10 mV	1 mV/15 mV	2 mV/25 mV
	Current (rms)		3 mA	2 mA	2 mA	2 mA
DC measurement accuracy: via GPIB or front-panel meters with respect to actual output at 25° C ±5° C	Voltage	0.03% +	2 mV	3 mV	6 mV	12 mV
	Low current range –20 mA to +20 mA	0.1% +	2.5 μA	2.5 μA	2.5 μA	2.5 μA
	High current range +20 mA to + rated I	0.2% +	1 mA	0.5 mA	0.25 mA	0.25 mA
	–20 mA to –rated I	0.2% +	1.6 mA	1.1 mA	0.85 mA	0.85 mA
Load regulation	Voltage/Current		2 mV/2 mA	2 mV/1 mA	4 mV/1 mA	5 mV/1 mA
Line regulation	Voltage/Current		0.5 mV/1 mA	0.5 mV/0.5 mA	1 mV/0.25 mA	1 mV/0.25 mA
Transient Response Time: Less than 100 μs (50 μs in the fast mode) for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply) following any step change in load current of up to 50% of the output current rating of the supply						
Average programming resolution	Voltage/Current		2 mV/2.5 mA	5 mV/1.25 mA	12.5 mV/0.5 mA	25 mV/0.25 mA
Sink current*			10 A	5 A	2 A	1 A
Minimum current in constant current mode**			40 mA	20 mA	8 mA	4 mA

* For the HP 6631B–6634B, the sink current tracks the programmed current to within 2 mA for programmed currents greater than 10 mA, 5 mA, 2.5 mA, 1.25 mA respectively. Below these values, they remain at the respective values of 10 mA, 5 mA, 2.5 mA, and 1.25 mA. When programming in the HP 6630A Series language compatibility mode, the sink current for the HP 6631B–6634B tracks the programmed current with a negative 500 mA, 250 mA, 100mA and 50 mA respectively.
**When programming in the HP 6630A Series language compatibility mode.

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground
Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead due to load current change.
Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB.
Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 μs (400 ms in fast mode). The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms (2 ms in the fast mode).
HP-IB Interface Capabilities: IEEE-488.2, SCPI command set, and 6630A Series programming compatability
Instrument Time: Average time to make a voltage or current measurement is 50 ms.
Input Power 350 VA, 250 W
Regulatory Compliance: Listed to UL-3111-1; certified to CSA 22.2 No. 1010.1; complies with EN 61010-1; complies with EMC directive 89/336/EEC (ISM Group 1, Class B)
Warranty Period: Three years
Size: 425.5 mm W x 88.1 mm H x 364.4 mm D (16.8 in x 3.5 in x 14.3 in)
Weight: 12.7 kg (28 lb) net; 15.0 kg (33 lb) shipping

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-2199

For more information, visit our web site:
http://www.hp.com/go/singlePS

Ordering Information

Standard: 104 to 127 Vac, 47 to 63 Hz
Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 230 207 to 253 Vac, 47 to 63 Hz
Opt 020 Front-panel Binding Posts
Opt 760 Isolation and Reversal Relays (HP 6632B-6634B only)
Opt 8ZJ Delete instrument feet
Opt ICM Rackmount Kit, HP p/n 5062-3974
Opt 1CP Rackmount Kit with Handles, HP p/n 5062-3975
Opt 0BN Service Manual and extra Operating Guide (Standard unit is shipped with operating guide and programming guide only.)
Accessories
HP p/n 1494-0060 Rack Slide Kit

HP 6541A
HP 6542A
HP 6543A
HP 6544A
HP 6545A
HP 6641A
HP 6642A
HP 6643A
HP 6644A
HP 6645A

- Linear output regulation
- Fast up- and down-programming
- SCPI (Standard Commands for Programmable Instruments)
- Complete front-panel control calibration and display
- Remote programming and sensing
- Fan-speed control to minimizes acoustic noise
- Low ripple and noise
- Over-voltage and over-current protection

Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)			HP 6641A	HP 6642A	HP 6643A	HP 6644A	HP 6645A
Manually Controlled Power Supplies (w/o GPIB)			**HP 6541A**	**HP 6542A**	**HP 6543A**	**HP 6544A**	**HP 6545A**
Output ratings	Output voltage Output current (40° C) Maximum current (50° C/55° C)		0 to 8V 0 to 20 A 18 A/17 A	0 to 20 V 0 to 10 A 9A/8.5 A	0 to 35 V 0 to 6 A 5.4 A/5.1 A	0 to 60 V 0 to 3.5 A 3.2 A/3 A	0 to 120 V 0 to 1.5 A 1.4 A/1.4 A
Programming accuracy (at 25° C ±5° C)	Voltage Current	0.06% + 0.15% +	5 mV 26 mA	10 mV 13 mA	15 mV 6.7 mA	26 mV 4.1 mA	51 mV 1.7 mA
Ripple and noise (from 20 Hz to 20 MHz)	Voltage Current	rms peak-peak rms	300 μV 3 mV 10 mA	300 μV 3 mV 5 mA	400 μV 4 mV 3 mA	500 μV 5 mV 1.5 mA	700 μV 7 mV 1 mA
Readback accuracy at 25° C ±5° C (percent of reading plus fixed) System models only	Voltage +Current –Current	0.07% + 0.15% + 0.35% +	6 mV 18 mA 40 mA	15 mV 9.1 mA 20 mA	25 mV 5 mA 12 mA	40 mV 3 mA 6.8 mA	80 mV 1.3 mA 2.9 mA
Load regulation	Voltage Current		1 mV 1 mA	2 mV 0.5 mA	3 mV 0.25 mA	4 mV 0.25 mA	5 mV 0.25 mA
Line regulation	Voltage Current		0.5 mV 1 mA	0.5 mV 0.5 mA	1 mV 0.25 mA	1 mV 0.25 mA	2 mV 0.25 mA
Transient Response Time: Less than 100 μs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply, or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current							
Average resolution	Voltage Current OVP		2 mV 6 mA 13 mV	5 mV 3 mA 30 mV	10 mV 2 mA 54 mV	15 mV 1.0 mA 93 mV	30 mV 0.5 mA 190 mV
OVP accuracy			160 mV	400 mV	700 mV	1.2 V	2.4 V
System Power Supplies (HP-IB) Manually Controlled (w/o HP-IB)			HP 6641A/ HP 6541A/	HP 6642A/ HP 6542A/	HP 6643A/ HP 6543A/	HP 6644A/ HP 6544A/	HP 6645A/ HP 6545A/

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.
Command Processing Time (HP 6641A, 6642A, 6643A, 6644A, 6645A only)**:** Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB
Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms.
Down Programming: An active down programmer sinks approximately 20% of the rated output current
Modulation: (Analog programming of output voltage and current)
Input Signal: 0 to –5V
Input Impedance: 10 k Ohm nominal
ac Input: (ac input frequency 47 to 63 Hz)

Voltage	100 Vac	120 Vac	220 Vac	230 Vac	240 Vac
Current	4.4 A	3.8 A	2.2 A	2.1 A	2.0 A

Input Power: 480 VA, 400 W at full load; 60 W at no load
Regulatory Compliance: Listed to UL-1244, complies with EN 61010-1; certified to CSA 22.2 No. 231; carries the CE mark
RFI Suppression: Complies with CISPR-11, Group 1, Class B
Size: 425.5 mm W x 88.1 mm H x 439 mm D (16.75 in x 3.5 in x 17.3 in)
Weight: Net, 14.2 kg (31.4 lb); shipping, 16.3 kg (36 lb)
Warranty Period: Three years

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-2199

For more information, visit our web site:
http://www.hp.com/go/singlePS

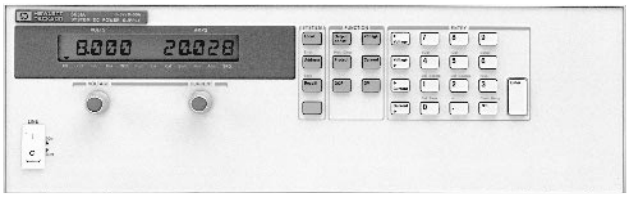
Ordering Information

Standard: 104 to 127 Vac, 47 to 63 Hz
Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 240 209 to 250 Vac, 47 to 63 Hz
Opt 908 Rackmount Kit (HP p/n 5062-3974)
Opt 909 Rackmount Kit w/Handles (HP p/n 5062-3975)
Opt 910 Service Manual, extra Operating Guide and Programming Guide
Accessories
HP p/n 1494-0060 Accessory Slide Kit
The following accessories for HP 6641A, 6642A, 6643A, 6644A and 6645A only:
HP p/n 1252-3698 7-pin Analog Plug
HP p/n 1252-1488 4-pin Digital Plug
HP p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)

Single-Output System and Manually Controlled: 500 W

HP 6551A
HP 6552A
HP 6553A
HP 6554A
HP 6555A
HP 6651A
HP 6652A
HP 6653A
HP 6654A
HP 6655A

- Complete front-panel control, calibration and display
- Remote programming and sensing
- Fan-speed control to minimize acoustic noise
- Low ripple and noise
- Over-voltage and over-current protection
- Linear output regulation
- Fast up- and down-programming
- SCPI (Standard Commands for Programmable Instruments)



Abbreviated Specifications and Characteristics

System Power Supplies (HP-IB)			HP 6651A	HP 6652A	HP 6653A	HP 6654A	HP 6655A
Manually Controlled Power Supplies (w/o HP-IB)			**HP 6551A**	**HP 6552A**	**HP 6553A**	**HP 6554A**	**HP 6555A**
Output ratings	Output voltage Output current (40° C) Maximum current (50° C/55° C)		0 to 8 V 0 to 50 A 45 A/42.5 A	0 to 20 V 0 to 25 A 22.5 A/21.3 A	0 to 35 V 0 to 15A 13.5 A/12.8 A	0 to 60 V 0 to 9 A 8.1 A/7.7 A	0 to 120 V 0 to 4 A 3.6 A/3.4 A
Programming accuracy (at 25° C ±5° C)	Voltage Current	0.06% + 0.15% +	5 mV 60 mA	10 mV 25 mA	15 mV 13 mA	26 mV 8 mA	51 mV 4 mA
Ripple and noise (from 20 Hz to 20 MHz)	Voltage Current	rms peak-peak rms	300 μV 3 mV 25 mA	300 μV 3 mV 10 mA	400 μV 4 mV 5 mA	500 μV 5 mV 3 mA	700 μV 7 mV 2 mA
Readback accuracy at 25° C ±5° C (percent of reading plus fixed) System models only	Voltage +Current –Current	0.07% + 0.15% + 0.35% +	6 mV 67 mA 100 mA	15 mV 26 mA 44 mA	25 mV 15 mA 24 mA	40 mV 7 mA 15 mA	80 mV 3 mA 7 mA
Load regulation	Voltage Current		1 mV 2 mA	2 mV 1 mA	3 mV 0.5 mA	4 mV 0.5 mA	5 mV 0.5 mA
Line regulation	Voltage Current		0.5 mV 2 mA	0.5 mV 1 mA	1 mV 0.75 mA	1mV 0.5 mA	2 mV 0.5 mA

Transient Response Time: Less than 100 μs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply, or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current

Average resolution	Voltage Current OVP	2 mV 15 mA 12 mV	5 mV 7 mA 30 mV	10 mV 4 mA 54 mV	15 mV 2.5 mA 93 mV	30 mV 1.25 mA 190 mV
OVP accuracy		160 mV	400 mV	700 mV	1.2 V	2.4 V
System Power Supplies (HP-B) General Purpose (w/o HP-B)		HP 6651A/ HP 6551A/	HP 6652A/ HP 6552A/	HP 6653A/ HP 6553A/	HP 6654A/ HP 6554A/	HP 6655A/ HP 6555A/

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.
Command Processing Time (HP 6651A, 6652A, 6653A, 6654A, 6655A only)**:** Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB
Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms.
Down Programming: An active down programmer sinks approximately 20% of the rated output current
Modulation: (Analog programming of output voltage and current)
Input signal: 0 to –5 V
Input impedance: 10 k Ohm nominal
ac Input: (ac input frequency 47 to 63 Hz)

Voltage	100 Vac	120 Vac	220 Vac	240 Vac
Current	12 A	10 A	5.7 A	5.3 A

Input Power: 1,380 VA, 1,100 W at full load; 120 W at no load
Regulatory Compliance: Listed to UL-1244; certified to CSA 556B; complies with EN 61010-1; carries the CE mark
RFI Suppression: Complies with CISPR-11, Group 1, Class B
Size: 425.5 mm W x 132.6 mm H x 497.8 mm D (16.75 in x 5.22 in x 19.6 in)
Weight: Net, 25 kg (54 lb); shipping, 28 kg (61 lb)
Warranty Period: Three years

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-2199

For more information, visit our web site: **http://www.hp.com/go/singlePS**

Ordering Information

Standard: 104 to 127 Vac, 47 to 63 Hz
Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 240 209 to 250 Vac, 47 to 63 Hz
Opt 908 Rackmount Kit (HP p/n 5062-3977)
Opt 909 Rackmount Kit w/ Handles (HP p/n 5062-3983)
Opt 910 Service Manual.extra Operating Guide and Programming Guide

Accessories
Rack Slide Kit (HP p/n 1494-0059)
The following accessories for HP 6651A, 6652A, 6653A, 6654A and 6655A only:
HP p/n 1252-3698 7-pin Analog Plug
HP p/n 1252-1488 4-pin Digital Plug
HP p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)

HP 6571A
HP 6572A
HP 6573A
HP 6574A
HP 6575A
HP 6671A
HP 6672A
HP 6673A
HP 6674A
HP 6675A

- Low ripple and noise
- Fast up- and down-programming
- SCPI (Standard Commands for Programmbale Instruments)
- Complete front-panel control, calibration and display
- Remote programming and sensing
- Fan-speed control to minimize acoustic noise
- Low ripple and noise
- Over-voltage and over-current protection

Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)			HP 6671A	HP 6672A	HP 6673A	HP 6674A	HP 6675A
General Purpose Power Supplies (w/o GPIB)			**HP 6571A**	**HP 6572A**	**HP 6573A**	**HP 6574A**	**HP 6575A**
Output ratings	Output voltage Output current (40° C)		0 to 8 V 0 to 220 A	0 to 20 V 0 to 100 A	0 to 35 V 0 to 60A	0 to 60 V 0 to 35 A	0 to 120 V 0 to 18 A
Programming accuracy (at 25° C ±5° C)	Voltage Current	0.04% + 0.11% +	8 mV 125 mA	20 mV 60 mA	35 mV 40 mA	60 mV 25 mA	120 mV 12 mA
Ripple and noise (from 20 Hz to 20 MHz)	Voltage Current	rms peak-peak rms	650 μV 7 mV 200 mA	750 μV 9 mV 100 mA	800 μV 9 mV 40 mA	1.25 mV 11 mV 25 mA	1.9 mV 16 mV 12 mA
Readback accuracy at 25° C ±5° C (percent of reading plus fixed) System models only	Voltage ±Current	0.05% + 0.1% +	12 mV 150 mA	30 mV 100 mA	50 mV 60 mA	90 mV 35 mA	180 mV 18 mA
Load and line regulation	Voltage Current	0.002%+ 0.005%+	300 μV 10 mA	650 μV 7 mA	1.2 mV 4 mA	2 mV 2 mA	4 mV 1 mA
Transient Response Time: Less than 900 μs for the output voltage to recover 100 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply							
Typical resolution	Voltage Current OVP		2 mV 55 mA 15 mV	5 mV 25 mA 35 mV	10 mV 15 mA 65 mV	15 mV 8.75 mA 100 mV	30 mV 4.5 mA 215 mV
Output voltage programming response time* (excluding command processing time) System models only			30 ms	60 ms	130 ms	130 ms	195 ms
System Power Supplies(GPIB) General Purpose (w/o GPIB)			HP 6671A/ HP 6571A/	HP 6672A/ HP 6572A/	HP 6673A/ HP 6573A/	HP 6674A/ HP 6574A/	HP 6675A/ HP 6575A/

* Full load programming rise/fall time (10% to 90% or 90% to 10%) with full resistive load equal to rated output voltage/rated output current.

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground
Output Common-Mode Noise Current: (to signal ground binding post) 500 μA rms, 4 mA peak-to-peak
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.
Command Processing Time (HP 6671A, 6672A, 6673A, 6674A, 6675A only)**:** Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB
Modulation: (Analog programming of output voltage and current)
Input Signal: 0 to –4V for voltage, 0 to 7 V for current
Input Impedance: 60 K Ohm, nominal
Input Power: 3,800 VA, 2,600 W at full load; 170 W at no load
Regulatory Compliance: Listed to UL-1244; certified to CSA 556B; complies with EN 61010-1; carries the CE mark
RFI Suppression: Complies with CISPR-11, Group 1, Class A
Size: 425.5 mm W x 132.6 mm H x 640 mm D (16.75 in x 5.22 in x 25.2 in)
Weight: Net, 27.7 kg (61 lb); shipping, 31.4 kg (69 lb)
Warranty Period: Three years

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5998-2199

For more information, visit our web site:
http://www.hp.com/go/singlePS

Ordering Information

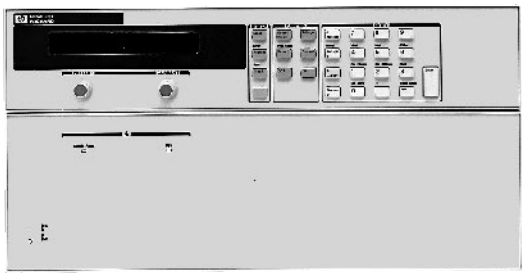
Standard: 191 to 250 Vac, 47 to 63 Hz
Opt 200 174 to 220 Vac, 47 to 63 Hz (Japan only)
Opt 908 Rackmount Kit (HP p/n 5062-3977)
Opt 909 Rackmount Kit w/ Handles (HP p/n 5062-3983)
Opt 910 Service Manual, extra Operating Guide and Programming Guide
A line cord option must be specified. See page 180 for ordering information.
Accessories
Rack Slide Kit (HP p/n 1494-0059)
The following accessories for HP 6671A, 6672A, 6673A, 6674A and 6675A only:
HP p/n 1252-3698 7-pin Analog Plug
HP p/n 1252-1488 4-pin Digital Plug
HP p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)

Power Supplies

Single-Output System: 5000 W

HP 6680A
HP 6681A
HP 6682A
HP 6683A
HP 6684A

- "One-Box" solution: includes V and I read-back
- Low ripple and noise
- Fast up- and down-programming
- High-accuracy current programming and read back
- SCPI (Standard Commands for Programmable Instruments)
- Selectable compensation for inductive loads



Abbreviated Specifications and Characteristics

			HP 6680A	HP 6681A	HP 6682A	HP 6683A	HP 6684A
Output ratings	Voltage Current (derated linearly 1%/° C from 40° to 55° C)		0 to 5 V 0 to 875 A	0 to 8 V 0 to 580 A	0 to 21 V 0 to 240 A	0 to 32 V 0 to 160 A	0 to 40 V 0 to 128 A
Programming accuracy (at 25° C ±5° C)	Voltage Current	0.04% + 0.1% +	5 mV 450 mA	8 mV 300 mA	21 mV 125 mA	32 mV 85 mA	40 mV 65 mA
Ripple and noise (from 20 Hz to 20 MHz)	Constant voltage rms peak-to-peak Constant current rms		1.5 mV 10 mV 290 mA	1.5 mV 10 mV 190 mA	1.75 mV 10 mV 40 mA	2.0 mV 10 mV 28 mA	2.5 mV 10 mV 23 mA
Readback accuracy at 25° C ±5° C (percent of reading plus fixed)	Voltage Current	0.05% + 0.1% +	7.5 mV 600 mA	12 mV 400 mA	32 mV 165 mA	48 mV 110 mA	60 mV 90 mA
Load and line regulation	Voltage Current	0.002% + 0.005% +	190 μV 65 mA	300 μV 40 mA	650 μV 17 mA	1.1 mV 12 mA	1.5 mV 9 mA
Transient Response Time: Less than 900 μs for the output voltage to recover within 150 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply							
Average programming resolution	Voltage Current OVP		1.35 mV 235 mA 30 mV	2.15 mV 155 mA 45 mV	5.7 mV 64 mA 120 mV	8.6 mV 43 mA 180 mV	10.8 mV 34 mA 225 mV
Output voltage programming response time (excludes command-processing time)	Full-load programming rise or fall time (10/90% or 90/10%, resistive load)		9 ms	12 ms	45 ms	60 ms	60 ms
Output common-mode noise current (to signal-ground binding post)		rms peak-to-peak	1.5 mA 10 mA	1.5 mA 10 mA	3 mA 20 mA	3 mA 20 mA	3 mA 20 mA

dc Floating Voltage: Output terminals can be floated up to ±60 Vdc maximum from chassis ground
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.
Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for power supplies connected directly to the GPIB
Modulation (analog programming of output voltage and current)
Input Signal: 0 to –5 V for voltage, 0 to +5 V for current
Input Impedance: 30 k Ohm or greater
ac Input (47 to 63 Hz)**:** 180 to 235 Vac (line-to-line, 3 phase), 27.7 A rms maximum; 360 to 440 Vac, 14.3 A rms maximum (maximum line current includes 5% unbalanced phase voltage condition.) Output voltage derated up to 95% at 50 Hz and below 200 Vac.
Input Power: 7350 VA and 6000 W maximum; 160 W at no load
Regulatory Compliance: Listed to UL-1244; certified to CSA 22.2 No. 231; complies with EN 61010-1; carries the CE mark
RFI Suppression: Complies with CISPR-11, Group 1, Class A
Size: 425.5 mm W x 220 mm H x 675.6 mm D (16.75 in x 8.75 in x 26.6 in)
Weight: Net, 51.3 kg (113 lb); shipping, 63.6 kg (140 lb)
Warranty Period: Three years

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-2199

For more information, visit our web site:
http://www.hp.com/go/singlePS

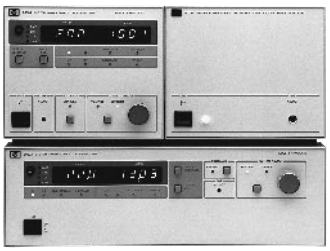
Ordering Information

Opt 400 360 to 440 Vac, 3 phase, 47 to 63 Hz
Opt 601 Output Connector Kit (required for bench applications) includes bus-bar spacer, connector bolts, and output cover (HP p/n 5060-3515)
Opt 602 Two Bus-Bar Spacers for paralleling power supplies (HP p/n 5060-3514)
Opt 908 Rackmount Kit (HP p/n 5062-3977 and p/n 5062-3974)
Opt 909 Rackmount Kit with Handles (HP p/n 5062-3983 and p/n 5062-3975). Support rails required for Option 908 and 909 HP Rack: E3663A, Rack Slides p/n 1494-0058, third party rack: E3664A
Opt 910 Service Manual (HP p/n 5960-5590), extra Operating Guide and Programming Guide

Accessories
HP p/n 5060-3513 Three 30-A Replacement Fuses for 180 to 235 Vac line
HP p/n 5060-3512 Three 16-A Replacement Fuses for 360 to 440 Vac line

HP 6010A
HP 6011A
HP 6012A
HP 6015A
HP 6023A
HP 6028A
HP 6030A
HP 6031A
HP 6032A
HP 6033A
HP 6035A
HP 6038A

Above:HP 6023A, HP 6028A
Below:HP 6010A, 6011A, 6012A and 6015A



Above:HP 6033A and HP 6031A(Option 001 on right)
Below:HP 6030A, 6031A, 6032A, and 6035A,

Abbreviated Specifications and Characteristics

System Autorangers (GPIB)			**HP 6030A**	**HP 6031A**	**HP 6032A**	**HP 6033A**	**HP 6035A**	**HP 6038A**
Autorangers (w/o GPIB)			**HP 6010A**	**HP 6011A**	**HP 6012B**	**HP 6023A**	**HP 6015A**	**HP 6028A**
Output ratings	Voltage Current		0 to 200 V 0 to 17 A	0 to 20 V 0 to 120 A	0 to 60 V 0 to 50 A	0 to 20 V 0 to 30 A	0 to 500 V 0 to 5 A	0 to 60 V 0 to 10 A
Maximum power	Watts		1,200 W	1,072 W	1,200 W	240 W	1,050 W	240 W
Autoranging output	V1, P1 V2, P2 V3, P3		200 V, 5 A 120 V, 10 A 60 V, 17 A	20 V, 50 A 14 V, 76 A 7 V, 120 A	60 V, 17.5 A 40 V, 30 A 20 V, 50 A	20 V, 10 A 14 V, 17.2 A 6.7 V, 30 A	500 V, 2 A 350 V, 3 A 200 V, 5 A	60 V, 3.3 A 40 V, 6 A 20 V, 10 A
Programming accuracy (at 25° C ±5° C) System models only	Voltage Current		0.035% +145 mV 0.2% +25 mA	0.035% +15 mV 0.25% +250 mA	0.035% +40 mV 0.2% +85 mA	0.035% +9 mV 0.15% +20 mA	0.25% +400 mV 0.3% +63 mA	0.035% +40 mV 0.09% +10 mA
Ripple and noise, (20 Hz to 20 MHz)	Voltage Current	rms p-p rms	22 mV 50 mV 15 mA	8 mV 50 mV 120 mA	5 mV 40 mV 25 mA	3 mV 30 mV 30 mA	50 mV 160 mV 50 mA	3 mV 30 mV 5 mA
Readback accuracy (at 25° C ±5° C) System models only	Voltage Current		0.08% + 80 mV 0.36% +15 mA	0.08% +7 mV 0.4% +100 mA	0.08% +20 mV 0.36% +35 mA	0.07% +6 mV 0.3% +25 mA	0.5% +200 mV 0.5% +50 mA	0.07% +50 mV 0.2% +11 mA
Load regulation	Voltage Current	0.01%+ 0.01%+	5 mV 10 mA	3 mV 15 mA	5 mV 10 mA	2 mV 9 mA	40 mV .03+34 mA	3 mV 5 mA
Line regulation System models only	Voltage Current	0.01%+ 0.01%+	5 mV 5 mA	2 mV 25 mA	3 mV 10 mA	1 mV 6 mA	13 mV .03+17 mA	2 mV 2 mA
Transient response time 10% step change	Time Level		2 ms 150 mV	2 ms 100 mV	2 ms 100 mV	1 ms 50 mV	5 ms 200 mV	1 ms 75 mV
dc floating voltage (either terminal can be grounded or floated from chassis ground)			±550 V	±240 V	±240 V	±240 V	±550 V	±240 V
ac input current	100 Vac (system only) 120 Vac 220 Vac 240 Vac		24 A 24 A 15 A 14 A	24 A 24 A 15 A 14 A	24 A 24 A 15 A 14 A	6.0 A 6.5 A 3.8 A 3.6 A	24 A 24 A 15 A 14 A	6.0 A 6.5 A 3.8 A 3.6 A
Weight	Net Shipping		16.3 kg (36 lb) 21.7 kg (48 lb)	17.2 kg (38 lb) 22.7 kg (50 lb)	16.3 kg (36 lb) 21.8 kg (48 lb)	9.6 kg (21 lb) 11.4 kg (25 lb)	16.3 kg (36 lb) 21.7 kg (48 lb)	9.6 kg (21 lb) 11.4 kg (25 lb)
System Autorangers (GPIB) Autorangers (w/o GPIB)			HP 6030A/ HP 6010A/	HP 6031A/ HP 6011A/	HP 6032A/ HP 6012B/	HP 6033A/ HP 6023A/	HP 6035A/ HP 6015A/	HP 6038A/ HP 6028A/

Remote Sensing: Up to 2 V drop in each lead. Voltage regulation degrades for greater than 0.5 V drop.
Regulatory Compliance: Listed to UL-1244; certified to CSA 556B; complies with EN 61010-1, carries the CE mark
RFI Suppression: Complies with CISPR-11, Group 1, Class A
Inductive Load: HP 6023A, 6028A are stable in CC mode for loads up to 1 H. HP 6010A–6012B, 6015A are stable in CC mode for loads up to 100 mH.
Size:
HP 6030A–32A, 6035A: 425.5 mm W x 132.6 mm H x 503.7 mm D (16.75 in x 5.25 in x 19.83 in).
HP 6033A, 6038A, 6023A, 6028A: 212.3 mm W x 177.0 mm H x 516.4 mm D (8.36 in x 6.97 in x 17.87 in).
HP 6010A–12B, 6015A: 425.5 mm W x 132.6 mm H x 516.4 mm D (16.75 in x 5.25 in x 20.33 in).

Key Literature

1999/00 HP Power ProductsCatalog, p/n 5968-2199
For more information, visit our web site:
http://www.hp.com/go/autorangingPS

Ordering Information

Standard: 104 to 127 VAC, 48 to 63 Hz
Opt 001 Front panel has only line switch, line indicator, and OVP adjust (HP 6030A–33A and 6038A only)
Opt 002 Provides extra programming and monitoring capabilities (HP 6010A–12B, 6023A, 6028A only)
Opt 100 87 to 106 Vac, 48 to 63 Hz (power supply output is derated to 75%) HP 6030A–33A, 6035A, 6038A only
Opt 220 191 to 233 Vac, 48 to 63 Hz
Opt 240 209 to 250 Vac, 48 to 63 Hz
Opt 800 Rackmount Kit for Two Half-rack Units Side by Side. HP p/n 5061-9694 and 5062-3978
Opt 908 Rackmount Kit for a Single Half-rack Unit
HP Models 6023A, 6028A, 6033A and 6038A (with blank filler panel); HP p/n 5062-3960
HP Models 6010A–12B, 6015A, 6030A–32A and 6035A; HP p/n 5062-3977
Opt 909 Rackmount Kit with Handles. For HP 6010A–12B, 6015A, 6030A–32A, 6035A; HP p/n 5062-3983
Opt 910 Service Manual and extra Operating Guide
For HP Models 6010A–12B, 6015A, 6023A, 6028A
For HP Models 6030A–33A, 6035A, 6038A
A line cord option must be specified for HP 6010A–12B, 6015A, 6030A–32A, 6035A. See page 180 for ordering information.

Accessories
HP 5080-2148 Serial Link Cable, 2 m (6.6 ft) for HP 6030A, 6031A, 6032A, 6033A, 6035A, and 6038A
HP 1494-0060 Rack Slide Kit

Power Supply Relay Devices and AC Line Cord Options

HP 59510A
HP 59511A

- Relay accessories to isolate load from dc output
- Switch and sequence power and sense leads
- DC output polarity reversal (HP 59511A only)

HP 59511A

HP 59510A and HP 59511A Relay Devices

The HP 59510A and 59511A are designed for control from 66XXA and 603XA series power supplies. These can be configured to switch dc power in multiple test fixtures or provide extra protection when a fault condition requires an emergency shutdown. Each unit switches one power supply output and can be used with any dc power supply within the voltage and current limits. The HP 59511A has all of the features of the HP 59510A, plus relays for reversing polarity. Using the PEM fasteners provided, both models can be mounted to a flat surface on any of the three sides.

Specifications

Operating Ranges: 200 V at 20 A, 120 V at 30 A, or 48 V at 60 A
dc Floating Voltage: Input to output, 200 Vdc; input or output to ground, 500 Vdc; TTL control to ground, 240 Vdc
Settling Time (TTL control)**:** Connect, 440 ms; disconnect, 160 ms; polarity reversal, 600 ms
dc Voltage Drop (at 60 A)**:** 0.5 V maximum on each relay
ac Input: Can be set for 100, 120, 220, or 240 Vac (–13%, +6%) at 48 to 63 Hz
Weight:
HP 59510A: Net, 2.3 kg (5 lb); shipping, 3.6 kg (8 lb); shipping with Option 850, 4.1 kg (9 lb)
HP 59511A: Net, 3.6 kg (8 lb); shipping, 5.0 kg (11 lb); shipping with Option 850, 5.5 kg (12 lb)
Mounting Orientation: Within ±10° from vertical
Size: 185.4 mm W x 130.6 mm H x 198.6 mm D (7.26 in x 5.14 in x 7.81 in)

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-2199

For more information, visit our web site: **http://www.hp.com/go/power**

Ordering Information

HP 59510A Output Isolation Relay Accessory
HP 59511A Output Isolation, Polarity Reversal Accessory
Opt 850 Rackmount Kit (side-by-side mounting of two units requires two kits)
Opt 910 Extra Operating and Service Manual, HP p/n 5957-6382

Power-Supply AC Line Cord Options

Power distribution regulations and techniques vary greatly among geographic regions. For this reason, line cord type must be specified for high-power (1000- to 5000-W) dc power supplies at the time of ordering. The HP 66000A modular power system mainframe is included because one line cord might supply ac power for up to eight 150-W modules. If no line cord option is specified for these models, an unterminated cable will be shipped with the unit.

Option Descriptions

Order the correct option according to local electrical codes. All the cords listed are 2.5 m (about 8.2 ft) long.

Unterminated Line Cords (user supplies plug)

Option 831: 12 AWG; UL-listed, CSA-certified; unterminated. Suggested for use in North and South America. Note for HP 6670 and 6570 Series: intended for use on a dedicated branch circuit and not intended for use in Canada. Note for HP 6030 and 66000 Series: intended for connection to 200- to 240-Vac service.
Option 832: 4-mm² wire size; harmonized cordage; unterminated. Suggested for use in Europe and other areas not listed.
Option 833: 1.5-mm² wire size; harmonized cordage; unterminated. For use in Europe and other areas not listed. Note for HP 6030 and 66000 Series: intended for connection to 200- to 240-Vac service.
Option 834: 10 AWG; UL-listed, CSA-certified; unterminated. Suggested for use in North and South America. Note for HP 6030 and 66000 Series: intended for connection to 100- to 120-Vac service.

Options Available

Options	6010A Series 6030A Series (1000 W only)	6570A 6670A Series	66000A Mainframe	6812A 6841A	6813A 6842A
831	•	•	•	•	•
832		•			•
833	•		•	•	
834	•	•	•	•	•
841	•	•	•	•	•
842		•			•
844		•			•
845	•		•	•	
846	•		•	•	
847	•		•	•	
848	•		•	•	

•available — not available

Terminated Line Cords Line cords with plugs

Option 841
12 AWG; UL-listed, CSA-certified; with NEMA 6-20P, 20-A, 250-V plug. Suggested for use in North and South America and Japan. Note for HP 6670 and 6570 Series: not intended for use in Canada. Intended for use on a dedicated branch circuit.

Option 842
4-mm² wire size; harmonized cordage with IEC 309, 32-A, 220-V plug. Suggested for use in Europe and other areas not listed.

Option 844
10 AWG; UL-listed, CSA-certified; with NEMA L6-30P, 30-A, 250-V locking plug. Suggested for use in North and South America.

Option 845
1.5-mm² wire size; harmonized cordage with IEC 309, 16-A, 220-V plug. Suggested for use in Denmark, Switzerland, Austria, China, and other countries not listed.

Option 846
10 AWG; UL-listed, CSA-certified; with NEMA L5-30P, 30-A, 120-V locking plug. Suggested for use in North America.

Option 847
1.5-mm² wire size; harmonized cordage with CEE 7/7, 16-A, 220-V plug. Suggested for use in continental Europe.

Option 848
1.5-mm² wire size; harmonized cordage with BS 546, 15-A, 240-V plug. Suggested for use in India and South Africa.

NEW

- Single-output, dual-range
- Low noise/excellent line and load regulation
- GPIB/RS-232 standard
- SCPI(Standard Commands for Programmable Instrument) compatible
- Front and rear output terminals
- Overvoltage protection
- Remote sense at rear output

HP E3640A/41A/42A/44A

This series of single-output dual-range power supplies consists of 30 W, 50 W, and 80 W models. For general purpose use, these programmable power supplies offer the performance of system power supplies at a surprisingly affordable price.

Excellent Performance You Can Trust

All models deliver clean and reliable power, dependable regulation (0.01%) and fast settling time (<90 msec). These linear power supplies specify both normal mode voltage noise and common mode current noise to assure less interference with your DUT.

Warranty: Three years
Size: 254 mm W x 104 mmH x 374 mmD, (10 in x 4.1 in x 14.8 in)
Weight:
E3640A/41A: 5.3 kg (11.7 lbs)
E3642A: 6.2 kg (13.7 lbs)
E3644A: 6 kg (13.21 lbs)

Remote Interface

These supplies come with GPIB and RS-232. They allow you to program both voltage and current. You can monitor the output terminals for voltage and current, and a query command lets you read the programmed voltage and current. All programming is done in easy to use SCPI. Plug&Play driver is available for both National Instruments, Labview and HP's VEE.

Front Panel Operation

Both voltage and current can be monitored simultaneously for output from the front panel on an easy to read vacuum fluorescent display. A knob allows you to set the output at the resolution you need for the most exacting adjustments, quickly and easily. Voltage and current levels can be set to a maximum resolution of 10 mV/1mA from the front panel. Store and recall key enables you to save and recall up to 5 frequently used operating states. The output on/off button enables/disables the output. New front panel binding posts offer flexibility to use safety test leads, banana plugs or stripped wires.

Key literature

HP Basic Instruments Catalog, p/n 5968-6064

For more information, visit our web site: **http://www.hp.com/go bi**

Ordering Information

HP E3640A 30 W Single Output Power Supply
HP E3641A 30 W Single Output Power Supply
HP E3642A 50 W Single Output Power Supply
HP E3644A 80 W Single Output Power Supply
Standard 115 Vac ± 10%, 47 to 63 Hz
Opt 0E3 230 Vac ± 10% 47 to 63 Hz
Opt 0E9 100 Vac ± 10% 47 to 63 Hz
Opt 1CM Rackmount Kit
Opt 910 Extra manual
(Standard unit is shipped with operating and service manual, quick reference guide and ac power cord.)

Abbreviated Specifications and Characteristics (at 0° C to 55° C unless otherwise specified)

		HP E3640A	HP E3641A	HP E3642A	HP E3644A
Number of Outputs		1	1	1	1
dc Outputs	Voltage/Current	8 V/3 A or 20 V/1.5A	35 V/ 0.8 A or 60 V/ 0.5 A	8 V/ 5 A or 20 V/2.5 A	8 V/ 8 A or 20 V/ 4A
Power (max)		30 W	30 W	50 W	80 W
Load and Line Regulation	Voltage/Current	<0.01% + 3 mV <0.01% + 250 uA	<0.01% +3 mV <0.01% + 250 uA	<0.01% + 3 mV < 0.01% + 250 uA	<0.01% + 3 mV <0.01% + 250 uA
Ripple and Noise (20 Hz to 20 MHz)	Normal-Mode Voltage Normal-Mode Current Common-Mode Current	< 500 uVrms/ 5 mVp-p < 4.0 mArms < 1.5 uArms	< 500 uVrms/5mV p-p < 4.0 mArms < 1.5 uArms	< 1 mVrms/8 mVp-p < 4.0 mArms < 1.5 uArms	< 500 uVrms/5 mVp-p < 4.0 mArms < 1.5 uArms
Programming Accuracy	Voltage Current	0.05% + 10 mV 0.2% + 10 mA	0.05% + 10 mV 0.2% + 10 mA	0.05% + 10 mV 0.2% + 10 mA	0.05% + 10 mV 0.2% + 10 mA
Readback Accuracy	Voltage Current	0.05% + 5 mV 0.15% + 5 mA	0.05% + 5mV 0.15% + 5 mA	0.05% + 5 mV 0.15% + 5 mA	0.05% + 5 mV 0.15% + 5 mA
Program Resolution	Voltage/Current	5 mV/1 mA	5 mV/1 mA	5 mV/1 mA	5 mV/1 mA
Readback Resolution	Voltage/Current	2 mV/ 1mA	2 mV/ 1mA	2 mV/ 1mA	2 mV/ 1mA
Meter Resolution	Voltage/Current	10 mV/ 1mA	10 mV/ 1mA	10 mV/ 1mA	10 mV/ 1mA
Transient response time	<50 us for output to recover within 15 mV following a change in output current from full load to half load or vice versa.				

All available via Quickship

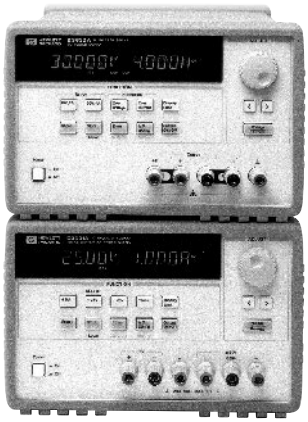
Power Supplies

Single- and Multiple-Output: 80 W to 200 W

HP E3631A Triple-output Features
- 80 watts of power
- Triple outputs
- GPIB/RS-232 standard
- Dual voltage and current meters
- SCPI (Standard Commands for Programmable Instruments)

HP E3632A Single-output Features
- 105/120 watts of power
- Single output, dual range
- Low noise/excellent regulation
- GPIB/RS-232 standard
- Remote sense, OVP and OCP capability
- 16-bit programming resolution and high accuracy

HP E3633A, E3634A Single-output Features
- 160/200 watts of power
- Single output, dual range
- Front and rear panel terminals
- Low noise/excellent regulation
- GPIB/RS-232 standard
- Remote sense, OVP and OCP capability
- 16-bit programming resolution and high accuracy



Above: HP E3632A, Below: HP E3631A

HP E3633A/34A

HP E3631A-HP E3634A

The HP E3631A is a triple-output programmable dc power supply designed to meet the most exacting engineering requirements with traditional HP quality and reliability designed in.

The HP E3632A (120 W) and E 3633A, E3634A (200 W) are single output, dual range programmable dc power supplies designed to deliver reliable and high quality operation at a very attractive price.

Low Noise/Excellent Regulation

0.01% load and line regulation keep the output steady. The linear supply specifies both normal-mode voltage noise and common-mode current noise. The low normal-mode specification assures clean power for precision circuitry and the low common-mode current provides isolation from power line current injection.

Front Panel Operation

Both voltage and current can be monitored simultaneously for output from the front panel on an easy-to-read vacuum fluorescent display. A knob allows you to set the output at the resolution you need for the most exacting adjustments, quickly and easily. Store and recall key enables you to save and recall up to three frequently-used states. The output on/off button enables/disables the output.

Isolated

All the outputs are isolated from the chassis ground and from the remote interface. In the E3631A, 6 V supply is isolated from the ±25 V supply to minimize any interference between circuits-under-test.

For more information, visit our web site: **http://www.hp.com/go/bi**

Abbreviated Specifications and Characteristics at 0° to 55° unless otherwise specified

		HP E3631A			HP E3632A Low Range/ High Range	HP E3633A Low Range/ High Range	HP E3634A Low Range/ High Range
dc outputs	Voltage Current	0 to +25 V/ 0 to 1 A	0 to –25 V/ 0 to 1 A	0 to 6 V/ 0 to 5 A	0 to 15 V, 7A/ 0 to 30 V, 4 A	0 to 8 V, 20A/ 0 to 20 V, 10 A	0 to 25 V, 7A/ 0 to 50 V, 4 A
Load and line regulation	Voltage Current	<0.01% + 2 mV <0.01% + 250 μA	<0.01% + 2 mV <0.01% + 250 μA	<0.01% + 2 mV <0.01% + 250 μA	<0.01% + 2 mV <0.01% + 250 μA	<0.01% + 2 mV <0.01% + 250 μA	<0.01% + 2 mV <0.01% + 250 μA
Ripple and noise (20 Hz to 20 MHz)	Normal-mode voltage Normal-mode current Common-mode current	<350 μV rms/ 2 mV p-p <500 μA rms <1.5 μA rms	<350 μV rms/ 2 mV p-p <500 μA rms <1.5 μA rms	<350 μV rms/ 2 mV p-p <2 mA rms <1.5 μA rms	<350 μVrms/ 2mVpp <2 mA rms <1.5 μA rms	<350 μVrms/ 3mVpp <2 mA rms <1.5 μA rms	<500 μVrms/ 3mVpp <2 mA rms <1.5 μA rms
Programming accuracy (25° C ±5° C)	Voltage Current	0.05% + 20 mV 0.15% + 4 mA	0.05% + 20 mV 0.15% + 4 mA	0.1% + 5 mV 0.2% + 10 mA	0.05% + 10 mV 0.2% +10 mA	0.05% + 10 mV 0.2% +10 mA	0.05% + 10 mV 0.2% +10 mA
Readback accuracy (25° C ±5° C)	Voltage Current	0.05% + 10 mV 0.15% + 4 mA	0.05% + 10 mV 0.15% + 4 mA	0.1% + 5 mV 0.2% + 10 mA	0.05% + 5 mV 0.15% + 5 mA	0.05% + 5 mV 0.15% + 5 mA	0.05% + 5 mV 0.15% + 5 mA
Resolution	Program/ readback Meter	1.5 mV, 0.1 mA/ 1.5 mV, 0.1 mA 10 mV/1 mA	1.5 mV, 0.1 mA/ 1.5 mV, 0.1 mA 10 mV/1 mA	0.5 mV, 0.5 mA/ 0.5 mV, 0.5 mA 1 mV/1 mA	1mV, 0.5 mA/ 0.5 mV/0.1 m A 1 mV/1 mA	1 mV, 1mA/ 0.5 mV, 1 mA 1 mV, 1 mA (<10A), 10 mA (≥10A)	3mV, 0.5mA/ 1.5mV, 0.5mA 1 mV/1 mA (<10A), 10 mA (≥10A)
Transient Response Time: 50 μsec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa							

Indicates QuickShip availability.

ac Input:
100 Vac ± 10%, 47 to 63 Hz (Option OE9)
115 Vac ± 10%, 47 to 63 Hz (Standard)
230 Vac ± 10%, 47 to 63 Hz (Option OE3)

Product Regulation: Certified to CASA 22.2 No. 231 (E3631A), No. 1010.1 (E3632A/33A/34A); conforms to IEC 1010.1; carries CE mark; complies with CISPR-11, Group 1, ClassA.
Warranty: Three years

Size: E3631A, 32A, 33A, 34A 213 mm W x 132 mm H x 348 mm D (8.4 in x 5.2 in. x 13.7 in)
Weight: E3631A 6.9 kg (15 lbs); **E3632A, E3633A, E3634A** 9.5 kg (21 lbs)

Ordering Information

Standard 115 Vac ± 10%, 47 to 63 Hz
Opt 0E3 230 Vac ± 10% 47 to 63 Hz
Opt 0E9 100 Vac ± 10% 47 to 63 Hz
Opt 1CM Rackmount Kit
Opt 910 Extra manual

HP E3620A Features
- Low noise, excellent regulation
- Two isolated power supplies
- Two digital meters
- Linear power supply
- 10-turn potentiometer

HP E3630A Features
- Triple output
- Low noise, excellent regulation
- Auto-tracking
- Two digital meters
- Linear power supplies

These multiple-output power supplies have 0.01% load and line regulation which keeps the outputs steady with changes of the power line and load. These supplies specify both normal-mode voltage noise and common-mode current noise. The low normal-mode noise specification of 350 µV rms assures clean power for precision circuitry, and the low common-mode current specification of 1 µA rms minimizes line frequency current injection.

Both power supplies have separate digital panel meters to monitor both the voltage and current of any output simultaneously. An LED indicator for each output lets the user know when any supply is overloaded. All the outputs on these models are protected against overload and short-circuit damage. Protection circuits prevent output voltage overshoot when supply is turned on and off. The +6 V output of E3630A employs current foldback; all others are current limited.

HP E3630A

This general-purpose power supply provides three outputs, one 0 to 6 V output to power logic or other circuitry and one 0 to +20 V and 0 to –20 V to power linear circuits. The 0 to +20 V and 0 to –20 V outputs track to within 1%. The 0 to –20 V output can be set to any value less than the 0 to +20 V output. One voltage control may be used to vary both simultaneously.

The HP E3630A is 213 mm W x 88 mm H x 213 mm D (8.4 in x 3.6 in x 12.6 in) and weighs 3.8 kg (8.4 lbs).

HP E3620A

This general-purpose power supply provides two separate, independent and isolated power supplies in one small package. Each output has a ten-turn potentiometer for fine adjustment. Convenient meter selection allows the user to read voltage and current of either output. Each output can deliver up to 25 watts.

The HP E3620A is 213 mm W x 88 mm H x 400 mm D (8.4 in x 3.6 in x 15.8 in) and weighs 5.5 kg (12.1 lbs).

HP E3620A, E3630A

Specifications at 0° to 55° C unless otherwise specified

		E3620A	E3630A
Number of outputs		2	3
Number of output ranges		1	1
Output ratings	Output 1 Output 2 Output 3 Power (max.)	0 to 25 V, 0 to 1 A 0 to 25 V, 0 to 1A 50 W	0 to 6 V, 0 to 2.5 A* 0 to +20 V, 0 to 0.5 A 0 to –20 V, 0 to 0.5 A 35 W
Load and line regulation		0.01% +2 mV	0.01% +2 mV
Ripple and noise	rms peak-to-peak	350 µV 1.5 mV	350 µV 1.5 mV
Control mode		CV/CL	CV/CL (±20 V) CV/CF (+6 V)
Resolution (minimum change using front-panel controls)	Voltage Current	10 mV (0-20V) 1 mA 100 mV (>20 V)	10 mV 10 mA

* Derate max., output current from 2.5 A a 5 V, to 1A at 0 V.

Indicates QuickShip availability

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-4646
HP Basic Instrument Catalog, p/n 5968-6064

For more information, visit our web site: **http://www.hp.com/go/bi**

Ordering Information

Standard 115 Vac ± 10%, 47 to 63 Hz
Opt 0E3 230 Vac ±10%, 47 to 63 Hz Input
Opt 0E9 100 Vac ±10%, 47 to 63 Hz Input
For use in Japan

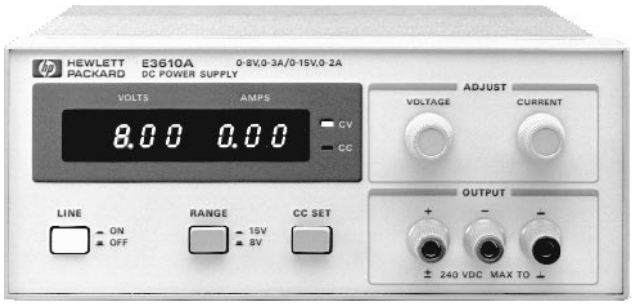
Power Supplies

Laboratory: Single Output, 24 W to 60 W

HP E3610A to HP E3617A

HP E3610A, E3611A, and E3612A Features
- Dual ranges
- Digital voltage and current meters
- 10-turn potentiometer
- Linear power supply

HP E3614A, E3615A, E3616A, and E3617A Features
- Digital voltage and current meters
- Front and rear output terminals
- Over-voltage protection
- Remote sensing
- Remote analog programming
- Linear power supply



HP E3610A–E3617A

HP E3610A, E3611A, E3612A

These popular low-cost CV/CC bench supplies are designed for general laboratory use. The constant-voltage, constant-current output allows operation as either a voltage source or current source. The changeover occurs automatically, based on the load. This feature also provides an adjustable current limit, allowing you to set the safest current limit level for a particular DUT. Also, a CC-set button lets you set the current limit without having to short the output.

Each model has two ranges, allowing more current at a lower voltage. For a higher-output voltage, supplies can be connected in series. Either the positive or negative terminal can be connected to ground, providing a positive or negative voltage output. Either terminal can also be floated up to 240 V from ground.

Dual digital meters monitor current and voltage simultaneously. Adjustments are made with the 10-turn voltage control and the 10-turn current control. Each power supply is 212 mm W x 88 mm H x 318 mm D (8.4 in x 3.5 in x 12.5 in) and weighs 3.8 kg (8.4 lb).

HP E3614A, E3615A, E3616A, E3617A

These flexible single range CV/CC power supplies can be used as either voltage sources or current sources. The CC-set button allows you to quickly set the current limit when operating in the CV mode, without shorting the output. 10-turn controls allow accurate adjustment of voltage and current output settings. The output voltage and current can also be controlled with external 0 to 10 volt analog signals or variable resistance.

Output connections can be made on either the front or rear panel. Remote sensing is available to eliminate the errors in voltage regulation due to voltage drops in the load leads. Either the positive or negative output terminal may be connected to ground to provide positive or negative output voltage. Either terminal can also be floated to a maximum of 240 volts. Multiple units can be combined in auto-parallel, auto-series and auto-tracking configurations to obtain more voltage or current output.

The load is protected with the over-voltage protection feature, which is easily monitored and adjusted from the front panel. The digital voltage and current meters provide continuous and accurate readings of the output levels. The HP E3614A–E3617A are 212 mm W x 88 mm H x 373 mm D (8.5 in x 3.5 in x 14.7 in).

Key Literature

1999/00 *HP Power Products Catalog,* p/n 5968-2199
HP Basic Instrument Catalog, p/n 5968-4646

For more information, visit our web site: **http://www.hp.com/go/bi**

Ordering Information

Standard 115 Vac ± 10%, 47 to 63 Hz
Opt 0E3 230 Vac ± 10% 47 to 63 Hz
Opt 0E9 100 Vac ± 10% 47 to 63 Hz

Specifications at 0° to 55° C unless otherwise specified

Single-output models		HP E3610A	HP E3611A	HP E3612A	HP E3614A	HP E3615A	HP E3616A	HP E3617A
Number of output ranges		2	2	2	1	1	1	1
Output ratings[1]	Range 1	0 to 8 V, 0 to 3 A[1]	0 to 20 V, 0 to 1.5 A[1]	0 to 60 V, 0 to 0.5 A[1]	0 to 8 V, 0 to 6 A	0 to 20 V, 0 to 3 A	0 to 35 V, 0 to 1.7 A	0 to 60 V, 0 to 1 A
	Range 2	0 to 15 V, 0 to 2 A[1]	0 to 35 V, 0 to 0.85 A[1]	0 to 120 V, 0 to 0.25 A[1]	—	—	—	—
	Power (max.)	30 W	30 W	30 W	48 W	60 W	60 W	60 W
Load and line regulation		0.01%+2 mV	0.01%+2 mV	0.01%+2 mV	0.01%+2 mV	0.01%+2 mV	0.01%+2 mV	0.01%+2 mV
Ripple and noise	rms	200 μV	200 μV	200 μV	200 μV	200 μV	200 μV	200 μV
	peak-to-peak	2 mV	2 mV	2 mV	1 mV	1 mV	1 mV	1 mV

Supplemental Characteristics Non-warranted characteristics determined by design and useful in applying the product

Control mode		CV/CC	CV/CC	CV/CC	CV/CC	CV/CC	CV/CC	CV/CC
Resolution	Voltage	10 mV	100 mV	100 mV	10 mV	10 mV (0-20 V) 100 mV (0-20 V)	10 mV (0-20 V) 100 mV (0-20 V)	10 mV (0-20 V) 100 mV (0-20 V)
(minimum change using front-panel controls)	Current	10 mA	10 mA	1 mA	10 mA	10 mA)	1 mA	1 mA

[1] Maximum current is derated 1% per °C between 40° to 55° C.

Indicates QuickShip availability.

- Versatile ac power test solutions
- Generate stable or distorted ac and dc power
- 50/60 Hz power up to 300 Vrms
- 400 Hz avionics power up to 300 Vrms
- Arbitrary waveform generation
- Built-in precision power analyzer
- Easy to integrate into ATE systems
- VXI plug and play drivers available
- SCPI (standard commands for programming instruments)
- Drop-in replacement - Elgar PIP9012 code built in
- Electronic calibration
- Full protection features (OV, OI, OP, OT)
- Three year warranty
- CE mark
- New FREE graphical user interface
- New dual power analyzer option

HP 6811B, 6812B, 6813B, top; HP 6814B, 6834B, bottom

HP 6800 AC Power Solutions AC Power Sources/Analyzers and Regulatory Test Solution

HP 6811B 300 V_{rms}, 375 VA Single phase model
HP 6812B 300 V_{rms}, 750 VA Single phase model
HP 6813B 300 V_{rms}, 1750 VA Single phase model
HP 6814B 300 V_{rms}, 3000 VA Single phase model
HP 6834B 300 V_{rms}, 4500 VA_{total} One/three phase model
HP 6843A 230 V_{rms}, 4800 VA_{total} Single phase model

Hewlett-Packard ac power source/analyzers are designed for applications which require precise control, accurate measurement, and analysis of single- and three-phase ac power. The feature set and performance levels of this product family provide the flexibility necessary to power and test a wide variety of devices. These products are ideal for applications such as power supply testing, AC Mains CE Mark Testing UPS testing, avionics, air traffic control equipment, testing power-factor-corrected equipment and telecom equipment.

The HP 6800 series utilizes a low noise switching topology, which delivers high performance and reduced size. These products can output dc (HP 6811B, 6812B, 6813B), ac complex and user-defined waveforms for exceptional application flexibility over the bus.

Key Features

- High peak current capability
- Programmable voltage, frequency, phase, output impedance, distortion and current limit
- Voltage and frequency slew control
- Power line disturbance simulation
- Avionics power disturbance simulation
- Measurement of Vrms, Irms, Ipeak, frequency, phase, VA, watts, PF and THD
- Two current measurement ranges. Low range increases sensitivity 10:1 (6811B, 6812B, 6813B)
- Harmonic analysis of V and I
- Programmable 1 phase/3 phase mode (6834B)
- Built-in GPIB and RS-232 interfaces
- Built-in output isolation relays
- MIL-STD 704 and RTCA DO160 (Section 16) testing capability
- Built-in 26 Vrms AUX output option
- Remote shutdown via TTL signal
- dc output autoranging on 6811B, 6812B, 6813B
- Application specific options

Powerful Direct Digital Synthesis (DDS) Waveform Generation

The HP 6800 series offers the ultimate in waveform generation versatility. For testing products under ac line distortion conditions, clipped sine waves can be generated with 0% to 43% distortion. There are a number of methods for creating waveforms some include inputting harmonic content, phase angles, and data points. These waveforms can be used to generate steady state outputs or can be combined for more complex transient generation schemes.

Flexible Transient Generation

When testing requires precise synchronization between waveform generation and measurement of the device under test, the HP 6800 series transient generation capability provides a powerful tool. The output voltage amplitude, frequency, phase, waveform shape, voltage slew rate, and frequency slew rate can be controlled in response to an input trigger generated from an internal or external event. The Step and Pulse modes offer an easy and convenient method of executing single-step and continuous-output changes. The List transient mode further extends this capability for more complex waveform generation needs. Up to 100 sequences of output settings can be precisely executed in response to a trigger or paced by programmed dwell times without computer intervention.

Extensive Measurement and Analysis

The HP 6800 series has measurement functionality equivalent to commercially available high-accuracy power analyzers. This eliminates the need for this standalone instrument for most applications, and lowers systems cost, increases available rack space, and simplifies cabling. All measurements are made with 16-bit resolution, suitable for even the most demanding applications.

The HP 6800 series has built-in voltage and current waveform digitization combined with harmonic analysis capability. Amplitude, phase, and total harmonic distortion results up to the 50th harmonic are provided for output frequencies equal to or less than 250 Hz. This measurement feature, accessible via the front panel graphical user interface software or over the bus, provides a sophisticated solution for testing during product development. A new dual power analyzer option (020) now provides the equivalent of two stand-alone power analyzers for measuring the input.

AC Mains Regulatory Testing

Testing for ac mains emissions and immunity tests is now even easier. The HP 14760A series regulatory test solution (RTS) software can be used with HP 6812B, 6813B, and 6834B ac power solutions. This Windows based software provides a fast and easy way to set-up, perform and document tests.

Multiple Interfaces

The HP 6800 series ac power solutions offer multiple programming interfaces for convenience. The front panel offers access to most commonly used commands, SCPI can be sent via GPIB or RS-232. The graphical user interface (GUI) that is shipped with every ac power solution provides easy access to the capabilities of the instrument. Key tests such as inrush characterization are set-up in templates to facilitate testing. In addition to saving waveforms in non-volatile memory, they can be saved in the GUI and quickly downloaded to the source.

Key Literature

1999/00 HP Power Products Catalog, p/n 5968-2199

For more information, visit our web site:
http://www.hp.com/go/hpacpower

Supplemental Characteristics Non-warranted characteristics determined by design that are useful in applying the product

		HP 6811B	HP 6812B*	HP 6813B*	HP 6814B	HP 6834B	HP 6843A*
Number of phases		1	1	1	1	1/3	1
Output ratings	Power	375 VA	750 VA	1750 VA	3000 VA	4500 VA	4800 VA
	Maximum rms voltage	300 V	300 V	300 V	300 V (high range) 150 V (low range)	300 V l-n (high range) 150 V l-n (low range)	300 V
	Maximum rms current	3.25 A	6.5 A	13 A	10 A (high range) 20 A (low range)	15 A/ 5A (high range) 30 A/ 10 A (low range)	32 A
	dc voltage range	± 425 V	± 425 V	± 425 V	N/A	N/A	N/A
	Maximum repetitive peak current	40 A	40 A	80 A	40 A (high range) 80 A (low range)	60 A/20A (high range) 120 A/ 40 A (low range)	48 A(high range) 96 A (low range)
	Crest factor	12	6	6	4	4	3
	Output frequency range	dc; 45-1kHz	dc; 45-1kHz	dc; 45-1kHz	45Hz to 5 kHz	45Hz to 5 kHz	45 Hz to 1 kHz
	Dc voltage	± 425 V	± 425 V	± 425 V	–	–	–
	Dc current	2.5 A	5 A	10 A	–	–	–

Measurement Accuracy (25 ± 5 dec C) from 45-100 Hz in High range where applicable

Output ratings	Rms voltage	0.03% +100mV	0.03% +100mV	0.03% +100mV	0.05% + 250 mV	0.05% + 250 mV	0.05% + 250 mV
	Rms current	0.05% + 10 mA	0.05% + 10 mA	0.05% + 10 mA	0.01% + 50 mA	0.01% + 50 mA 0.01% + 25 mA (in 3phase)	0.1% + 75 mA
	Power (VA)	0.1% + 1.5 VA +12 mVA/V	0.1% + 1.5 VA +12 mVA/	0.1% + 1.5 VA +12 mVA/	0.15% + 5 VA	0.15% + 5 VA 0.15% + 3 VA l (in 3 phase)	0.15% + 9 VA
	Power (Watts)	0.1% + 0.3 W + 1.2 mW/V	0.1% + 0.3 W + 1.2 mW/V	0.1% + 0.3 W + 1.2 mW/V	0.15% + 5W	0.15% + 5W 0.15% +3 W (in 3 phase)	0.15% + 9 W

Regulatory Test Solution IEC mode measurement system characteristics

		HP 6811B	HP 6812B*	HP 6813B*	HP 6814B	HP 6834B	HP 6843A*
Output frequency range		–	50/60 Hz	50/60 Hz	–	–	–
Reference impedance accuracy		–	3% (at 0.4 Ω and 796 uH)	3% (at 0.4 Ω and 796 uH)	–	–	3% (at 0.4 Ω and 796 uH)
Maximum total harmonic distortion		–	0.25%	0.25%	–	–	1%
Measurement accuracy							
Current magnitude (low range)	Fundamental		0.03 % + 1.5 mA	0.03 % + 1.5 mA	–	–	0.03 % + 3 mA
	Harmonics 2-49		0.03% + 1mA + 0.2%/kHz	0.03% + 1mA + 0.2%/kHz	–	–	0.03% + 2mA + 0.2%/kHz
Current magnitude (high range)	Fundamental		0.05 % + 5 mA	0.05 % + 5 mA	–	–	0.05 % + 6 mA
	Harmonics 2-49		0.05% + 3mA + 0.2%/kHz	0.05% + 3mA + 0.2%/kHz	–	–	0.05% + 3 mA + 0.2%/kHz

^ HP 14761A Harmonic and Flicker Emissions Test Software bundled in to 6843A price. *Regulatory test ready.

Remote Sensing: Up to 10 Vrms can be dropped across each load lead.
Command Processing Time: The average time for the output rms voltage to start to change after receiving an HP-IB command is 10 milliseconds.
Calibration Interval: One year
HP-IB Capabilities: SH1, AH1, T6 L4, SR1, RL1 PP0, DC1, DT1, E1, and C0, and a command set compatible with IEEE-488.2 and SCPI
Regulatory Compliance: Listed to UL-1244; certified to CSA 22.2 No. 231; complies with EN61010-1
RFI Suppression: Complies with CISPR-11, Group 1, Class A

Ordering Information

HP 14761A Harmonic and Flicker Emissions Tests Software
HP 14762A Voltage and Frequency Disturbances Immunity Tests Software
HP 14763A Interharmonics Immunity Test Software
HP 14769A All the 14760A Series test Software
HP 14812A Upgrade to a Regulatory Test Ready 6812B
HP 14813A Upgrade to a Regulatory Test Ready 6813B
- **Opt 0BN** Extra Documentation
- **Opt 1CM** Rackmount Kit (p/n 5062-3977)
- **Opt ICP** Rackmount Kit with Handles, (HP 6811B/12B/13B only, p/n 5062-3983)
- **Opt 001** Harmonic Flicker – Emissions Test Software (HP 6812B/13B)
- **Opt 002** Voltage & Frequency – Immunity Test Software (HP 6812B/13B)
- **Opt 003** Interharmonics – Immunity Test Software (HP 6812B/13B)
- **Opt 019** 2000 VA output ac source, 16 A rms Imax, 48 A Ipk
- **Opt 020** Dual Power Analyzer option (HP 6811B/12B/13B)
- **Opt 022** 2000 VA output and dual power analyzer option (HP 6813B only)
- **Opt 026** 26 V reference signal (HP 6811B/12B/13B) (HP 6834B)
- **Opt 100** 87 to 106 Vac, 48 to 63 Hz (Japan only), (HP 6811B/12B)
- **Opt 200** 174 to 220 Vac, 47 to 63 Hz. If Option 200 is not ordered, the ac source will be configured to operate at 191 to 254 Vac, 47 to 63 Hz. (HP 6813B)
- **Opt 230** 191 to 254 Vac, 48 to 63 Hz (HP 6811B/12B)

HP 14814A FW upgrade for HP 6814A/42A/43A for HP 14763A and HP 14769A
Support rails (p/n 12679B) required when rackmounting the HP 6812B and 6813B Opt 1CM and Opt 1CP
- **Opt 400** 360 to 440 Vac, 3-phase, 47 to 63 Hz operation (HP 6814B/34B)

Support rail kit p/n 5064-0001 must be ordered with Opt 1CM for rackmounting the HP 6814B and 6834B

A Line Cord Option must be specified. For details, refer to page 192.

Accessories

HP p/n 5060-3513 Three 30-A replacement fuses for 180 to 235 Vac line (HP 6814B/34B)
HP p/n 5060-3512 Three 16-A replacement fuses for 360 to 440 Vac line (HP 6814B/34B)
HP p/n 5063-2310 Heavy-duty rack slide kit (HP 6814B/34B)

Oscilloscopes

HP Basic Instruments Catalog
5968-4646EN/EUS
HP 54645A Oscilloscope Overview
5968-2321EN/EUS
HP 54645D Mixed Signal Oscilloscope Data Sheet
5968-2610EN/EUS
TDR Using the HP 54750A (CD-ROM)
5968-2517E
Rambus Signal Integrity Measurements (CD-ROM)
5962-0097E
HP Infiniium Oscilloscopes: 54810A, 54815A, 54820A, 54825A, 54835A, 54845A Data Sheet
5968-6659
Brochure
5968-3831EN/EUS

(PN 54600-4) Using the Fast Fourier Transform in HP 54600 Series Oscilloscopes
5091-7227E
(PN 54720A-1) Bandwidth and Sampling Rate in Digitizing Oscilloscopes
5091-3757E
(PN 54720A-3) Selecting Oscilloscope Probes for High-Speed Digital Circuit Measurements
5091-3758E
(PN 54720A-4) Triggering an Oscilloscope
5091-3755E
HP Infinium CD ROM
5966-0958E
HP Infinium HW & SW Upgrades
5968-6657EN/EUS
HP Infinium Communication Mask Test Kit
5968-6658EN/EUS
HP Infinium Voice Control Kit
5968-6659EN/EUS

Oscilloscope Probes & Accessories

HP Wedge: A hands-free solution for probing fine-pitch ICS
5966-4179E
HP Basic Instruments Catalog
5968-4646EN/EUS
HP N1020A TDR Probe
5968-4811
HP 1144A 800 MHz Active Probe Data Sheet
5091-7935E
Two-Channel, 750 MHz, Small-Geometry Active Probe for Surface-Mount Devices
5968-3853E
HP 1180/81/82A Testmobile Data Sheet
5091-2520E
Probes and Accessories for Infiniium Oscilloscopes
5968-3832 EN/EUS

Logic Troubleshooting Tools

HP 54620 A/C Logic Analyzer Data Sheet
5968-2614EN/EUS
HP LogicDart Advanced Logic Probe E2310A Data Sheet
5966-0434EN/EUS

Electronic Counters

4 Hints for Making Better Microwave Counter Measurements
5967-6195E
8 Hints for Making Better RF Counter Measurements
5967-6038E
HP Basic Instruments Catalog
5968-6064EN/EUS

Digital Multimeters

HP Basic Instruments Catalog
5968-4646EN/EUS
HP 34401A Digital DMM Data Sheet
5968-0162EN/EUS
HP 34420A Nanovolt/Micro-ohm Meter Data Sheet
5963-7535EN/EUS
HP 3458A 8½ Digital DMM Technical Data
5965-4971E

Data Acquisition & Switching

HP 34970A Data Acquisition/Switch Unit Product Overview
5965-5290EN/EUS

Function Generators & Waveform Synthesizers

HP Basic Instruments Catalog
5968-4646EN/EUS
HP 33120A 15 MHz Function/Arb Generator Data Sheet
5968-0125EN/EUS

(PN 8904A-1) Using the HP 8904A Multifunction Synthesizer as a Communications Signaling Source
5951-6748
(PN 8904A-2) Using the HP 8904A Multifunction Synthesizer as an FM Stereo Composite Generator
5953-8487
(PN 8904A-3) Using the HP 8904A Multifunction Synthesizer as a Modulation Source for Navigation Applications
5953-8488

Software

HP Basic Instruments Catalog
5968-4646EN/EUS
HP BenchLink Scope, Arb, Meter Data Sheet
5967-6370EN/EUS

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00

Digital Timing Analyzers

Dynamic Frequency and Jitter Analysis at the Touch of a Button
5966-4093E
Simplify Jitter and Wander Analysis with Time Interval Analyzer Solutions
5968-1605E
Ensure Your Network Conforms to the Latest Sychronization Standards
5965-6659E
Characterize and Reduce Clock Jitter to Improve System Speed and Reliability
5968-0108E
Increase Your Confidence in SONET/SDH Integration with Existing Networks
5967-6288EE
Capture and Analyze the Timing of Every Edge to Improve Margin
5967-6285EE

DC Electronic Loads

HP 6050A, 6051A Electronic Load Mainframes
5962-6858E
HP 60501B 150-Watt Electronic Load Module
5962-6856E
HP 60502B 300-Watt Electronic Load Module
5962-6855E
HP 60503B 240-Watt Electronic Load Module
5962-6854E
HP 60504B 500-Watt Electronic Load Module
5962-6948E
HP 6060B, 6063B Single-Input Electronic Load Family
5962-6857E
1999/2000 Power Products Catalog
5968-2197EN/EUS
1999/2000 HP System Power Products Selection Guide
5968-2197EN/EUS
HP 60504B 600-Watt Electronic Load Module
5962-6853E

(PN) Zero Volt Electronic Load
5968-6360E

Power Supplies

HP's Answer To Your High Performance, High Power Burn-in Needs
5091-6952E
HP Basic Instruments Catalog
5968-4646EN/EUS
HP Model 66000A Modular Power System Mainframe
5962-6861E
HP Model 66001A-66006A Modular Power System Power Modules
5962-6860E
HP Models 6625A, 6626A, 6628A and 6629A Multiple Output Linear System DC Power Supplies
5962-6864E
HP Models 6621A-6624A, 6627A System DC Power Supplies
5091-9510E
HP 6671A-6675A HP-IB System DC Power Supplies
5962-8774E
HP 6015A Autoranging DC Power Supply
5962-6863E
HP 6030A-6033A, 6035A, 6038A Autoranging System DC Power Supplies
5962-6862E
GPIB System DC Power Supplies, HP Models 6631B-6634B
5966-1108
GPIB System DC Power Supplies, HP Models 6641A-6645A
5962-6947E
GPIB System DC Power Supplies, HP Models 6651A-6655A
5962-8775E
GPIB System DC Power Supplies, HP Models 6671A-6675A
5962-8774E
12 Factors to Consider When Selecting a System Power Supply Brochure
5952-4199E
HP 66101A, 66102A, 66103A, 66104A, 66105A, 66106A Modular Power System Power Modules Technical Specifications Brochure
5962-6860E
1999/2000 Power Products Catalog
5968-2199EN/EUS
HP Power Supplies E3640A/41A/42A/44A
5968-5267EN/EUS
1999/2000 HP system Power Products Selection Guide
5968-2197EN/EUS
HP E363XA Series Programmable Power Supplies
5968-2617EN/EUS
HP E4350A, E4351A Solar Array Simulator
5966-0711EN/EUS
HP 6611C-6614C System DC Power Supplies
5966-1109EN/EUS
HP 6631BC-6634B System DC Power Supplies
5966-1108
HP 66312A, 66332A Dynamic Measurement DC Source
5965-1679EN/EUS
HP 66111A, 66309B/D, 66311B/D Mobile Communication DC Sources
5968-6603E
HP E4356A Telecommunication DC Power Supply
5968-6603E

(PN 6285A) MPEG-2 Digital Video Encoder Stress Test Patterns – E6285A
5965-6492E
(PN 66000) HP 66000 Modular Power System
5091-2497E

AC Power Source/Analyzers

HP 6800 Series AC Power Source/Analyzers, HP Models 6812A-6814A, 6834A
5962-7088E
HP 6800 Regulatory Test Solution
5968-1435EN/EUS

(PN) Testing Uninterruptible Power Supplies
5967-6056E
(PN) HP 6800 Series AC Power Source/Analyzer
5963-7044E
Application Note 1273, Regulatory Testing
5964-1917E

1999/2000 Power Products Catalog
5968-2199EN/EUS
1999/2000 HP System Power Products Selection Guide
5968-2197EN/EUS

Signal Sources Hewlett-Packard offers the widest variety of signal generators from dc to 110 GHz. They cover every application from low-frequency navigation signals, through cellular mobile radio, to millimeter-wave satellite systems. A variety of modulations are available, as well as pulse and digital formats for testing the latest communications systems.

Economy RF Signal Generators
Digital I/Q Modulation
High-Performance RF Signal Generators
CW Microwave Sources
High Performance Microwave Sources
Swept Frequency Microwave Sources

Signal Analyzers These instruments provide frequency-domain, time-domain, and modulation-domain measurement capability. Some of the key measurements that can be made with a signal analyzer are absolute and relative frequency, absolute and relative amplitude, scalar, noise, distortion products, amplitude modulation (AM), frequency modulation (FM), pulsed RF, and digital modulation.

Spectrum Analyzers
Dynamic Signal Analyzers
Distortion and Audio Analyzers
Vector Signal Analyzers
Modulation Analyzers
Measuring Receivers
Modulation Domain Analyzers

Network/Spectrum Analyzers These analyzers are high-performance, cost-effective, intelligent analyzers with combined vector network and spectrum analysis capabilities.

RF Network
Spectrum
Impedance Analyzer
Baseband
IF Network
Spectrum Analyzers

Network Analyzers Vector network analyzers accurately characterize the linear and nonlinear electrical performance of components and circuits. They measure the effect of devices on the amplitude and phase of swept-frequency and swept-power test signals. Network analyzers provide the ability to measure the input characteristics of each port of a device as well as the transfer characteristics from one port to another.

RF Network Analyzers
Microwave Network Analyzers
Scalar Network Analyzers
S-Parameter Test Sets
Vector Voltmeters

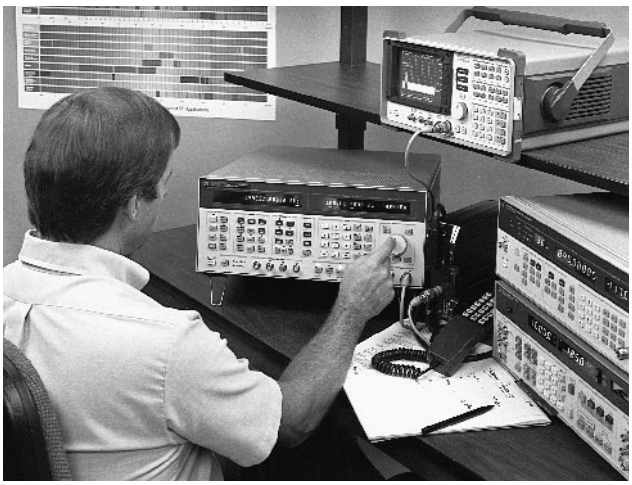
Power Meters New generation power meters and sensors feature DSP technology, fast measurement speed, improved absolute accuracy and repeatability, and ease of use and portability. Full-featured models are available for MMS and VXI systems.

Power Meters
Power Sensors
EPM Power Meters
E-Series Power Sensors
Peak Power Meters
MMS and VXI Power Meters

Noise Figure Products Automatic noise figure solutions provide accurate and simple measurement of noise figure and gain, with special modes to support the measurement of frequency translating devices. Characterize the performance of your receiver and receiver components, with standard solutions to 26.5 GHz and custom solutions to 110GHz.

Automatic Noise Figure Meter
Microwave Noise Figure Measurement System
Noise Figure Test Set
Broadband Noise Sources

RF and Microwave Test Accessories Hewlett-Packard offers a complete line of RF and microwave test accessories for use in test and measurement systems from dc to 110 GHz. Products include step and fixed alternators, amplifiers, detectors, couplers, switches, switch drivers, adapters and waveguide devices.



Hewlett-Packard offers the widest selection of high-performance signal sources from dc to 110 GHz. They cover every application range from low-frequency navigation signals, through cellular mobile radio, to millimeterwave satellite systems. Each offers synthesized frequency accuracy and stability as well as calibrated level and remote programmability. Modulation capabilities range from general purpose AM, ΦM, FM, pulse, and I/Q modulation to specific formats such as PSK, QPSK, OQPSK, GMSK, π/4 DQPSK, FSK, and QAM.

For more information, visit our web site:
http://www.hp.com/go/signal_sources

Signal Sources

Analog RF Signal Generators

Frequency	Model	Characteristics	Page
0.25 to 1000 MHz 0.25 to 2000 MHz 0.25 to 3000 MHz 0.25 to 4000 MHz	HP E4400B HP E4420B HP E4421B HP E4422B	**ESG-A series analog signal generator platform.** Flexible architecture for upgrade paths. Superior level accuracy.Step sweep (frequency, power and list). Electronic attenuator to 4 GHz. Built-in function generator.	208
0.25 to 1000 MHz 0.25 to 2000 MHz 0.25 to 3000 MHz 0.25 to 4000 MHz	HP E4423B HP E4424B HP E4425B HP E4426B	**ESG-AP series analog signal generator platform.** Superior spectral purity. Superior level accuracy. Step sweep (frequency, power and list). Electronic attenuator to 4 GHz. Built-in function generator.	192
0.25 to 1000 MHz	HP 8647A	**HP's lowest cost synthesized source with electronic attenuator.** ±1.5 dB level accuracy. Remote sequencingcapability. 10 Hz frequency resolution. –110 dBc/Hz @ 20 kHz SSB phase noise.	194
0.1 to 1000 MHz 0.009 to 2000 MHz 0.009 to 3200 MHz 0.009 to 4000 MHz	HP 8648A HP 8648B HP 8648C HP 8648D	**Economy signal generator family.** ±1 dB level accuracy up to 2.5 GHz. Provides HP 8647A performance plus improved residual FM, output power, switching speed and phase noise. Electronic attenuator on HP 8648A. HP 8648B/C/D offer pulse modulation and high power options. All four models offer variable frequency modulation generator (Option 1E2).	194

Digital RF Signal Generators

0.25 to 1000 MHz 0.25 to 2000 MHz 0.25 to 3000 MHz 0.25 to 4000 MHz	HP E4430B HP E4431B HP E4432B HP E4433B	**ESG-D series digital and analog signal generator platform.** Flexible architecture for upgrade paths. Excellent modulation accuracy and stability. Analog I and Q. Optional digital modulation formats. Data generation and burst capabilities. Optional internal bit-error rate analyzer and dual arbitrary waveform generator.	196
0.25 to 1000 MHz 0.25 to 2000 MHz 0.25 to 3000 MHz 0.25 to 4000 MHz	HP E4434B HP E4435B HP E4436B HP E4437B	**ESG-DP series digital and analog signal generator platform.** Superior spectral purity. Excellent modulation accuracy and stability. Analog I and Q. Optional digital modulation formats. Data generation and burst capabilities.	199

Optional internal bit-error rate analyzer and dual arbitrary waveform generator. Superior level accuracy. Step sweep (frequency, power and list). Electronic attenuator to 4 GHz. Built-in function generator.

Digital I/Q Modulation

dc to 6 MHz	HP E2747A HP E2748A	**Vector waveform generator in a PC-format instrument with a maximum of 3 channels, or a module assembly designed for use with a compatible DSP carrier for developing ATE or large channel systems.** Open platform based around a digital transmitter architecture. Accepts data input and generates live messages with protocol. Provides both I and Q outputs (or composite IF). Support new, unique and standard digital modulation formats.	218

High-Performance RF Signal Generators

0.252 to 1030 MHz 0.252 to 2060 MHz	HP 8643A HP 8644B	**Performance signal generator for RF design.** < –130 dBc/Hz @ 1 GHz SSB phase noise HP 8643A; < –137 dBc/Hz HP 8644B. < –100 dBc spurious. AM, FM and pulse modulation. Advanced modulation source. Lowest specified leakage. Avionics option available (Option 009).	201
0.01 to 1280 MHz	HP 8662A	**Low close-in noise.** 0.1 Hz frequency resolution, 5 x 10^{-10}/day stability. Calibrated and leveled output from +13 to –140 dBm. Digital sweep. Completely GPIB programmable. AM/FM modulation. Fast switching.	203
0.1 to 2560 MHz	HP 8663A	**Low close-in noise with complex modulation.** 0.1 Hz frequency resolution, 5 x 10^{-10}/day stability. Calibrated and leveled output from +16 to –130 dBm. Digital sweep. Completely GPIB programmable. AM, ΦM, FM and pulse modulation. Fast switching.	203
0.1 to 3000 MHz 0.1 to 4200 MHz 0.1 to 6000 MHz	HP 8664A HP 8665A HP 8665B	**Performance signal generators for 3.0 GHz, 4.2 GHz and 6 GHz testing.** Excellent spectral purity. AM and FM. High-performance pulse modulation. Advanced modulation source.	201
0.252 to 1030 MHz 0.252 to 2060 MHz	HP 8645A	**Performance signal generator for testing frequency-agile radios and surveillance receivers.** 15 µs switching speed. Spectral purity. AM, FM, pulse modulation. FM deviation to 20 MHz. Flexible control of frequency.	207

CW Microwave Sources

Frequency	Model	Characteristics	Page
1 to 20 GHz 0.01 to 20 GHz	HP 83711B HP 83712B	**Precision CW signals, pure and simple.** +10 to –90 dBm, < –50 dBc harmonics, < 1.5 x 10^{-9}/day stability, optional 1 Hz frequency resolution. Noise figure meter and millimeter source module compatible. GPIB and SCPI programming. < 35 lbs.	206

High-Performance Microwave Sources

1 to 20 GHz 0.01 to 20 GHz	HP 83731B HP 83732B	**Optimum choice for high-performance microwave receiver and subsystem test.** +10 to –90 dBm, harmonics, < –55 dBc, spurious < –60 dBc. < 1.5 x 10^{-9}/day stability, optional 1 Hz frequency resolution. Built-in multi-mode pulse generator, <10 ns pulse rise/fall time, < 25 ns pulse width. Logarithmic AM with > 60 dB depth. FM with >300 modulation index 10 MHz peak deviation. GPIB and SCPI programming. < 35 lbs.	207
0.01 to 50 GHz	HP 8360B Series	**Versatile synthesized sweeper.** Covers many application needs, including signal simulation with pulse, scan, amplitude, and frequency modulation requirements. General-purpose sweeper with full network analyzer capability.	212
0.01 to 20 GHz	HP E6432A Series	**VXI microwave synthesizer.** Optimized for system use with extensive triggering and sychronizing modes, plus a list mode supporting 128k entries. Frequency switching time is under 400 µs regardless of frequency change. Maximum continuous power out (2-20 GHz) is +20dBm. Module is C-size, 3 slots, and register based.	208

Swept Frequency Microwave Sources

0.01 to 20 GHz	HP 83751A/B HP 83752A/B	**Synthesized microwave sweeper.** Fully synthesized sweep. Continuous analog or digital step sweep, 2 MHz swept frequency accuracy, +17 dBm output power available. SCPI and GPIB programmable, HP 8350 GPIB mnemonics for drop-in replacement. Optimized for HP 8757 scalar network analyzers.	211
0.01 to 50 GHz	HP 8360L Series	General-purpose synthesized swept CW generator with full network analyzer compatibility. + 15 dBm output power available.	212

High-Performance VXI

.01 to 20 GHz	HP E6432A	**VXI Microwave Synthesizer.** High-performance microwave synthesizer in three C-size slots. Fast-switching architecture is register-based. Amplitude range -20 to +17 dBm, optionally -90 to +20 dBm. AM, FM and pulse modulation. 1 Hz frequency resolution. Exceptional spectral purity and spurious performance. Optimized for system use with deep list mode (128k entries), full triggering and synchronization.	208

High-Performance Modular

1 to 20 GHz	HP 70340A	**Modular signal generator for MMS.** Full performance signal source in half-rack width (4/8 MMS). Logarithmic AM, FM, and pulse modulation. Optional 1 Hz frequency resolution and internal multimode pulse generator. < 10 ns pulse rise/fall times, < 25 ns pulse width. GPIB, SCPI, and CIIL programming.	81
0.01 to 1 GHz	HP 70341A	**Companion low-frequency module to HP 70340A.** 1/8 MMS module adds 0.01 to 1 GHz frequency coverage when used with the HP 70340A. Extend high performance AM, FM, and pulse modulation to RF frequencies.	81

Frequency-Agile/Complex Signal Simulation

0.252 to 1030 MHz 0.252 to 2060 MHz	HP 8645A	**Performance signal generator for testing frequency-agile radios and surveillance receivers.** 15 µs switching speed. Spectral purity. AM, FM, pulse modulation. FM deviation to 20 MHz. Flexible control of frequency.	215
DC to 50 MHz	HP 8791 Model 7	**Baseband FASS.** Architecturally equivalent to the Model 11, the Model 7 provides exceptional baseband performance to 50 MHz. Full arbitrary control of AM, FM and pulse make this high-performance ΦM direct-digital synthesizer an excellent fit for entry-level FASS users in applications such as communi-cations, digital, video, radar target simulation and exciter design. Fully upgradeable to Model 11 or 21.	
0.01 to 3 GHz	HP 8791 Model 11	**Reconfigureable frequency agile-signal simulator for radar, EW, and communications simulation.** Advanced frequency-agile signal simulation for EW, radar and communication receiver test. 100 ns - frequency hopping over 3 GHz. Arbitrary control over AM, FM, pulse modulation and agile carrier. 40 MHz ΦM modulation bandwidth. Easy-to-use application-specific instrument-on-a-disk software. Optional upconversion available to 18 GHz, upgradeable to Model 21.	
0.05 to 18 GHz	HP 8791 Model 21	**Microwave-agile simulator.** Same as Model 11 (above), but uses state-of-the-art microwave-agile upconverter with 100 ns (typical) switching time for the entire range from 50 MHz to 18 GHz. Intended for "exotic" modulation requirements in radar/EW, and secure communication applications.	

Millimeter Modules

26.5 to 40 GHz 33 to 50 GHz 40 to 60 GHz 50 to 75 GHz 75 to 110 GHz	HP 83554A HP 83555A HP 83556A HP 83557A HP 83558A	**Efficient frequency multipliers.** Effectively extends the performance of an 11 to 20 GHz microwave source HP 8673B/C/D, 8340, 8341, 8350B, 83751/52 or 8360 to the millimeter-wave frequency ranges.	216

190 Analog RF Signal Generators

HP E4400B
HP E4420B
HP E4421B
HP E4422B

- 250 kHz up to 4.0 GHz
- Flexible architecture, upgrade paths for options
- 4 GHz electronic attenuator for reliability and repeatability
- Superior level accuracy
- Wideband FM and Phase Modulation
- Step sweep (frequency, power and list)
- Built-in function generator
- 3 year warranty

HP ESG-A series HP E4422B

5 HP ESG-A Series Analog Signal Generators

The HP ESG-A Series of analog RF signal generators offer excellent in-channel performance with superior quality and reliability, at an affordable price. The first in a new generation of signal generators, they provide excellent frequency and level control, and wide modulation capabilities. They are ideally suited to meet the demanding requirements of today's receiver test, component test and local oscillator applications.

Adaptable to Tomorrow's Requirements

The innovative design of the HP ESG-A provides a flexible architecture that can be tailored to meet the changing demands of evolving markets. These signal generators provide upgrade paths for options (current or future), and analog to digital.

Low Cost of Ownership

Lower initial cost, high reliability three-year warranty and a two-year calibration cycle, all strive to minimize the cost of ownership. The HP ESG-A RF signal generators are designed for long-term dependability, maximizing production throughput and uptime.

For more information, visit our web site: **http://www.hp.com/go/esg**

Specifications

Frequency

HP E4400B: 250 kHz to 1000 MHz
HP E4420B: 250 kHz to 2000 MHz
HP E4421B: 250 kHz to 3000 MHz
HP E4422B: 250 kHz to 4000 MHz
Resolution: 0.01 Hz
Switching Speed:
Modulation On: < 45 ms, typical
Modulation Off: < 35 ms, typical
Accuracy: Stability x fc timebase

Sweep Modes

Operating modes: Step: frequency and power, and arbitrary list
Dwell Time: 1 ms to 60 sec
Number of points: 2 to 401

Internal Reference Oscillator

Timebase Stability:

	Standard	High Stability (Option 1E5)
Aging Rate	< ± 1 ppm/yr.	< ± 0.1 ppm/yr. or < ± 0.0005 ppm/day after 45 days
Temperature (0° to 55° C)	< ± 1ppm, typical	< ± 0.05 ppm, typical
Line Voltage	< ± 0.1 ppm (+5%, –10%), typical	< ± 0.002 ppm, typical (+5%, –10%)

Timebase Reference Output:
Frequency: 10 MHz
Amplitude: > 0.35 V_{rms} into 50 Ω load

External Reference Input:
Frequency: 1, 2, 5, 10 MHz ± typ. 10 ppm (1 ppm, Option 1E5)
Amplitude: > 0.15 V_{rms}
Input Impedance: 50 Ω

Output

Range	Standard	Option UNB
250 kHz to 1000 MHz	+13 to –136 dBm	+17 to -136 dBm
> 1000 MHz to 3000 MHz	+10 to –136 dBm	+16 to -136 dBm
> 3000 MHz to 4000 MHz	+7 to –136 dBm	+13 to -136 dbm

Resolution: 0.02 dB

Level Accuracy (at 23° ± 5° C):	**+7 to –127 dBm**	**< –127 dBm**
250 kHz to 2 GHz	± 0.5 dB	± 1.5 dB
2 GHz to 4 GHz	± 0.9 dB	± 2.5 dB

Attenuator Hold Level Range: > 17 dB (>23 dB Option UNB)
Switching Speed: < 25 ms typical (30 ms, Option UNB)
With Power Search Mode: < 235 ms typical (245 ms, Option UNB)
Reverse Power Protection[1]**:**
250 kHz to 2000 MHz: 50 watts
> 2000 MHz to 4000 MHz: 25 watts
Max. DC Voltage: 50 V

SWR (typical)**:**	**Standard**	**Option UNB**
250 kHz to 2000 MHz	< 1.4:1	< 1.25:1
> 2000 to 4000 MHz	< 1.9:1	< 1.35:1

Output Impedance: 50 Ω

Frequency Bands

Band	Frequency Range	N #
1	250 kHz to ≤ 249.999 MHz	1
2	> 249.999 to ≤ 500 MHz	0.5
3	> 500 MHz to ≤ 1 GHz	1
4	> 1 to ≤ 2 GHz	2
5	> 2 to ≤ 4 GHz	4

Spectral Purity

SSB Phase Noise (typical, at 20 kHz offset)
at 500 MHz: < –120 dBc/Hz
at 1000 MHz: < –116 dBc/Hz
at 2000 MHz: < –110 dBc/Hz
at 3000 MHz: < –104 dBc/Hz
at 4000 MHz: < –104 dBc/Hz
Residual FM (CW mode, 0.3–3 kHz BW, CCITT, rms)
Phase Noise Mode 1: < N x 2 Hz
Phase Noise Mode 2: < N x 4 Hz

Frequency Modulation

Maximum Deviation: N x10 MHz
Resolution: 0.1% of deviation or 1 Hz, whichever is greater
Deviation Accuracy (1 kHz rate, dev. < N x 100 kHz)**:**
< ± (3.5% of FM deviation + 20 Hz)

Modulation Frequency Response (deviation = 100 kHz)

Path	Rates	
	1 dB Bandwidth	**3 dB Bandwidth, typical**
FM1	dc/20 Hz to 100 kHz	dc/5 Hz to 10 MHz
FM2	dc/20 Hz to 100 kHz	dc/5 Hz to 1 MHz

Distortion (1 kHz rate, THD, dev.=N x 100 kHz)**:** < 1%

[1]The reverse power protection circuitry triggers at nominally 1 watt.
[2]Specifications apply for FM deviations < 100 kHz and are not valid for ΦM.

Phase Modulation

Maximum Deviation: N x 90 radians
Resolution: 0.1% of set deviation
Deviation Accuracy (1 kHz rate): < ± (5% of deviation + 0.01 radians)

Modulation Frequency Response:

ΦM Mode	Maximum Deviation	Rates (3 dB BW)	
		ΦM1	ΦM2
Normal	N x 90 rad	dc–100 kHz	dc–100 kHz
High Bandwidth	N x 2π rad N x π/2 rad	dc–1.5 MHz (typ.) dc–4 MHz (typ.)	dc–1 MHz (typ.) dc–0.9 MHz (typ.)

Distortion (1 kHz rate, THD, dev < N x 90 radians): < 1%

Amplitude Modulation[3] f_c > 500 kHz

Range (envelope peak ≤ max. specified power): 0 to 100%
Resolution: 0.1%
Rates (3 dB bandwidth): dc/10 Hz to 10 kHz
Distortion (1 kHz rate, THD): 30% AM: < 1.5%, 90% AM: < 4% (typical)
Accuracy (1 kHz rate): < ± (6% of setting + 1%)

Pulse Modulation

On/Off Ratio: ≤ 3 GHz: > 80 dB; > 3 GHz: > 60 dB
Rise/Fall Times: 150 ns, typical
Minimum Width (typical): ALC On: 2µs; ALC Off: 0.4µs
Pulse Repetition Frequency (typical):
- **ALC On:** 10 Hz–250 kHz
- **ALC Off:** DC–1.0 MHz

Level Accuracy (relative to CW)[4]: ± 0.5 dB, typical
Internal Pulse Generator
- **Squarewave Rates:** 0.1 Hz–50 kHz

Pulse
- **Period:** 16 µs to 30 sec
- **Width:** 8 µs to 30 sec

Resolution: 4 µs

Internal Modulation Source

Provides FM, ΦM, and AM Modulation Signals and LF Out
Waveforms: Sine, square, ramp, triangle, pulse, and noise
Rate Range:
- **Sine:** 0.1 Hz–50 kHz
- **Square, Ramp, Triangle:** 0.1 Hz–10 kHz

Resolution: 0.1 Hz
- **Pulse Only:** 4 µs

Frequency Accuracy: 0.005%
Swept Sine Mode (Frequency, Phase Continuous)
- **Operating Modes:** Triggered or Continuous Sweeps
- **Frequency Range:** 0.1 Hz to 50 kHz
- **Sweep Time:** 1 ms to 65 sec
- **Resolution:** 1 ms

Dual Sinewave Mode
- **Frequency Range:** 0.1 Hz to 50 kHz
- **Amplitude Ratio:** 0 to 100%
- **Amplitude Resolution:** 0.1%

LF Out (Internal Modulation Source)

Amplitude: 0 to 3 V_{peak} into 50 Ω
Output Impedance: < 1 Ω

External Modulation Inputs

Modulation Types:
- **Ext1:** FM, ΦM, AM, and Burst Envelope
- **Ext2:** FM, ΦM, AM, and Pulse

High/Low Indicator (100 Hz to 10M Hz BW, AC coupled inputs only): Activated when input level error exceeds 3% (normal)

Simultaneous Modulation

All modulation types may be simultaneously enabled, except: FM with ΦM, AM with Burst Envelope. AM, ΦM and FM can sum simultaneous inputs from any two sources (INT, EXT1, and EXT2). Any given source (INT, EXT1 or EXT2) may only be routed to one activated modulation type.

Remote Programming

Interface: GPIB (IEEE-488.2-1987) with Listen and Talk. RS-232.
Control Languages: SCPI version 1992.0, also compatible with HP 8656B and 8657A/B/D/J mnemonics
Functions Controlled: All front-panel functions except power switch and knobs
IEEE-488 Functions: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2

General

Power Requirements: 90 to 254 V; 50, 60, or 400 Hz; 200 W maximum
Operating Temperature Range: 0 to 55° C
Leakage: Conducted and radiated interference meets MIL-STD-461B RE02 Part 2 and CISPR 11
Storage Registers: Up to 100 storage registers, up to 10 sequences available
Weight: < 12.7 kg (28 lb) net, < 21 kg (46 lb) shipping
Dimensions: 133 mm H x 426 mm W x 432 mm D (5.25 in H x 16.8 in W x 17 in D)

Key Literature

HP ESG Family Brochure, p/n 5968-4313E
ESG Series Technical Specifications, p/n 5965-3096E
HP ESG Family Option Profile, p/n 5968-2807E
Source Catalog, p/n 5965-3094E

Ordering Information

HP E4400B
HP E4420B
HP E4421B
HP E4422B
- **Opt 1EM** Move Connectors to Rear Panel
- **Opt 1E5** Add High-Stability Timebase
- **Opt UNB** High Power with mechanical attenuator

Accessories
Transit Case p/n 9211-1296
HP 83300A Remote Interface

[3] AM is typical above 3 GHz.
[4] With ALC on, specifications apply for repetition rates < 10 kHz and pulse widths ≥ 5 ms.

HP E4423B
HP E4424B
HP E4425B
HP E4426B

NEW

- 250 kHz up to 4.0 GHz
- Superior Spectrul Purity
- Flexible architecture, upgrade paths for options
- 4 GHz electronic attenuator for reliability and repeatability
- Superior level accuracy
- Wideband FM and Phase Modulation
- Step sweep (frequency, power and list)
- Built-in function generator
- 3 year warranty

HP ESG-AP series HP E4422B

5

HP ESG-AP Series Analog Signal Generators GPIB

The new HP ESG-AP Series provides outstanding phase-noise performance and analog modulation features for all general-purpose test needs. This series offers excellent in-channel performance with superior quality and reliability, at an affordable price. The first in a new generation of signal generators, they provide excellent frequency and level control, and wide modulation capabilities. They are ideally suited to meet the demanding requirements of today's receiver test, component test and local oscillator applications.

Adaptable to Tomorrows Requirements

The innovative design of the HP ESG-AP series provides a flexible architecture that can be tailored to meet the changing demands of evolving markets. These signal generators provide upgrade paths for options (current or future), and analog to digital.

Low Cost of Ownership

Lower initial cost, high reliability three-year warranty and a two-year calibration cycle, all strive to minimize the cost of ownership. The HP ESG series of RF signal generators are designed for long-term dependability, maximizing production throughput and uptime.

For more information, visit our web site: **http://www.hp.com/go/esg**

Specifications

Frequency

HP E4423B: 250 kHz to 1000 MHz **HP E4425B:** 250 kHz to 3000 MHz
HP E4424B: 250 kHz to 2000 MHz **HP E4426B:** 250 kHz to 4000 MHz
Resolution: 0.01 Hz
Switching Speed:
Modulation On: < 45 ms, typical
Modulation Off: < 35 ms, typical
Accuracy: Stability x fc timebase

Sweep Modes

Operating modes: Step: frequency and power, and arbitrary list
Dwell Time: 1 ms to 60 sec
Number of points: 2 to 401

Internal Reference Oscillator

Timebase Stability:

	Standard
Aging Rate	< ± 0.1 ppm/yr. or < ± 0.0005 ppm/day after 45 days
Temperature (0° to 55° C)	< ± 0.05 ppm, typical
Line Voltage	< ± 0.002 ppm, (+5%, –10%) typical

Timebase Reference Output:
Frequency: 10 MHz
Amplitude: > 0.35 Vrms into 50Ω load
External Reference Input:
Frequency: 1, 2, 5, 10 MHz ± typ. 10 ppm (1 ppm, Option 1E5)
Amplitude: > 0.15 Vrms
Input Impedance: 50Ω

Output

Range	Standard	Option UNB
250 kHz to 1000 MHz	+13 to –136 dBm	+17 to –136 dBm
> 1000 MHz to 3000 MHz	+10 to –136 dBm	+16 to –136 dBm
> 3000 MHz to 4000 MHz	+7 to –136 dBm	+13 to –136 dbm

Resolution: 0.02 dB Level Accuracy: at 23° ± 5° C)	**+7 to –127 dBm**	**< –127 dBm**
	250 kHz to 2 GHz	± 0.5 dB ± 1.5 dB
	2 GHz to 4 GHz	± 0.9 dB ± 2.5 dB

Attenuator Hold Level Range: > 17 dB (>23 dB Option UNB)
Switching Speed: <25 ms typical (30 ms, Option UNB)
With Power Search Mode: <235 ms typical (245 ms, Option UNB)
Reverse Power Protection1:
250 kHz to 2000 MHz: 50 watts
>2000 MHz to 4000 MHz: 25 watts
Max. DC Voltage: 50 V

SWR (typical):	**Standard**	**Option UNB**
250 kHz to 2000 MHz	< 1.4:1	< 1.25:1
> 2000 to 4000 MHz	< 1.9:1	< 1.35:1

Output Impedance: 50Ω

Frequency Bands

Band	Frequency Range	N #
1	250 kHz to ≤249.999 MHz	1
2	> 249.999 to ≤500 MHz	0.5
3	> 500 MHz to ≤1 GHz	1
4	> 1 to ≤2 GHz	2
5	> 2 to ≤4 GHz	4

[1]The reverse power protection circuitry triggers at nominally 1 watt.
[2]Specifications apply for FM deviations < 100 kHz and are not valid for FM.

Spectral Purity

Preliminary SSB Phase Noise (typical, at 20 kHz offset)
at 500 MHz: < –138 dBc/Hz
at 1000 MHz: < –135 dBc/Hz
at 2000 MHz: < –129 dBc/Hz
at 3000 MHz: < –123 dBc/Hz
at 4000 MHz: < –123 dBc/Hz
Residual FM (CW mode, 0.3–3 kHz BW, CCITT, rms)
< N x 1 Hz (Nx 0.5 Hz, typical)

Frequency Modulation

Maximum Deviation: N x1 MHz
Resolution: 0.1% of deviation or 1 Hz, whichever is greater
Deviation Accuracy (1 kHz rate, dev. < N x 100 kHz):
< ± (3.5% of FM deviation + 20 Hz)

Modulation Frequency Response (deviation = 100 kHz)

Path	Rates	
	1 dB Bandwidth	**3 dB Bandwidth, typical**
FM1	dc/20 Hz to 100 kHz	dc/5 Hz to 10 MHz
FM2	dc/20 Hz to 100 kHz	dc/5 Hz to 1 MHz

Distortion (1 kHz rate, THD, dev.=N x 100 kHz): < 1%

[1]The reverse power protection circuitry triggers at nominally 1 watt.
[2]Specifications apply for FM deviations < 100 kHz and are not valid for ΦM.

HP E4423B
HP E4424B
HP E4425B
HP E4426B

NEW

Phase Modulation

Maximum Deviation: Normal BW N x 10 radius
High BW N x 1 radius
Resolution: 0.1% of set deviation
Deviation Accuracy (1 kHz rate): < ± (5% of deviation + 0.01 radians)

Modulation Frequency Response:

ΦM Mode	Maximum Deviation	Rates (3 dB BW)	
		ΦM1	ΦM2
Normal BW	N x 10 rad	dc–100 kHz	dc–100 kHz
High BW	N x 7rad	dc–7 MHz (typ.)	dc–1 MHz (typ.)

Distortion (1 kHz rate, THD, dev < N x 90 radians): < 1%

Amplitude Modulation[3] f_c > 500 kHz

Range (envelope peak ≤ max. specified power): 0 to 100%
Resolution: 0.1%
Rates (3 dB bandwidth): dc/10 Hz to 10 kHz
Distortion (1 kHz rate, THD): 30% AM: < 1.5%, 90% AM: < 4% (typical)
Accuracy (1 kHz rate): < ± (6% of setting + 1%)

Pulse Modulation Standard

On/Off Ratio: ≤ 3 GHz: > 80 dB; > 3 GHz: > 60 dB
Rise/Fall Times: 150 ns, typical
Minimum Width (typical): ALC On: 2µs; ALC Off: 0.4µs
Pulse Repetition Frequency (typical):
- **ALC On:** 10 Hz–250 kHz
- **ALC Off:** DC–1.0 MHz

Level Accuracy (relative to CW)[4]: ± 0.5 dB, typical
Internal Pulse Generator
- **Squarewave Rates:** 0.1 Hz–50 kHz

Pulse
- **Period:** 16 µs to 30 sec
- **Width:** 8 µs to 30 sec

Resolution: 4 µs
High Performance Pulse Modulation, Option 1E6
- **On/Off Ratio:** >80 dB
- **Rise/fall times:** <10ns

Internal Modulation Source

Provides FM, FM, and AM Modulation Signals and LF Out

Waveforms: Sine, square, ramp, triangle, pulse, and noise
Rate Range:
- **Sine:** 0.1 Hz–50 kHz
- **Square, Ramp, Triangle:** 0.1 Hz–10 kHz

Resolution: 0.1 Hz
Pulse Only: 4 µs
Frequency Accuracy: 0.005%
Swept Sine Mode (Frequency, Phase Continuous)
- **Operating Modes:** Triggered or Continuous Sweeps
- **Frequency Range:** 0.1 Hz to 50 kHz
- **Sweep Time:** 1 ms to 65 sec
- **Resolution:** 1 ms

Dual Sinewave Mode
- **Frequency Range:** 0.1 Hz to 50 kHz
- **Amplitude Ratio:** 0 to 100%
- **Amplitude Resolution:** 0.1%

LF Out (Internal Modulation Source)

Amplitude: 0 to 3 V peak into 50Ω
Output Impedance: < 1Ω

External Modulation Inputs

Modulation Types:
- **Ext1:** FM, FM, AM, and Burst Envelope
- **Ext2:** FM, FM, AM, and Pulse

High/Low Indicator (100 Hz to 10M Hz BW, AC coupled inputs only): Activated when input level error exceeds 3% (normal)

Simultaneous Modulation

All modulation types may be simultaneously enabled, except: FM with FM, AM with Burst Envelope. AM, FM and FM can sum simultaneous inputs from any two sources (INT, EXT1, and EXT2). Any given source (INT, EXT1 or EXT2) may only be routed to one activated modulation type.

Remote Programming

Interface: GPIB (IEEE-488.2-1987) with Listen and Talk. RS-232.
Control Languages: SCPI version 1992.0, also compatible with HP 8656B and 8657A/B/D/J mnemonics
Functions Controlled: All front-panel functions except power switch and knobs
IEEE-488 Functions: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2

General

Power Requirements: 90 to 254 V; 50, 60, or 400 Hz; 200 W maximum
Operating Temperature Range: 0 to 55° C
Leakage: Conducted and radiated interference meets MIL-STD-461B RE02 Part 2 and CISPR 11
Storage Registers: Up to 100 storage registers, up to 10 sequences available
Weight: < 12.7 kg (28 lb) net, < 21 kg (46 lb) shipping
Dimensions: 133 mm H x 426 mm W x 432 mm D
(5.25 in H x 16.8 in W x 17 in D)

Key Literature

HP ESG and Family Brochure, p/n 5968-4313E
ESG Series Technical Specifications, p/n 5965-3096E
HP ESG Family Option Profile, p/n 5968-2807E
Source Catalog, p/n 5965-3094E

Ordering Information

HP E4423B
HP E4424B
HP E4425B
HP E4426B
Opt 1EM Move Connectors to Rear Panel
Opt 1E6 High Performance Pulse Modulation
Opt UNB High Power with mechanical attenuator

Accessories
Transit Case p/n 9211-1296
HP 83300A Remote Interface

[3] AM is typical above 3 GHz.
[4] With ALC on, specifications apply for repetition rates < 10 kHz and pulse widths.

HP 8647A
HP 8648A
HP 8648B
HP 8648C
HP 8648D

- ±1 dB level accuracy through 2.5 GHz
- 4 Hz residual FM at 500 MHz
- Electronic attenuator (1 GHz models)
- +10/+13 to –136 dBm output power
- Simple, dependable operation
- Pager signaling (HP 8648A Option 1EP)

HP 8648A/B/C/D

HP 8647A and HP 8648A/B/C/D Synthesized Signal Generators

GPIB

Superior Value in Economy Signal Generators

The HP 8647A and 8648A/B/C/D family of synthesized signal generators delivers solid performance and reliability at an affordable price. These signal generators provide the features and performance needed for semi-automated receiver testing and for use in a variety of general-purpose applications over a 9 kHz to 4000 MHz frequency range.

High Reliability and Simplicity

Designed to Hewlett-Packard's stringent quality specifications, these signal generators provide consistent performance. The all-electronic attenuator in the HP 8647A and 8648A easily handles millions of amplitude cycles with highly repeatable output levels.

An easy-to-use front panel interface shortens the operator's learning curve and increases productivity. A front panel organized in functional blocks speeds identification of the task and simplifies operation.

Ideal for Manufacturing and Semi-Automated Test

The HP 8647A and 8648 series are ideal for manufacturing high-volume products such as cordless telephones, pagers and two-way radios. The HP 8647A is the basic model providing essential performance. The HP 8648 series provides enhancements in frequency range, residual FM, level accuracy, and phase noise, in addition to optional high power, pulse modulation, and waveform modulation. The HP 8648 series provides ±1 dB absolute amplitude accuracy up to 2.5 GHz. All of the models offer ultra stable dc FM, with ±500 Hz carrier frequency accuracy below frequencies of 1001 MHz, and low RF leakage.

Applications such as receiver tuning and alignment benefit from the simple user interface. These signal generators are so easy to learn and use that experienced operators are no longer required. With 300 full storage registers and ten user-definable sequences, the signal generator easily adapts to any test procedure. Once setups are stored in registers, operators can quickly sequence through them, either from the front panel or through a remote keypad (HP 83300A). In addition, the HP 83301A memory interface provides the means to transfer register information from one HP 8647/48 to another.

For automated test applications, the HP 8647/48 offers full GPIB programmability and uses SCPI programming codes. In addition, the HP 8648 series reduces software development costs by providing full GPIB code compatibility with the HP 8656B and 8657A/B signal generators.

New Cost-Effective Pager Testing

The HP 8648A with Option 1EP provides an economical, one-box solution for pager test. Option 1EP adds the pager encoding capability for POCSAG, FLEX, and FLEX-TD formats to the HP 8648A. Ideal for pager test applications, the HP 8648A with Option 1EP offers superior frequency accuracy, deviation accuracy, and dc FM performance.

Specifications

Frequency
HP 8647A: 250 kHz to 1000 MHz
HP 8648A: 100 kHz to 1000 MHz
HP 8648B: 9 kHz to 2000 MHz
HP 8648C: 9 kHz to 3200 MHz
HP 8648D: 9 kHz to 4000 MHz

Resolution
HP 8647A: 1 Hz; HP 8648A/B/C/D: 0.001 Hz
Display: 10 Hz

Switching Speed (typical)
HP 8647A: < 120 ms
HP 8648A/B/C/D: <1001 MHz: < 75 ms; ≥ 1001 MHz: < 100 ms

Accuracy (after one hour warm-up and within one year calibration): Typically ± 3 x 10^{-6} x carrier frequency in Hz, ± 0.15 x 10^{-6} x carrier frequency in Hz for Option 1E5 (typically ± 0.072 x 10^{-6} x fc)

Internal Reference Oscillator
Accuracy and Stability (calibration adjustment dependent; after one hour warm-up and within one year of calibration), ± aging rate ± temperature effects ± line voltage effects

	Standard Timebase	Option 1E5
Aging	< ± 2 ppm/yr	< ± 0.1 ppm/yr; < ± 0.0005 ppm/day
Temperature	< ± 1 ppm	< ± 0.01 ppm (typ.)
Line Voltage (± 5%)	< ± 0.5 ppm	N/A

Output: 10 MHz, typically > 0.5 V_{rms} into 50 Ω
External Reference Oscillator Input: Accepts 2, 5, 10 MHz ±5 ppm and a level range of 0.5 V to 2 V_{rms} into 50 Ω

Spectral Purity
Harmonics (output ≤ 4 dBm): < –30 dBc
Subharmonics (output ≤ +4 dBm) < 1001 MHz: –60 dBc; ≥ 1001 MHz: –50 dBc; > 3200 MHz: –40 dBc
Nonharmonics (≥ 5 kHz offset, ≤ +4 dBm output level)
HP 8647A: < –60 dBc (–55 dBc from 220 to 250 MHz)
HP 8648A/B/C/D
< 249 MHz: < –55 dBc; < 2001 MHz: < –54 dBc
< 1001 MHz: < –60 dBc; ≤ 4000 MHz: < –48 dBc
Residual FM (CCITT, rms)
HP 8647A
< 249 MHz: < 20 Hz, typically < 11 Hz
< 501 MHz: < 10 Hz, typically < 6 Hz
≤ 1000 MHz: < 20 Hz, typically < 11 Hz
HP 8648A/B/C/D
< 249 MHz: < 7 Hz, typically < 4 Hz
< 501 MHz: < 4 Hz, typically < 2 Hz
< 1001 MHz: < 7 Hz, typically < 4 Hz
< 2001 MHz: < 14 Hz, typically < 8 Hz
≤ 4000 MHz: < 28 Hz, typically < 12 Hz
SSB Phase Noise (at 20 kHz offset, typical)
HP 8647A
@ fc 500 MHz: < –110 dBc/Hz; @ fc 1000 MHz: < –106 dBc/Hz
HP 8648A/B/C/D
@ fc 500 MHz: < –120 dBc/Hz; @ fc 3000 MHz: < –106 dBc/Hz
@ fc 1000 MHz: < –116 dBc/Hz; @ fc 4000 MHz: < –104 dBc/Hz
@ fc 2000 MHz: < –110 dBc/Hz

Output Range
HP 8647A and 8648A: +10 to –136 dBm
HP 8648B/C/D: ≤ 2500 MHz: +13 to –136 dBm; > 2500 MHz: +10 to –136 dBm

Max. Power with Option 1EA (High Power) on HP 8648B/C/D only

Freq. (MHz)	< 0.1	≤ 1000	≤ 1500	≤ 2100	≤ 2500	≤ 4000
Power (dBm)	+17	+20	+19	+17	+15	+13

Display Resolution: 0.1 dB
Accuracy (specified power < 13 dBm to –127 dBm)
HP 8647A: ± 1.5 dB
HP 8648A/B/C/D (applies at 25° ± 5° C):
≤ 2500 MHz: ± 1.0 dB
≤ 3200 MHz: ± 1.5 dB (≥ –100 dBm; ± 3.0 dB < –100 dBm)
≤ 4000 MHz: ± 2.0 dB (≥ –100 dBm; ± 3.0 dB < –100 dBm)
Reverse Power Protection (watts into 50 Ω)
HP 8647A and 8648A/B: 50 watts
HP 8648C/D: 50 watts ≤ 2000 MHz; 25 watts > 2000 MHz

SWR: (output < –6 dBm, typical)
HP 8647A: < 2.0:1
HP 8648A/B/C/D:
< 249 kHz: < 2.5:1
≤ 2500 MHz: < 1.5:1
≤ 3200 MHz: < 2.0:1
Output Impedance: Nominally 50 Ω

Frequency Modulation

Peak Deviation (rates > 25 Hz ac FM)	8647A	8648A/B/C/D
< 249 MHz	0 to 100 kHz	0 to 200 kHz
< 501 MHz	0 to 50 kHz	0 to 100 kHz
< 1001 MHz	0 to 100 kHz	0 to 200 kHz
< 2001 MHz	N/A	0 to 400 kHz
≤ 4000 MHz	N/A	0 to 800 kHz

Resolution
For ≤ 10% peak deviation
< 2001 MHz: 10 Hz
≥ 2001 MHz: 20 Hz
For > 10% to maximum peak deviation
< 2001 MHz: 100 Hz
≥ 2001 MHz: 200 Hz
Deviation Accuracy (internal 1 kHz rate)
HP 8647A: ± 7.5% of FM deviation ± 30 Hz
HP 8648A/B/C/D
< 1001 MHz: ± 3% of deviation ± 30 Hz
< 2001 MHz: ± 3% of deviation ± 60 Hz
≤ 4000 MHz: ± 3% of deviation ± 120 Hz
HP 8648A Option 1EP only:
50 Hz at 276 to 284 MHz, 406 to 512 MHz, and 929 to 932 MHz
Rates
HP 8647A
Internal: 400 Hz or 1 kHz
External dc: DC to 75 kHz (typical, 3 dB BW)
External ac: 20 Hz to 75 kHz (typical, 3 dB BW)
HP 8648A/B/C/D
Internal: 400 Hz to 1 kHz (10 Hz to 20 kHz for Option 1E2)
External dc: dc to 150 kHz (typical, 3 dB BW)
External ac: 1 Hz to 150 kHz (typical, 3 dB BW)
Distortion (1 kHz rate, THD + N, 0.3 to 3 kHz BW)
< 1001 MHz: < 1% at deviations > 4 kHz
< 2001 MHz: < 1% at deviations > 8 kHz
≤ 4000 MHz: < 1% at deviations > 16 kHz
HP 8648A/B/C/D 88 to 108 MHz: < 0.5% at deviations ≥ 75 kHz
Carrier Frequency Accuracy (relative to CW in dc FM, at 25° ± 5° C)
< 1001 MHz: ± 100 (typ. 40*) Hz, deviations < 10 kHz
< 2001 MHz: ± 200 (typ. 80*) Hz, deviations < 20 kHz
≤ 4000 MHz: ± 400 (typ. 160*) Hz, deviations < 40 kHz
FM + FM: Internal 1 kHz to 400 Hz source plus external. In internal plus external FM mode, the internal source produces the set level of deviation. The external input should be set to ≤ ±0.5 V peak or 0.5 Vdc (one-half the set deviation).

Phase Modulation
Peak Deviation
< 249 MHz: 0 to 10 radians
< 501 MHz: 0 to 5 radians
< 1001 MHz: 0 to 10 radians
< 2001 MHz: 0 to 20 radians
≤ 4000 MHz: 0 to 40 radians
Resolution
< 2001 MHz: 0.01 radian
≥ 2001 MHz: 0.02 radian
Deviation Accuracy (internal 1 kHz rate, typical)
HP 8647A: ± 7.5% of deviation ± 0.05 radians
HP 8648A/B/C/D
< 1001 MHz: ± 3% of deviation ± 0.05 radians
< 2001 MHz: ± 3% of deviation ± 0.1 radians
≤ 4000 MHz: ± 3% of deviation ± 0.2 radians
Rates
Internal: 400 Hz or 1 kHz (10 Hz to 20 kHz for Option 1E2, 8648A/B/C/D only)
External: 20 Hz to 10 kHz (typical, 3 dB BW)
Distortion (1 kHz rate)
HP 8647A < 2% at deviations ≥ 3 radians
HP 8648A/B/C/D
< 1001 MHz: < 1% at deviations ≥ 3 radians
< 2001 MHz: < 1% at deviations ≥ 6 radians
≤ 4000 MHz: < 1% at deviations ≥ 2 radians

*Within one hour after dc FM calibration

Amplitude Modulation
(AM is not specified below 1.5 MHz and is typical above 1001 MHz.)
Range: 0 to 100%; output ≤ +4 dBm
Resolution: 0.1%
Accuracy (1 kHz rate): ± 5% of setting ± 1.5% (for HP 8648B/C/D, specification is applicable at 25° ±5° C and < 70% depth)
Rates
Internal: 400 Hz or 1 kHz (10 Hz to 20 kHz for Option 1E2, 8648A/B/C/D only)
External dc: dc to 25 kHz (typical, 3 dB BW)
External ac: 1 Hz to 25 kHz (typical, 3 dB BW)
Distortion (1 kHz rate, THD+ N, 0.3 to 3 kHz BW)
HP 8647A and 8648A: @ 30% AM: < 2%; @ 90% AM: < 3%
HP 8648B/C/D: @ 30% AM: < 2%; @ 70% AM: < 3%
Pager Test Option 1EP (HP 8648A only)
Signaling Formats: POCSAG, FLEX, and FLEX-TD (RCR-43)
Pulse Option 1E6 (HP 8648B/C/D only)
On/Off Ratio: > 80 dB < 2000 MHz;> 70 dB ≥ 2000 MHz
Rise/Fall Times: < 10 ns
Modulation Generator Option 1E2 (HP 8648A/B/C/D only)
Adds variable frequency modulation generator.
Frequency Range
Sine: 10 Hz to 20 kHz
Square, Triangle, Sawtooth: 100 Hz to 2 kHz
Frequency Accuracy: ± 0.01% typical
Frequency Resolution: 1 Hz (3 digits displayed)

Modulation Source
Internal: 400 Hz or 1 kHz, front panel BNC connector provided at nominally 1 V (p-p) into 600 Ω
External: 1 V peak into 600 Ω (nominal) required for full scale modulation. (High/Low indicator provided for external signals ≤ 10 kHz.)

Remote Programming
Interface: GPIB (IEEE-488.2-1987) with Listen and Talk
Control Languages: SCPI version 1992.0. The HP 8648A/B/C/D are code compatible with the HP 8656B and 8657.
Functions Controlled: All front panel functions except power switch and knobs
IEEE-488: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2

ISO Compliant
The HP 8647A and 8648A/B/C/D signal generators are manufactured in an ISO 9002 registered facility in concurrence with HP's commitment to quality.

General

Power Requirements: 90 to 264 V, 48 to 440 Hz; 170 VA max.
Operating Temperature: 0° to 50° C
Leakage: Conducted and radiated interference meets MIL-STD-461B RE02 and FTZ 1046. Typically < 1 µV.

Key Literature

HP 8647A and 8648A/B/C/D Data Sheet, p/n 5965-3432E
Signal Generator Selection Guide, p/n 5965-3094E
HP 8647A and 8648A/B/C Brochure, p/n 5962-6191E
HP 8648A Option 1EP Pager Encoder Datasheet, p/n 5964-4116E

Ordering Information

HP 8647A Synthesized Signal Generator
HP 8648A Synthesized Signal Generator
HP 8648B Synthesized Signal Generator
HP 8648C Synthesized Signal Generator
HP 8648D Synthesized Signal Generator
Opt 1EA High Power (HP 8648B/C/D only)
Opt 1EP Pager Encoder (HP 8648A only)
Opt 1E6 Pulse (HP 8648B/C/D only)
Opt 1E2 Modulation Generator
Opt 1E5 High-Stability Timebase
Opt 1CM Rack Kit, p/n 08647-61020 (HP 8647A)
Opt 1CM Rack Kit, p/n 08648-60001 (HP 8648)
HP 83300A Remote Interface
HP 83301A Memory Interface

HP E4430B
HP E4431B
HP E4432B
HP E4433B

- 250 kHz up to 4 GHz
- Personalities for W-CDMA, cdma2000, EDGE and CDMA
- 20 MHz RF bandwidth for I and Q
- Superior level accuracy
- Step sweep (frequency, power and list)
- Wideband AM, FM and phase modulation
- Internal data generator and burst capabilites (Option UN8)
- Flexible creation of custom modulation (Option UN8, UND)
- Built-in TDMA formats for DECT, GSM, NADC, PDC, PHS and TETRA (Option UN8)
- Internal dual arbitrary waveform generator (Option UND)
- Internal bit-error-rate analyzer (Option UN7)
- 3 year warranty

HP ESG Series E4433B

HP ESG-D Series Digital and Analog Signal Generators

GPIB

The HP ESG-D series of RF signal generators provide a wide range of digital modulation capabilities, in addition to a comprehensive feature set and excellent analog performance–all at an affordable price. They provide excellent modulation accuracy and stability, as well as unprecedented level accuracy. The HP ESG-D series is ideally suited to meet the demanding requirements of today's digital receiver test, component test and local oscillator applications.

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Customized Modulations and DECT, EDGE, GSM, NADC, PDC, PHS, TETRA Standards (Option UN8)

Internally generate signals for common standards to test receivers. Change modulation types, data, symbol rate, filter type and filter factor to generate customized signals for component and system margin testing. Create custom signals by mapping I/Q values and building a unique FIR filter. Easily configure timeslots to simulate different types of traffic, control or synchronization channels (or bursts). Generate mobile or base station transmissions with the internal burst capabilities. Also reduce the need for external equipment with comprehensive data generation capabilities.

Internal Dual Arbitrary Waveform Generator (Option UND)

Playback virtually any mathematically generated waveform. Download long or multiple waveforms (up to 1 Msample) to play or store in non-volatile RAM for later use. The 14 bits of DAC resolution enhance dynamic range and noise performance. Optimized for I/Q generation, the dual arbitrary option simplifies setup.

W-CDMA and cdma2000

Generate correctly coded signals according to developing international standards. Simulate fully coded channels for base-station and mobile receiver test or partially coded statistically correct multichannel signals that accurately stress active components for the developing international 3G standards.

Multichannel and Multicarrier CDMA

The HP ESG-D series supports CDMA (Option UN5) personality. Generate multicarrier CDMA signals with multiple channels in each carrier for base-station and mobile tests at system or component level. Tailor a test to specific requirements like the complementary commulative distribution function (CCDF) by selecting pre-defined multicarrier CDMA configurations or by explicitly defining the characteristics of each channel on each carrier.

Internal Bit Error Rate Analyzer (Option UN7)

Perform bit-error-rate analysis for sensitivity and selectivity measurements. Option UN7 provides analysis capabilities for PN9 and PN15 bit sequences and indicates pass or fail conditions for user-specified test limits.

Broadband I and Q Modulation

Use the analog I and Q inputs to generate complex modulation formats required for the development and testing of RF digital communications systems. A built-in quadrature modulator processes the I and Q input signals to provide superior modulation accuracy and stability over 10 MHz (1dB) baseband bandwidth.

Excellent Level Accuracy

Make sensitivity tests accurately and efficiently with the wide power range (+13 dBm to –136 dBm, +17 dBm to –136 dBm with Option UNB) and superior level accuracy of the HP ESG-D series RF signal generators. Level accuracies of better than +1.1 dB (+0.6 dB typical) for built-in modulation formats ensures precise measurement of even the most sensitive digital receivers.

Specifications

Frequency
HP E4430B: 250 kHz to 1000 MHz
HP E4431B: 250 kHz to 2000 MHz
HP E4432B: 250 kHz to 3000 MHz
HP E4433B: 250 kHz to 4000 MHz

For Analog Remote Programming and General Specifications, see ESG Series on page 208.

Level Accuracy with Digital Modulation

(With ALC on; relative to CW; with PRBS-modulated data)[1]
π/4 DQPSK or QPSK Formats
± 0.15 dB (with raised cosine or root-raised cosine filter and $\alpha \geq 0.35$; with 10 kHz ≤ symbol rate ≤ 1 MHz; at RF freq. ≥ 25 MHz; power ≤ max. specified –3 dBm or –6 dBm with Option UNB.
Constant Amplitude Formats
(FSK, GMSK, etc.): No degradation in power level accuracy
Level Accuracy with ALC Off[2]
± 0.3 dB, typical (After power search is executed; relative to CW level accuracy with ALC on; if external I/Q is enabled: $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$)

I/Q Modulation

I&Q Inputs:
Input Impedance: 50 Ω
Full Scale Input: $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$
Adjustments/Impairments (nominal)**:**
DC Offset: (I and Q independently adjustable) +100%
I/Q Gain Ratio: ± 4 dB
I/Q Quadrature: ± 10°

DC Vector Accuracy
Relative to full scale, power ≤ + 7 dBm (≤ +10 dBm for Option UNB)

Frequency (GHz)	< 0.6	0.6 to 2	2 to 3.7	≤ 4
Static EVM[1] (rms)	< 0.75%	< 0.5%	< 0.75%	< 1%
Magnitude Error[1] (rms)	< 0.5%	< 0.35%	< 0.5%	< 0.75%
Phase Error[1] (rms)	< 0.35°	< 0.25°	< 0.35°	< 0.5°
Origin Offset (dBc)	< –46	< –46	< –40	< –40

Burst Envelope

On/Off Ratio: V_{IN}: ≤ –1.05 V
≤ 3 GHz: > 75 dB
> 3 GHz: > 60 dB
Rise/Fall Time: < 2 μs, typical
Minimum Burst Rate
ALC On: 10 Hz, typical
ALC Off: DC

External Input: Ext 1
Input Impedance: 50 Ω
Input Voltage
RF Off: –1.0 V
RF On: 0 V

Coherent Carrier Out[3]

Range: 250 MHz to maximum carrier frequency
Level: 0 dBm ± 5 dB, typical
Impedance: 50 Ω

For more information, visit our web site: **http://www.hp.com/go/esg**

[1] Typically, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V_{rms}.
[2] When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level.
[3] Coherent carrier is modulated by FM or ΦM when enabled.

HP E4430B
HP E4431B
HP E4432B
HP E4433B

Optional Real-Time I/Q Baseband Generator (Option UN8)

Modulation Formats
PSK: BPSK, QPSK, OQPSK, π/4DQPSK, 8PSK, 16PSK, D8PSK
MSK: User-defined phase offset
QAM: 4, 16, 32, 64, 256
FSK: Symmetric 2, 4, 8, 16
Custom FSK: User-defined asymmetric
Custom I/Q: Map of 16 unique values for I and Q
Filters: Nyquist, Root Nyquist, Gaussian, Custom FIR
Filter Rate: α: 0 to 1; BT 0.1 to 1
Symbol Rate: Adjustable up to 12 Msymbols/sec
Data Structure
Frames and timeslots may be configured as different types of traffic or control channels. The data field of a timeslot can accept user file, PRBS or external data with the appropriate clock.
Internal Data
Pseudo-Random Patterns: Continuous PN9, PN11, PN15, PN20 or PN23
Repeating Sequence: Any 4-bit sequence

Downdoadable Data
Maximum Size (Pattern RAM)**:** 1 Mbits, 8 Mbits (Option UN9)
Maximum Size (User File)**:** 128 kbytes
External Data
Inputs: Data, bit/symbol clocks (accepts rates ± 5% of specified data rate)
Reference Frequency: Internal or external 1, 2, 5, 10 MHz reference. Data clock can be locked to an external 13 MHz GSM reference
Frame Trigger Delay Control
Range: 0 to 65,535 bits
Resolution: 1 bit
Internal Burst Shape Control
Rise/Fall Time Range: Up to 30 bits
Rise/Fall Delay Range: 0 to 63.5 bits (varies w/standard)
I/Q Outputs
EVM (NADC, PDC, PHS, TETRA)**:** 1% rms
Global Phase Error (GSM)**:** 0.75° rms
Deviation Accuracy (DECT)**:** 1 kHz

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	NADC		PDC		PHS		TETRA[5]		DECT	GSM (DCS, PCS)	
Error Vector Magnitude[4] (% rms)	**Cont.**	**Burst**	**Cont.**	**Burst**	**Cont.**	**Burst**	**Cont.**	**Burst**			
Low EVM Mode	0.7	1.4	0.9	1.3	0.9	0.9	0.8	1.7	N/A	N/A	
Low EVM Mode (typical)	0.4	1.1	0.6	0.9	0.6	0.7	0.5	1.3	N/A	N/A	
Low ACP Mode (typical)	1.0	1.4	0.8	1.0	0.9	0.9	0.9	1.5	N/A	N/A	
Global Phase Error[4] (rms/pk)	N/A		N/A		N/A		N/A		N/A	0.6° / 2.2° 0.3° / 1.3°(typ.)	
Deviation Accuracy[4] (kHz)	N/A		N/A		N/A		N/A		3 (2, typ)	N/A	
Adjacent Channel Power[4] (ACP) (Low ACP Mode dBc, typical)	**Cont.**	**Burst**	**Cont.**	**Burst**	**Cont.**	**Burst**	**Cont.**	**Burst**	**N/A**	**Cont.**	**Burst**
at Adjacent Channel[6]	–35	–34	—	—	—	—	–69[7]	–64	N/A	–37	–37
at 1st Alternate Channel[6]	–80	–78	–74	–72	–80	–78	–80	–78	N/A	–72	–71
at 2nd Alternate Channel[6]	–82	–81	—	—	–80	–79	–81	–80	N/A	–82	–80
at 3rd Alternate Channel[6]	–84	–83	–81	–79	—	—	–81	–80	N/A	–82	–81
Supported Burst Types	Custom, Up/Down TCH		Custom, Up/Down TCH, Up Vox		Custom, TCH, Sync		Custom, Up Control 1 & 2, Up Normal, Down Normal, Down Sync		Custom, Dummy B 1 & 2, Traffic B, Low Capacity	Custom, Normal, FCorr, Sync, Dummy, Access	
Scramble Capabilities	—		—		Yes		Yes		—	—	

[4] Specifications apply for the frequency range, symbol rates, root raised cosine filter, filter factors (α or B_bT) and default scaling factor specified for each standard, and at power levels ≤ + 7 dBm (≤ 4 dBm for TETRA), (≤ + 10 dBm for Option UNB).
[5] ACP for TETRA is measured over a 25 kHz bandwidth, with an 18 kHz root raised cosine filter applied at power levels ≤ 4 dBm (≤ +8 dBm for Option UNB).
[6] The "channel spacing" determines the offset size of the adjacent and alternate channels: Adjacent Chan. offset = 1 x channel spacing, 1st Alt. Chan. = 2 x channel spacing, 2nd Alt. Chan. = 3 x channel spacing, etc.
[7] TETRA ACP performance is typically –72 dBc with Option H99 in continuous modulation mode.

HP E4430B
HP E4431B
HP E4432B
HP E4433B

Optional Dual Arbitrary Waveform Generator (Option UND)

Channels: 2
Resolution: 14 bits (1/6384)
Waveform Memory Length
Playback: 1 Msample/channel
Storage (non-volatile RAM)**:** 1 Msample/channel
Waveform Segments
Length: 16 samples to 1 Msample
Number of Segments: 128
Sequencing: Continuously repeating
Sample Rate: 1 Hz to 40 MHz
Output Reconstruction Filters
Type: Elliptic
Fcutoff (nominal, 3 dB): 250 kHz, 2.5 MHz, 8 MHz and Through

Baseband Spectral Purity
(typical, full scale sinewave, >20x oversampling)
Harmonic distortion
< 100 kHz: <-80 dBc
100 kHz to 2 MHz: <-65 dBc
Non-Harmonic spurious: <-80 dBc
Phase Noise: <-120 dBc/Hz
(baseband output of 1 MHz sinewave at 20kHz offset)
IM Performance: <-69 dB
(two sinewaves at 950 kHz and 1050 kHz at full scale)

Optional Bit-Error-Rate Analyzer (Option UN7)

Clock Rate: 100 Hz to 10 MHz
Supported Data Patterns: PN9, PN15
Resolution: 10 digits
Minimum Synchronization Length: 9 bits (PN9 <2 MHz)
Bit Sequence Length: 100 bits to 4.294 Gbits after synchronization

Multichannel CDMA Personalities (Option UN5)

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Spurious Emissions (typical dBc, with high crest factor on)

Reverse Channel (≤0 dBm)

	Offset 885 to 1.25 MHz			Offset 1.25 to 1.98 MHz			Offset 1.98 to 5 MHz		
	Std.	UNB	H99	Std.	UNB	H99	Std.	UNB	H99
30-200 MHz	–72	–75	–73	–76	–78	–74	–79	–79	–77
700- 1000 MHz	–73	–76	–79	–76	–79	–82	–79	–79	–79
1000-2000 MHz	–66	–74	–79	–70	–78	–82	–79	–79	–79

9/64 Channels (<-2 dBm)

	Offset 885 to 1.25 MHz			Offset 1.25 to 1.98 MHz			Offset 1.98 to 5 MHz		
	Std.	UNB	H99	Std.	UNB	H99	Std.	UNB	H99
30-200 MHz	–68	–71	–72	–73	–76	–72	–78	–78	–77
700- 1000 MHz	–70	–73	–75	–75	–77	–79	–79	–79	–79
1000-2000 MHz	–63	–71	–74	–68	–75	–78	–78	–78	–78

Chip (symbol) Rate: Adjustable from 1 Hz to 10 MHz with 4x oversampling
Predefined Channel Configurations: Pilot, 9, 32, 64, reverse
Rho: 0.9996
(<4 dBm, IS-95 filter, < 2 GHz, typical)
User-Defined Channels
Number of Channels: 1 to 256
Walsh Codes: 0 to 63
Channel Power: 0 to –40 dB
PN Offset: 0 to 511
Data: 00-FF (HEX) or random

Key Literature

HP ESG Family Brochure, p/n 5968-4313E
HP ESG Series Technical Specifications, p/n 5965-3096E
HP ESG Configuration Guide, p/n 5965-4973E
HP ESG Family Option Profile, p/n 5968-2807E
Source Catalog, p/n 5965-3094E
Using the HP ESG-D Series and the HP 8922 GSM Test Set for GSM Applications, p/n 5965-7158E
Generating and Downloading Data to the HP ESG-D Series for Digital Modulation, p/n 5966-101E
Controlling TDMA Timeslot Power Levels in the HP ESG-D Series, p/n 5966-4472E
Generate Digital Modulation with the HP ESG Series Internal Dual Arbitrary Waveform Generator, p/n 5966-4097E
Customize Digital Modulation with the HP ESG-D Series Real-time I/Q Baseband Generator, p/n 5966-4096E
Making Bit-Error-Rate Measurements with the HP ESG-D Series, p/n 5966-4098E

Ordering Information

HP E4430B
HP E4431B
HP E4432B
HP E4433B
Opt 1CM Rackmount kit, p/n 5063-9214
Opt 1CN Front handle kit, p/n 5063-9227
Opt 1CP Rackmount kit with handles, p/n 5063-9221
Opt 1E5 Add high stability time base
Opt 1EM Move all front panel connectors to rear panel
Opt UNA Alternate timeslot power level control option for UN8
Opt UNB High power with mechanical attenuator
Opt UND Internal dual arbitrary waveform generator
Opt UN5 Multichannel, multicarrier CDMA personality for UND
Opt H03 Single channel CDMA personality
Opt UN7 Internal bit-error-rate analyzer
Opt UN8 Real-time I/Q baseband generator with TDMA standards
Opt UN9 Additional 7Mbits RAM memory for UN8
Opt 100 Multichannel W-CDMA personality based on Option UND
Opt 101 Multichannel cdma 2000 personality based on Option UND
Opt 201 cdma 2000 receiver test based on Option UN8
Opt 202 EDGE personality based on Option UN8
Opt H99 Improved ACP performance for W-CDMA, CDMA, TETRA
Opt W50 Five-year warranty

Accessories
Transit Case p/n 9211-1296
HP 83300A Remote Interface

HP E4434B
HP E4435B
HP E4436B
HP E4437B

NEW

- 250 kHz up to 4 GHz
- Personalities for W-CDMA, cdma 2000, EDGE and CDMA
- Superior spectral purity
- 20 MHz RF bandwidth for I and Q
- Superior level accuracy
- Step sweep (frequency, power and list)
- Wideband AM, FM and phase modulation
- Internal data generator and burst capabilites (Option UN8)
- Flexible creation of custom modulation (Option UN8, UND)
- Built-in TDMA formats for DECT, GSM, NADC, PDC, PHS and TETRA (Option UN8)
- Internal dual arbitrary waveform generator (Option UND)
- Internal bit-error-rate analyzer (Option UN7)
- 3 year warranty

E4434B

HP ESG-DP Series Digital and Analog GPIB Signal Generators

The new HP ESG-DP series sets a new price-performance level by offering excellent spectral purity and digital capabilities that are ideal for general purpose R&D bench-top use. The HP ESG-DP series of RF signal generators provide a wide range of digital modulation capabilities, in addition to a comprehensive feature set and excellent analog performance—all at an affordable price. They provide excellent modulation accuracy and stability, as well as unprecedented level accuracy. The HP ESG-DP series is ideally suited to meet the demanding requirements of today's digital receiver test, component test and local oscillator applications.

Customized Modulations and DECT, EDGE, GSM, NADC, PDC, PHS, TETRA Standards (Option UN8)

Internally generate signals for common standards to test receivers. Change modulation types, data, symbol rate, filter type and filter factor to generate customized signals for component and system margin testing. Create custom signals by mapping I/Q values and building a unique FIR filter. Easily configure timeslots to simulate different types of traffic, control or synchronization channels (or bursts). Generate mobile or base station transmissions with the internal burst capabilities. Also reduce the need for external equipment with comprehensive data generation capabilities.

W-CDMA and cdma2000

Generate correctly coded signals according to developing international standards. Simulate fully coded channels for base-station and mobile receiver test or partially coded statistically correct multichannel signals that accurately stress active components for the developing international 3G standards.

Internal Dual Arbitrary Waveform Generator (Option UND)

Playback virtually any mathematically generated waveform. Download long or multiple waveforms (up to 1 M sample) to play or store in non-volatile RAM for later use. The 14 bits of DAC resolution enhance dynamic range and noise performance. Optimized for I/Q generation,the dual arbitrary option simplifies setup.

Multicarrier and Multichannel CDMA

Generate multicarrier CDMA signals with multiple channels in each carrier for base-station and mobile tests at system or component level. Tailor a test to specific requirements like the complementary cummulative distribution function (CCDF) by selecting pre-defined multicarrier CDMA configurations or by explicitly defining the characteristics of each channel on each carrier.

Internal Bit Error Rate Analyzer (Option UN7)

Perform bit-error-rate analysis for sensitivity and selectivity measurements. Option UN7 provides analysis capabilities for PN9 and PN15 bit sequences and indicates pass or fail conditions for user-specified test limits.

Broadband I and Q Modulation

Use the analog I and Q inputs to generate complex modulation formats required for the development and testing of RF digital communications systems. A built-in quadrature modulator processes the I and Q input signals to provide superior modulation accuracy and stability over 10MHz (1dB) base band bandwidth.

Excellent Level Accuracy

Make sensitivity tests accurately and efficiently with the wide power range (+13 dBm to –136 dBm, +17 dBm to –136 dBm with Option UNB) and superior level accuracy of the HP ESG-D series RF signal generators. Level accuracies of better than +1.1 dB (+0.6 dB typical) for built-in modulation formats ensures precise measurement of even the most sensitive digital receivers.

Specifications

Frequency

HP E4434B: 250 kHz to 1000 MHz
HP E4435B: 250 kHz to 2000 MHz
HP E4436B: 250 kHz to 3000 MHz
HP E4437B: 250 kHz to 4000 MHz

For Analog Remote Programming and General Specifications, see ESG Series on page 194.

HP E4434B
HP E4435B
HP E4436B
HP E4437B

NEW

Level Accuracy with Digital Modulation

(With ALC on; relative to CW; with PRBS-modulated data)[1]

π/4 DQPSK or QPSK Formats
± 0.15 dB (with raised cosine or root-raised cosine filter and a ≥0.35; with 10 kHz ≤symbol rate ≤1 MHz; at RF freq. ≥25 MHz; power ≤max. specified –3 dBm or –6 dBm with Option UNB.
Constant Amplitude Formats
(FSK, GMSK, etc.): No degradation in power level accuracy
Level Accuracy with ALC Off2
± 0.3 dB, typical (After power search is executed; relative to CW level accuracy with ALC on; if external I/Q is enabled: $I_2 + Q_2 = 0.5\ V_{rms}$)

I/Q Modulation

I&Q Inputs:
Input Impedance: 50 Ω
Full Scale Input: $I_2 + Q_2 = 0.5\ V_{rms}$
Adjustments/Impairments (nominal):
DC Offset: (I and Q independently adjustable) +100%
I/Q Gain Ratio: ±4 dB
I/Q Quadrature: ±10°
DC Vector Accuracy
Relative to full scale, power ± 7 dBm (≤+10 dBm for Option UNB)

Frequency (GHz)	<0.6	0.6 to 2	2 to 3.7	≤4
Static EVM[1] (rms)	<0.75%	<0.5%	<0.75%	<1%
Magnitude Error[1] (rms)	<0.5%	<0.35%	<0.5%	<0.75%
Phase Error[1] (rms)	<0.35°	<0.25°	0.35°	<0.5°
Origin Offset (dBc)	<–46	<–46	<–40	<–40

1 Typically, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V rms.
2 When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level.
3 Coherent carrier is modulated by FM or FM when enabled.

Burst Envelope

On/Off Ratio: V_{IN}: ≤–1.05 V
≤3 GHz: > 75 dB
>3 GHz: > 60 dB
Rise/Fall Time: <2 µs, typical
Minimum Burst Rate:
ALC On: 10 Hz, typical
ALC Off: DC
External Input: Ext 1
Input Impedance: 50Ω
Input Voltage
RF Off:–1.0 V
RF On: 0 V

Coherent Carrier Out3

Range: 250 MHz to maximum carrier frequency
Level: 0 dBm ± 5 dB, typical
Impedance: 50Ω

For more information, visit our web site: **http://www.hp.com/go/esg**

Optional Real-Time I/Q Baseband Generator (Opt UN8) NEW

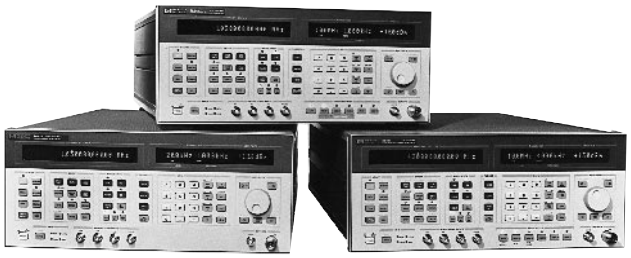
Modulation Formats
PSK: BPSK, QPSK, OQPSK, ≠ 4DQPSK, 8PSK, 16PSK, D8PSK
MSK: User-defined phase offset
QAM: 4, 16, 32, 64, 256
FSK: Symmetric 2, 4, 8, 16
Custom FSK: User-defined asymmetric
Custom I/Q: Map of 16 unique values for I and Q
Filters: Nyquist, Root Nyquist, Gaussian, Custom FIR
Filter Rate: a: 0 to 1; BT 0.1 to 1
Symbol Rate: Adjustable up to 12 Msymbols/sec
Data Structure: Frames and timeslots may be configured as different types of traffic or control channels. The data field of a timeslot can accept user file, PRBS or external data with the appropriate clock.
Internal Data
Pseudo-Random Patterns: Continuous PN9, PN11, PN15, PN20 or PN23
Repeating Sequence: Any 4-bit sequence
Downdoadable Data
Maximum Size (Pattern RAM): 1 Mbits, 8 Mbits (Option UN9)
Maximum Size (User File): 128 kbytes
External Data
Inputs: Data, bit/symbol clocks (accepts rates ± 5% of specified data rate)
Reference Frequency: Internal or external 1, 2, 5, 10 MHz reference. Data clock can be locked to an external 13 MHz GSM reference
Frame Trigger Delay Control
Range: 0 to 65,535 bits
Resolution: 1 bit
Internal Burst Shape Control
Rise/Fall Time Range: Up to 30 bits
Rise/Fall Delay Range: 0 to 63.5 bits (varies w/standard)
I/Q Outputs
EVM (NADC, PDC, PHS, TETRA): 1% rms
Global Phase Error (GSM): 0.75° rms
Deviation Accuracy (DECT): 1 kHz

	NADC		PDC		PHS		TETRA[5]		DECT	GSM (DCS, PCS)
Error Vector Magnitude[4] (% rms)	**Cont.**	**Burst**	**Cont.**	**Burst**	**Cont.**	**Burst**	**Cont.**	**Burst**		
Low EVM Mode	0.7	1.4	0.9	1.3	0.9	0.9	0.8	1.7	N/A	N/A
Low EVM Mode (typical)	0.4	1.1	0.6	0.9	0.6	0.7	0.5	1.3	N/A	N/A
Low ACP Mode (typical)	1.0	1.4	0.8	1.0	0.9	0.9	0.9	1.5	N/A	N/A
Global Phase Error[4] (rms/pk)	N/A		N/A		N/A		N/A		N/A	0.6° / 2.2° 0.3° / 1.3°(typ.)
Deviation Accuracy[4] (kHz)	N/A		N/A		N/A		N/A		3 (2, typ)	N/A
Adjacent Channel Power[4] (ACP) (Low ACP Mode dBc, typical)	**Cont.**	**Burst**	**Cont.**	**Burst**	**Cont.**	**Burst**	**Cont.**	**Burst**	**N/A**	**Cont.** **Burst**
at Adjacent Channel[6]	–35	–34	—	—	—	—	–69[7]	–64	N/A	–37 –37
at 1st Alternate Channel[6]	–80	–78	–74	–72	–80	–78	–80	–78	N/A	–72 –71
at 2nd Alternate Channel[6]	–82	–81	—	—	–80	–79	–81	–80	N/A	–82 –80
at 3rd Alternate Channel[6]	–84	–83	–81	–79	—	—	–81	–80	N/A	–82 –81
Supported Burst Types	Custom, Up/Down TCH		Custom, Up/Down TCH, Up Vox		Custom, TCH, Sync		Custom, Up Control 1 & 2, Up Normal, Down Normal, Down Sync		Custom, Dummy B 1 & 2, Traffic B, Low Capacity	Custom, Normal, FCorr, Sync, Dummy, Access
Scramble Capabilities	—		—		Yes		Yes		—	—

[4]Specifications apply for the frequency range, symbol rates, root raised cosine filter, filter factors (∝ or B_bT) and default scaling factor specified for each standard, and at power levels ≤ + 7 dBm (≤ 4 dBm for TETRA), (≤ + 10 dBm for Option UNB).
[5]ACP for TETRA is measured over a 25 kHz bandwidth, with an 18 kHz root raised cosine filter applied at power levels ≤ 4 dBm (≤ +8 dBm for Option UNB).
[6]The "channel spacing" determines the offset size of the adjacent and alternate channels: Adjacent Chan. offset = 1 x channel spacing, 1st Alt. Chan. = 2 x channel spacing, 2nd Alt. Chan. = 3 x channel spacing, etc.
[7]TETRA ACP performance is typically –72 dBc with Option H99 in continuous modulation mode.

HP 8643A
HP 8644B
HP 8664A
HP 8665A
HP 8665B

- Frequency ranges of 1 GHz, 2 GHz, 3 GHz, 4.2 GHz, or 6 GHz
- Lowest overall noise and spurious
- AM, FM, and pulse modulation
- Lowest specified leakage (optional)
- Internal modulation source for complex waveforms
- Onsite repair and calibration



HP 8643A, 8644B, 8665B

These signal generators offer RF designers and manufacturers a selection of frequency range and high performance. The HP 8643A, 8644B, and 8664A are for traditional out-of-channel receiver test applications. The HP 8665A/B are for high-performance applications up to 6 GHz, particularly radar, telemetry and spurious testing of UHF receivers. All signal generators within this performance family have options that allow them to be configured to meet specific application needs.

HP 8643A 1 GHz/2 GHz Signal Generator

HP has optimized the HP 8643A's configuration with the performance necessary for out-of-channel receiver tests while maintaining a low price. Options have been limited on the HP 8643A, but many performance/feature capabilities have been included as standard.

Standard Electronic Attenuator and Advanced Modulation Source

Reliability is enhanced by the use of an electronic attenuator on the 1 GHz version. Instead of using mechanical relays for setting levels, the HP 8643A uses solid-state components accurate to within ±1.0 dB. The HP 8643A comes standard with an advanced internal modulation synthesizer that provides coverage to 400 kHz and two-tone capability with the selection of sine, square, sawtooth, and white Gaussian noise waveforms.

HP 8644B 1 GHz/2 GHz High-Performance Signal Generator

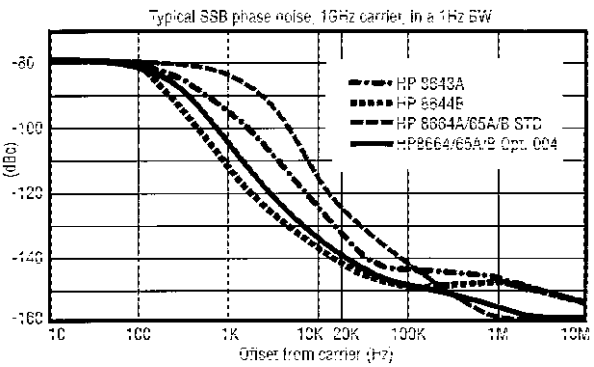
The HP 8644B represents the highest overall performance in HP's line of 1 GHz and 2 GHz signal generators. The HP 8644B builds on the HP 8643A's performance by lowering SSB phase noise (–136 dBc/Hz versus –130 dBc/Hz) and lowering spurious (–105 dBc versus –100 dBc). The HP 8644B can be used either for specific tests that require the lowest SSB phase noise or for applications with diversified performance requirements.

HP 8664A 3 GHz, HP 8665A 4.2 GHz and HP 8665B 6 GHz High-Performance Signal Generators

These three signal generators offer identical performance except for frequency coverage and price. Your application will dictate which instrument is required. The HP 8664A and HP 8665A/B are suited for out-of-channel receiver measurements through the use of Option 004 (low-noise enhancement) and for such applications as radar testing through the use of Option 008 (pulse modulation).

Wideband FM and Optional Pulse Modulation

FM rates of up to 2 MHz and deviations to 20 MHz peak are suitable for many applications such as higher-rate digital communications. An optional pulse modulator with on/off ratio of > 80 dB and rise/fall times of < 5 ns is available. Pulse width and delay can be internally adjusted between 50 ns and 999 ms, eliminating the need for an external pulse generator.



Typical SSB Phase Noise, at 1 GHz Carrier, in a 1 Hz BW

Specifications

	HP 8643A	HP 8644B	HP 8664A; HP 8665A/B
Frequency			
Range	0.252 to 1030 MHz 0.252 to 2060 MHz (Option 002)	0.252 to 1030 MHz 0.252 to 2060 MHz (Option 002)	0.1 to 3000 MHz (HP 8664A) 0.1 to 4200 MHz (HP 8665A) 0.1 to 6000 MHz (HP 8665B)
Resolution	0.01 Hz	0.01 Hz	0.01 Hz
Accuracy	Timebase stability x f_c	Timebase stability x f_c	Timebase stability x f_c
Switching speed (typical)	< 90 ms; < 200 ms with FM on	< 350 ms	< 100 ms (Option 004)

Internal Reference Oscillator

Output: 10 MHz, > 0.15 V_{rms} into 50 Ω; (Option 001) > I V_{rms} into 50 Ω

Timebase Stability

	Standard Timebase	High Stability (Opt. 001)
Aging Rate:	1.5×10^{-8}/day	3×10^{-10}/day
Temperature Effects:	7×10^{-10}	6×10^{-10}
Line Voltage Effects:	2×10^{-10}	1×10^{-10}

Specifications, cont'd

	HP 8643A	HP 8644B	HP 8664A; HP 8665A/B
Spectral Purity			
SSB phase noise @ 1 GHz (20 kHz offset)	–130 dBc/Hz	–136 dBc/Hz	–117 dBc/Hz; –134 dBc/Hz (Option 004)
Nonharmonics: (>10 kHz offset)	< –100 dBc, 0.252 to 1030 MHz < –94 dBc, 1030 to 2060 MHz	< –105 dBc, 0.252 to 1030 MHz < –100 dBc, 1030 to 2060 MHz	< –100 dBc, 187.5 to 2060 MHz < –90 dBc, 2060 to 6000[1] MHz, 0.1 to 187.5 MHz
Harmonics < –30 dBc, output ≤ +8 dBm (with Option)		< –25 dBc, output ≤ +10 dBm	< –30 dBc, output ≤ +10 dBm
Subharmonics	None, 0.252 to 515 MHz < –52 dBc, 515 to 1030 MHz < –40 dBc, 1030 to 2060 MHz	None, 0.252 to 515 MHz < –52 dBc, 515 to 1030 MHz < –40 dBc, 1030 to 2060 MHz	< –75 dBc, 0.1 to 1500 MHz < –40 dBc, 1500 to 3000 MHz < –50 dBc, 3000 to 6000 1 MHz
Residual FM @ 1 GHz: 0.3 to 3 kHz post det. BW	< 2 Hz rms	<1 Hz rms	< 7.5 Hz rms; <1.2 Hz rms (Option 004)
Output Level			
Range	+ 13 to –137 dBm	+ 16 to –137 dBm, + 13 dBm (Option 002, 005)	+ 13 to –139.9 dBm, + 9 dBm (Option 008)
Resolution	0.1 dB	0.1 dB	0.1 dB
Absolute accuracy	± 1 dB, output ≥ –127 dBm	± 1 dB, output ≥ –127 dBm	± 1 dB, output ≥ –119.9 dBm, 1 to 1000 MHz ± 1.5 dB, output ≥ –119.9 dBm, 1000 to 3000 MHz ± 2 dB, output ≥ –119.9 dBm, > 3000[1] MHz, < 1 MHz
Reverse power protection	50 W	50 W	25 W[2], 0.1 to 2060 MHz; 1 W, > 2060[1] MHz
Amplitude Modulation			
Depth: (@ ≤ + 7 dBm)	0 to 100%	0 to 100%	0 to 100%
Resolution	0.1%	0.1%	0.1%
Bandwidth (3 dB) ≤ + 7 dBm	dc to 100 kHz, 128 MHz < f_c < 1030 MHz	dc to 100 kHz, 128 MHz < f_c < 1030 MHz	dc to > 10 kHz, > 10 MHz
Accuracy: 1 kHz rate	± (7% of setting + 1%) up to 80% depth	± (7% of setting + 1%) up to 80% depth	± (6% of setting + 1%) up to 90% depth
Distortion: 30% depth, 1 kHz rate	< 2%; < 4% (Option 002)	< 2%; < 4% (Option 002)	< 4%
Frequency Modulation			
Maximum peak deviation (Deviation halves per lower octave)	2 MHz, 1030 to 2060 MHz; 1 MHz, 515 to 1030 MHz	20 MHz/200 kHz[3], > 1030 MHz; 10 MHz/100 kHz[3], > 515 MHz	20 MHz, 3000 to 6000[1] MHz; 10 MHz, 1500 to 3000 MHz
Resolution	2.5% of setting	2.5% of setting	2.5% of setting
Bandwidth (3 dB)	dc to 100 kHz	dc to 100 kHz	dc to 800 kHz
Carrier accuracy in FM	± 0.5% of setting	± 0.5% of setting	± 0.6% of setting
Indicator accuracy	< 5%, < 30 kHz rate; < 10%, < 100 kHz rates	< 5%, < 30 kHz rates; < 10%, < 100 kHz rates	± 9%, < 20 kHz rates
Distortion	< 5%, 20 Hz to 100 kHz rates	< 5%, 20 Hz to 100 kHz rates	< 1%, 20 Hz to 20 kHz rates
Pulse Modulation			**Option 008**
On/off ratio	> 50 dB; > 80 dB, > 1030 MHz	> 35 dB; > 80 dB, > 1030 MHz	> 80 dB
Rise/fall time, 10 to 90%	< 100 ns	< 100 ns	< 8 ns
Repetition rate	dc to 1 MHz	dc to 1 MHz	dc to 10 MHz
Internal width/delay	N/A	N/A	Variable, 50 ns to 1s
Internal Modulation Source			
Waveforms and rates	Sine; white Gaussian noise (0.1 Hz to 400 kHz); Triangle, sawtooth, square (0.1 Hz to 50 kHz)		
Frequency accuracy	Same as timebase		
Output level (into 600 Ω)	1 V pk, 2 V pk for HP 8643A and 8644B		
Output resolution	2 mV pk		
Frequency Sweep			
Digital sweep	Digitally stepped sweep over entire frequency range. Linear/log selection. 0.5 to 1000 s sweeps.		
Markers/Z-axis output	3 markers available/Z-axis output nominally + 5 V/X-axis output nominally 0 to 10 V		
Phase continuous sweep	40 MHz of span available at maximum carrier frequency. 20 ms to 10 s sweep times.		
Remote Programming			
Interface	GPIB (IEEE 488.2-1987)		
Control language	Hewlett-Packard Systems Language (HP-SL). All functions controlled except power.		
IEEE-488 functions	SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2		
General			
Power requirements	± 10% of 100 V, 120 V, 220 V, or 240 V; 48 to 440 Hz; 500 VA (except HP 8643A/44B: 400 VA)		
Operation temperature	0° to 55° C		
Leakage	Conducted and radiated interference meets MIL-STD-461B RE0 <None> 2 and FTZ 1046		
Calibration interval	Recommended 3 years (MTBC)		
Weight	HP 8643A: 23 kg (50 lb). HP 8644B: 30 kg (67 lb). HP 8664A/65A/B: 35 kg (78 lb).		
Size	177 mm H x 426 mm W x 624 mm D (7 in x 16.8 in x 24.6 in). Option 010 adds 35 mm (1.4 in) to D.		

[1] 3000 MHz for HP 8664A, 4200 MHz for HP 8665A, 6000 MHz for HP 8665B
[2] N/A to HP 8665B
[3] Low-noise mode

Ordering Information

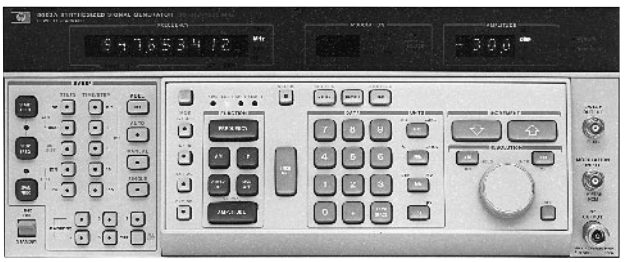
	HP 8643A	HP 8644B	HP 8664A	HP 8665A	HP 8665B
Options					
001 High-Stability Timebase					
002 2 GHz Doubled Output					
004 Low-Noise Option					
005 Electronic Attenuator (N/A with Option 002)					
008 Pulse Modulation					
009 Specified VOR/ILS[2]					
011 2 GHz Internal Frequency Counter					
Service Kit	(08645-61116)	(08645-61116)	(08665-61116)	(08665-61116)	(08665-61116)
003 Rear-Panel Input/Output					
010 Reduced-Leakage Configuration					
W30 Add 3 Years to Return Warranty					
907 Front-Handle Kit (5062-3990)	🚚	🚚	🚚	🚚	
908 Rack Flange Kit (5062-3978)	🚚	🚚	🚚	🚚	🚚
909 Combined Front/Rack Flange Kit (5061-9684)					

[1] See Specifications
[2] Not compatible with Options 002 or 005

🚚 Indicates QuickShip availability.

HP 8662A
HP 8663A

- 10 kHz to 1280 MHz frequency range
- < – 147 dBc/Hz SSB phase noise at 10 kHz offset
- 0.1 Hz frequency resolution



HP 8662A

- 100 kHz to 2560 MHz frequency range
- AM/FM/ΦM/pulse in one generator
- Internal variable modulation oscillator

HP 8663A

HP 8662A/HP 8663A Synthesized Signal Generators

Spectral purity is the key contribution of both the HP 8662A and 8663A, making them ideal for many radar, satellite communication, and phase noise measurement applications. Typical absolute phase noise performance of these generators at a 1 kHz offset is as low as –135 dBc/Hz, depending on the band of operation.

The frequency range of the HP 8662A is 10 kHz to 1280 MHz. It offers versatile AM/FM, using either internal 400 Hz and 1 kHz rates or externally applied modulating signals which can be either ac- or dc-coupled. It also has simultaneous modulation capability.

The HP 8663A and 8662A provide the U.S. Air Force MATE (Modular Automatic Test Equipment) capability, via Option 700. This option is an external translator that allows the signal generator to be controlled by the MATE language CIIL (Control Interface Intermediate Language).

HP 8662A Specifications

Frequency

Range: 10 kHz to 1280 MHz (1279.9999998 MHz)
Resolution: 0.1 Hz (0.2 Hz above 640 MHz)
Accuracy and Stability: Same as reference oscillator
Internal Reference Oscillator: 10 MHz quartz oscillator. Aging rate < 5 x 10^{-10}/day after 10-day warmup (typically 24 hrs. in normal operating environment).

Spectral Purity

Front-Panel Absolute SSB Phase Noise (dBc/Hz):

	Frequency range (MHz)					
	0.01 to 119.9[1]		120 to 159.9[2]		160 to 319.9[2]	
	Spec	Typ	Spec	Typ	Spec	Typ
1 Hz	– 68	– 78	– 66	– 76	– 60	– 70
10 Hz	– 98	– 108	– 96	– 106	– 90	– 100
100 Hz	– 116	– 126	– 115	– 125	– 109	– 119
1 kHz	– 126	– 132	– 129	– 135	– 124	– 130
3 kHz	– 126	– 135	– 129	– 138	– 124	– 133
5 kHz	– 128	– 138	– 131	– 141	– 126	– 136
10 kHz	– 132	– 138	– 142	– 148	– 136	– 142
100 kHz	– 132	– 139	– 142	– 148	– 136	– 142

	Frequency range (MHz)					
	320 to 639.9[2]		640 to 1279.9[3]		1280 to 2559.9[4]	
	Spec	Typ	Spec	Typ	Spec	Typ
1 Hz	– 54	– 64	– 48	– 58	– 42	– 52
10 Hz	– 84	– 94	– 78	– 88	– 72	– 82
100 Hz	– 103	– 114	– 97	– 108	– 92	– 102
1 kHz	– 118	– 125	– 112	– 119	– 106	– 113
3 kHz	– 118	– 127	– 112	– 121	– 106	– 115
5 kHz	– 120	– 130	– 114	– 124	– 108	– 118
10 kHz	– 131	– 136	– 124	– 130	– 118	– 124
100 kHz	– 131	– 136	– 124	– 130	– 118	– 124

Residual SSB Phase Noise (dBc/Hz):

	Frequency range (MHz)					
	0.01 to 119.9[1]		120 to 159.9[2]		160 to 319.9[2]	
	Spec	Typ	Spec	Typ	Spec	Typ
10 Hz	– 108	– 114	– 112	– 119	– 106	– 113
100 Hz	– 121	– 126	– 122	– 129	– 118	– 124
1 kHz	– 128	– 133	– 131	– 138	– 127	– 134
3 kHz	– 128	– 136	– 131	– 139	– 127	– 135
5 kHz	– 129	– 138	– 133	– 141	– 129	– 136
10 kHz	– 132	– 137	– 142	– 147	– 136	– 142
100 kHz	– 132	– 137	– 142	– 147	– 136	– 142

	Frequency range (MHz)					
	320 to 639.9[2]		640 to 1279.9[3]		1.28 to 2559.9[4]	
	Spec	Typ	Spec	Typ	Spec	Typ
10 Hz	– 100	– 107	– 93	– 101	– 88	– 95
100 Hz	– 112	– 119	– 105	– 112	– 100	– 106
1 kHz	– 121	– 128	– 115	– 122	– 109	– 116
3 kHz	– 121	– 129	– 115	– 123	– 109	– 117
5 kHz	– 123	– 130	– 117	– 124	– 111	– 118
10 kHz	– 131	– 136	– 124	– 130	– 118	– 124
100 kHz	– 131	– 136	– 124	– 130	– 118	– 124

[1] HP 8663A band begins at 0.1 MHz; specifications extend up to and including 119.9999999 MHz.
[2] Specifications extend up to and including 0.1 Hz less than the starting frequency of the next band.
[3] Specifications extend up to and including 1279.9999998 MHz.
[4] This band available on HP 8663A only; specifications extend up to and including 2559.9999996 MHz.

Option 003 Specified SSB Phase Noise for Rear-Panel 640 MHz Output:

	Spec	Typ
1 Hz	– 54	–64
10 Hz	– 84	–94
100 Hz	– 104	–114
1 kHz	– 121	–126
3 kHz	– 121	–127
5 kHz	– 129	–138
10 kHz	– 145	–149
100 kHz	– 157	– 159

SSB Broadband Noise Floor in 1 Hz BW at 3 MHz Offset From Carrier: < –146 dBc for fc between 120 and 640 MHz at output levels above +10 dBm.

HP 8662A
HP 8663A

Spurious Signals:

	Frequency Range (MHz)				
	0.01 to 120	**120 to 160**	**160 to 320**	**320 to 640**	**640 to 1280**
Spurious non-harmonically related[1,2]	–90 dBc	–100 dBc	–96 dBc	–90 dBc	–84 dBc
Sub-harmonically related $\left(\frac{1}{2}, \frac{3f}{2}, \text{'etc.}\right)$	none	none	none	none	–75[3] dBc
Power-line (60 Hz) related or microphonically generated (within 300 Hz)[4]	–90 dBc	–85 dBc	–80 dBc	–75 dBc	–70 dBc
Harmonics	< –30 dBc				

Output

Level Range: +13 to –139.9 dBm (1V to 0.023 μV_{rms} into 50 Ω)
Resolution: 0.1 dB
Absolute Level Accuracy: (+15° to +45° C): ±1 dB between +13 and –120 dBm; ± 3 dB between –120 and –130 dBm
SWR: Typically from 1.5 to 1.8, depending on output level and frequency
Reverse Power Protection: Typically up to 30 W or ± 8 Vdc

Amplitude Modulation

Depth: 0 to 95% at output levels of +8 dBm and below (+10 dBm in uncorrected mode). AM available above these output levels but not specified.
Resolution: 1%, 10 to 95% AM; 0.1%, 0 to 9.9% AM
Incidental PM: (at 30% AM): 0.15 to 640 MHz, < 0.12 radian peak; 640 to 1280 MHz, < 0.09 radian peak
Incidental FM: (at 30% AM): 0.15 to 640 MHz, < 0.12 x f_{mod}; 640 to 1280 MHz, < 0.09 x f_{mod}
Indicated Accuracy: ± 5% of reading ± 1% AM. Applies for rates given in table below, internal or external mode, for depths ≤ 90%.

Rates and Distortion with Internal or External Modulating Signal:

		AM Distortion		
Frequency Range	**AM Rate**	**0 to 30% AM**	**30 to 70% AM**	**70 to 90% AM**
0.15 to 1 MHz	dc to 1.5 kHz	2%	4%	5.75%
1 to 10 MHz	dc to 5 kHz	2%	4%	5.75%
10 to 1280 MHz	dc to 10 kHz	2%	4%	5.75%

Frequency Modulation

FM Rates: (1 dB bandwidth): External ac, 20 Hz to 100 kHz; external dc, dc to 100 kHz
FM Deviation: 25 to 200 kHz, depending on carrier frequency
Indicated FM Accuracy: ± 8% of reading plus 10 Hz (50 Hz to 20 kHz)
FM Resolution: 100 Hz for deviations < 10 kHz, 1 kHz for deviations ≥ 10 kHz
Incidental AM: (AM sidebands at 1 kHz rate and 20 kHz deviation): < –72 dBc, f_c < 640 MHz; < –65 dBc, f_c ≥ 640 MHz
FM Distortion: < 1.7% for rates < 20 kHz, < 1% for rates < 1 kHz
Center Frequency Accuracy and Long-Term Stability in AC Mode: Same as CW mode

Supplemental Characteristic

Frequency-Switching Speed:[5] From 420 µs to 12.5 ms, depending on the programming mode

HP 8663A Specifications

The HP 8663A signal generator is related to the HP 8662A in both concept and structure. Like the HP 8662A, the HP 8663A is an extremely low phase noise signal source, incorporating signal generator modulation capabilities and output characteristics. The HP 8663A also offers increased frequency range to 2560 MHz, increased output level to +16 dBm, and the addition of phase and pulse modulation while maintaining high spectral purity. The result is a highly flexible and powerful signal generator that uses and extends the proven circuitry of the HP 8662A. Thus, the HP 8662A and HP 8663A share many of the same specifications.

Frequency

Range: 100 kHz to 2560 MHz (2559.9999996 MHz)
Resolution: 0.1 Hz (f_c < 640 MHz);
0.2 Hz (640 MHz to 1280 MHz);
0.4 Hz (f_c ≥ 1280 MHz)
Accuracy, Stability, and Internal Reference Oscillator: Identical to HP 8662A

Spectral Purity

(See HP 8662A specifications)
Spurious Signals: Identical to HP 8662A, except that for f_c between 1280 and 2560 MHz the spurious non-harmonics are –78 dBc; the sub-harmonically related (f/2, 3f/2, etc.) between 640 and 1280 MHz are –70 dBc and between 1280 and 2560 MHz are –40 dBc; and the power-line (60 Hz) or microphonically generated spurious are –65 dBc.
Harmonics: < –30 dBc, ≤ + 13 dBm output; < –25 dBc, + 13 dBm to + 16 dBm output, f_c < 1280 MHz; < –25 dBc, f_c ≥ 1280 MHz

Output

Level Range: + 16 dBm to –129.9 dBm
Resolution: 0.1 dB
Absolute Level Accuracy: (+ 15° to + 45° C): ± 1 dB, + 16 dBm to –119.9 dBm; ± 3 dB, –120 dBm and below
SWR: < 1.5

Amplitude Modulation

Depth: 0 to 95% at levels of + 10 dBm and below
Resolution: 0.1%
Incidental FM: (at 30% AM): Identical to HP 8662A except: < 0.3 x f_{mod} for 1280 ≤ f_c < 2560 MHz
Indicated Accuracy: ± 6% of reading ± 1% AM (400 Hz and 1 kHz, depth 90%)
AM Bandwidth: (1dB): dc to > 1.5 kHz, 0.15 MHz ≤ f_c < 1 MHz; dc to > 5 kHz, 1 MHz ≤ f_c ≤ 10 MHz; dc to > 10 kHz, f_c > 10 MHz: external dc coupling. External ac coupling or internal; low-frequency coupling is 20 Hz.
Distortion: (400 Hz and 1 kHz): < 2% (0 to 30% AM); < 3% (30 to 70% AM); < 4% (70 to 90% AM)

Frequency Modulation

FM Rates: (1 dB bandwidth): External ac, 20 Hz to 100 kHz, external dc, dc to 100 kHz
Maximum Allowable Peak Deviation: Identical to HP 8662A for f_c between 100 kHz and 1280 MHz. Up to 400 kHz for f_c between 1280 and 2560 MHz.
Indicated FM Accuracy: (50 Hz to 20 kHz): ± 7% of setting +10 Hz
FM Resolution: 100 Hz to 1 kHz, depending on f_c and deviation setting
Incidental AM: (AM sidebands at 1 kHz rate and 20 kHz deviation): < –72 dBc (10 ≤ f_c < 2560 MHz)
FM Distortion: < 1% (400 Hz and 1 kHz rates); < 1.7% (rates less than 20 kHz)

[1] In the remote mode it is possible to have microprocessor clock-related spurious signals spaced 3 MHz apart at an absolute level of typically less than –145 dBm.
[2] Spurious signals can be up to 3 dB higher in the dc FM mode.
[3] f/2 spurs not specified for carrier frequencies above 850 MHz.
[4] At a 50 Hz line frequency, power-line or microphonically-related spurious signals may be up to 3 dB higher and appear at offsets as high as 1 kHz from the carrier.
[5] Due to automatic leveling loop bandwidth changes, brief (30 ms) level inaccuracies may occur when switching through 150 kHz and 1 MHz RF output frequencies.

Phase Modulation (Option 002)

Maximum Peak Phase Deviation: From ± 25° for f_c between 120 and 160 MHz to ± 400° for f_c between 1280 and 2560 MHz
Maximum Rate: From 10 kHz for f_c between 0.15 and 10 MHz to 10 MHz for f_c between 640 and 2560 MHz
Phase Deviation Resolution: 1° (0.1 ≤ f_c < 640 MHz); 2° (640 ≤ f_c < 1280 MHz); 4° (1280 ≤ f_c < 2560 MHz)
Phase Modulation Distortion: 10% at maximum rate

Biphase Modulation (BPSK)

Biphase modulation is available on the standard HP 8663A for f_c less than 640 MHz and available for all f_c with Option 002.
Deviation: ± 90°
Carrier Null when Modulated with 1 MHz, 50% Duty Cycle Square Wave: > 25 dBc
Modulation Input Required: TTL positive true. The internal modulation oscillator can be used for 50% duty-cycle modulation. External input is on rear panel.

Pulse Modulation[1]

Pulse On/Off Ratio: > 80 dB (50 to 2560 MHz)
Pulse Rise/Fall Time: < 250 ns (50 to 120 MHz); < 800 ns (120 to 640 MHz); < 100 ns (f_c ≥ 640 MHz)
Pulse Repetition Frequency (50% duty cycle):
Internal: 10 Hz to 99.9 kHz
External: 10 Hz to 2 MHz, 50 MHz < f_c < 640 MHz; 10 Hz to 5 MHz, f_c > 640 MHz
Internal Modulation Oscillator
Rates: 10 Hz to 99.9 kHz
Frequency Resolution: 3 digits
Frequency Accuracy: Same as reference oscillator
Output Level (available on rear panel): 1 V peak into 600 Ω
Output Impedance: 600 Ω
Flatness (referenced to 1 kHz): < ± 1%
Distortion: < 1%

Other HP 8662A and HP 8663A Information

Remote Programming: The GPIB interface is standard on the HP 8662A and HP 8663A signal generators. All functions controlled from the front panel, with the exception of the line switch, are programmable with the same accuracy and resolution as in manual mode.
Operating Temperature Range: 0° to + 55° C
Leakage: Meets radiated and conducted limits of MIL-STD-461A methods RE02 and CE03 as well as BVDE 0871
Power Requirements: 115 (90 to 126) V or 230 (198 to 252) V; 48 to 66 Hz; 450 VA max
Size:
HP 8662A: 425 mm W x 178 mm H x 572 mm D (16.75 in x 7 in x 22.5 in)
HP 8663A: 425 mm W x 178 mm H x 642 mm D (16.75 in x 7 in x 25.3 in)
Note: depth includes front panel depth of 45 mm (1.75 in).
Weight: HP 8662A: net, 30 kg (65.5 lb); shipping, 36 kg (80 lb)
HP 8663A: net, 33.8 (74 lb); shipping, 40 kg (88 lb)

Key Literature

Synthesized Signal Generator 10 kHz to 1280 MHz
Technical Data, p/n 5953-8402
Synthesized Signal Generator 100 kHz to 2.56 GHz
Technical Data, p/n 5953-8376

Ordering Information — Price

HP 8662A 1280 MHz Signal Generator[2]
Opt 001 RF Connectors on Rear Panel Only
Opt 003 Specified SSB Phase Noise for 640 MHz Output
Opt 907 Front Handle Kit (5062-3990)
Opt 908 Rack Flange Kit (5062-3978)
Opt 909 Rack Flange Kit w/Front Handles(5062-3984)
Opt 910 Two Sets of Operating and Service Manuals (08662-90069)
Opt W30 Extended Repair Service (see page 70)
Opt W32 Calibration Service (see page 70)

HP 11721A

HP 8663A 2560 MHz Signal Generator[2]
Opt 001 RF Connectors on Rear Panel Only
Opt 002 Wideband Linear Phase Modulation
Opt 003 Specified SSB Phase Noise for 640 MHz Output
Opt 907 Front Handle Kit (5061-9690)
Opt 908 Rack Flange Kit (5061-9678)
Opt 909 Rack Flange Kit w/Front Handles (5061-9684)
Opt 910 Additional Operation and Calibration Manual (08663-90069) and Service Manuals (08663-90071)
Opt 915 Add Service Manual (08663-90071)
Opt W30 Extended Repair Service (see page 70)
Opt W32 Calibration Service (see page 70)
HP 11714A Service Support Kit (required for servicing HP 8662A/8663A)

[1] Pulse modulation is available for f_c < 50 MHz but is unspecified.
[2] GPIB cables not supplied. For description and price, see page 568.

Indicates QuickShip availability.

HP 11721A Frequency Doubler

The HP 11721A doubler is an ideal accessory for extending the usable frequency range of signal generators, frequency synthesizers, or other signal sources. Operating on input frequencies of 50 MHz to 1300 MHz, it provides a doubled output in the range of 100 MHz to 2600 MHz. The HP 11721A will work well with any RF source with an output in the range of 50 to 1300 MHz.

The 50 Ω passive circuit of the HP 11721A offers low conversion loss, low spurious, and excellent flatness over its entire frequency range when operated above +10 dBm.

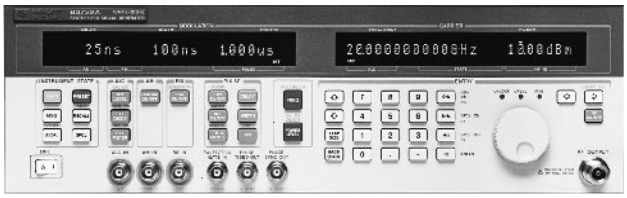
HP 11721A Specifications

Input Frequency Range: 50 to 1300 MHz
Output Frequency Range: 100 to 2600 MHz
Conversion Loss (+13 dBm input, 50 to 1280 MHz): < 15 dB
Spurious Referenced to Desired Output Frequency f:
(+ 13 dBm input with harmonics < – 50 dBc, 50 to 1280 MHz):
f/2, –15 dB; 3f/2, –15 dB
Input SWR: 1.5 typical
Input/Output Impedance: 50 Ω nominal
Operating Temperature Range: 0° to 50° C
Connectors: Input, type-N male; output, type-N female
Size: 161 mm L x 30 mm W x 20.5 mm H (6.38 in x 1.19 in x .19 in)
Weight: Net, .02 kg (0.5 lb); shipping, 0.4 kg (1 lb)

Ordering Information

HP 11721A Frequency Doubler
Opt W30 Extended Repair Service (see page 584)

HP 83711B
HP 83712B
HP 83731B
HP 83732B



Typical single-sideband phase noise at 50 MHz, 1 GHz and 20 GHz, 25° C, CW mode. Offsets less than 100 Hz require the high stability timebase, Option 1E5.

HP 83711B/12B and HP 83731B/32B Signal Sources

The HP 83711B/12B synthesized CW generators and HP 83731B/32B synthesized signal generators set new standards for performance at prices that are surprisingly affordable. No longer will you have to give up frequency coverage, modulation, or reliability to meet your budget. These signal sources will perform beyond your expectations at a price within your reach.

Clean Signals with Plenty of Power

Choose the HP 83711B/83731B, 1 to 20 GHz, or the HP 83712B/ 83732B, 10 MHz to 20 GHz, for your receiver and system test applications. Fundamental oscillators and switched low-pass filters deliver < –55 dBc harmonics, eliminate subharmonics, and suppress spurious to < –60 dBc. These signal sources provide plenty of output power (typically > + 14 dBm), while spectral purity is maintained even at high power levels (typical output power at frequencies below 1 GHz is + 20 dBm). These signal sources deliver >100 dB dynamic range. Level resolution is 0.01 dB with typical accuracy of ± 1.0 dB at any frequency or power level. User Level Correction simplifies generating accurate, leveled power at distant test ports.

HP 83731B and HP 83732B Provide Unmatched Modulation Performance

Sophisticated modulation lets you simulate real-world signals. Test state-of-the-art radar and EW receivers with high-fidelity pulse modulation. < 10 ns pulse rise/fall times, < 25 ns pulse width, and > 80 dB pulse on/off ratio give you the performance you need to verify modern receivers. A built-in multimode pulse generator adds the flexibility to generate triggered, doublet and gated burst pulse modes.

In addition, logarithmic and linear AM is a standard feature in the HP 83731B/32B. Use the > 60 dB depth log AM and the fast pulse modulation simultaneously (scan modulation) for accurate simulation of antenna scanning patterns, or sweep power linearly and accurately to test power-sensitive devices.

The HP 83731B/32B offer unmatched performance for testing satellite communications and telemetry receivers. 10 MHz peak FM and optional 100 radians peak phase modulation deviations, combined with the highest-modulation index available (> 300 for FM), simplify simulation of these difficult-to-generate signals. The HP 83731B/32B remain fully synthesized even at high-modulation indices, eliminating the troublesome frequency drift of other signal sources.

Real-world signals often combine two or more modulations. The HP 83731B/32B let you use all three modulations simultaneously with optional independent internal modulation generator without any degradation in performance. FM and phase modulation cannot be applied simultaneously.

Versatile and Reliable

The HP 83711B/12B and HP 83731B/32B signal sources are the recommended local oscillators for the HP 8970B noise figure meter. Low broadband noise minimizes errors in measurements of low gain devices. Use these signal sources with the HP 83550 series millimeter-wave modules to generate signals to 110 GHz. All front-panel functions are completely GPIB-programmable and SCPI-compatible.

These signal sources are designed to remain within factory specifications for the entire life of the instrument. The recommended two-year performance verification cycle minimizes downtime and cost of ownership. If a unit ever drifts, automated adjustment routines can be run to return the unit to factory performance in less than six hours. Extensive use of surface-mount technology and a minimum number of adjustments combine to deliver an estimated MTBF of more than 20,000 hours. Built-in functional verification routines speed servicing.

Key Literature

HP 83711B/12B and HP 83731B/32B Technical Data Sheet, p/n 5963-6615E

Specifications

Frequency Characteristics
Frequency Range:
HP 83711B, 1.0 to 20 GHz
HP 83712B, 10 MHz to 20 GHz
HP 83731B, 1.0 to 20 GHz
HP 83732B, 10 MHz to 20 GHz
Frequency Resolution: 1 kHz, 1 Hz with Option 1E8

Internal Reference Oscillator

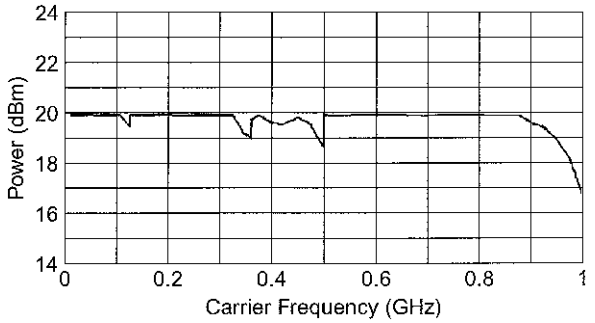
Frequency: 10 MHz
Timebase Stability:

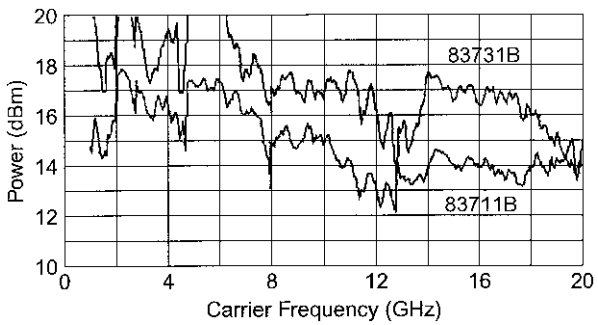
	Standard Timebase	Option 1E5
Aging Rate	< 1.0×10^{-8}/day	< 1.5×10^{-9}/day
Temperature	< 5×10^{-6}	< 1×10^{-7}
Line Voltage	N/A	< 5×10^{-10} (10% change in voltage)

Timebase Accuracy = ± aging rate ± temperature effects ± line voltage effects

Output Characteristics

Output Power (with Option 1E1): 0.01 to 1 GHz + 13 dBm
Maximum Leveled Output Power: 1 to 18 GHz + 10 dBm; 18 to 20 GHz + 8 dBm
Minimum Leveled Output Power: –4 dBm; with Option 1E1, –110 dBm



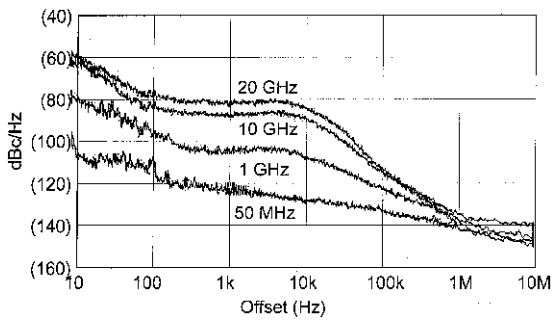


HP 83711B
HP 83712B
HP 83731B
HP 83732B

Resolution: 0.01 dB
Accuracy (–4 dBm to maximum specified leveled output power):
10 MHz to 50 MHz, ± 1.3 dB
50 MHz to 20 GHz, ± 1.0 dB
Accuracy (over all specified temperatures, and power levels):
10 MHz to 50 MHz, ± 2.3 dB
50 MHz to 20 GHz, ± 2.0 dB
Flatness: ± 0.5 dB

Spectral Purity

Harmonics:
HP 83711B/83712B, < –50 dBc (at levels < + 6 dBm)
HP 83731B/83732B, < –55 dBc (at levels < + 6 dBm)
Sub-Harmonics: None
Non-Harmonic Spurious (> 3 kHz)**:** –60 dBc
Phase Noise (@ 10 kHz offset)**:** 500 MHz: –103 dBc/Hz;
2 GHz: –92 dBc/Hz; 18 GHz: –76 dBc/Hz
(Phase noise decreases 6 dB/octave below 500 MHz and reaches a floor of < –140 dBc/Hz)



Typical single-sideband phase noise at 50 MHz, 1 GHz, 10 GHz and 20 GHz, 25° C, CW mode. Offsets less than 100 Hz require the high-stability timebase, Option 1E5.

SSB phase noise (dBc/Hz, CW mode):

	Offsets			
Carrier Freq.	**100 Hz**	**1 kHz**	**10 kHz**	**100 kHz**
0.5 to <1 GHz	-78	-92	-103	-115
1 to <2 GHz	-73	-83	-92	-107
2 to <5 GHz	-70	-78	-83	-100
5 to <10GHz	-69	-78	-82	-100
10 to 20 GHz	-65	-73	-76	-100

Phase noise decreases 6 dB/octave below 500 MHz and reaches a floor of <-140 dBc/Hz.

General Specifications

Operating Temperature Range: 0° to + 55° C
Size: 426 mm W x 133 mm H x 498 mm D (16.8 in x 5.2 in x 19.6 in)
Weight: < 16 kg (35 lb)
Power: 90 to 132 V, 48 to 440 Hz; 198 to 264 V, 48 to 66 Hz; 400 VA max.
EMC: Meets or exceeds EN55011/CISPR 11/1990, Class A and MIL-STD-461C Part 2 RE02, CE03, CS02, RS03

HP 83731B, 83732B Modulation Specifications

Pulse Modulation

On/Off Ratio: > 80 dB
Rise/Fall Times: < 10 ns
Minimum Pulse Width: < 25 ns, 1 to 20 GHz

Internal Multimode Pulse Modulation Source

Modes: Internal free-run, triggered, doublet, and gated burst modes
Pulse Repetition Frequency: 3 Hz to > 3 MHz
Pulse Width: 25 ns to 419 ms
Pulse Delay: –419 ms to +419 ms, free-run mode; 225 ns to 419 ms, triggered mode
Minimum Pulse Parameter Resolution: 25 ns

Frequency Modulation

Rates: 1 kHz to 1 MHz
Maximum Deviation: 10 MHz pk, 2 to 20 GHz; 5 MHz pk, 1 to 2 GHz; decreases by a factor of 2 for each octave below 1 GHz
Maximum Modulation Index: > 300

Option 800 Analog Phase Modulation

Sensitivity: Two ranges

Maximum Deviation:

Frequency	Low range	High range
2 to 20 GHz	4 rad	200 rad
1 to 2 GHz	2 rad	100 rad
0.5 to 1 GHz	1 rad	50 rad
0.256 to 0.5 GHz	0.5 rad	25 rad

Logarithmic Amplitude Modulation

Depth: > 60 dB
Sensitivity: –10 dB/V
Step Response: < 5 μs for 50 dB step

Linear Amplitude Modulation

Sensitivity: Two ranges selectable: 30% V_{pk} + 100% V_{pk}
Maximum Depth: 90% (> 90% typical)

Key Literature

HP 83711B/12B and HP 83731B/32B Technical Data, p/n 5963-6615E

Ordering Information

HP 83711B Synthesized CW Generator
HP 83712B Synthesized CW Generator
HP 83731B Synthesized Signal Generator
HP 83732B Synthesized Signal Generator
The following options apply to all models:
Opt 1E1 Add 110 dB Output Step Attenuator
Opt 1E2 Add High-Performance Modulation Generator[1]
Opt 1E5 Add High-Stability Timebase
Opt 1E8 Add 1 Hz Frequency Resolution
Opt 1E9 3.5 mm RF Output Connector
Opt 800 Add Analog Phase Modulation[1]
Opt 0B0 Delete Manual Set
Opt 0B1 Extra User's Guide
Opt 0BV Service Manual (Component Level)
Opt 0BW Service Manual (Assembly Level)
Opt 0BX Service Manual (Assembly and Component Level)
Opt 1CM Rackmount Kit (HP p/n 5062-3977)
Opt 1CP Rackmount and Handle Kit (HP p/n 5062-3983)
Opt 1CR Rack Slide Kit (HP p/n 1494-0059)
Opt W30 Three Additional Years Return-to-HP Service:
HP 83711B
HP 83712B
HP 83731B
HP 83732B

[1] Available on the HP 83731B/32B only.

208 VXI Microwave Synthesizer, 10 MHz to 20 GHz

HP E6432A

NEW

- Broadband frequency coverage, 10 MHz to 20 GHz
- Amplitude range –90 dBm to +17 dBm (Opt 1E1)
- High power output of +20 dBm 2 GHz to 20 GHz (Opt UNF)
- 1 Hz frequency resolution
- Less than 400 µs frequency switching time
- Excellent harmonics, spurious, and phase noise
- AM, FM, and pulse modulators
- VXIplug&play driver included

HP E6432A

Optimized for Automated Test Systems

The HP E6432A microwave synthesizer is designed especially for demanding performance in modern automated test systems. Rather than using slow and heavy magnetically tuned circuits, it uses small, lightweight, and fast VCO's and mixers to deliver fully synthesized microwave signals. It is register-based in order to deliver its promised switching speeds to the user in real-world applications. Communication with the HP E6432A is through its Plug&Play driver. This driver is an integral part of the HP E6432A and should be thought of as an extension of the instrument firmware.

Fast frequency and amplitude switching

Tuning between any two arbitrary frequencies requires less than 400 µs and is typically 220 µs. Amplitude-only switching between any two power levels within the vernier range requires less than 50 µs. If the optional step attenuator requires a change, switching time is slowed to 25 ms. This fast switching brings a direct benefit of decreased measurement time in scenarios where throughput is currently limited by the time it takes to retune the signal source. Examples of such scenarios are antenna testing and satellite payload testing, where large numbers of frequencies are measured. Another example is RFIC and MMIC manufacturing, where time budgets for testing each device are measured in milliseconds.

Comprehensive list and triggering modes

A deep list mode of up to 128k entries provides sequence memory for very long test scenarios. Each entry may hold settings for frequency, amplitude, attenuator setting, settling and blanking modes, and a marker. The host computer constructs the list array and downloads the array into the HP E6432A hardware prior to execution.

Triggering modes are free-run, sync, and triggered. A repeat mode may be enabled and active in any trigger mode. All events available on the front panel are also available on the TTL trigger bus. Interrupts may also be enabled for specific events.

Spectrally pure; free of harmonics and spurious

The PC assembly shielding technology is patented. Critical circuitry is contained within two hybrid thin- and thick-film microcircuits. DC to DC converters inside the module carefully filter and re-regulate the VXI mainframe power supplies. These features combine to give the HP E6432A performance superior to other VXI signal sources, rivaling the finest sources available.

HP E6432A

NEW

5

Specifications

Frequency
Range: 10 MHz to 20 GHz
Accuracy: depends on external time base
Resolution: 1 Hz
Switching time: 220 µs typical

Amplitude
Output range:
Standard: –20 to +17 dBm
Option 1E1: –90 to +16 dBm
Option UNF: +20 dBm maximum, (2 to 20 GHz)
Option UNH: +13 dBm maximum, (10 MHz to 2 GHz)
Vernier accuracy:
–10 to +10 dBm: ±0.5 dB
–20 to +20 dBm: ±1.0 dB
Resolution: 0.02 dB
Switching time:
Vernier: 40 µs typical
Attenuator: 20 ms typical
External ALC range: 40 dB
Flatness:
–10 to +10 dBm: ±2.5 dB
–90 to +20 dBm: ±4.1 dB
VSWR @ 50: 1.6:1 typical
Harmonics:
10 MHz to 2 GHz: <–25 dBc
Option UNH: <–55 dBc
2 to 20 GHz: <–55 dBc, <–65 dBc typical
Spurious responses:
<–55 dBc
<–70 dBc typical
SSB phase noise (any carrier freq.):
100 Hz offset: <–67 dBc/Hz
10 kHz offset: <–90 dBc/Hz

Modulation
Amplitude:
Rate: DC to 100 kHz
Depth: 0 to 40 dB
Accuracy: < 8% of depth
Frequency:
Rate: 100 kHz to 8 MHz
50 kHz to 10 MHz typical
Maximum deviation: > 8 MHz
Pulse (2 GHz to 20 GHz):
On/Off ratio: > 80 dB
Rise/Fall time: <10 ns
PRF range: 10 Hz to 10 MHz
Pulse width:
leveled: >2.5 µs
unleveled: >15 ns
Vernier accuracy:
leveled: ±0.5 dB
unleveled: ±0.5 dB typical
Video feedthrough: <10 mV

General Specifications

VXI Characteristics
VXI device type: Register-based
Data transfer bus: A16, A24, D16/32 slave only
Size: C
Slots: 3
Connectors: P1/P2
Shared memory: none
VXI busses: TTL trigger bus
C-size compatibility: n/a
VXIplug&play framework: Microsoft WindowsNT service pack 3 or greater

Cooling/Slot
Watts/slot: 34.3
DP mm H2O: 1.1
Air flow liter/s: 4.0

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	10	2
+12 V:	2.4	0.8
–12 V:	1.0	0.05
+24 V:	0.4	0.5* (0.06)
–24 V:	0.15	0.03
–5.2 V:	2.35	0.1
–2 V:	0	0

*step attenuator

Key Literature

HP E6432A Brochure, p/n 5967-6313E
HP E6432A Technical Specifications, p/n 5968-1242E
HP E6432A Product Overview, p/n 5967-6178E
HP E6432A Configuration Guide, p/n 5967-6272E
Test System and VXI Products Catalog, p/n 5968-3698E
An Introduction to the HP E6432A VXIplug&play Driver, p/n 5968-3660E

Ordering Information

HP E6432A VXI Microwave Synthesizer
Opt 1E1 70 dB step attentuator
Opt UK6 Commercial calibration certificate with test data
Opt UNF High output power (+20 dBm) 2 GHz to 20 GHz
Opt UNH Improved spectral purity 10 MHz to 2 GHz
Opt W30 3 yrs Customer Return Repair Service
Opt W50 5 yrs Customer Return Repair Service

HP 83751A
HP 83751B
HP 83752A
HP 83752B

- Fully synthesized (phase-locked) CW, step, and ramp modes
- 2 MHz swept frequency accuracy
- Power flatness correction
- Broad 20 GHz frequency coverage
- +17 dBm output power at 20 GHz
- Internal pulse generator

HP 83753B

HP 83750 Series Sweepers

The HP 83750 sweepers bring outstanding synthesized performance to the component-test marketplace. They deliver the best performance for the price in general-purpose benchtop, swept test, or scalar applications.

The latest technological advances in fundamental oscillator design provide up to 20 GHz of frequency coverage with superior harmonic suppression and no subharmonics. When this excellent spurious performance is combined with high-output power capabilities, high-measurement dynamic range is achieved.

The HP 83750 synthesized sweepers provide superior accuracy and stability while maintaining the speed of analog sources. Fully-synthesized CW, stepped, and ramp sweep modes are available in broadband and narrowband operation. The synthesis capabilities are particularly useful for the characterization of narrowband devices, in which the frequency instabilities of open-loop sources become most apparent.

Excellent output-power flatness and accuracy can be translated to the input port of the device-under-test with the power flatness correction feature of these sources. This feature uses a power meter to create an array of power corrections that compensate for power variations in the measurement path between the source and the test device.

Swept testing of frequency translation devices can be achieved simply and economically with the HP 83570 series synthesized sweepers. A traditionally difficult measurement, sweeping the RF and local oscillator (LO) input ports at a fixed offset over a wide frequency span, is easy to implement with superior frequency accuracy by positioning two synchronously tracking HP 83750s in a two-tone configuration. With broadband frequency coverage and excellent performance, the HP 83750 synthesized sweepers are ideal stimuli for frequency translation measurements.

The HP 83750 series make optimal companion sources for scalar-measurement applications. Full compatibility is available via the HP 8757 system interface bus. The HP 8757D scalar analyzer and HP 83750 series have a complementary design that achieves superior frequency accuracy, power accuracy and flatness while significantly reducing measurement uncertainty. In addition, the HP 83750's high-power and low-harmonic capabilities increase the spurious-free measurement dynamic range of scalar systems. Ten independent, continuously variable markers and a marker sweep function allow fast, efficient analysis of the test device at or between critical measurement frequencies. CW, stepped, ramp, or power sweep modes are available for device characterization. A 25 dB power sweep range is particularly useful for compression measurements of active devices such as amplifiers and mixers.

The high-power models HP 83751B and 83752B provide +17 dBm output power with –20 dBc harmonics from 2 to 20 GHz. This high-power capability eliminates the need to externally amplify the signal for test devices that require high-input power levels. When Option 1EE (source module interface connector and extension cable) is added, these sources can directly drive the HP 83550 series mm-wave source modules to provide waveguide frequency coverage up to 110 GHz. All HP 83750 sweepers with Option 1EE automatically provide bias, power flatness correction, and internal leveling for the HP 83550 series source modules.

HP 83750 sweepers offer two operating languages to ensure compatibility with instruments today and in the future. The default language is SCPI (Standard Command for Programmable Instruments), an industry standard. The second operating language employs HP 8350 mnemonics to provide programming compatibility with HP 8350-based measurement systems.

HP 83751A
HP 83751B
HP 83752A
HP 83752B

Specifications

Frequency Characteristics

Frequency Range
HP 83751B: 2 to 20 GHz
HP 83752B: 0.01 to 20 GHz

Internal Reference Oscillator

Frequency: 10 MHz

Timebase Stability
Standard Timebase: ± 10 x 10^{-6}
High-Stability Timebase (Option 1E5)
Aging Rate: 5 x 10^{-10}/day; 1 x 10^{-7}/year
Temperature Effects: 1 x 10^{-10}/ °C
Line Voltage Effects: 5 x 10^{-10} (10° change in voltage)
CW and Manual Modes
Accuracy: Stability x f_c time base
Resolution: 1 Hz
Switching Time (typical)**:** 70 ms max.
Ramp Sweep Mode
Accuracy[1,2]**:** The greater of ± 0.01% of span ± timebase stability x f_c or ± 75 k Hz ± timebase stability x f_c
Sweep Time: 10 ms to 100 s; 50 ms for full span
Resolution: 1 kHz
Step Sweep Mode
Accuracy: Timebase stability x f_c
Number of Points: 2 to 1601
Switching Time (typical)[3]**:** 7 ms ± 8 ms/GHz step

Output Power Characteristics

Maximum Leveled Power[1,4]
HP 83751A, 83752A: 10 dBm
HP 83751B, 83752B: 17 dBm (16 dBm < 2 GHz on HP 83752B)
Minimum Settable Power
HP 83751A, 83752A: –15 dBm (–85 dBm w/Option 1E1)
HP 83751B, 83752B: –10 dBm (–80 dBm w/Option 1E1)
Resolution: 0.01 dB settable
Accuracy[1]
HP 85751A, 83752A only: ± 1.0 dB (levels > –10 dBm)
HP 83751A/B, 83752A/B: ± 1.5 dB (levels > –75 dBm)
Flatness
HP 85751A, 83752A only: ± 0.7 dB (levels > –10 dBm)
HP 85751A/B, 83752A/B: ± 1.3 dB (levels > –75 dBm)
Power Sweep Range: 25 dB/sweep
Power Slope Range: 0 to ± 2 dB/GHz, 25 dB max
Source Match (typical)**:** < 1.7:1 SWR

Spectral Purity

Harmonics
HP 83751A, 83752A: –45 dBc (–30 dBc < 1.5 GHz on HP 83752A)
HP 83751B, 83752B: –20 dBc
Subharmonics: None
Non-Harmonic Spurious[5]**:** –50 dBc
Residual FM: 1 kHz RHS in CW mode (0.05 to 15 kHz BW)
Phase Noise (typical)**:** < –75 dBc/Hz at 10 GHz in CW mode, 10 kHz offset

Modulation

External AM (typical)
Sensitivity: 1 dB/V
3 dB Bandwidth: > 100 kHz, usable to 1 MHz
Depth
HP 83751A, 83752A: 20 dB (–10 to + 10 dBm)
HP 83751B, 83752B: 22 dB (–5 to + 17 dBm)
Input Impedance: 3.5 Ω
External FM (typical)
DC/Unlocked Mode
Rates: dc to 10 MHz
Maximum Deviation
dc to 100 Hz Rates: ± 75 MHz
100 Hz to 1 MHz Rates: ± 7 MHz
1 to 2 MHz Rates: ± 5 MHz
2 to 10 MHz Rates: ± 1 MHz
AC/Locked Mode
Rates: 50 kHz to 10 MHz
Maximum Deviation: Same as unlocked mode up to 25 x rate
Pulse (typical)
On/Off Ratio: 60 dB
Rise/Fall Times
50 MHz to 2 GHz: 15 ns
2 to 20 GHz: 100 ns rise/50 ns fall
Minimum Pulse Width: 2 µs
Internal Pulse Generation
Width Range: 1 µs to 65 ms
Period Range: 2 µs to 65 ms
Resolution: 1 µs
Internal Square Wave: 1 kHz and 27.8 kHz (scalar analyzer mode)

General

Bandwidth Points: 2 GHz, 3.75 GHz, 6.75 GHz, and 11 GHz. The 3.75 and 6.75 GHz synthesizer switch will disappear if sweep is < 0.8 of an octave in the 2 to 11 GHz band.
RF Output Connector: 3.5 mm
Option 1ED: Type-N
Operating Temperature Range: 0° to 55° C
Weight: Net 16 kg (35 lb)
Size: 425 W mm x 133 H mm x 483 D mm (16.75 in x 5.25 in x 19 in)

Key Literature

HP 83751A/B and HP 83752A/B Synthesized Sweepers
Technical Data, p/n 5091-5908E

Ordering Information

HP 83751A 2 to 20 GHz Synthesized Sweeper
HP 83751B 2 to 20 GHz Synthesized Sweeper (High Power)
HP 83752A 0.01 to 20 GHz Synthesized Sweeper
HP 83752B 0.01 to 20 GHz Synthesized Sweeper (High Power)
The following options apply to all models:
Opt 1E1 70 dB Step Attenuator
Opt 1E4 Rear-Panel RF Output
Opt 1E5 High-Stability Time Base
Opt 1ED Type-N Connector Output
Opt 1EE Source Module Interface Connector and Extension Cable

[1] For operating temperatures of 25 ± 5° C.
[2] For 100 ms sweep times; improves with slower sweeps.
[3] Up to 50 ms switching times can occur when crossing the 2 GHz band switch point.
[4] Option 1E1 reduces output power up to 1 dB.
[5] For spurs > 500 kHz from output frequency.

HP 8360B Series
HP 8360L Series

- +20 dBm (HP 83624B) to –110 dBm (Option 001) calibrated output power
- –50 dBc harmonics < 26.5 GHz typical
- SSB phase noise < –80 dBc at 10 GHz and 10 kHz offset
- Complete analog sweeper
- 1Hz frequency resolution (Option 008)
- Pulse, amplitude and frequency modulation (HP 8360B series only)

The HP 8360B/L series for the winning combination of precision, versatility and flexibility

5

HP 8360B/L Synthesized Swept Signal and CW Generator Series

GPIB

The HP 8360 family consists of the general-purpose B-model series and the L-model (without modulation) series. They combine the excellent frequency resolution, level control, signal purity, and modulation capabilities you expect of a high-performance synthesized signal generator with the speed and convenience of a sweep oscillator. They are ideal for the demanding requirements of signal simulation, local oscillator, and stimulus/response component or subsystem test applications.

The HP 8360 family offer a choice of models to meet a variety of application requirements. Ultra-broadband frequency coverage for 10 MHz to 50 GHz is available in coax using a 2.4-mm precision connector. High-power models with up to +20 dBm are also available. The HP 8360 can also be customized with 1 Hz frequency resolution, fast pulse, a synthesized internal modulation generator and a blank front panel for automated test applications.

Flexible and Upgradeable for Growth

The HP 8360 is designed to facilitate future growth. The hardkey and softkey front-panel design offers easily-accessible functions that are simple to use. Softkey flexibility and modular architecture provide upgrade capability, while retaining system compatibility. The family delivers the cost-effective and state-of-the-art performance you need today, while protecting your investment in the future.

Pulse, Scan, Amplitude, and Frequency Modulation (HP 8360B series only)

High-performance pulse modulators with > 80 dB on/off ratio, and rise/fall times < 10 ns (Option 006), make the HP 8360B suitable for the most demanding pulse modulation applications.

In addition to its linear AM mode (100%/V), the HP 8360B offers a scan modulation mode (10 dB/V). Both modes have dc-coupled amplitude modulation capability with a 3 dB bandwidth of 100 kHz, and 99.7% (50 dB) of modulation depth. Pulse and amplitude modulation capabilities can be used independently and simultaneously.

The HP 8360B also offers dc-coupled frequency modulation capabilities with rates up to 8 MHz.

Specifications Summary

Frequency
Range (by model):
HP 83620B 10 MHz to 20 GHz
HP 83622B 2 GHz to 20 GHz
HP 83623B 10 MHz to 20 GHz (high power)
HP 83624B 2 GHz to 20 GHz (high power)
HP 83630B 10 MHz to 26.5 GHz
HP 83640B 10 MHz to 40 GHz
HP 83650B 10 MHz to 50 GHz
HP 83623L 10 MHz to 20 GHz
HP 83630L 10 MHz to 26.5 GHz
HP 83640L 10 MHz to 40 GHz
HP 83650L 10 MHz to 50 GHz
Resolution: 1 kHz (1 Hz with Option 008)

Internal Reference Oscillator

Frequency: 10 MHz
Timebase Stability
Aging Rate: 5×10^{-10}/day; 1×10^{-7}/year
Temperature Effects: 1×10^{-10}/°C
Line Voltage Effects: 5×10^{-10} (10° C change in voltage)

CW and Manual Modes

Accuracy: Timebase stability xf_c
Switching Time
For Steps Within a Frequency Band: 15 ms + 5 ms/GHz step size
Maximum, or Across Band Switch Points: 50 ms
Step or List Modes Within a Frequency Band: 5 ms + 5 ms/GHz step size

Step Sweep Mode

Accuracy: Timebase stability xf_c
Minimum Step Size: Same as frequency resolution
Number of Points: 2 to 801
Switching Time: Same as CW
Dwell Time: 100 µs to 3.2 s

List Mode

Accuracy: Timebase stability xf_c
Minimum Step Size: Same as frequency resolution
Number of Points: 1 to 801
Switching Time: Same as CW
Dwell Time: 100 µs to 3.2 s

Ramp Sweep Mode

Accuracy: (Sweep time ≥ 100 ms and ≤ 5 s)
Sweep Widths ≤ n x 10 MHz: 0.1% of sweep width ± timebase stability xf_c
Sweep Widths > n x 10 MHz: Lesser of 1% of sweep width or n x 1 MHz + 0.1% of sweep width
Sweep Time: 10 ms to 100 s, 300 MHz/ms maximum rate

RF Output

Output Power

Maximum Leveled (dBm)	Standard	Option 006 (B models only)
HP 83620B, 83622B	+13	+13
HP 83623B	+17	+17
HP 83623L	+15	N/A
HP 83624B	+20	+17
HP 83630B/L		
Output Frequencies < 20 GHz	+13	+13
Output Frequencies ≥ 20 GHz	+10	+10
HP 83640B/L		
Output Frequencies < 26.5 GHz	+10	+10
Output Frequencies ≥ 26.5 GHz	+6	+6
HP 83650B/L		
Output Frequencies < 26.5 GHz	+10	+10
Output Frequencies ≥ 26.5 GHz and < 40 GHz	+5	+5
Output Frequencies ≥ 40 GHz	+2.5	+2.5

Minimum Settable Output Power
Standard: –20 dBm
Option 001: –110 dBm
Resolution: 0.02 dB
RF Output Connector
Nominal output impedance 50 ohms (precision 3.5-mm male on 20 and 26.5 GHz models, 2.4-mm male on 40 and 50 GHz models, front panel)

Spectral Purity

Spurious Signals (dBc)

Output Frequencies	83620B 83622B	83623B 83624B	83623L	83630B/L	83640B/L 83650B/L
Harmonics					
< 2.0 GHz					
Standard	–30	–25[1]	–25[1]	–30	–30[1]
Option 006	–30[1]	–25[1]	—	–30[1]	–30[1]
≥ 2.0 GHz and < 26.5 GHz					
Standard	–50	–25	–45	–50	–50
Option 006	–60	–60	—	–60	–50
≥ 26.5 GHz					
Standard	—	—	—	—	–40
Option 006	—	—	—	—	–40
Subharmonics					
< 7 GHz	None	None	None	None	None
≥ 7 and ≤ 20 GHz	–50	–50	–50	–50	–50
≥ 20 GHz and ≤ 40 GHz	—	—	—	–50	–40[2]
> 40 GHz	—	—	—	—	–35[2]

[1] Specification is –20 dBc below 50 MHz.
[2] Specifications typical below 0 dBm.

Nonharmonically Related
10 MHz to < 2.0 GHz[3]: –60
≥ 2.0 to < 20 GHz: –60
> 20 GHz to ≤ 26.5 GHz: –58
> 26.5 to ≤ 40 GHz: –54
≥ 40 GHz to ≤ 50 GHz: –52

Single-Sideband Phase Noise (dBc/Hz)

	Offset from Carrier			
Frequency Range	**100 Hz**	**1 kHz**	**10 kHz**	**100 kHz**
10 MHz to < 7 GHz	– 70	– 78	– 86	–107
7 GHz to < 13.5 GHz	– 64	– 72	– 80	–101
13.5 GHz to 20 GHz	– 60	– 68	– 76	– 97
> 20 GHz to < 26.5 GHz	– 58	– 66	– 74	– 95
26.5 GHz to < 38 GHz[4]	– 54	– 62	– 70	– 91
38 GHz to 50 GHz	– 52	– 60	– 68	– 89

Modulation (HP 8360B series only)

All modulation specifications are only applicable to the HP 8360B series. Pulse modulation specifications apply for output frequencies 400 MHz and above.

Pulse (HP 8360B only)	Standard	Option 006
On/Off Ratio	80 dB	80 dB
Rise/Fall Times	25 ns	10 ns
Minimum Width		
Internally Leveled	1 µs	1 µs
Search Mode		
Output Frequencies < 2.0 GHz	50 ns	50 ns
Output Frequencies ≥ 2.0 GHz	50 ns	15 ns
ALC Off Mode		
Output Frequencies < 2.0 GHz[4]	50 ns	50 ns
Output Frequencies ≥ 2.0 GHz	50 ns	15 ns

AM and Scan (HP 8360B only)
Bandwidth (3 dB, 30% depth, modulation peaks 3 dB below maximum rated power): dc to 100 kHz
Modulation Depth
Normal Mode: –20 dBm to maximum available power
Deep Mode: 50 dB below maximum available power
Sensitivity
Linear: 100%/volt
Exponential: 10 dB/volt

FM (HP 8360B only)
Locked Mode
Maximum Deviation: ± 8 MHz
Rates (3 dB bandwidth, 500 kHz deviation)**:** 100 kHz to 8 MHz

[3] Specification applies at output levels 0 dBm and below.
[4] This band is 26.5 GHz to 40 GHz on the HP 83640A.
[5] Frequency range is 26.5 GHz to 40 GHz on the HP 83640B/L.

Unlocked Mode
Maximum Deviation
At rates ≤ 100 Hz: ± 75 MHz
At rates > 100 Hz: ± 8 MHz
Rates (3 dB bandwidth, 500 kHz deviation)**:** dc to 8 MHz
Sensitivity: 100 kHz, 1 MHz, or 10 MHz/volt, switchable
Accuracy (1 MHz rate, 1 MHz deviation)**:** 10%

Internal Modulation Generator (Option 002)

AM, FM Modulation Signals (HP 8360B only)
Internal Waveforms: Sine, square, triangle, ramp, noise

Rate
Range:
Sine: 1 Hz to 1 MHz
Square, triangle, ramp: 1 Hz to 100 kHz
Resolution: 1 Hz

Depth, deviation
Range: Same as the base instrument
Resolution: 0.1%
Accuracy: Same as the base instrument

Pulse (HP 8360B only)
Modes: Free-run, gated, triggered, delayed
Period Range: 300 ns to 400 ms
Width Range: 25 ns to 400 ms
Resolution: 25 ns
Accuracy: 5 ns
Video Delay
Internal sync pulse: 0 to 400 ms
Externally-supplied sync pulse: 225 ns to 400 ms

Weight and Dimensions
Net Weight: 27 kg (60 lb)
Dimensions: 178 H x 425 W x 648 mm D (7.0 x 16.75 x 25.5 inches)

Additional Key Literature

Brochure, p/n 5964-6793E
Technical Specifications, p/n 5964-6162E
Configuration Guide, p/n 5964-6062E

Ordering Information

HP 83620B 10 MHz to 20 GHz
HP 83622B 2 GHz to 20 GHz
HP 83623B 10 MHz to 20 GHz (high power)
HP 83624B 2 GHz to 20 GHz (high power)
HP 83630B 10 MHz to 26.5 GHz
HP 83640B 10 MHz to 40 GHz
HP 83650B 10 MHz to 50 GHz
HP 83623L 10 MHz to 20 GHz
HP 83630L 10 MHz to 26.5 GHz
HP 83640L 10 MHz to 40 GHz
HP 83650L 10 MHz to 50 GHz
The following options apply to all models:
Opt 001 Adds Step Attenuator
Opt 002 Adds Internal Modulation Generator (HP 8360B only)
Opt 004 Rear-Panel RF Output
Opt 006 Fast-Pulse Modulation (HP 8360B only)
Opt 008 1 Hz Frequency Resolution
Opt 700 MATE System Compatibility
Opt 806 Rack Slide Kit
Opt 908 Rack Flange Kit
Opt 910 Extra Operating and Service Manuals
Opt 913 Rack Flange Kit
Opt W30 3 Years of Customer Return Repair Service*
Upgrades
Model and frequency upgrades are available. Please contact your Hewlett-Packard sales representative for details (listed on page 563).
Dedicated HP 8510 System Source Models[1]
HP 83621B 45 MHz to 20 GHz
HP 83631B 45 MHz to 26.5 GHz
HP 83651B 45 MHz to 50 GHz

[1] No modulation, no front panel. Price of this option varies for different HP 8360 series models.

HP 8645A

- 252 kHz to 1030 MHz frequency range with optional coverage to 2060 MHz
- 15 µs frequency switching
- Standalone control of frequency agility
- Specified performance while fast hopping
- FM rates to 10 MHz, deviations to 20 MHz
- Low spurious and phase noise

HP 8645A

HP 8645A Agile Signal Generator

The HP 8645A agile signal generator combines high performance with frequency agility for new fast-switching test requirements. These capabilities are important for performance testing of such devices as frequency agile radios and surveillance receivers. Besides extending traditional receiver testing to agile applications, the HP 8645A can be used to create complex signal simulations involving several modulation types and frequency agility. These complex RF signals can quantitatively exercise a receiver's vulnerability to a jamming transmission. The HP 8645A can also be a fast-switching stimulus needed to decrease production test times. The high performance and frequency agility of the HP 8645A provide capability for both static and agile test requirements with just one calibrated signal generator.

Specified Agile Performance

The HP 8645A provides specified signal performance in both static and agile operation. Fully-synthesized outputs with high timebase accuracy are standard when not frequency hopping. The Fast Hop mode activates a frequency-lock loop to allow frequency switching as fast as 15 µs from 128 to 2060 MHz. Over the frequency range of 8 to 2060 MHz, the fastest switching time is 85 µs and outputs below 8 MHz require 500 µsec. Frequency accuracy of each output is better than ± 2 ppm while in Fast Hop mode. At each frequency, a specific amplitude can be assigned within a 20 dB range for performance tests versus amplitude while frequency hopping. For a full test of a receiver, up to 4000 frequencies can be entered and sequences of up to 8000 frequency settings can be specified. Performance parameters such as phase noise, spurious, amplitude accuracy and modulation remain high-quality and are completely specified while fast hopping to insure confident test results.

Flexible, High-Performance Modulation

For receiver measurements, the HP 8645A offers independent or simultaneous FM and AM for both static and hopped frequency tests. The modulating signal can be the internal 0.1 Hz to 400 kHz synthesizer or an external input that allows FM deviations up to 20 MHz at rates up to 10 MHz. In Fast Hop operation, maximum deviation is 3.5 MHz with 10 MHz rates. AM is available with up to 100 kHz rates and 99% depth. Pulse modulation allows a 35 dB on/off ratio with 100 ns rise/fall times.

Complete Control of Frequency Hopping

The HP 8645A offers flexible and comprehensive control of the frequency hopping output. Parameters can be entered from the front panel, through the GPIB port or using TTL inputs on the rear panel. Extensive hopped-frequency simulations including hop frequencies, amplitude, dwell times, hop rate, modulation and so forth can be entered into nonvolatile memory from the front panel. Activating a hop sequence requires only a press of the Hop key. Agile control is available by a computer with the added advantage of using the Hewlett-Packard Systems Language (HP-SL). For real-time control, rear-panel inputs accept TTL signals for triggering, dwell time and frequency selection to allow direct connection with the hardware under test. With this wide choice of control, use of the HP 8645A can be readily customized to a wide variety of test situations from benchtop use to ATE systems.

HP 8645A Specifications

Frequency

Range: 251.46485 kHz to 1030 MHz; 251.46485 kHz to 2060 MHz with Option 002 or with HP 11845A 2 GHz retrofit kit installed
Frequency Bands: The exact endpoints of each frequency band can be determined by dividing the 1030 to 2060 MHz band by two for each band decrease. The specifications use approximate endpoints.
Phase Offset: Adjustable in 1 degree increments
Reference Oscillator Stability, Option 001: < 5 x 10^{-10}/day aging

Fast-Hop Operation

Frequency Switching Time: 128 to 1030 MHz: < 15 µs, 8 to 1030 MHz: < 85 µs, 0.25 to 1030 MHz: < 500 µs. Option 002: add 5 µs.
Frequency Hop Range: 0.25 to 2060 MHz. With FM on, limited to any three consecutive frequency bands.
Frequency Accuracy[1]**:** ± 2 ppm of carrier frequency
Amplitude Accuracy: ± 1 dB, > –127 dBm output (± 1.5 dB, > –127 dBm output when amplitude level is varied up to –5 dB from the constant learned value during Fast Hop)
Channel and Sequence Tables: In Fast Hop, each specific frequency and amplitude to be output is entered into a Channel Table. The order of channels to be output is entered into a Sequence Table.
Maximum Number of Channels: 4000
Maximum Number of Channels in Sequence Table: 8000
Hop-Rate Range: Fixed rates from 8 Hz to 50 kHz using internal timer. An external input allows more range and variable rates.
Dwell-Time Range: Fixed times of 6.4 µsec to 99 ms using the internal timer. External input allows longer and variable dwell.
Learn-Cycle Time: Typically, 10 seconds to 3.5 minutes, depending on sequence size
Fast-Hop Bus: Allows real-time selection of any channel for output. Typically, frequency switching time increases by 5 µs.
Modulation: Internal or external AM, FM, or simultaneous AM/FM
Output Level: Allowed amplitude variation of all channels entered is 0 to 20 dB. Output level is reduced by > 60 dB while switching between channels. External dc AM can be used to shape the output.

Spectral Purity

SSB Phase Noise (CW, AM, or FM[2] operation)**:**

Carrier frequency (MHz)	Standard operation 20 kHz (dBc/Hz)	100 kHz (dBc/Hz)	Fast Hop 20 kHz (dBc/Hz)
1030 to 2060	–120	–127	–116
515 to 1030	–127	–134	–123
257 to 515	–132	–137	–128
128 to 257	–136	–140	–133
64 to 128	–139	–141	–137
32 to 64	–141	–141	–139
16 to 32	–142	–142	–141
8 to 16	–143	–143	–142
4 to 8	–144	–144	–143
Less than 4 MHz	–144	–144	–144

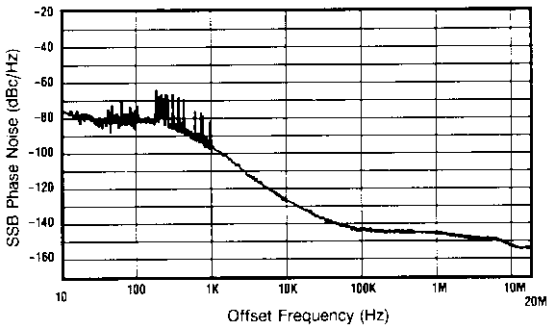
Harmonics: < –30 dBc, output ≤ 10 dBm. Option 002, output > 8 dBm: < –30 dBc, 0.25 to 1030 MHz; < –25 dBc, 1030 to 2060 MHz.
Subharmonics: None, < 515 MHz; < –60 dBc, 515 to 1030 MHz; < –40 dBc, > 1030 to 2060 MHz
Nonharmonics: > 20 kHz offset[3]: < –100 dBc, < 1030 MHz; < –94 dBc, > 1030 to 2060 MHz

[1] Typically, + 2 ppm of carrier frequency multiplied by the temperature change in °C must be added if ambient temperature changes occur between the learn operation and the conclusion of frequency hopping. FM at minimum deviation.
[2] FM at minimum deviation.
[3] Typically, nonharmonic spurs at all offsets are < 30 dB above the instrument's phase noise level as measured in a 1 Hz bandwidth.

Residual FM[1] (CW, AM, FM[2] operation):

Carrier Frequency (MHz)	Post Detection Bandwidth 0.3 to 3 kHz (Hz rms)	0.05 to 15 kHz (Hz rms)
0.25 to 257	< 1	< 1.2
257 to 515	< 1.2	< 2
515 to 1030	< 2	< 4
1030 to 2060	< 4	< 8

Typical SSB Phase Noise and Spurs at 1 GHz:



Residual AM: < 0.01% AM rms, 0.3 to 3 kHz post detection BW
Typical SSB AM Noise Floor, Offsets > 100 kHz: < –157 dBc/Hz at +16 dBm output, 0.25 to 1030 MHz. < –150 dBc/Hz at +13 dBm output, 1030 to 2060 MHz.

Output
Maximum Level: +16 dBm, 0.25 to 1030 MHz; Option 002: +14 dBm, 0.25 to 1030 MHz. +13 dBm, above 1030 MHz.
Minimum Level: –137 dBm
Absolute Accuracy: ± 1 dB, output ≥ –127 dBm
Reverse Power Protection: 50 watts from a 50 Ω source, 25 Vdc
Typical Third Order Intermodulation: < – 50 dBc, outputs < 8 dBm
Typical Output Level Overrange: 2 dB more than maximum level
Typical SWR and Output Impedance: < 1.7:1 at < – 2 dBm; 50 Ω

Modulation
External Modulation Input: Coupling is ac or dc for AM, FM, and phase modulation. Pulse modulation input is dc coupled. Displayed deviation or depth corresponds to ± 1 V external input.
Simultaneous Modulation: AM/FM, AM/Phase, AM/Pulse, FM/Pulse, Phase/Pulse, AM/FM/Pulse, AM/Phase/Pulse
Simultaneous Internal/External Modulation: FM and Phase

Amplitude Modulation
Depth: 0 to 99.9%, for output < ± 7 dBm
AM Indicator Accuracy: ± (6% of setting + 2%, AM), up to 90% depth and 1kHz rate for carrier frequencies > 1 MHz. When amplitude level is varied up to – 5 dB from the constant learned value during Fast Hop: ± (7% of setting +1% AM) up to 80% depth, 1 kHz rate.

Distortion, at 400 Hz and 1 kHz Rates:

Depth	Carrier Frequency 0.25 to 1030 MHz	1030 to 2060 MHz
0 to 30%	< 2%	< 5%
30 to 70%	< 3%	< 5%
70 to 90%	< 5%	< 8%

3 dB Bandwidth[3]: > 5 kHz, 0.25 to 8 MHz. > 50 kHz, 8 to 128 MHz; > 100 kHz, 128 to 2060 MHz
Incidental Phase Modulation: < 0.2 rad peak, at 30% depth and1 kHz
Typical External Input Impedance: 600 Ω

Frequency Modulation
FM Deviation and Rate: In the highest frequency band of 1030 to 2060 MHz, the maximum FM peak deviation is 20 MHz for standard operation and 3.52 MHz for Fast Hop. Maximum FM rate (3 dB bandwidth) in the 515 to 1030 MHz band and above is 10 MHz. Divide rate and deviation by two for each frequency band decrease.
FM Indicator Accuracy: ± 10%, < 50 kHz rate and < 10% of maximum deviation (< 50% of maximum deviation in Fast Hop)
FM Distortion: Rates 20 Hz to 100 kHz: < 2.7%, deviation < 2% of maximum available (Fast Hop: < 10% of maximum deviation)
Carrier Frequency Accuracy in FM: ± 0.4% of deviation setting, ac- or dc-coupled. Typically add 1% of deviation in Fast Hop.
Incidental AM: < 0.5%, deviation limited to < 6% of max. or 20 kHz
Typical External FM Group Delay: 30 µs for rates 20 Hz to 20 kHz, decreases to < 1 µs at rates > 200 kHz. Fast Hop: < 1 µs.
Typical External FM Input Impedance: 50 or 600 Ω

Pulse Modulation
On/Off Ratio: > 35 dB
Rise/Fall Time: < 100 ns, between 10% and 90% response points
Maximum Pulse Repetition Frequency: 1 MHz
Minimum Pulse Width: 0.5 µs
Typical Output Level Accuracy: ± 2 dB
Typical External Input Levels and Impedance: On: > 3.0 V peak; Off: < 0.8 V peak. Damage level: ≥ ± 10 V peak. 600 Ω.

Internal Modulation Source
Waveforms: Sine, square, sawtooth, and white Gaussian noise
Frequency Range: Sine, white Gaussian noise: 0.1 Hz to 400 kHz. Square, sawtooth: 0.1 Hz to 50 kHz.
Frequency Accuracy: Same as internal reference oscillator
Output Level: Typically, 1 V_{pk} max. into 600 Ω. Accuracy: ± 20 mV.
Output Level Resolution: 2 mV. Typical impedance: 600 Ω.
Distortion: < 0.1%, output at 1 V peak and ≤ 15 kHz

Frequency Sweep
Phase Continuous Sweep: Linear sweep with times from 10 ms to10 s, not dependent on span. Maximum span is 40 MHz from 1030 to 2060 MHz frequency band, divided by two for each band decrease.
Fast Hop Sweep: Linear or log stepped with times from 10 ms to100 s. Number of steps varies with time selected. Typical time per step is 30 µs for outputs within 128 to 2060 MHz, 170 µs for 8 to 2060 MHz, and 650 µs for 0.25 to 2060 MHz.
Sweep Control and Markers: X-axis: 0 to +10 V. Z-axis: +5 V retrace, +1 V trace, 0 V markers. Three markers available.

General
Remote Control: GPIB (IEEE-488.2-1987). The control language used is the Hewlett-Packard Systems Language (HP-SL). All front-panel functions except power switch and knob. A unique Fast Hop bus interface accepts TTL levels for frequency agile control.
Operating Temperature Range: 0° to +55° F
Leakage: Meets MIL-STD-461B-RE02 and FTZ 1046
Storage Registers: 10 full function and 40 freq./ampl. locations
Memory Erasure: All memory contents according to MIL-STD-380-380
Size: 426 mm W x 177 mm H x 624 mm D (16.8 in x 7 in x 24.6 in)
Weight: Net, 31 kg (69 lb); shipping, 42 kg (95 lb)

Key Literature
HP 8645A Agile Signal Generator Data Sheet, p/n 5953-8498E
HP 8645-1 Communications-Agile Operation of the HP 8645A Product Note, p/n 5951-6711

Ordering Information
HP 8645A Agile Signal Generator[4]
Opt 001 High-Stability Timebase
Opt 002 2 GHz Output
Opt 003 RF Connectors on Rear Panel Only
Opt 907 Front Handle Kit (5062-3990)
Opt 908 Rack Flange Kit (5062-3978)
Opt 909 Rack Flange Kit with Front Handles (5062-3984)
Opt 910 Provides an additional operation/calibration manual (08645-90023) and 2 service manuals
Opt 915 Add Service Manual (08645-90104)
08645-61116 Service Kit
9211-2662 Transit Case
1494-0059 Non-Tilting Rack Slide Kit

[1] Specified for 48 to 63 Hz power line. Typical for 400 Hz power line and Fast Hop operation.
[2] Deviation < 0.1% of maximum available.
[3] Lower 3 dB bandwidth limit is 0 Hz for dc coupling and typically 20 Hz for ac coupling.
[4] GPIB cables not included. For description and price, see page 557.

Indicates QuickShip availability.

HP 83550 Series Millimeter-Wave Source Modules

HP 83554A
HP 83555A
HP 83556A
HP 83557A
HP 83558A

- 26.5 to 110 GHz frequency range
- Leveled high output power
- Can be driven by many HP microwave sources
- Source module remotable up to one meter length
- Low entry cost

HP 83558A mm-wave source module. 75GHz to 110 GHz

HP 83550 Series Millimeter-Wave Source Modules

The five HP 83550 series millimeter-wave source modules provide a simple approach to extend the frequency range of 11 to 20 GHz sources to cover 26.5 to 40 GHz (HP 83554A), 33 to 50 GHz (HP 83555A), 40 to 60 GHz (HP 83556A), 50 to 75 GHz (HP 83557A) and 75 to 110 GHz (HP 83558A) bands. The HP 83550 series source modules offer leveled high output power, full waveguide band frequency coverage and the high-frequency accuracy and resolution of the driving microwave source.

As shown in the figure in the right column, there are two basic ways of configuring a millimeter-wave source to best suit your specific needs. You can choose between an individual synthesized sweeper (HP 83623B/L, HP 83624B, HP 83751B, or HP 83752B) or a combination of an HP 8349 amplifier and another HP 8360 B/L series or HP 8370 series synthesized sweeper.

Pulse, AM, and FM Modulation

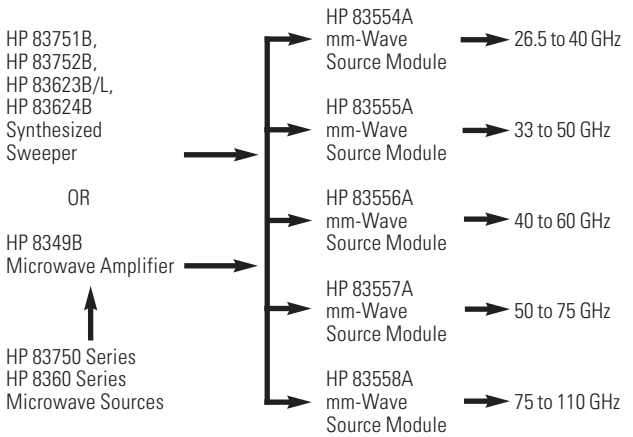
The high-performance pulse modulators of the Hewlett-Packard synthesized sources offer > 80 dB on/off ratio and < 50 ns rise and fall times. Pulse amplitudes are leveled for pulse widths as narrow as 1 µs.

The HP 8360 B-series also feature dc-coupled AM with a 3 dB bandwidth of 250 kHz. Pulse and amplitude modulation can be used to simultaneously simulate antenna scan patterns.

FM rates between 100 kHz and 8 MHz may be applied to the HP 8360 B-series synthesizer input to achieve deviations up to 16 MHz (HP 83554A) and 24 MHz (HP 83555A, 83556A), 32 MHz (HP 83557A), and 48 MHz (HP 83558A) at millimeter-wave frequencies.

High-Output Power

Leveled-output power from the source modules is rated at +8 dBm for the HP 83554A, +3 dBm for the HP 83555A, +3 dBm for the HP 83556A, +3 dBm for the HP 83557A, and 0 dBm for the HP 83558A. This high-output power can permit the source module to serve as a mixer LO in some applications and also expands the available dynamic range in frequency response measurements.



All at a Lower Cost

The HP 83550 series source modules combine performance and quality with a low cost of entry. This is possible because the source modules are backward-compatible with existing HP microwave sources. Thus you can generate a full waveguide band of millimeter-wave frequencies for just the cost of a source module and an HP 8349B amplifier (where required). Also, the cost of ownership is reduced even further by the two-year warranty on the microcircuits of the HP 83550 series source modules and the HP 8349B microwave amplifier.

HP 83554A Output Characteristics

	HP 8360 Series/8349B, HP 83623B/L, 83624B	HP 8370 Series/8349B, HP 83751B, 83752B
Maximum leveled power (25° ± 5° C) **Minimum settable power**	+ 8 dBm – 5 dBm	+ 8 dBm – 5 dBm
Power level accuracy[2] (25° ± 5° C) **Power flatness** (at max. leveled power)	± 2.00 dB ± 1.50 dB[3]	± 2.00 dB ± 1.50 dB[3]
Source output SWR	< 2.0	< 2.0
Spurious signals[4] Harmonically related spurious: 26.5 to 26.7 GHz 26.7 to 40.0 GHz	 < – 25 dBc < – 40 dBc	 < – 25 dBc < – 20 dBc

[1] All specifications apply to internally leveled operation only.
[2] Specified with respect to HP 83550A or HP 8349B power display. Includes power level flatness.
[3] Must have 0.5 V/GHz modification on microwave source.
[4] Expressed in dB relative to the carrier level (dBc).

HP 83555A Output Characteristics[1]

	HP 8360 Series/8349B, HP 83623B/L, 83624B	HP 8370 Series/8349B, HP 83751B, 83752B
Maximum leveled power (25° ±5° C) **Minimum settable power**	+3 dBm –5 dBm	+3 dBm –5 dBm
Power level accuracy[2] (25° ± 5° C) **Power flatness** (at max. leveled power)	±2.00 dB ±1.50 dB[3]	±2.00 dB ±1.50 dB[3]
Source output SWR	< 2.0	< 2.0
Spurious signals[4] Harmonically related spurious: 33.0 to 37.5 GHz 37.5 to 49.5 GHz 49.5 to 50.0 GHz	 < –20 dBc < –40 dBc < –20 dBc	 < –20 dBc < –50 dBc < –20 dBc

HP 83556A Output Characteristics[1]

	HP 8360 Series/8349B, HP 83623B/L, 83624B	HP 8370 Series/8349B, HP 83751B, 83752B
Maximum leveled power (25° ± 5° C) **Minimum settable power:**	+3 dBm –5 dBm	+3 dBm –5 dBm
Power level accuracy[2] (25° ±5° C) **Power flatness** (at max. leveled power)	±2.25 dB ±1.75 dB[3]	±2.25 dB ±1.75 dB[3]
Source output SWR	< 2.0	< 2.0
Spurious signals[4] Harmonically related spurious: 40.0 to 45.0 GHz 45.0 to 60.0 GHz	 < –20 dBc < –40 dBc	 < –20 dBc < –50 dBc

HP 83557A Output Characteristics

	HP 8360 Series/8349B, HP 83623B/L, 83624B	HP 8370 Series/8349B, HP 83751B, 83752B
Maximum leveled power (25° ± 5° C) **Minimum settable power**	+3 dBm –2 dBm	+3 dBm –2 dBm
Power level accuracy (25° ± 5° C) **Power flatness** (at max. leveled power)	±2.0 dB ±1.5 dB	±2.5 dB ±2.0 dB
Source output SWR Leveled: Unleveled:	 < 2.0 < 3.0	 < 2.0 < 3.0
Spurious signals[4] Harmonically related spurious:	 < –20 dBc	 < –20 dBc

HP 83558A Output Characteristics

	HP 8360 Series/8349B, HP 83623B/L, 83624B	HP 8370 Series/8349B, HP 83751B, 83752B
Maximum leveled power (25° ± 5° C) **Minimum settable power**	0 dBm –5 dBm	0 dBm –5 dBm
Power level accuracy (25° ± 5° C) **Power flatness** (at max. leveled power)	±2.0 dB ±1.5 dB	±2.5 dB ±2.0 dB
Source output SWR Leveled: Unleveled:	 < 2.0 < 3.0	 < 2.0 < 3.0
Spurious signals[4] Harmonically related spurious:	 < –20 dBc	 < –20 dBc

[1] All specifications apply to internally leveled operation only.
[2] Specified with respect to HP 83550A or HP 8349B power display. Includes power level flatness.
[3] Must have 0.5 V/GHz modification on microwave source.
[4] Expressed in dB relative to the carrier level (dBc).

General Specifications

Waveguide Output Connector
HP 83554A: EIA size WR 28 waveguide; JAN UG-599 flange
HP 83555A: EIA size WR 22 waveguide; JAN UG-383 flange
HP 83556A: EIA size WR 19 waveguide; JAN UG-383 (mod.) flange
HP 83557A: EIA Size WR 15 waveguide; JAN UG-385 flange
HP 83558A: EIA Size WR 10 waveguide; JAN UG-387 flange
Weight: Net, 1.7 kg (4 lb)
Size: Module, 80 mm W x 80 mm H x 210 mm D (3.15 in x 3.15 in x 8.27 in)
Furnished with Each Source Module: Operating and Service Manual, Modification Procedures for 0.5 V/GHz Output, Type-N RF Cable, Module Base Assembly, Synthesizer Interface Cable

Key Literature

HP 83557A/83558A Data Sheet, p/n 5958-0398
HP 83554A/83555A/83556A, MM-Wave Source Modules Data Sheet, p/n 5954-8364D

Ordering Information

HP 83554A 26.5 to 40.0 GHz mm-Wave Source Module
HP 83555A 33.0 to 50.0 GHz mm-Wave Source Module
HP 83556A 40.0 to 60.0 GHz mm-Wave Source Module
HP 83557A 50.0 to 75.0 GHz mm-Wave Source Module
HP 83558A 75.0 to 110.0 GHz mm-Wave Source Module
Opt 910 Extra Service Manua
Opt W30 Extended Repair Service (see page 70)
HP 83554/5/6
HP 83557/8
Opt W32 Calibration Service (see page 70)
HP 83554/5/6
HP 83557/8

HP E2747A
HP E2748A

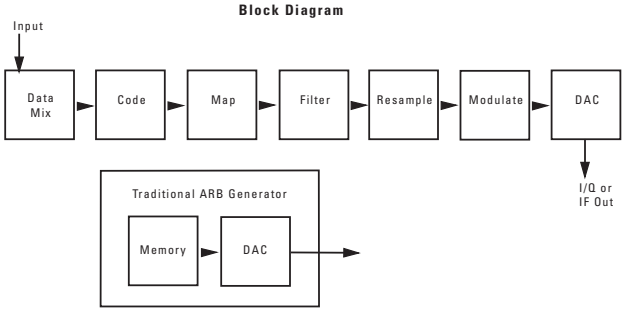
- Digital transmitter architecture
- Open platform for new or unique modulation formats
- Generate messages, including protocol
- Real-time signal generation from data
- Simulate realistic spectral environments with multiple channels
- Modulated IF and baseband I/Q outputs
- PC instrument or VXI system form factor

HP E2747A Vector Waveform Generator
HP E2748A Vector Waveform Generator Module

Virtual Transmitter for Rapid Prototyping

The HP E2747/48A family of baseband vector waveform generators lets digital communications designers generate a wide range of digitally modulated signals. The HP E2747A is a preconfigured PC-format instrument. The HP E2748A vector waveform generator module is a system builder's element which plugs into one of two supported carriers.

HP E2747A/E2748A Vector Waveform Generator
Block Diagram



Both the HP E2747A and HP E2748A use a generalized digital transmitter architecture. Unlike arbitrary waveform generators, which can only play back pre-computed samples stored in memory, the vector waveform generator can also accept data as input, then apply the required coding, filtering, mapping and modulation, just as a digital transmitter does. This allows real-time signal generation from data.

You have complete control over all the parameters of each block of the architecture, such as modulation type, symbol rate, number of symbol bits, etc. There are two means of accessing these: a "soft-panel" user interface which provides "fill-in-the-blanks" simplicity of operation, and a function library interface for programmatic control. Both user interfaces run in a Windows NT/95 environment on a PC controller.

Real-World Signals for Real-World Testing

Because you have complete control of message formatting, you can generate signals which contain protocol fields and payload. Messages have 16 fields, each of varying length. You can direct the vector waveform generator to fill each field with data from one of several data sources, including a data register for fixed data, a RAM file, or a COM port for real time message creation. You can also use the onboard random noise generator as a data source.

Generate even more realistic test signals with a multi-channel system. With independent control of each channel's frequency, modulation format, symbol rate, and more, use it for simulating realistic spectral environments, including impairments. You can vary the parameters without reloading your message data.

PC and VXI Format

Choose the form factor which best meets your needs. The PC-based HP E2747A allows a maximum of 3 channels. More channels are possible with the HP E2748A in its VXI-based carrier (the HP SCMVX008 with options -001 and -082.) Each VXI carrier accepts 6 HP E2748A modules, and you can use multiple carriers per VXI mainframe.

IS95A Base Station Emulator Option

Emulate the forward CDMA channel structure of an IS95A-compliant base station signal. Generate pilot, sync, paging and traffic channels. This flexible, real-time signal generation capability allows production of a compliant signal and modifications to its characteristics and data as desired. Users can supply data real-time from a file. A Graphical User Interface (GUI) and a library of Application Programming Interface (API) calls are also included in this Special Option.

Specifications

Form Factor
HP E2747A: Pre-configured PC-format instrument
HP E2748A: Module assembly to be used in a separate carrier (VXI or PCI) for system builder applications

Hardware
Carrier Frequency: dc to 6 MHz
Signal Bandwidth: 6 MHz in playback mode; 2 MHz typical, real time
Level Accuracy: ±0.5 dB at 10 kHz
Flatness (relative to 10 kHz): ±0.75 dB
Spurious Distortion: –70 dB below full scale
Harmonic Distortion: –55 dBc

Software
Operating System: Compatible with Windows NT or Windows 95
User Interface: Graphical soft front panel, or function library calls
Configurable Parameters: Data source for message fields; message fields descriptions; coder; filter modes and shapes, including wizard to synthesize custom filters; symbol mapping; modulation format; carrier frequency, and more.

Key Literature

HP E2747A & E2748A Product Overview, p/n 5966-4764E
HP E2747A & HP E2748A Technical Specifications, p/n 5968-1047E
HP E2747A & HP E2748A Configuration Guide, p/n 5967-5509E

Ordering Information

HP E2747A Vector Waveform Generator
- **Opt 001** Add one additional channel
- **Opt 002** Add two additional channels
- **Opt 003** Single channel upconversion to 3 GHz via HP ESG Series Model E4432B
- **Opt 004** Multi-channel upconversion to 2.65 GHz via HP 89431A

HP E2748A Vector Waveform Generator Module

Hewlett-Packard offers a complete line of signal analyzers to provide frequency-, time-, order-, angle- and modulation-domain measurement capability. This section is devoted primarily to the frequency domain. It includes spectrum analyzers, distortion analyzers audio analyzers, modulation analyzers and measuring receivers. Each type of instrument has distinctive capabilities that make it the preferred instrument for a particular measurement application.

The spectrum analyzer is a swept-tuned, superheterodyne receiver that provides a display of amplitude versus frequency. It is essentially a frequency-selective, peak-responding voltmeter calibrated to display the rms value of a sine wave. The spectrum analyzer can show the individual frequency components that make up a complex signal. (It does not provide phase information about a signal, however.) The swept receiver technique used in Hewlett-Packard spectrum analyzers enables frequency-domain measurements to be made over a large dynamic range and a wide frequency range (30 Hz to 325 GHz).

The Fourier analyzer uses digital sampling and mathematical transformation techniques to form a Fourier spectrum of a signal. This method is useful for measuring signals from a few µHz to 100 kHz, and provides frequency, amplitude and phase information. With its real-time signal analysis capability, the Fourier analyzer is able to capture periodic as well as random transient events.

Distortion analyzers and audio analyzers employ broadband detectors and notch filters to measure signal properties such as total harmonic distortion. These tunable filters enable the analyzer to selectively display the level and frequency of harmonic and distortion products. Measurement results are shown on a meter or digital display. Audio analyzers include a signal source, making possible measurements such as SINAD, which include signal and distortion levels. The frequency range covered by HP distortion and audio analyzers extends from 5 Hz to 600 kHz.

Modulation analyzers and measuring receivers are designed to capture and analyze a fundamental signal and its entire modulation envelope. Modulation analyzers use independent AM and FM detection circuits for simultaneous analysis of complex modulated signals. When these analyzers are combined with a downconverter and local oscillator, accurate measurements of frequency, power and modulation characteristics can be made on signals from 150 kHz to 26.5 GHz. All measurement results are presented on a digital display.

Spectrum Analyzers

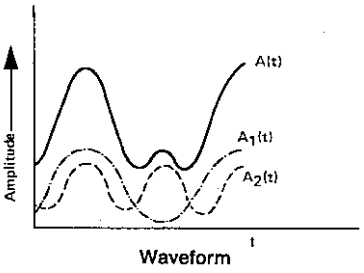
Spectrum analyzers take advantage of the frequency-conversion properties of the swept-tuned heterodyne receiver to make significant contributions to frequency-domain signal analysis. The following are some of the measurements that can be made with spectrum analyzers:

- Absolute and relative frequency
- Absolute and relative amplitude
- Scalar
- Noise
- Distortion products
- AM, FM, pulsed RF, and digital modulation
- Stimulus response
- Electromagnetic compatibility (EMC)

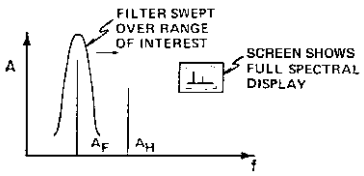
These measurements are possible because spectrum analyzers have the following characteristics:

- Broad frequency coverage from 30 Hz to 325 GHz
- Wide amplitude range from –156 dBm to +30 dBm
- Tracking generators for scalar measurements
- Excellent sensitivity for low signal detection
- Excellent frequency stability
- High resolution of frequency and amplitude
- Digital demodulation capability

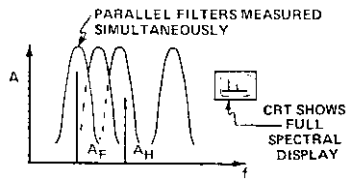
These capabilities allow spectrum analyzers to provide frequency-domain signal analysis for numerous applications, including the manufacture and maintenance of microwave communication links, radar, telecommunications equipment, CATV systems and broadcast equipment, mobile communication systems, EMI diagnostic testing, component testing, lightwave measurements and signal surveillance.



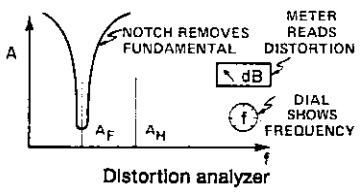
Waveform



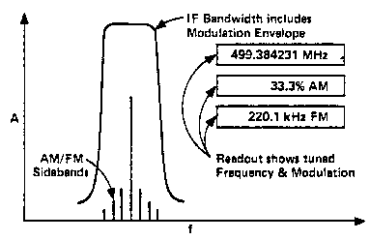
Spectrum analyzer



Fourier analyzer



Distortion analyzer



Modulation analyzer

In addition to the swept-tuned frequency mode, spectrum analyzers can also be used in the fixed-tuned mode (zero span) to provide time-domain measurement capability much like that of an oscilloscope.

Vector signal analyzers extend the capabilities available in a spectrum analyzer. Though similar to Fourier analyzers, vector signal analyzers provide capabilities through the RF range, offering fast, high-resolution spectrum measurements, demodulation and advanced time-domain analysis. They are especially useful for characterizing complex signals such as burst, transient, or modulated signals used in communications, video, broadcast, sonar, and ultrasound imaging applications.

With the addition of computers, the capability of spectrum analyzers can be greatly enhanced. Computers can be used to directly control the operation of spectrum analyzers over GPIB. Computers can also be used to develop downloadable programs (DLPs) for spectrum analyzers with the capability to store such programs in non-volatile memory. These custom measurement routines are then as easy to use as any of the standard instrument features. Custom measurement "personality" cards are available for many spectrum analyzers.

In addition, spectrum analyzers can directly control a plotter or printer, enabling a hard copy of the display to be made without the use of a computer. Application areas that require accurate, high-speed, repetitive routines, physical separation of the operator and the analyzer, unattended operation or operation by personnel with limited technical skills are all candidates for automation.

Areas that benefit significantly from automated spectrum analysis include:

- EMC testing
- frequency spectrum monitoring
- production testing of RF or microwave components, subsystems, or systems
- remote-site testing

The basic measurement capabilities of the spectrum analyzer, combined with its ability to automate and to interface with other GPIB instruments and peripherals, make this instrument ideal for many general-purpose and specialized applications.

Fourier Analyzers

Fourier analyzers offer fast, high-resolution spectrum and network analysis. Unlike conventional swept analyzers, Fourier-based analyzers can measure dynamic signals because they measure all frequencies simultaneously, not one at a time.

Fourier analyzers characterize signals using digital signal-processing techniques based on the Discrete Fourier Transform. For a complete description of these techniques, see Application Note 243, *The Fundamentals of Signal Analysis.*

Fourier analyzers are especially useful on low-frequency signals (< 100 kHz) or where very fast measurements are desired. They can improve measurement speed from a factor of 10 to 100, and allow accurate measurements on frequencies as low as a few µHz. Signal components as closely spaced as 20 µHz can be clearly resolved and accurately measured.

Since both the magnitude and phase of each frequency component are measured, the Fourier analyzer can measure the statistical properties of signals, or the joint properties or relationships of two or more signals. Applications include acoustic, modal, vibration, or rotating machine analysis. In addition, various types of modulation can be detected and measured.

Simultaneous measurement of magnitude and phase on two or more channels provides high-quality network measurements. Transfer functions or frequency response can be easily measured, and the use of band-limited or band-translated random noise as the stimulus allows the entire frequency span of interest to be measured at once. Measurement of the coherence function can provide an indication of the validity of many network measurements.

Distortion and Audio Analyzers

The Hewlett-Packard distortion and audio analyzers consist of narrow-band rejection filters and broadband detectors. Before the fundamental is rejected, the analyzer first measures the amplitude of the fundamental, all the harmonic components, and the noise. Then the rejection filter is employed to remove the fundamental. The ratio of the two measurements is total harmonic distortion plus noise.

Audio Analyzers

The audio analyzer performs several basic low-frequency measurements in addition to distortion, making it a general-purpose audio test set. The audio analyzer includes the SINAD function for testing mobile radio receiver sensitivity. It contains a low-distortion audio oscillator for stimulus-response testing in combination with its distortion analyzer. It has a true rms voltmeter and dc voltmeter for accurate measurement of complex waveform levels. Swept ac level and swept distortion measurements can be made using the internal source and rms voltmeter. A reciprocal frequency counter is included that continuously counts the frequency of the input signal.

True Harmonic Distortion Measurements

Computer-controlled spectrum analyzers provide a rapid means of measuring true harmonic distortion levels. The fundamental and its harmonic components are rapidly measured one at a time, and the distortion is computed and either stored or printed.

Modulation Analyzers/ Measuring Receivers/ Vector Signal Analyzers

A modulation analyzer is a precision receiver designed to detect the entire modulation envelope of a signal under test. It can measure and display the carrier characteristics of RF frequency and power, as well as AM, FM and phase modulation characteristics such as AM depth, peak deviation, residual modulation, and various associated ratios. The modulation analyzer faithfully recovers the actual modulation signal for further analysis such as distortion testing.

In addition to having all the capabilities of the modulation analyzer, the measuring receiver can measure power down to –127 dBm. With very high accuracy, it can look at signals up to millimeter-wave frequencies. This makes it ideal for the calibration of signal generators and attenuators.

Vector Signal Analyzers

The vector signal analyzer is also capable of modulation analysis. Similar to Fourier analyzers, vector signal analyzers extend the capabilities of DSP through the RF range. Since both the magnitude and the phase of signals are captured, vector signal analyzers can provide a broad range of measurements including spectrum, modulation and power on baseband, IF, or RF signals. Vector or I and Q formats can be analyzed in addition to AM, FM and PM formats. Vector signal analyzers are especially useful when a broad range of measurements is required, for example, in the development of digital communication systems.

Microwave Modulation Analyzers

Most modern microwave communication and radar/EW system designers are turning to the use of complex modulations, which involves the use of quadrature or vector modulation formats such as QPSK or 16 QAM in the case of communication systems or complex, coded formats in the case of radar/EW systems.

In all these receivers, the signal processing is not handled in the traditional one-channel, amplitude-only mode, but instead is demodulated into in-phase and quadrature-phase signals that provide dynamic phase and amplitude information about the modulation of the carrier.

Modulation-domain analyzers represent an extension of Hewlett-Packard's counter/timer technology. They provide helpful views of the frequency, phase, or timing of a signal versus time. They also provide histograms and statistical analyses, making it easy to quickly analyze large amounts of measurement data. Modulation-domain analyzers allow you to directly view frequency switching and settling of VCOs, PLLs and synthesizers. They also make it easy to analyze complex phase and frequency modulations found in modern communications systems. See page 130 for a complete overview.

Signal Analyzer Selection Guide

Spectrum Analyzers[1]

Frequency range	Frequency accuracy (±) [2]	Resolution bandwidth range	Average noise level (narrowest RBW)	Optimum dynamic range 2nd/3rd order	Amplitude accuracy (±)	HP model number	Page
Low frequency							
122 MHz to 102.4 kHz	30 ppm	61 MHz to 1024 Hz	<–140 dBVrms/$\sqrt{Hz}$	90 dB typical	0.25 dB[3]	35665A/35670A	261
dc to 10 MHz	30 Hz	312 µHz to 3 MHz	–170 dBm	75 dB/75 dB	0.7 dB[3]	89410A[4]	250
10 Hz to 500 MHz	0.13 ppm[6]	1 Hz to 1 MHz	<–145 dBm	95 dB/100 dB	0.8 dB[3]	4395A	
RF (data given for CF = 1 GHz)							
9 kHz to 1.5 GHz	2.0 kHz	1kHz	–117 dBm	78.5 dB/83 dB	1.0 dB[8]	E4411B	229
9 kHz to 1.5 GHz	101 Hz	10 Hz	–151 dBm	90 dB/97 dB	1.0 dB[8]	E4401B	223
1 MHz to 1.8 GHz	210 Hz	30 Hz to 3 MHz[6]	≤ – 88 dBmV	76 dB/88 dB[6]	1.7 dB[3]	8591C	513
9 kHz to 1.8 GHz	210 Hz[6]	30 Hz to 3 MHz[6]	–130 dBm[6]	77 dB/90 dB[6]	1.7 dB[5,3]	8591E	230
dc to 2.65 GHz	180 Hz	312 µHz to 3 MHz	–185 dBm	75 dB/75 dB	1.1 dB[3]	89441A	250
2 Hz to 1.8 GHz	130 Hz[6]	1 Hz to 3 MHz[6]	–147 dBm	86 dB/102 dB	1.0 dB[3]	4396B	241
9 kHz to 2.9 GHz	210 Hz[6]	30 Hz to 3 MHz[6]	–127 dBm[6]	78 dB/88 dB[6]	1.7 dB[5,3]	8594E	230
30 Hz to 2.9 GHz + mm	106 Hz	1 Hz to 2 MHz	–145 dBm	88 dB/103 dB	1.85 dB[3]	8560E	236
100 Hz to 2.9 GHz	110 Hz	10 Hz to 300 kHz (3 MHz)[6]	–134 dBm (–156 dBm)[6]	82 dB/92 dB	1.5 dB (0.9 dB)[7,3]	71100C/P	241
9 kHz to 3.0 GHz	101 Hz	10 Hz	–151 dBm	90 dB/97 dB	1.0 dB[8]	E4402B	223
9 kHz to 3.0 GHz	2.0 kHz	1 kHz	–117 dBm	78.5 dB/83 dB	1.0 dB[8]	E4403B	229
7 MHz to 4.0 GHz	180 Hz	100 mHz to 1 MHz	–106 dBm	/108 dB	0.5 dB[8]	E4406A	353
30 Hz to 6.5 GHz + mm	106 Hz	1 Hz to 2 MHz	–145 dBm	88 dB/103 dB	1.85 dB[3]	8561E	237
9 kHz to 6.5 GHz	210 Hz[6]	30 Hz to 3 MHz[6]	–125 dBm[6]	77 dB/86 dB[6]	2.2 dB[5,3]	8595E	230
9 kHz to 6.7 GHz	101 Hz	10 Hz	–151 dBm	90 dB/97 dB	1.0 dB[8]	E4404B	223
Microwave (data given for CF = 10 GHz)							
9 kHz to 12.8 GHz	210 Hz[6]	30 Hz to 3 MHz[6]	–125 dBm	77 dB/86 dB[6]	2.7 dB[3,5]	8596E	230
9 kHz to 13.2 GHz	101 Hz	10 Hz	–151 dBm	90 dB/97 dB	1.0 dB[8]	E4405B	223
30 Hz to 13.2 GHz	103 Hz	1 Hz to 2 MHz	–151 dBm	95 dB/108 dB	2.1 dB[3]	8562E	237
100 Hz to 26.5 GHz + mm	1 kHz	10 Hz to 3 MHz	–137 dBm (–155 dBm)[6]	99 dB/96 dB	2 dB (0.9 dB)[7,3]	71209A/P	241
100 Hz to 22 GHz + mm[6] + lightwave	1 kHz	10 Hz to 3 MHz	–136 dBm (–153 dBm)[6]	96 dB/98 dB	2.5 dB(0.9 dB)[7,3]	71210C/P	241
50 kHz to 22 GHz + mm[6]	1 kHz	10 Hz to 3 MHz	–109 dBm (–135 dBm)[6]	84 dB/91 dB	2 dB (0.9 dB)[7,3]	71200C/P	241
9 kHz to 22 GHz (26.5 GHz)[6]	1.2 kHz[6]	30 Hz to 3 MHz[6]	–117 dBm[6]	103 dB/81 dB[6]	2.7 dB[5,3]	8593E	230
9 kHz to 26.5 GHz + mm (30 Hz to 26.5 GHz)[6]	1 kHz	1 Hz to 2 MHz	–145	117 dB/102 dB	3 dB[3]	8563E	237
9 kHz to 26.5 GHz	101 Hz	10 Hz	–151	90 dB/97 dB	1.0 dB[8]	E4407B	223
9 kHz to 26.5 GHz	2.0 kHz	1 kHz	–117	78.5 dB/83 dB	1.0 dB[8]	E4408B	229
100 Hz to 40 GHz + mm[6]	1 kHz	10 Hz to 3 MHz	–136 dBm (–155 dBm)[6]	99 dB/96 dB	2 dB (0.9 dB)[7,3]	71209A/P Z40	241
9 kHz to 40 GHz	1 kHz	1 Hz to 2 MHz	–143	117 dB/100 dB	3 dB[3]	8564E	237
9 kHz to 50 GHz	1 kHz	1 Hz to 2 MHz	–143	117 dB/100 dB	3 dB[3]	8565E	237

[1] Data shown here is for comparison purposes only. Consult data sheets for more complete specifications.
[2] Accuracy includes 1-year aging. Settability and temperature drift not included.
[3] Relative accuracy consists of relative frequency response plus the lesser of either scale fidelity or IF gain accuracy.
[4] Combination vector-network and spectrum analyzer.
[5] Based on IF gain accuracy specified over 60 dB range. 0 to –50 dBm input signal; span ≤20 kHz; 20 to 30° C.
[6] Includes optional performance.
[7] Transfer accuracy using HP 70100A-H01 power meter.
[8] For reference levels 0 to –50 dBm; input attenuation 10dB; RBW=1 kHz; VBW=1kHz; log scale; 0 to 50 dB log range from reference level; coupled sweep time; sample detector;

Signal Analyzers

Signal Analyzer Selection Guide

Dynamic Signal Analyzers

Frequency range	Channel match	Frequency resolution in lines	Real-time bandwidth*	Dynamic range	Amplitude** accuracy (+)	HP model number	Page
0.000122 Hz to 102.4 kHz	± 0.04 dB, ± 0.5°	100 to 1600	25.6 kHz	80 dB, 90 dB typ.	0.15 dB	35670A	537
0.000244 Hz to 102.4 kHz	± 0.04 dB, ± 0.5°	100 to 800	12.8 kHz	< –72 dB	0.25 dB	35665A	
0.000122 Hz to 102.4 kHz	± 0.1 dB, ± 0.5°	25 to 3200	25.6 kHz	80 dB	0.15 dB	3567A	
0.000122 Hz to 12.8 kHz	± 0.1 dB, ± 0.5°	25 to 3200	12.8 kHz (4 ch.)	72 dB	0.15 dB	3566A	
0.0325 Hz to 40 kHz	± 0.2 dB, ± 0.5°	50 to 1600	> 2.0 kHz	60 dB	0.5 dB	3560A	537
dc to 4 MHz	NA	51 to 12,800	1 MHz	80 to 110 dBFS	0.03 dB	3587S	320
0.0002 Hz to 10 MHz	± 0.25 dB, ± 2.0°	51 to 3201	78.125 kHz (1 ch.)	75 dB, 85 dB typ.	0.5 dB	89410A	250
0.0325 - 25.6 µHz	± 0.1 dB, ± 1.0°	50 to 1600, Octaves	> 6.4 kHz, 20 kHz Octaves	72 dB	0.5 dB	3569A	

*One-year aging; settability and temperature drift included.
**Relative accuracy = relative frequency response + lesser of either scale fidelity or IF gain accuracy.

Distortion/Audio Analyzers

Fundamental frequency range	Minimum distortion	Auto set level	Auto nulling	True RMS	AM detector	Filters	Internal source	GPIB	HP model number	Page
20 Hz to 100 kHz	0.01% (–80 dB)	•	•	•	See Note	•	•	•	8903B*	365
20 Hz to 100 kHz	0.01% (–80 dB)	•	•	•	See Note	•	—	•	8903E**	365

*The HP 8903B also performs frequency count, signal/noise, SINAD, watts and ac/dc voltage measurements.
**The HP 8903E also performs frequency count, SINAD and ac/dc voltage measurements.
Note: The HP 8901A modulation analyzer provides complete demodulation of AM, FM and ΘM signals.

Modulation Analyzers/Measuring Receivers/Vector Signal Analyzers

Frequency range	Modulation measurements	Amplitude measurement range	Audio frequency count + distortion measurement	HP model number	Page
150 kHz to 1300 MHz	AM, FM, ΘM	+30 to 0 dBm	No	8901A	247
150 kHz to 1300 MHz	AM, FM, ΘM	+30 to –20 dBm	Yes	8901B	250
150 kHz to 1300 MHz	AM, FM, ΘM	+30 to –127 dBm	Yes	8902A	245
150 kHz to 18 GHz or 26.5 GHz	AM, FM, ΘM	+30 to –100 dBm	Yes	8902S	292
dc to 2650 MHz	Baseband, IF, RF, I, Q, mag/phase, AM, FM, ΘM	+25 to –160 dBm	No	89441A	250

*50 to 200 MHz standard. Operation above 200 MHz available as specials.

Modulation Domain Analyzers

Frequency range	Resolution freq./time	Sample rate	Memory size	Analysis and displays	HP model number	Page
10 Hz to 200 MHz (2.5 GHz option)	10 digits/200 ps	2.5 M (8 M rep.)	8 K (32 K option)	Frequency and time interval vs. time, histograms, statistics (digital RF communications option)	53310A	128
50 Hz to 150 MHz	10 digits/100 ps	80 M	512 K	Frequency, time interval, time stamp, histograms, statistics (application specific software solutions available)	E1740A (VXI)	126

VCO/PPL Signal Test System

Frequency range	Maximum sensitivity (depends on offset frequency)	Functions available	HP model number	Page
10 MHz to 12.6 GHz	–147 dBc/Hz @ offset freq. 100 kHz to 10 MHz (as phase noise measurement performance)	Frequency, power level, C/N ratio (phase noise), FMdeviation and dc consumption current	4352S VCO/PLL Signal Test System	325

- 28 updates/sec measurement speed
- ±1 dB amplitude accuracy
- Optional 10 Hz resolution bandwidth filter
- Six-slot option card cage
- 97 dB third order dynamic range
- Field rugged portability
- Three year warranty

HP ESA-E Series Spectrum Analyzers NEW

The HP ESA-E series general purpose, portable spectrum analyzers offer a wide range of performance, features, and flexibility previously unavailable in this price range. Five models offer frequency ranges starting at 9 kHz and ending between 1.5 GHz and 26.5 GHz.

Fast measurement speed

The 5 ms full-span RF sweep time and up to 28 measurements per second gives you virtual real-time measurement response. This means you spend less time testing or tuning circuits. High-speed remote measurements and data transfer of up to 19 measurements per second reduce critical test time in automatic test environments. Optional 20 µs zero-span sweep time illuminates fast changing signals in the time domain.

Highly accurate

A continuously phase-locked synthesizer operating over the entire sweep provides improved frequency accuracy, stability, and repeatability. The outstanding amplitude accuracy of ±1 dB up to 3 GHz and ±2.5 dB up to 26.5 GHz adds measurement confidence, improved yield and reduced test margins. The amplitude correction factor capability lets users remove frequency-related effects.

Automatic background alignment provides continuous calibration between sweeps, which means the full accuracy is maintained without operator intervention.

Digital resolving power

With the optional digital resolution bandwidth (RBW) filters (10 Hz to 300 Hz), you obtain finer resolving power to separate and measure closely spaced signals. A narrow shape factor (5:1) aids measurement of small signals close to the carrier. These digital RBW filters sweep up to 80 times faster than their analog equivalents, while improving sensitivity.

Wide dynamic range

97 dB maximum 3rd order dynamic range (+11 dBm TOI) and the 5 dB step attenuator let you see low-level distortion. Spur searching is enhanced with the 151 dBm sensitivity, optional built-in preamp, and the fast measurement speed. Up to 120 dB of calibrated display range allows simultaneous display of large and small signals.

Rugged portability

Take the analyzer's lab grade performance into the field protected by rubber encased frames, rain-resistant front panel, and shielded vents. A snap on battery provides up to 1.9 hours of cordless operation and 12 Vdc capability allows operation with automotive electrical systems. Five-minute warm-up offers full measurement accuracy without waiting. And, automatic background alignment maintains the full measurement accuracy over time and varying temperatures.

Flexible platform

The ESA-E series can be configured specifically for your application as well as protect your investment into the future. The six-slot option card cage allows you to choose only the performance you need now and upgrade in the future. This scalable performance in combination with HP measurement personalities, downloaded into the internal memory, can transform the analyzer into an application focused solution, for example, cdmaOne or GSM measurements.

A growing number of plug-in option boards provide even more measurement capability. Most option boards are easily installed into the built-in card cage and are retrofittable.

Options include:

- Digital narrow resolution bandwidth filters of 10, 30, 100, 200 EMI and 300 Hz.
- Time-gated spectrum analysis
- FM demodulation – measurements plus tune and listen
- TV trigger
- 1.5/3.0 GHz built-in tracking generators
- Pre-amplifier (1.5/3.0 GHz fully calibrated)
- GPIB and parallel printer port
- RS-232 and parallel printer port
- High stability frequency reference
- Fast time-domain sweeps
- Additional user memory up to 10 MB
- External mixing capability to 110 GHz
- RF and digital communication hardware
- 75Ω input

Features

- 16.8 cm, high-resolution color display with wide viewing angle make it easy to identify signals of interest.
- The next generation user interface improves ease-of-use. Built-in help gives immediate assistance without manuals. When manuals are needed they are provided in printed form, on CD-ROM and on the World Wide Web.
- One-button measurements such as ACP, Occupied BW, Emissions BW, channel power, 10 peaks table and harmonic distortion provide faster and more repeatable results.
- Multiple limit lines with margins and pass/fail messages simplify production testing. Built-in frequency counter with 1 Hz resolution precisely measures individual signals.
- Store up to 200 traces or states or multiple measurement personalities in the expandable user memory. Use the floppy disk drive for storing and transferring measurement results to a PC, or use HP BenchLink for transfers over GPIB and RS-232 connections. SCPI remote control language and Plug-n-Play drivers enhance remote program development.
- 3 year global warranty lowers cost of ownership.

cdmaOne measurement personality

Options BAC (downloadable program) and B74 (hardware) combine to make cdmaOne standard tests required to verify the performance of cdmaOne transmitters. Measurement features include frequency, time domain, modulation accuracy (Rho), and code domain power. See page 355 for further information.

GSM measurement personality

Options BAH (downloadable program) and B74 (hardware) combine to provide all the GSM 900, DCS1800, and PCS1900 tests required to verify the performance of GSM transmitters. GSM900, E-GSM, R-GSM, DCS1800, and PCS1900 limits and frequency bands are supported. See page 355 for further information.

HP E4401B
HP E4402B
HP E4404B
HP E4405B
HP E4407B

HP ESA-E Series

5

Specifications

All specifications apply over 0° C to +55° C unless otherwise noted. The analyzer will meet its specifications after 2 hours of storage within the operating temperature range, 5 minutes after the analyzer is turned on, and after ALIGN NOW [RF] has been run.

Frequency Specifications

Frequency Range

HP E4401B		
50Ω		9 kHz to 1.5 GHz
75Ω		1 MHz to 1.5 GHz
HP E4402B		9 kHz to 3.0 GHz
HP E4404B		
Band		
0		9 kHz to 3.0 GHz (dc coupled)
0		100 kHz to 3.0 GHz (ac coupled)
1		2.85 GHz to 6.7 GHz
HP E4405B		
Band	LO harmonic = N	
0	1-	9 kHz to 3.0 GHz (dc coupled)
0	1-	100 kHz to 3.0 GHz (ac coupled)
1	1-	2.85 GHz to 6.7 GHz
2	2-	6.2 GHz to 13.2 GHz
HP E4407B		
Band	LO harmonic = N	
0	1-	9 kHz to 3.0 GHz
1	1-	2.85 GHz to 6.7 GHz
2	2-	6.2 GHz to 13.2 GHz
3	4-	12.8 GHz to 19.2 GHz
4	4-	18.7 GHz to 26.5 GHz

Frequency Reference		(Opt.1D5)
Aging	±2 x 10^{-6}/year	±1 x 10^{-7}/year
Temperature Stability	±5 x 10^{-6}	±5 x 10^{-8}
Settability	±5 x 10^{-7}	±1 x 10^{-8}

Frequency Readout

Accuracy (Start, Stop, Center, Marker)	±(frequency indication x frequency reference error[1] + span accuracy + 15% of RBW + 10 Hz)

Marker Frequency Counter[2]

Accuracy[3]	±(marker frequency x frequency reference error[1] + counter resolution + 1 Hz x N[4])
Counter Resolution	Selectable from 1 Hz to 100 kHz

Frequency Span

Range	0 Hz (zero span), 100 Hz x N[4] to the range of the spectrum analyzer
Resolution	2 Hz x N[4]
Accuracy	±1% of span

Frequency Sweep Time

Range	5 ms to 2000 s
Span = 0 Hz	5 ms to 2000 s
(Opt. AYX)	20 µs to 2000 s (RBW ≥ 1 kHz)
Accuracy	±1%
Sweep Trigger	Free run, Single, Line, Video, External, Delay, and Gate (Opt.1D6)
Delay trigger range	1 µs to 400 s

Resolution Bandwidth (RBW)

Range	1 kHz to 5 MHz (-3 dB) in 1-3-10 sequence. 9 kHz and 120 kHz (-6 dB) EMI bandwidths.
Option 1DR	Adds 10, 30, 100, and 300 Hz (–3 dB) bandwidths and 200 Hz (-6 dB) EMI bandwidth.
Accuracy	
1 kHz to 3 MHz RBW	±15%
5 MHz	±30%
10 Hz to 300 Hz RBW (Opt 1DR)	±10%

Selectivity (Characteristic) -60 dB/-3 dB

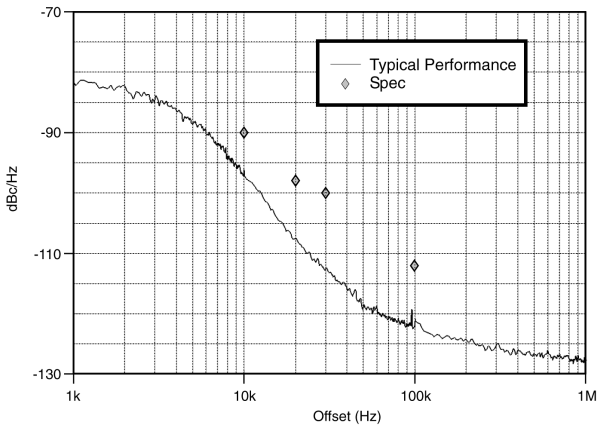
10 Hz to 300 Hz (Option 1DR)	<5:1
1 kHz to 5 MHz	<15:1

Video Bandwidth

Range	30 Hz to 3 MHz[6] in 1-3-10 sequence
Option 1DR	1 Hz to 3 MHz[6]

Stability Noise sidebands (1 kHz RBW, 30 Hz VBW and sample detector)

≥10 kHz offset from CW signal	≤–90 dBc/Hz + 20 Log N[4]
≥20 kHz offset from CW signal	≤–98 dBc/Hz + 20 Log N[4]
≥30 kHz offset from CW signal	≤–100 dBc/Hz + 20 Log N[4]
≥100 kHz offset from CW signal	≤–112 dBc/Hz + 20 Log N[4]



Residual FM

1 kHz RBW, 1 kHz VBW	≤150 x N[4] Hz pk-pk in 100 ms
Option 1D5	≤100 x N[4] Hz pk-pk in 100 ms
Options 1DR ,1DE	≤2 x N[4] Hz pk-pk in 20 ms

System-Related Sidebands (offset from CW signal)

≥30 kHz	≤–65 dBc + 20 Log N[4]

Amplitude Specifications

Amplitude Range

Measurement Range	Displayed average noise level to maximum safe input level
Input Attenuator range	
HP E4401B	0 to 60 dB, in 5 dB steps
HP E4402B/04B/05B/07B	0 to 65 dB, in 5 dB steps

Maximum Safe Input Level

Average Continuous Power	(input attenuator ≥15 dB)
HP E4401B	+30 dBm (1 W)
HP E4401B (75Ω Opt. 1DP)	+75 dBmV (0.4 W)
HP E4402B/04B/05B/07B (input attenuator ≥5 dB)	+30 dBm (1 W)
Peak Pulse Power	(input attenuator ≥30 dB)
HP E4401B	+30 dBm (1 W)
HP E4401B (75Ω Opt. 1DP)	+75 dBmV (0.4 W)
HP E4402B/04B/05B/07B	+50 dBm (100 W)
dc	
HP E4401B (75Ω Opt. 1DP)	100 Vdc
HP E4401B, E4402B	100 Vdc
HP E4404B, E4405B	0 Vdc (dc coupled) 50 Vdc (ac coupled)
HP E4407B	0 Vdc

1 dB Gain Compression (total power at input mixer[5])

≥50 MHz	0 dBm
≥6.7 GHz	–3 dBm
≥13.2 GHz	–5 dBm

HP E4401B
HP E4402B
HP E4404B
HP E4405B
HP E4407B

Displayed Average Noise Level (dBm) (Input terminated, 0 dB attenuation, sample-detector, 30/1 Hz VBW)

	1 kHz RBW	10 Hz RBW (Opt 1DR)	1 kHz RBW w/ preamp (Opt 1DS)	10 Hz RBW w/ preamp(Opt 1DR, 1DS)
HP E4401B				
400kHz-1MHz	≤–115	≤–134	≤–131	≤–149
1MHz-500MHz	≤–119	≤–138	≤–135	≤–153
500MHz-1GHz	≤–117	≤–136	≤–133	≤–151
1GHz-1.5GHz	≤–113	≤–132	≤–129	≤–147
HP E4402B				
1MHz-10MHz	≤–117[6]	≤–136[6]	≤–132[6]	≤–150[6]
10MHz-1GHz	≤–117	≤–136	≤–132 (–133[14])	≤–150 (–151[14])
1GHz-2GHz	≤–116	≤–135	≤–131 (–133[14])	≤–149 (–151[14])
2GHz-3GHz	≤–114	≤–133	≤–129 (–132[14])	≤–147 (–150[14])
HP E4404/05/07B				
1MHz-10MHz	≤–116[6]	≤–134[6]	≤–131[6]	≤–149[6]
10MHz-1GHz	≤–116	≤–135	≤–131 (–132[14])	≤–149 (–150[14])
1GHz-2GHz	≤–115	≤–134	≤–129 (–131[14])	≤–147 (–149[14])
2GHz-3GHz	≤–112	≤–131	≤–127 (–130[14])	≤–145 (–148[14])
3GHz-6GHz	≤–112	≤–131	–	–
6GHz-12GHz	≤–110	≤–129	–	–
12GHz-22GHz	≤–107	≤–126	–	–
22GHz-26.5GHz	≤–101	≤–120	–	–

Display Range

Log scale — 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1dB steps; ten divisions displayed.
RBW ≤300 Hz (Opt 1DR) — 0 to –120 dB from reference level is calibrated
RBW ≥ 1 kHz — 0 to –85 dB from reference level is calibrated
Linear scale — 10 divisions
Scale units — dBm, dBmV. dBµV, Volts, and Watts

Marker Readout Resolution
Log scale — 0.04 dB
Linear scale — 0.01% of reference level

Fast sweep times for zero span (Option AYX)
Log scale
0 to –85 dB from ref. level — 0.3 dB
Linear scale — 0.3% of reference level

Frequency Response (10 dB input attenuation)

	Absolute[7]	Relative Flatness[8]
20° C to 30° C		
9 kHz to 3.0 GHz	±0.5 dB	±0.5 dB
3.0 GHz to 6.7 GHz	±1.5 dB	±1.3 dB
6.7 GHz to 26.5 GHz	±2.0 dB	±1.8 dB
0° C to 55° C		
9 kHz to 3.0 GHz	±1.0 dB	±1.0 dB
3.0 GHz to 6.7 GHz	±2.5 dB	±1.5 dB
6.7 GHz to 26.5 GHz	±3.0 dB	±2.0 dB

Input Attenuation Switching Uncertainty at 50 MHz
Attenuation setting
0 dB to 5 dB — ±0.3 dB
10 dB — Reference
15 dB — ±0.3 dB
20 to 60 dB (HP E4401B) — ±(0.1 dB + 0.01 x Attenuator setting)
20 to 65 dB — ±(0.1 dB + 0.01 x Attenuator setting)

Overall Amplitude Accuracy[9] ± (0.54 dB + Absolute Frequency Response)
RF Input VSWR (at tuned frequency) 10 dB atten.
100 kHz to 6.7 GHz — ≤1.4:1[6]
Resolution Bandwidth Switching Uncertainty
(Referenced to 1 kHz RBW, at reference level)
10 Hz to 3 MHz RBW — ±0.3 dB
5 MHz — ±0.6 dB

Reference Level
Range — same as amplitude range
Resolution — 0.1 dB for log scale, ±0.12% of reference level for linear scale
Accuracy (reference level attenuator setting)
–10dBm to –60 dBm — ±0.3 dB
–60dBm to –85 dBm — ±0.5 dB
–85dBm to –90 dBm — ±0.7 dB

Display Scale Fidelity
Log maximum cumulative
0 dB to –85 dB — ±(0.3 dB + 0.01 x dB from ref. level)
0 dB to –98 dB (Opt 1DR) — ±(0.3 dB + 0.01 x dB from ref. level)
98 dB to –120 dB (Opt 1DR) — ±(2 dB + 0.01 x dB from ref. level)[6]
Log incremental accuracy
0 dB to –85 dB — ±0.4dB/4dB form reference
Linear Accuracy — ±2% of reference level
Linear to Log Switching Uncertainty — ±0.15 dB at reference level
Log Scale Switching — No error

Spurious Responses

Second Harmonic Distortion
E4401B
2 MHz to 750 MHz — <-75 dBc for –40 dBm tone at input mixer[5]. (+35 dBm SHI)

E4402/04/05/07B
10 MHz to 500 MHz — <-65 dBc for –30 dBm tone at input mixer[5]. (+35 dBm SHI)
500 MHz to 1.5 GHz — <-75 dBc for –30 dBm tone at input mixer[5]. (+45 dBm SHI)
1.5 GHz to 2.0 GHz — <-85 dBc for –10 dBm tone at input mixer[5]. (+75 dBm SHI)
>2.0 GHz — <-100 dBc for –10 dBm tone at input mixer[5] (or below displayed average noise level). (+90 dBm SHI)

Third Order Intermodulation Distortion
E4401B
10 MHz to 1.5 GHz — <-80 dBc for two –30 dBm tones at input mixer[5] and >50kHz separation. (+10 dBm TOI, +15 dBm typical[14])

E4402B/04B/05B/07B
100 MHz to 6.7 GHz — <-82 dBc for two –30 dBm tones at input mixer[5] and >50kHz separation. (+11 dBm TOI, +16 dBm typical[14])
>6.7 GHz — <-75 dBc for two –30 dBm tones at input mixer[5] and >50kHz separation.

Other Input Related Spurious (in band)
>offset 30kHz — <-65 dBc, for –20 dBm tones at input mixer[5].

Residual Responses (input terminated and 0 dB attenuation)
150 kHz to 6.7 GHz — <-90 dBm

General Specifications

Temperature Range
Operating — 0° C to +55° C
Storage — –40° C to +75° C
EMI Compatibility — Conducted and radiated interference is in compliance with CISPR Pub. 11/1990 Group 1 Class A
Audible Noise (ISO7779) — <40 dBa pressure and <4.6 Bels power
Military Specification — Has been type tested to the environmental specifications of MIL-PRF-28800F class 3.

Power Requirements
ON
AC Operation (Line 1)
voltage, frequency — 90 to 132 V rms, 47 to 440 Hz
195 to 250 V rms, 47 to 66 Hz
Power consumption — <300 W
Standby (Line 0)
Power consumption — <5 W
DC Operation
Voltage — 12 to 20 Vdc
Power Consumption — <200 W

Measurement Speed[6]
Measurement rate — ≥28 updates/s[10]
Remote measurement and GPIB transfer rate — ≥19 updates/s[10,11]

Data Storage (nominal)
Internal — 200 traces or states
External (Floppy) — 200 traces or states

Downloadable Program Memory — 2 MB available
Opt B72 — 10 MB available

Weight (without options)[6]

E4401B	12.6 kg	(27.7 lbs.)
E4402B	14.9 kg	(32.9 lbs.)
E4404B/05B/07B	16.2 kg	(35.6 lbs.)

Dimensions
w/o Handle — 222mm(H) x 409mm(D) x 373mm(W)
w/handle (max.) — 222mm(H) x 516mm(D) x 408mm(W)

5

Option Specifications

Option 1DN and 1DQ Tracking Generator

Frequency Range

E4401B	
Opt. 1DN, (50Ω)	9 kHz to 1.5 GHz
Opt. 1DQ, (75Ω)	1 MHz to 1.5 GHz
E4402B/04B/05B/07B	
Opt. 1DN, (50Ω)	9 kHz to 3.0 GHz
Resolution BW Range	1 KHz to 5 MHz

Output Level

Range	
E4401B	
Opt. 1DN	0 to –70 dBm
Opt. 1DQ	+42.75 to –27.25 dBmV
E4402B/04B/05B/07B	–2 to –66 dBm
Absolute Accuracy (@ 50 MHz)	
Opt.1DN (HP E4401B)	±0.5 dB
Opt.1DN	±0.75 dB
Opt.1DQ (HP E4401B)	±1.5 dB

Dynamic Range

Maximum output power-Displayed Average Noise Level

Option 1D6 Time Gated Spectrum Analysis

Gate Delay/Length

Range	1 µsec to 400 sec.
Resolution	<Gate Delay(s)/65000; rounded up to nearest µs.
Accuracy	±(500 ns + 0.01% x Gate Delay Readout)

Option BAA FM Demodulation[6]

Input Level[6]	–60 dBm + attenuator setting
Signal Level[6]	0 to –30 dB below reference level

FM Deviation (FM Gain)[6]

Range	10 kHz to 1 MHz
Resolution	Provides 1 Hz display annotation resolution
FM deviation range	
10 kHz to 40 kHz	12 Hz
>40 kHz to 200 kHz	60 Hz
>200 kHz to 1 MHz	300 Hz
Accuracy[12]	<(2% of FM deviation range + 2 x Resolution)

FM Bandwidth (–3 dB)[6]

FM deviation range	
10 kHz to 40 kHz	7.5 x FM deviation range
>40 kHz to 200 kHz	1.3 x FM deviation range
>200 kHz to 1 MHz	0.3 x FM deviation range

Notes:

[1]Frequency reference error = (aging rate x period of time since adjustment + settability + temperature stability).
[2]Not available in RBW <1kHz (Option 1DR)
[3]Marker level to DANL > 25dB, Frequency offset = 0 Hz, RBW/Span ≥0.002.
[4]N = LO harmonic mixing mode
[5]Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuator. (dB).
[6]Characteristic
[7]Referenced to 50 MHz Amplitude Reference
[8]Reference to midpoint between highest and lowest frequency response deviations.
[9]For reference levels 0 to –50 dBm; RBW, 1 kHz; Video BW, 1 kHz; Scale Log, Log range 0 to 50 dB; Sweep time coupled, Sample detector; Signal input, 0 to 50 dBm; Span, ≤20 kHz; Input attenuation 10 dB, 20° to 30° C.
[10]Auto align off, 5ms sweep time, fixed center frequency, characteristic
[11]401 point trace, display off, and integer 32-bit data format.
[12]In time domain sweeps
[13]Settings are: Reference level –20 dBm (–25 dBm HP E4401B); input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; span 2 kHz; sweep time coupled, sample detector; signal at reference level.
[14]20° to 30° C

Ordering Information

E4401B ESA-E 1.5 GHz Spectrum Analyzer
E4402B ESA-E 3.0 GHz Spectrum Analyzer
E4404B ESA-E 6.7 GHz Spectrum Analyzer
E4405B ESA-E 13.2 GHz Spectrum Analyzer
E4407B ESA-E 26.5 GHz Spectrum Analyzer
- **Opt 0B0** Delete manual set
- **Opt 0B1** Add manual set
- **Opt 0BV** Component level service documentation
- **Opt 0BW** Assembly level service guide and CD-ROM with adjustments
- **Opt 1AX** RS-232 and Parallel printer interface (includes RS-232 cable)
- **Opt 1CP** Rackmount and handle kit with slides
- **Opt 1D5** High stability time base
- **Opt 1D6** Time-gated spectrum analysis
- **Opt 1D7** 50Ω/75Ω matching pad with dc block
- **Opt 1DN** 1.5 GHz tracking generator (E4401B only)
- **Opt 1DN** 3 GHz tracking generator
- **Opt 1DP** 75Ω input (E4401B only)
- **Opt 1DQ** 75Ω tracking generator (E4401B only)
- **Opt 1DR** Narrow resolution bandwidths
- **Opt 1DS** 1.5 GHz Preamplifier (E4401B only)
- **Opt 1DS** 3.0 GHz Preamplifier
- **Opt A4H** GPIB and parallel printer interfaces
- **Opt A4J** IF, sweep and video ports
- **Opt A5D** 12 Vdc power cable
- **Opt AXT** Transit case
- **Opt AYT** Grey soft carrying/operating case
- **Opt AYU** Yellow soft carrying/operating case
- **Opt AYX** Fast zero-span sweeps
- **Opt B70** BenchLink Spectrum Analyzer software
- **Opt B72** Increases useable memory to 10 MB
- **Opt B74** RF/Digital communication hardware
- **Opt B75** Performance Bundle (1D5+1DR+1DS)
  E4401B only
  E4402B, E44044B, E4405B, E4407B
- **Opt BAA** FM Demodulation
- **Opt BAB** APC 3.5mm Connector (E4407B only)
- **Opt BAC** cdmaOne Measurement Personality
- **Opt BAH** GSM Measurement Personality
- **Opt UK6** Commerical Calibration Certificate
- **Opt UK9** Front panel cover
- **Opt B7B** TV Trigger with picture on screen (requires Opt BAA)
- **Opt AY2** External Mixing (E4407B only)

HP E1779A Battery pack
HP E4444A BenchLink Spectrum Analyzer Software
HP N2717A Performance and Adjustment Software for calibration of ESA Analyzers
HP 10833A GPIB Cable 1 meter
HP 5182-4794 RS-232 cable, 9 pin (3m)
HP C2950A Parallel printer cable (2m)
HP 87405A Preamp (10 MHz to 3 GHz, 24 dB gain) (fastened to RF input, powered from analyzer)
HP 85905A 75Ω Preamp (45 MHz to 1 GHz, 20 dB gain) (powered from analyzer)
HP 41800A Active Probe (5 Hz to 500 MHz)
HP 85024A Active Probe (300 kHz to 3 GHz)
HP 11742A dc blocking capacitor, M–F APC 3.5 mm connector (45 MHz to 26.5 GHz)
HP 11693A Limiter, M–F N Type N connector (100 MHz to 12.4 GHz)

- Frequency range of 9 kHz to 1.5 GHz, 3.0 GHz, and 26.5 GHz
- ± 1.1 dB absolute amplitude accuracy
- Rugged, portable package follows you from lab, to factory, to field
- >28 measurement updates/second to the display, >19 measurement updates/second over GPIB
- Affordable

HP E4403B

HP E4411B, E4403B, E4408B

NEW

HP expands the ESA-L series, our new, low-cost, fully synthesized spectrum analyzer to 3.0 and 26.5 GHz. Now get quick and accurate results every time, at an affordable price. It has the performance of a high-quality spectrum analyzer and the rugged ease of use expected in a field instrument.

Fast measurements

The HP ESA-L series gives you > 28 measurement updates/second to the display and >19 measurement updates/second over GPIB. Also, the state-of-the-art 5 ms sweep time reduces test time and increases throughput.

Accurate results

The continuously phase-locked synthesizer adds stability and repeatability to frequency measurements, and the automatic background alignment offers continuous calibration. Plus, you'll have specified performance only 5 minutes after power-up. This includes ±1.1 dB absolute amplitude accuracy up to 3.0 GHz and ±2.6 dB up to 26.5 GHz.

Portable operation

Optional snap-on battery eliminates the restrictions of power cords. The optional 12 V-dc power cable allows direct operation from automotive and truck batteries.

Rugged packaging and construction

Ideal for field environments, the HP ESA-L series instruments have a sealed front panel, louvered air vents and side-mounted fan to protect the instrument in a wide range of weather conditions. Rubber-encased front and rear frames resist the rigors of transportation.

Easy to use

The built-in help button gives key function and remote programming commands which eliminates the need to carry manuals. In addition, testing is simplified with built-in limit lines and pass/fail messages. The built-in disk drive makes saving and moving measurement results to your PC quick and easy.

Low cost

All this at a very affordable price, with a standard 3 year global warranty.

PC Software for the HP ESA-L series

The new HP BenchLink Spectrum Analyzer PC software provides an easy-to-use communications link between your PC and the HP ESA-L series spectrum analyzers. Taking full advantage of the Windows interface, you can easily transfer screen images or trace data via GPIB or RS-232 interfaces, thereby making it easy to capture, analyze and document measurement results in your PC. For more information, see page 229.

Frequency Specifications

Frequency Range

HP E4411B: 50 ohms: 9 kHz to 1.5 GHz
HP E4411B: 75 ohms (Option 1DP): 1 MHz to 1.5 GHz
HP E4403B: 9 kHz to 3.0 GHz
HP E4408B: 9 kHz to 26.5 GHz

Band	LO harmonic-N	Center Frequency
0	1	9 kHz to 3.0 GHz
1	1	2.85 GHz to 6.7 GHz
2	2	6.2 GHz to 13.2 GHz
3	4	12.8 GHz to 19.2 GHz
4	4	18.7 GHz to 26.5 GHz

Frequency Reference

Aging: ± 2 x 10^{-6}/year
Settability: ± 5 x 10^{-7}
Temperature Stability: ± 5 x 10^{-6}

Frequency Readout Accuracy

(Start, Stop, Center, Marker): ± (frequency readout x frequency reference error[1] + span accuracy +15% of RBW + 10 Hz)

Marker Frequency Counter

Resolution: Selectable from 1 Hz to 100 kHz
Accuracy: ± (marker frequency x frequency reference error[1] + counter resolution)

Frequency Span

Range: 0 Hz (zero span), and
HP E4411B: 100 Hz to 1.5 GHz
HP E4403B: 100 Hz to 3.0 GHz
HP E4408B: 100 x N^2 Hz to 26.5 GHz
Resolution: Four digits or 2 Hz, whichever is greater
Accuracy: ± 1% of span

Sweep Time

Range: 5 ms to 2000 s
Accuracy (5 ms to 2000s): ± 1%
Sweep Trigger: Free Run, Single, Line, Video, External, Delayed

Resolution Bandwidth

Range (–3 dB width): 1 kHz to 3 MHz, in 1-3-10 sequence, and 5 MHz.
Accuracy (1 kHz to 1 MHz RBW): ± 10%
(9 kHz, 120 kHz, and 3 MHz RBW): ± 15%
(5 MHz RBW): ± 30%
Selectivity (60 dB/3 dB bandwidth ratio): < 15:1, characteristic

Video Bandwidth Range (–3 dB)

30 Hz to 1 MHz in 1-3-10 sequence. 3 MHz, characteristic.

Stability

Noise Sidebands (offset from CW signal, 1 kHz RBW, 30 Hz VBW and sample detector)
≥10 kHz: ≤ –90 dBc/Hz + 20 Log N^2
≥20 kHz: ≤ –98 dBc/Hz + 20 Log N^2
≥30 kHz: ≤ –100 dBc/Hz + 20 Log N^2
≥100 kHz: ≤ –112 dBc/Hz + 20 Log N^2
Residual FM
1 kHz RBW, 1 kHz VBW: ≤150 Hz peak-to-peak X N^2 in 100 ms
System-Related Sidebands, offset from CW signal:
≥30 kHz: ≤–65 dBc + 20 Log N^2

Amplitude Specifications

Absolute Amplitude Accuracy

Overall Amplitude Accuracy[4]: ±(0.6 dB + absolute frequency response)
At reference settings[5]: ± 0.4 dB
Measurement Range
Displayed average noise level to maximum safe input level
Input Attenuator Range:
HP E4411B: 0 to 60 dB, in 5 dB steps
HP E4403B, HP E4408B: 0 to 65 dB, in 5 dB steps

Maximum Safe Input

Average Continuous Power
HP E4411B: (≥ 15 dB attenuation): +30 dBm(1W)
HP E4403B, E4408B: (≥ 5 dB attenuation): +30 dBm(1W)

Peak Pulsed Power
HP E4411B: (≥ 15 dB attenuation): +30 dBm(1W)
HP E4403B, E4408B: (≥ 5 dB attenuation): +50 dBm(100W)
1 dB Gain Compression: (Total power at input mixer)[3]
HP E4411B, E4403B: 0 dBm;
HP E4408B: (50MHz to 6.7 GHz):0 dBm, (6.7 GHz to 13.2 GHz): –3 dBm, (13.2 GHz to 26.5 GHz): –5 dBm

Displayed Average Noise Level (Input terminated, 0 dB attenuation, 30 Hz VBW, sample detector, 1 kHz RBW, reference level = –70 dBm)
HP E4411B:
400 kHz to 1 MHz: ≤ _–117 dBm
1 MHz to 500 MHz: ≤ –119 dBm
500 MHz to 1.0 GHz: ≤ –117 dBm
1.0 GHz to 1.5 GHz: ≤ –113 dBm
HP E4403B:
10 MHz to 1GHz: ≤ –117 dBm
1 GHz to 2.0 GHz: ≤ –116 dBm
2.0 GHz to 3.0 GHz: ≤ –114 dBm
HP E4408B:
10 MHz to 1.0 GHz: ≤ –116 dBm
1.0 GHz to 2.0 GHz: ≤ –115 dBm
2.0 GHz to 6.0 GHz: ≤ –112 dBm
6.0 GHz to 12.0 GHz: ≤ –110 dBm
12.0 GHz to 22.0 GHz: ≤ –107 dBm
22.0 GHz to 26.5 GHz: ≤ –101 dBm

Display Range
Log Scale: 0 to –85 dB from reference level is calibrated; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps; ten divisions displayed
Linear Scale: ten divisions
Scale Units: dBm, dBmV, dBµV, V, and W
Absolute Frequency Response: (Referenced to 50 MHz, 10 dB attenuation, 20 to 30° C)
9 kHz to 3.0 GHz: ± 0.5 dB
3.0 GHz to 6.7 GHz: ± 1.5 dB
6.7 GHz to 13.2 GHz: ± 2.0 dB
13.2 GHz to 25 GHz: ± 2.5 dB
25 GHz to 26.5 GHz ± 3.0 dB

Resolution Bandwidth Switching Uncertainty (at reference level referenced to 3 kHz RBW)
1 kHz, 10 kHz to 3 MHz RBW: ± 0.3 dB
5 MHz RBW: ± 0.6 dB

Reference Level
Range: adjustable over amplitude measurement range
Resolution
Log Scale: ± 0.1 dB
Linear Scale: ± 0.12% of reference level
Accuracy: (at a fixed frequency, a fixed attenuation, and referenced to –30 dBm)
Reference Level – Input Attenuator Setting:
–10 dBm to >–60 dBm ± 0.3 dB
–60 dBm to >–85 dBm ± 0.5 dB
–85 dBm to >–90 dBm ± 0.7 dB

Display Scale Switching Uncertainty
Linear to Log Switching: ± 0.15 dB at reference level
Log Scale Switching: No error

Display Scale Fidelity
Log Maximum Cumulative
0 to –85 dB from reference level: ± (0.3 dB + 0.01 x dB from reference level)
Log Incremental Accuracy
Reference level: ± 0.4 dB/4 dB
Linear Accuracy: ± 2% of reference level

Spurious Responses
Second Harmonic Distortion
HP E4411B:
2 MHz to 750 MHz <–75 dBc for –40 dBm signal at input mixer[3]
HP E4403B, E4408B:
10 MHz to 500 MHz <–60 dBc for –30 dBm signal at input mixer[3]
500 MHz to 1.5 GHz <–70 dBc for –30 dBm signal at input mixer[3]
1.5 GHz to 2.0 GHz <–80 dBc for –10 dBm signal at input mixer[3]
2.0 GHz to 13.25 GHz <–95 dBc for –10 dBm signal at input mixer[3]
Maximum Achievable Second Order Dynamic Range
HP E4411B: (at 500 MHz) 77 dB
HP E4403B: (at 1 GHz) 79 dB
HP E4408B: (at 1 GHz) 78 dB

Third Order Intermodulation Distortion
HP E4411B:
10 MHz to 1.5 GHz <–75 dBc for two –30 dBm signals at input mixer[3], >50 kHz separation
HP E4403B, E4408B:
100 MHz to 6.7 GHz <–75 dBc for two –30 dBm signals at input mixer[3] , >50 kHz separation
6.7 GHz to 26.5 GHz <–70 dBc for two –30 dBm signals at input mixer[3], >50 kHz separation
Maximum Achievable Third Order Dynamic Range
HP E4411B: (at 1.0 GHz) 83 dB
HP E4403B: (at 1.0 GHz) 83 dB
HP E4408B: (at 1.0 GHz) 82 dB
Other Input-Related Spurious
HP E4411B: <–65 dBc, 30 kHz ≤ offset ≤1.2 GHz,for –20 dBm signal at input mixer[3]
HP E4403B, E4408B: <–65 dBc, >30 kHz offset, for –20 dBm signal at input mixer[3]
Residual Responses (Input terminated and 0 dB attenuation):< –90 dBm
AM Demod: Tune and listen to AM signals

Options

Tracking Generator Specifications (Option 1DN or 1DQ)
Output Frequency Range
HP E4411B: 50 Ω (Option 1DN): 9 kHz to 1.5 GHz
HP E4411B: 75 Ω (Option 1DQ): 1 MHz to 1.5 GHz
HP E4403B, E4408B: (Option 1DN): 9kHz to 3.0 GHz

Output Power Level
Range
HP E4411B: 50 Ω (Option 1DN): 0 to –70 dBm
HP E4411B: 75 Ω (Option 1DQ): +42.76 to –27.24 dBmV
HP E4403B, E4408B: 50 Ω (Option 1DN): -1 to –66 dBm
Vernier
HP E4411B: Range: 10 dB **Output Attenuator Range:** 0 to 60 dB in 10 dB steps
HP E4403B, E4408B: Range: 9 dB **Output Attenuator Range:** 0 to 56 dB in 8 dB steps

General Specifications

Measurement Speed
Local measurement and display update rate[6]: ≥28 per second, characteristic
Remote measurement and GPIB transfer rate[6,7]: ≥19 per second, characteristic

Temperature Range
Operating: 0° C to + 55° C
Storage: –40° C to + 75° C
Audible Noise (ISO 7779)
Sound pressure at 25° C: < 40 dB (< 5.3 Bels power)
Military Specification: Has been type tested to the environmental specifications of MIL-PRF-28800F Class 3
EMI Compatibility: Conducted and radiated emission is in compliance with CISPR Pub.11/1990 Group 1 Class A
Power Requirements
ac Voltage: 90 to 132 Vrms, 195 to 250 Vrms
Frequency: 47 to 440 Hz, 47 to 66 Hz
Power Consumption, On: < 300 W
Power Consumption, Standby: < 5 W
dc Voltage: 12 to 20 Vdc
Power Consumption: <200W
Weight (without options)
HP E4411B: 12.6 kg (27.7 lb), characteristic
HP E4403B: 14.9 kg (32.9 lb), characteristic
HP E4408B: 16.2 kg (35.6 lb), characteristic
Dimensions
Height: 222 mm (8.75 in)
Width: 373 mm (14.7 in) w/o handle, 408 mm (16.1 in) w/handle
Depth: 409 mm (16.1 in) w/o handle, 516 mm (20.3 in) w/handle

1 Frequency reference error = (aging rate x period of time since adjustment + settability + temperature stability).
2 N = Harmonic mixing mode. N = 1 for E4411B and E4403B.
3 Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuator. (dB). For RBW ≤ 30 kHz, maximum input signal amplitude must be ≤ reference level + 10 dB.
4 For reference level 0 to –50 dBm: input attenuation, 10 dB; 50 MHz; RBW, 3 kHz; VBW, 3 kHz; log range 0 to 50 dB; sweep time coupled, signal input, 0 to –50 dBm; span, ≤–60 kHz.
5 For reference level –25 dBm for E4411B, –20 dBm for E4403B and E4408B; input attenuation 10 dB; center frequency 50 MHz; resolution bandwidth 3 kHz; video bandwidth 3 kHz; span 2 kHz; sweep time coupled; signal at reference level.
6 Autoalign Off, 5 ms sweep time, fixed center frequency.
7 Display Off, 401-point trace, and integer 32-bit data format, requires Option A4H.

Inputs and Outputs

Amplitude Reference (Internal)
HP E4411B: –25 dBm, nominal
HP E4403B, E4408B: –20 dBm, nominal

Front Panel

Input
Connector/Impedance: Type N (f), 50 ohm, nominal; BNC (f), 75 ohm, nominal (Option 1DP); APC 3.5(m) (Option BAB, HP E4408B)
RF Out
Option 1DN, Connector/Impedance: Type N (f), 50 ohm, nominal
Option 1DP, Connector/Impedance: BNC (f), 75 Ω, nominal
Probe Power
Voltage/Current: +15 Vdc, –12.6 Vdc at 150 mA max., characteristic
Speaker: Front-panel knob controls volume
Headphone: 3.5-mm (1/8 inch) miniature audio jack

Rear Panel

10 MHz Ref Out: BNC (f), 50 ohm, > 0 dBm, characteristic
10 MHz Ref In: BNC (f), 50 ohm –15 to +10 dBm, characteristic
Ext.Trig In: BNC (f), (5 V TTL)
Hi Swp Out: BNC (f), (5 V TTL)
VGA Output: VGA-compatible monitor, 15-pin mini D-SUB, resolution 640 x 480
Aux IF Out (Option A4J): BNC (f), 21.4 MHz, nominal –10 to –70 dBm (uncorrected), characteristic
Aux Video Out (Option A4J): BNC (f), 0 to 1 V (uncorrected), characteristic
Hi Swp in (Option A4J): BNC (f), (5 V TTL)
Hi Swp out (Option A4J): BNC (f), (5 V TTL)
Swp Out (Option A4J): BNC (f), 0 to +10 V ramp, characteristic
GPIB Interface (Option A4H): IEEE-488 bus connector
Serial Interface (Option 1AX): RS-232, 9-pin D-SUB
Parallel Interface (Option A4H or 1AX): 25-pin D-SUB (f), printer port only

Key Literature

HP ESA-L series Spectrum Analyzer Product Overview, p/n 5965-6309E

For more information on compatible printers, visit our web site:
http://www.hp.com/go/pcg

Ordering Information

HP E4411B 9 kHz to 1.5 GHz ESA-L Portable Spectrum Analyzer
HP E4403B 9 kHz to 3.0 GHz ESA-L Portable Spectrum Analyzer
HP E4408B 9 kHz to 26.5 GHz ESA-L Portable Spectrum Analyzer

Opt A4H GPIB and parallel (Centronics) interfaces
Opt 1AX RS-232 and parallel (Centronics) interfaces (includes RS-232 cable)
Opt A4J IF, Sweep, and Video Ports
Opt 1DN 50-Ohm tracking generator (9 kHz to 1.5 GHz for HP E4411B)(9 kHz to 3.0 GHz for HP E4403B and HP E4408B)
Opt 1DP 75 Ohm Input Impedance (1 MHz to 1.5 GHz) HP E4411B Only
Opt 1DQ 75 Ohm Tracking Generator (1 MHz to 1.5 GHz) (requires Option 1DP)
Opt A5D 12 Vdc power cable
Opt 1D7 50 to 75 Ohm matching pad (type N(m) to BNC (f))
Opt UK9 Front panel protective cover
Opt 1CP Rackmount kit with handles and slides
Opt 0BW Assembly level service guide and CD-ROM with adjustments
Opt UK6 Commercial calibration certificate with data
Opt 0B0 Delete manuals, keep CD-ROM manual
Opt 0BV Component level service documentation
Opt AXT Add hard transit case
Opt AYT Grey soft carrying/operating case
Opt AYU Yellow soft carrying/operating case
Opt B70 HP BenchLink Spectrum Analyzer
Opt BAB APC 3.5 Input connector (HP E4408B only)

Accessories
HP 10833A GPIB cable (1 meter)
HP 5182-4794 RS-232 cable (3 meter, 9 pin) (for serial 9 pin PC connection to analyzer)
HP 87405A Preamplifier (10 MHz to 3 GHz, 24 dB gain) (fastened to RF input, powered from analyzer)
HP 85905A 75 Ohm preamplifier (45 MHz to 1 GHz, 20 dB gain) (powered from analyzer)
HP 41800A Active probe (5 Hz to 500 MHz)
HP 85024A High frequency active prob (300 kHz to 3 GHz)
HP E1779A Snap-on battery pack
HP C2950A Parallel printer cable (2 m)
HP N2717A Performance and adjustment software for calibration of ESA Analyzers

HP E4444A BenchLink Spectrum

Analyzer Software

HP BenchLink Spectrum Analyzer provides an easy-to-use communications link between your PC and the HP 8560-series, 8590-series, ESA-E/L series portable spectrum analyzers, HP E7400 series EMC analyzers; and HP CaLan 2010/3010 series sweep/ingress analyzers. HP BenchLink Spectrum Analyzer is a member of the HP BenchLink family of PC/basic instrument connectivity solutions, and takes full advantage of the Windows interface to easily transfer screen images or trace data via GPIB or RS-232 interfaces.

HP BenchLink Spectrum Analyzer makes it easy to capture, analyze and document measurement results in your PC. HP has done all the programming for you.

You'll be able to transfer:

- Screen images–you can transfer a picture of the spectrum analyzer screen to your PC for viewing, annotation, storage, or printing. HP BenchLink Spectrum Analyzer provides convenient annotation tools, and Windows makes it easy to cut and paste your annotated image into other applications like word processing, presentation, and graphics packages or e-mail. You can also save your image in PCX, TIF, GIF, and BMP formats. You'll find documenting measurement results to be fast and simple.
- Trace data–HP BenchLink Spectrum Analyzer transfers the trace frequency/amplitude pairs of data from your spectrum analyzer to your PC for further review and analysis. Once the trace data is captured, you can use pan and zoom and trace markers in BenchLink to analyze the trace. Additionally, the frequency/amplitude pairs of trace data can be easily copied as comma-separated-values to spreadsheets or other analysis programs using files or the Windows clipboard.

The software runs on Windows 3.1, Windows 3.11, Windows 95, Windows 98 and Windows NT 4.0 and includes a complete context-sensitive on-line help system. System requirements are IBM PC compatible with at least 486-25 MHz processor, 8 MB ram, and 3 MB disk space available.

Ordering Information

E4444A BenchLink Spectrum Analyzer Software

Remote Operation Software for the HP 8590 Series

iPanels software for Windows 95/NT provides remote operation for HP 8590 series spectrum analyzers (with GPIB or RS-232 interface). The virtual HP 8590 series instrument panel created on your PC monitor is easily controlled with a mouse as if you were sitting in front of the analyzer. Remote functionality through modem or LAN varies for different analyzer models and options. Contact Hamilton Software for analyzer compatibility and product details.

Hamilton Software
2270 Northpoint Parkway
Santa Rosa, CA 95407
(800) 704-0085
(707) 542-2700
http://www.hamsoft.com

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Spectrum Analyzers, Portable

HP 8590 E-Series

- Easy-to-use, expandable, portable spectrum analyzers
- Full range of price and performance options
- One-button measurements for FFT, TOI, ACP, and more
- Expanded memory and trace-storage capability
- Optional narrow resolution bandwidths
- New custom measurement personalities

HP 8590 Series Spectrum Analyzers

The HP 8590 E-series spectrum analyzers offer a wide range of performance, features, and prices designed to fit your budget. Choose from low-cost, basic performance analyzers or from higher-performance models. Whatever your choice, you'll find HP 8590 series spectrum analyzers easy to use and reliable. Their expandable feature sets allow them to be easily configured to meet your growing measurement needs.

Application measurement personalities customize the analyzer for tasks such as cable TV, EMC, digital cellular radio, RF communication, noise-figure and scalar network analysis measurements (see page 235). You can also add a variety of printers, plotters and other accessories.

One Spectrum Analyzer for Many Applications

You can change the test capabilities of these spectrum analyzers to fit specific measurement needs. A memory card reader enables you to load application measurement personalities. Complex measurement routines are reduced to a keystroke. An option cardcage, unique to the HP 8590 E-series, allows you to add circuit-card options for additional capability. Optional built-in tracking generators provide a synchronously swept signal source for stimulus-response measurements. Operating any HP 8590 series spectrum analyzer requires only minimal training.

Easy-to-Use Features

Numerous features make it easier to control measurements and to analyze the results. These spectrum analyzers have built-in, automatic calibration to ensure measurement consistency. Frequency panning lets you quickly reposition signals without repeated sweeps. The internal memory allows over 50 traces to be stored, and more can be stored on RAM cards using the memory-card reader. Time and date stamping come standard. Direct output to printer or plotter is available with either the GPIB/parallel or the RS-232/parallel interface option. Both Hewlett-Packard and selected Epson printers are supported.

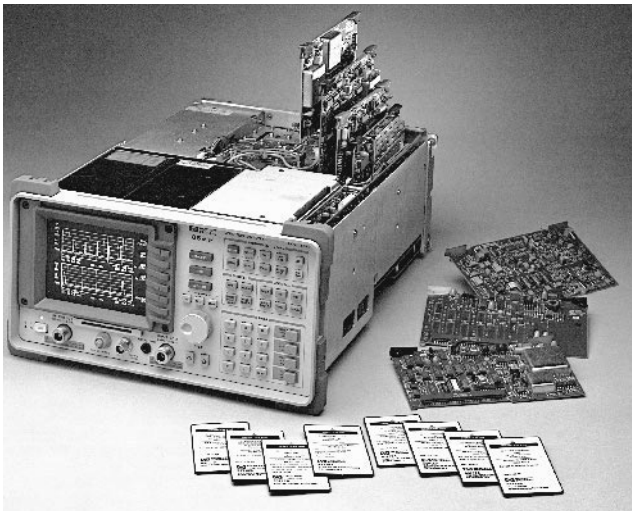
PC Software for HP 8590 Series

The new HP BenchLink Spectrum Analyzer PC software provides an easy-to-use communications link between your PC and the HP 8590 series spectrum analyzers. Taking full advantage of the Windows interface, you can easily transfer screen images or trace data via GPIB or RS-232 interfaces, thereby making it easy to capture, analyze, and document measurement results in a PC environment. For more information, see page 225.

HP 8591E, 8593E, 8594E, 8595E and 8596E Spectrum Analyzers

These portable spectrum analyzers bring powerful, comprehensive measurement capabilities to RF, microwave and digital applications. Five models offer a choice of frequency coverage starting at 9 kHz and extending to 26.5 GHz.

Performance specifications include low phase noise of –105 dBc at 30 kHz offset and frequency-synthesized accuracy of 2.1 kHz at 1 GHz, which can be improved to 210 Hz with an optional precision frequency reference. Second- and third-order dynamic ranges are 77 and 90 dB, respectively. Calibrated amplitude range is +30 to –130 dBm with Option 130, and calibrated onscreen display range is 70 dB. Narrow resolution bandwidths of 30, 100, 200 EMI and 300 Hz are available on an optional circuit card, which can be added to these analyzers at any time.



HP 8591E with measurement personality and circuit card options

Standard Features

A window capability divides the display into two horizontal areas, allowing you to zoom in on critical areas of a measurement trace or to display test data and the trace simultaneously. Many one-button measurements are standard, including a marker table, FFT, N dB bandwidths, third-order intercept, percent AM and adjacent-channel power. A built-in memory card reader allows you to load measurement personalities, your own custom programs and measurement data on 32-, 128-, 256-, and 512-K memory cards.

Option Flexibility

A growing number of circuit-card options provides even more measurement capability. Circuit cards are installed easily into a built-in cardcage, and most are retrofittable.

Circuit-card options include:

- Narrow resolution bandwidths of 30, 100, 200 EMI and 300 Hz
- Time-gated spectrum analysis
- "Analog+" display and fast time-domain sweeps
- AM/FM demodulator
- TV receiver/video tester
- Quasi-peak detector
- Noise-figure measurements
- Demodulators for CT2-CAI and DECT
- Digital demodulators and/or digital signal processing for GSM900, DCS-1800, PCS-1900, NADC-TDMA, PHS, CDMA and PDC wireless communication formats

A built-in 1.8 GHz tracking generator (retrofittable) is available for the HP 8591E, and a 2.9 GHz tracking generator (retrofittable) for the HP 8593E, 8594E, 8595E and 8596E. The HP 85902A burst carrier trigger provides a TTL timing reference for digital wireless communication measurements. See page 244.

For more information, visit our web site: **http://www.hp.com/go/8590**

- One-button measurement solutions
- Save time, money and training
- Customized for your application
- Easy to use

Easy-to-install measurement personalities

Measurement Personalities

Measurement personalities are software programs provided on ROM-based memory cards. They customize your HP 8590 analyzer to perform complex tests simply and quickly with the push of a button from easy-to-follow screen menus. The personalities automatically set the analyzer controls and perform calculations required by application standards, improving accuracy and repeatability.

Cable TV and Broadcast

(See page 70.1 for more information.)

HP 85721A Cable TV Measurements and System Monitor Personality

The HP 85721A measurement personality customizes the HP 8591C and 8590 E-series analyzers for easy, non-interfering proof-of-performance measurements on NTSC-, PAL-, or SECAM-format signals. The personality includes the capability to measure power levels for digital carriers. This software adds dedicated cable TV test functions and measurements for channel and system operation. Three video measurements as well as differential gain and phase and chrominance-to-luminance delay inequality can be performed if the spectrum analyzer has Option 107 TV receiver/video tester.

HP 85724A Broadcast Measurement Personality

The HP 85724A adds measurements for testing TV broadcast transmitters and relays. It allows selection of PAL-I/B/G, NTSC-M and SECAM-D/K systems, channel bands CCIR VHF, UHF, S, M & B, FCC-AIR and PRC and channel number. Tests include carrier level, chroma level, vision, three-tone intermodulation, depth of modulation, spurious signals, NICAM carrier power and intermodulation and FE deviation. Three video measurements as well as differential gain and phase, and chrominance-to-luminance delay inequality can be performed if the spectrum analyzer has Option 107 TV receiver/video tester.

Lightwave

(See page 462 for more information.)

HP 11982A Option 001 Lightwave Converter Personality

The HP 11982A Option 001 personality provides frequency response correction and amplitude conversion of the optical marker for lightwave signals when used with the HP 11982A amplified lightwave converter and an HP 8590 series analyzer.

Component Test

(See page 240 for more information.)

HP 85714A Scalar Measurement Personality

An HP 85714A measurement personality and HP 8590 series analyzer with optional built-in tracking generator make fast, accurate scalar transmission measurements from 100 kHz to 2.9 GHz. Features include guided calibration, pass/fail limit line testing, 120 dB display, bandwidth, Q factor, and shape factor. The HP 85630A scalar test set adds simultaneous transmission/reflection display.

HP 85719A Noise Figure Measurement Personality

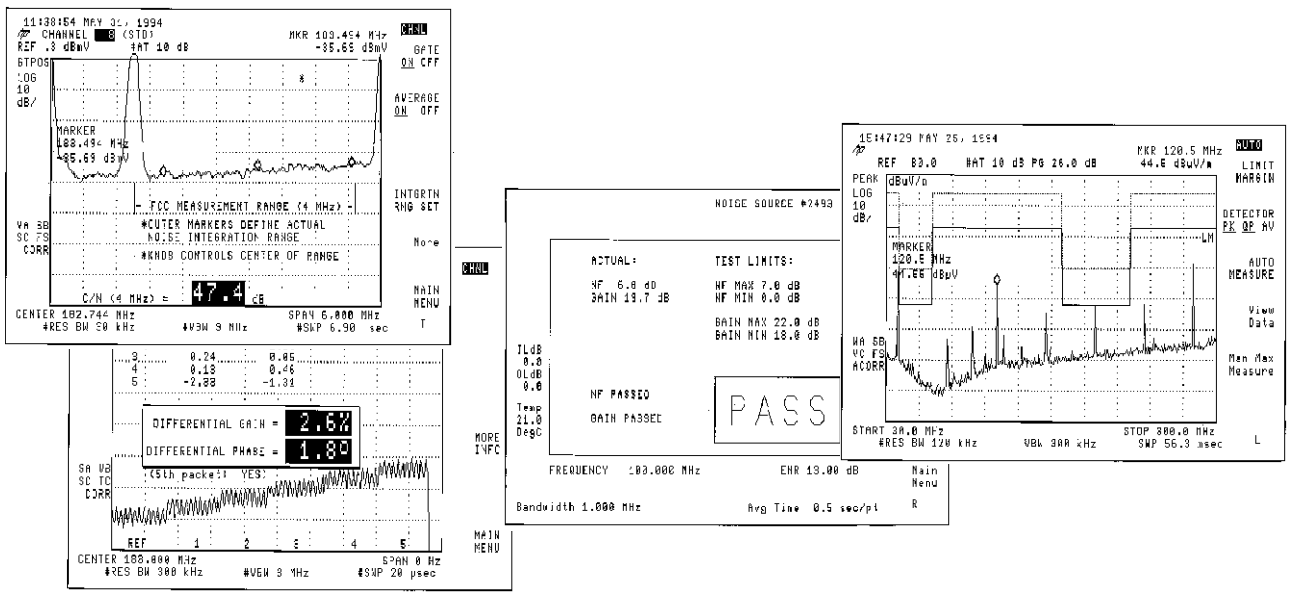
The HP 85719A noise figure measurement personality customizes an HP 8590 Option 119 E-series spectrum analyzer for displayed swept noise figure and gain measurements from 10 MHz to 2.9 GHz.

Electromagnetic Compatibility

(See page 316 for more information.)

HP 85712D EMC Auto-Measurement Personality

The HP 85712D simplifies precompliance EMI measurements. The spectrum analyzer is set up automatically with the correct limit lines, transducer factor corrections, frequency range, and bandwidths which are supplied on the personality card. It can perform automatic peak, quasi-peak, and average on up to 20 signals at a time and print the results directly, or store them to a RAM card for future viewing.



5 Wide selection of measurement personalities

Wireless Communications

(See page 65.13 for more information.)

HP 85715B GSM 900 Measurement Personality

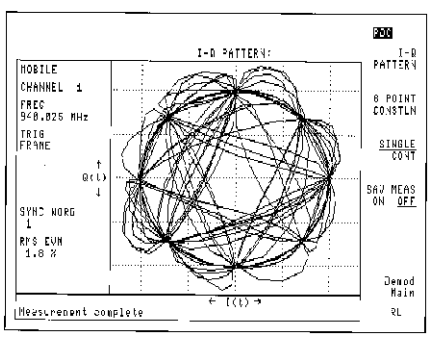
The HP 85715B provides all the GSM900 transmitter tests specified in the GSM 11.10 (mobile) and GSM 11.21 (base) recommendations. Measurements include those for power, frequency, timing and modulation accuracy. GSM Phase II specification limits are used and the extended GSM (E-GSM) frequency bands are supported.

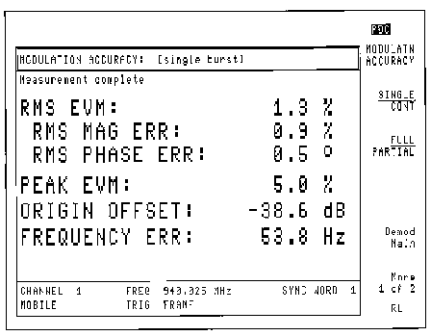
HP 85717A CT2-CAI Measurement Personality

The HP 85717A personality provides all transmitter measurements in the MPT 1375 and I-ETS 300-131 specifications for second generation cordless telephone with common air interface. In addition, it has the flexibility to allow you to define your own custom channel tuning plan and band edges as well as spurious parameters. Transmitter tests include: mean carrier power, carrier-off power, adjacent channel power, out-of-band power, spurious emissions, intermodulation attenuation and frequency error and deviation.

HP 85718B NADC-TDMA Measurement Personality

Based on EIA/TIA IS-54 and IS-136 standards, the HP 85718B simplifies testing of time-division multiple access (TDMA) transmitters for North American Dual-Mode Cellular (NADC) and PCS IS-136 radio systems. The personality provides nine power, frequency and timing tests as well as seven modulation accuracy tests.





HP 85720C PDC Measurement Personality

The HP 85720C provides transmitter measurements for Personal Digital Cellular (PDC) time-division multiple access radio systems. Tests are based on the RCR STD-27C standard. There are 11 power, frequency and timing tests as well as six modulation accuracy tests.

HP 85722B DCS1800 Measurement Personality

The HP 85722B provides all the DCS1800 transmitter tests specified in the GSM 11.10 (mobile) and GSM 11.21 (base) recommendations. Measurements include those for power, frequency, timing and modulation accuracy. Phase II specification limits are used. GSM-based PCS measurements at 1900 MHz may be made using the HP 85722B special Option H19.

HP 85723A DECT Measurement Personality

The HP 85723A adds the key DECT transmitter measurements to the HP 8590 E-series analyzers. With the measurement personality, DECT power, frequency, timing and modulation accuracy tests can be made. An optional DECT source built-in to the analyzer can be used as a stimulus for module testing or sensitivity measurements.

HP 85725C CDMA Measurement Personality

Simplify your measurements of cellular, PCS and other spread spectrum transmitters based on EIA/TIA IS-95, -97, -98 and J-STD-008 with the HP 85725C. Frequency- and time-domain measurements are provided. The new C version of this personality adds the adjacent channel power ratio (ACPR) measurement, as well as tuning plans for Japan and Korea. The HP 85725C is designed with a great amount of flexibility, including on-screen help messages, enabling measurements to be easily configured to meet your special needs.

HP 85726B PHS Measurement Personality

Measure Personal Handy Phone System (PHS) personal and cell station transmitters operate easily, quickly and reliably. The HP 85726B PHS personality provides tests based on RCR STD-28. Measurements included are antenna power, adjacent channel power, burst ramp-up and ramp-down power versus time, carrier-off time leakage power, spurious emission, occupied bandwidth and modulation accuracy (EVM).

HP 85727A GSM Multi-Band Measurement Personality

For GSM systems operating in more than one GSM band, the HP 85727A provides all the GSM transmitter tests specified in the GSM 11.10 (mobile) and GSM 11.21 (base) recommendations. Measurements include those for power, frequency, timing and modulation accuracy. GSM phase II specification limits are used and the extended GSM (E-GSM), R-GSM, DCS1800 and PCS1900 frequency bands are supported.

Digital Radio Measurements

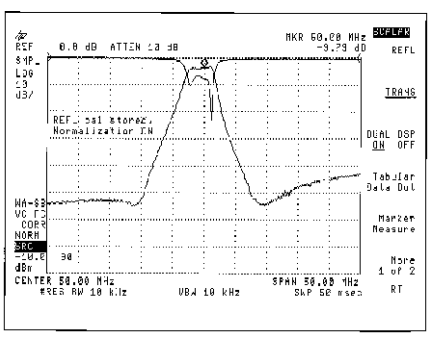
(See page 337 for more information.)

HP 85713A Digital Radio Measurement Personality

The HP 85713A measurement personality for microwave spectrum analyzers includes five major agency masks for testing to US, UK, and FRG digital radio specifications. Automatic compare-to-mask and mean power level measurements are made on the modulated signal. Functions include transient analysis monitoring and frequency response measurement. You can create and store your own masks for later use. For additional digital radio tests, see the HP 11758V digital radio test system.

HP 11770A Link Measurement Personality

The HP 11770A enables group delay and amplitude flatness measurements on systems that carry digital data, such as microwave radio systems, coax cable and satellite links. Capability includes end-to-end link, DADE, and IF return loss measurements.



HP 8591E

HP 8591E, 8593E, 8594E, 8595E, 8596E

Specifications

Specifications apply to any of these analyzers unless otherwise noted.

Frequency

Frequency Range
HP 8591E:
50 Ω: 9 kHz to 1.8 GHz
75 Ω: 1 MHz to 1.8 GHz
HP 8594E: 9 kHz to 2.9 GHz, dc-coupled; 100 kHz to 2.9 GHz, ac-coupled
HP 8595E: 9 kHz to 6.5 GHz, dc-coupled; 100 kHz to 6.5 GHz, ac-coupled

	Band	LO harmonic = N	Center frequency
HP 8596E	0	1	9 kHz to 2.9 GHz (dc-coupled)
	0	1	100 kHz to 2.9 GHz (ac-coupled)
	1	1	2.75 to 6.5 GHz
	2	2	6.0 to 12.8 GHz
HP 8593E	0	1	9 kHz to 2.9 GHz
	1	1	2.75 to 6.5 GHz
	2	2	6.0 to 12.8 GHz
	3	3	12.4 to 19.4 GHz
	4	4	19.1 to 22 GHz
	4	4 (Option 026/027)	19.1 to 26.5 GHz

Frequency Reference
Aging: ± 2 x 10^{-6}/year; ± 1 x 10^{-7}/year (Option 004)
Temperature Stability: ± 5 x 10^{-6}; ± 1 x 10^{-8} (Option 004)
Initial Achievable Accuracy: ± 0.5 x 10^{-6}; ± 2.2 x 10^{-8} (Option 004)
Frequency Readout Accuracy (start, stop, center, marker):
± (freq. readout x freq. ref error + span accuracy + 1% of span + 20% of RBW + 100 Hz x N)
Marker Count Accuracy
Span ≤ 10 MHz x N: ± (marker freq. x freq. ref error + counter resolution + 100 Hz x N)
Span > 10 MHz x N: ± (marker freq. x freq. ref error + counter resolution + 1 kHz x N)
Counter Resolution
Span ≤ 10 MHz x N: Selectable from 10 Hz to 100 kHz
Span > 10 MHz x N: Selectable from 100 Hz to 100 kHz
Frequency Span
Range: 0 Hz (zero span) and
HP 8591E: 10 kHz to 1.8 GHz; 1 kHz min (Option 130)
HP 8594E: 10 kHz to 2.9 GHz; 1 kHz min (Option 130)
HP 8595E: 10 kHz to 6.5 GHz; 1 kHz min (Option 130)
HP 8596E: [10 x N] kHz to 12.8 GHz; [1 x N] kHz min (Option 130)
HP 8593E: [10 x N] kHz to 19.25 GHz; [1 x N] kHz min (Option 130)
Resolution: Four digits or 20 Hz x N, whichever is greater
Accuracy
Span ≤ 10 MHz x N: ± 2% of span
Span > 10 MHz x N: ± 3% of span
Sweep Time
Range
Span = 0 Hz or > 1 kHz: 20 ms to 100 s
Span = 0 Hz (Option 101): 20 µs to 100 s
Accuracy
20 ms to 100 s: ± 3%
20 µs to < 20 ms (Option 101): ± 2%
Sweep Trigger: Free run, single, line, video, external

Resolution Bandwidth: 1 kHz to 3 MHz (3 dB) in 1, 3, 10 sequence; 9 kHz and 120 kHz (6 dB) EMI bandwidths. Option 130 adds 30, 100 and 300 Hz (3 dB) bandwidths and 200 Hz (6 dB) EMI bandwidth.
Accuracy: ± 20%
Selectivity (characteristic)
–60 dB/–3 dB: 3 kHz to 10 kHz, 15:1
100 kHz to 3 MHz, 15:1
1 kHz, 30 kHz, 16:1
–40 dB/–3 dB: 30 Hz to 300 Hz, 10:1
Video Bandwidth Range: 30 Hz to 1 MHz in 1, 3 sequence (1 Hz to 1 MHz with Option 130)
Stability
Noise Sidebands (1 kHz RBW, 30 Hz VBW, sample detector)
> 10 kHz offset from CW signal: ≤ –90 dBc/Hz + 20 log N
> 20 kHz offset from CW signal: ≤ –100 dBc/Hz + 20 log N
> 30 kHz offset from CW signal: ≤ –105 dBc/Hz + 20 log N
Residual FM
HP 8591E:
1 kHz RBW, 1 kHz VBW: ≤ 250 Hz pk-pk in 100 ms
30 Hz RBW, 30 Hz VBW: ≤ 30 Hz pk-pk in 300 ms
HP 8593E, 8594E, 8595E, 8596E:
1 kHz RBW, 1 kHz VBW: ≤ (250 x N) Hz pk-pk in 100 ms
30 Hz RBW, 30 Hz VBW: ≤ (30 x N) Hz pk-pk in 300 ms
System Related Sidebands (> 30 kHz offset from CW signal):
≤ –65 dBc + 20 log N
Comb Generator Frequency (HP 8593E, 8596E): 100 MHz fundamental frequency; ± 0.007% frequency accuracy

Amplitude

Amplitude Range: Displayed average noise level to +30 dBm
HP 8591 Option 001: Displayed average noise level to +72 dBmV
Maximum Safe Input Level (input attenuator ≥ 10 dB)
Average Continuous Power: +30 dBm (1 W)
HP 8591E Option 001: +72 dBmV (0.2 W)
Peak Pulse Power
HP 8591E: ± 30 dBm (1 W)
HP 8591E Option 001: +72 dBmV (0.2 W)
HP 8593E, 8594E, 8595E, 8596E: +50 dBm (100 W) for < 10 µs pulse width and < 1% duty cycle, input atten. ≥ 30 dB
DC
HP 8591E: 25 Vdc
HP 8591E Option 001: 100 Vdc
HP 8593E: 0 Vdc
HP 8594E, 8595E, 8596E: 0 V (dc-coupled); 50 V (ac-coupled)
Gain Compression (> 10 MHz): ≤ 0.5 dB (total power at input mixer = –10 dBm)

Displayed Average Noise Level (input terminated, 0 dB atten., 30 Hz VBW or 1 Hz VBW with Option 130, sample detector)

	30 Hz RBW	1 kHz RBW
HP 8591E		
400 kHz to 1 MHz	≤ –130 dBm	≤ –115 dBm
1 MHz to 1.5 GHz	≤ –130 dBm	≤ –115 dBm
1.5 GHz to 1.8 GHz	≤ –128 dBm	≤ –113 dBm
HP 8591E Option 001		
1 MHz to 1.5 GHz	≤ –78 dBmV	≤ –63 dBmV
1.5 GHz to 1.8 GHz	≤ –76 dBmV	≤ –61 dBmV
HP 8594E		
400 kHz to 5 MHz	≤ –122 dBm	≤ –107 dBm
5 MHz to 2.9 GHz	≤ –127 dBm	≤ –112 dBm
HP 8595E		
400 kHz to 2.9 GHz	≤ –125 dBm	≤ –110 dBm
2.75 to 6.5 GHz	≤ –127 dBm	≤ –112 dBm
HP 8596E		
400 kHz to 2.9 GHz	≤ –125 dBm	≤ –110 dBm
2.75 to 6.5 GHz	≤ –127 dBm	≤ –112 dBm
6.0 to 12.8 GHz	≤ –115 dBm	≤ –100 dBm
HP 8593E		
400 kHz to 2.9 GHz	≤ –127 dBm	≤ –112 dBm
2.75 to 6.5 GHz	≤ –129 dBm	≤ –114 dBm
6.0 to 12.8 GHz	≤ –117 dBm	≤ –102 dBm
12.4 to 19.4 GHz	≤ –113 dBm	≤ –98 dBm
19.1 to 22 GHz	≤ –107 dBm	≤ –92 dBm
HP 8593E Option 026/027		
19.1 to 26.5 GHz	≤ –102 dBm	≤ –87 dBm

HP 8590 E-Series
HP 8591E
HP 8593E
HP 8594E
HP 8595E
HP 8596E

Specifications (cont'd)

Spurious Responses
- **Second Harmonic Distortion**
- **HP 8591E** (5 MHz to 1.8 GHz): < –70 dBc for –45 dBm tone at input mixer
- **HP 8593E** (10 MHz to 2.9 GHz): < –70 dBc for –40 dBm tone at input mixer
- **HP 8594E, 8595E, 8596E** (> 10 MHz): < –70 dBc for –40 dBm tone at input mixer
- **HP 8593E, 8595E, 8596E** (> 2.75 GHz): < –100 dBc for –10 dBm tone at input mixer (or below DANL)
- **Third-Order Intermodulation**
- **HP 8591E** (5 MHz to 1.8 GHz): < –70 dBc for two –30 dBm tones at input and > 50 kHz separation
- **HP 8593E, 8594E, 8595E, 8596E** (> 10 MHz): < –70 dBc for two –30 dBm tones at input and > 50 kHz separation
- **Other Input-Related Spurious** (≥ 30 kHz offset, –20 dBm tone at input mixer)
- **HP 8591E, 8594E, 8595E, 8596E:** < – 65 dBc
- **HP 8593E:** < –65 dBc (applied frequency ≤ 18 GHz); < –60 dBc (applied frequency ≤ 22 GHz)

Residual Responses (input terminated, 0 dB attenuation)
- **1 MHz to 1.8 GHz** (HP 8591E Option 001): < –38 dBmV
- **150 kHz to 1.8 GHz** (HP 8591E): < –90 dBm
- **150 kHz to 2.9 GHz** (HP 8594E): <–90 dBm
- **150 kHz to 6.5 GHz** (HP 8593E, 8595E, 8596E): < –90 dBm

Display Range
- **Log Scale:** 0 to –70 dB from ref level is calibrated; 0.1, 0.2, 0.5 dB/div and 1 to 20 dB/div in 1 dB steps; 8 div displayed
- **Linear Scale:** 8 divisions
- **Scale Units:** dBm, dBmV, dBμV, V, W

Marker Readout Resolution
- **Log Scale:** 0.05 dB
- **Linear Scale:** 0.05% of ref level
- **Fast Time Sweep for Zero Span** (Option 101 or 301, 20 μs to 20 ms)
- **≤ 1 GHz:** 0.7% of ref level for linear scale
- **> 1 GHz:** 1.0% of ref level for linear scale

Reference Level
- **Range:** Same as amplitude range
- **Resolution:** ± 0.01 dB for log scale; ± 0.12% of ref level for linear scale
- **Accuracy:** ± 0.3 dB at –20 dBm; 0 to –59.9 dBm: ± (0.3 dB + 0.01 x dB from –20 dBm)

Frequency Response (10 dB input attenuation)
- **Absolute** (referenced to 300 MHz CAL OUT)
- **HP 8591E, 8594E:** ± 1.5 dB
- **HP 8595E:** ± 1.5 to ± 2.0 dB
- **HP 8596E:** ± 1.5 to ± 2.5 dB
- **HP 8593E:** ± 1.5 to± 5.0 dB (preselector peaked)
- **Relative Flatness** (referenced to midpoint between highest and lowest frequency response deviations)
- **HP 8591E, 8594E:** ± 1.0 dB
- **HP 8595E:** ± 1.0 to ± 1.5 dB
- **HP 8596E:** ± 1.0 to ± 2.0 dB
- **HP 8593E:** ± 1.0 to ± 2.0 dB (preselector peaked)

Calibrator Output Amplitude: –20 dBm ± 0.4 dB; + 28.75 dBmV ± 0.4 dB, HP 8591 Option 001

Resolution Bandwidth Switching Uncertainty (ref to 3 kHz RBW, at ref level)
- **3 kHz to 3 MHz RBW:** ± 0.4 dB
- **1 kHz RBW:** ± 0.5 dB
- **30 Hz to 300 Hz RBW:** ± 0.6 dB

Log to Linear Switching: ± 0.25 dB at ref level

Display Scale Fidelity
- **Log Incremental Accuracy** (0 to –60 dB from ref level): ± 0.4 dB/4 dB
- **Log Maximum Cumulative** (0 to –70 dB from ref level)
- **3 kHz to 3 MHz RBW:** ± (0.3 + 0.01 x dB from ref level)
- **30 Hz to 1 kHz RBW:** ± (0.4 + 0.01 x dB from ref level)
- **Linear Accuracy:** ± 3% of ref level

General Specifications

MIL-T-28800: Has been type-tested to the environmental specifications of MIL-T-28800 Class 5

Temperature
- **Operating:** 0° to +55° C
- **Storage:** – 40° to +75° C

EMI Compatibility: Conducted and radiated interference CISPR Pub. 11 and Messempfaenger Postverfuegung 526/527/79

Audible Noise: < 37.5 dBA pressure and < 5.0 Bels power (ISODP7779)

Power Requirements
- **On** (line 1): 90 to 132 V rms, 47 to 440 Hz
- 195 to 250 V rms, 47 to 66 Hz
- Power consumption < 500 VA; < 180 W
- **Standby** (line 0): Power consumption < 7 W

User Program Memory (nominal): 238 KB nonvolatile RAM

Data Storage (nominal)
- **Internal:** 24 traces or 32 states
- **External:** 50 traces, 8 states
- **Memory Cards:** HP 85700A (32 KB), 24 traces or 32 states; HP 85702A (128 KB), 99 traces or 128 states
- **Video Cassette Recorder** (VCR): Continuous video recording of display supported through composite video output

Size (nominal, without handle, feet, or cover): 325 mm W x 163 mm H x 427 mm D

Weight: 14.5 kg (HP 8591E); 16.4 kg (HP 8593E, 8594E, 8595E, 8596E)

Option 010 and 011 Built-In Tracking Generators

Option 010 (50 Ω) is available for all HP 8590 E-series spectrum analyzers. Option 011 (75 Ω) is available for the HP 8591E only.

Frequency Range
- **Option 010:** 100 kHz to 1.8 GHz (HP 8591E); 9 kHz to 2.9 GHz (HP 8593E, 8594E, 8595E, 8596E)
- **Option 011:** 1 MHz to 1.8 GHz (HP 8591E)

Output Level
- **Range**
- **Option 010:** 0 to –70 dBm (HP 8591E); –1 to – 66 dBm (HP 8593E, 8594E, 8595E, 8596E)
- **Option 011:** +42.8 to –27.2 dBmV (HP 8591E)
- **Resolution:** 0.1 dB
- **Absolute Accuracy:** ± 1.0 dB (HP 8591E); ± 0.75 dB (HP 8593E, 8594E, 8595E, 8596E)

Vernier
- **Range:** 10 dB (HP 8591E); 9 dB (HP 8593E, 8594E, 8595E, 8596E)
- **Accuracy:** ± 0.75 dB (HP 8591E); ± 0.5 dB (HP 8593E, 8594E, 8595E, 8596E)

Output Flatness: ± 1.75 dB (HP 8591E); ± 2.0 dB, > 10 MHz (HP 8593E, 8594E, 8595E, 8596E)

Spurious Output
- **Harmonic Spurs:** 0 dBm +42.8 dBmV output, < –25 dBc (HP 8591E); –1 dBm output, < –25 dBc (HP 8593E, 8594E, 8595E, 8596E)
- **Nonharmonic Spurs:** < –30 dBc (HP 8591E); ≤ –27 dBc, 300 kHz to 2.0 GHz, ≤ –23 dBc, 2.0 GHz to 2.9 GHz (HP 8593E, 8594E, 8595E, 8596E)

Dynamic Range (characteristic; max. output level –TG feedthrough)
- **Option 010:** 106 dB (HP 8591E); 106 dB (HP 8594E, > 400 kHz); 109 dB (HP 8595E, 8596E, > 400 kHz); 111 dB (HP 8593E, > 400 kHz)
- **Option 011:** 100 dB

Power Sweep
- **Range**
- **Option 010:** –75 dBm to 0 dBm (HP 8591E); –66 dBm to –1 dBm in 8 dB increments (HP 8593E, 8594E,8595E, 8596E)
- **Option 011:** –32.2 to +42.8 dBmV (HP 8591E)
- **Resolution:** 0.1 dB

Key Literature

HP 8590 Series Configuration Guide, p/n 5963-6858E
HP 8590 E-Series Data Sheet, p/n 5963-6909E
HP 8590 Series Brochure, p/n 5963-6908E

For information on compatible printers, visit the website:
http://www.hp.com/go/pcg

Ordering Information

HP 8591E Spectrum Analyzer, 9 kHz to 1.8 GHz
HP 8594E Spectrum Analyzer, 9 kHz to 2.9 GHz
HP 8595E Spectrum Analyzer, 9 kHz to 6.5 GHz
HP 8596E Spectrum Analyzer, 9 kHz to 12.8 GHz
HP 8593E Spectrum Analyzer, 9 kHz to 22 GHz

Options[1]

Opt 001 75 Ω Input (HP 8591E only)
Opt 004 Precision Frequency Reference
Opt 009 LO and Sweep + Tune
Opt 010 Tracking Generator (100 kHz to 1.8 GHz, HP 8591E only)
Opt 010 Tracking Generator (9 kHz to 2.9 GHz)
Opt 011 Tracking Generator (75 Ω, HP 8591E only)
Opt 012 Source for DECT Receiver Test
Opt 015 Soft Tan Carrying/Operating Case
Opt 016 Soft Yellow Carrying/Operating Case
Opt 026 26.5 GHz Frequency Extension, APC-3.5 mm Connector (HP 8593E only)
Opt 027 26.5 GHz Frequency Extension, Type-N Connector (HP 8593E only)
Opt 040 Front Panel Protective Cover With Storage
Opt 041 GPIB and Parallel Printer Interfaces
Opt 042 Protective Soft Carrying Case/Backpack
Opt 043 RS-232 and Parallel Printer Interfaces
Opt 050 Improved Amplitude Accuracy (NADC-TDMA bands)
Opt 051 Improved Amplitude Accuracy for PDC Bands
Opt 052 Improved Amplitude Accuracy for PHS Band
Opt 053 Improved Amplitude Accuracy for CDMA Bands
Opt 101 Fast Time-Domain Sweeps and Analog+ Display
Opt 102 AM/FM Demodulator and TV Sync Trigger (TV Sync requires Option 101)
Opt 103 Quasi-Peak Detector, AM/FM Demodulator
Opt 105 Time-Gated Spectrum Analysis
Opt 107 TV Receiver Video Tester
Opt 110 CT2 Demodulator
Opt 111 Group Delay and Amplitude Flatness[3] (HP 8593/4/5/6E only) (Requires HP 11770A Link Measurement Personality)
Opt 112 DECT Demodulator
Opt 119 Noise Figure
Opt 130 Narrow Resolution Bandwidths (30 to 300 Hz and 200 Hz EMI)
Opt 140 Narrow Bandwidths and Precision Frequency Reference
Opt 151 DSP, FAST ADC, and Digital Demodulator
Opt 160 PDC, PHS, NADC, and CDMA Firmware for Option 151
Opt 163 GSM900/DCS1800 Firmware for Option 151
Opt 180 TV Picture NTSC/PAL/SECAM
Opt 301 TV Sync Trigger, Fast Time-Domain Sweeps, AM/FM Demodulator, Analog+ Display
Opt 711 50/75 Ω Matching Pad/100 Vdc Block
Opt 0Q8 Factory Service Training
Opt BD0 Code Division Multiple Access
Opt BD1 Global System for Mobile Communication
Opt BD2 North American Digital Cellular System
Opt BD3 Pacific Digital Cellular System
Opt BD4 Personal Handyphone System
Opt B70 HP BenchLink Spectrum Analyzer s/w
Opt UK6 Commercial Calibration Certificate with Test Data
Opt ABX Quick Reference Guide in Local Languages
Opt W30 Two Additional Years Return-to-HP Service
Opt W32 Two Additional Years Return-to-HP Calibration

Application Measurement Cards/Personalities[2]

HP 11770A Link Measurement Personality
HP 85700A Blank 32-KB Memory Card
HP 85702A Blank 128-KB Memory Card
HP 85704A Blank 256-KB Memory Card
HP 85705A Blank 512-KB Memory Card
HP 85712D EMC Measurement Personality
HP 85713A Digital Radio Measurement Personality
HP 85714A Scalar Measurement Personality
HP 85715B GSM900 Measurement Personality
HP 85717A CT2-CAI Measurement Personality
HP 85718B NADC-TDMA Measurement Personality
HP 85719A Noise-Figure Measurement Personality
HP 85720C PDC Measurement Personality
HP 85721A Cable TV Measurement Personality
HP 85722B DCS1800 Measurement Personality
HP 85723A DECT Measurement Personality
HP 85724A Broadcast Measurement Personality
HP 85725C CDMA Measurement Personality
HP 85726B PHS Measurement Personality
HP 85727A GSM Multi-band Measurement Personality

Accessories

HP 10833A GPIB Cable (1 m)
HP 24542U RS-232 Cable 3 Meter (9 Pin F to 9 Pin F) Option 043 Only (for RS-232 9 Pin PC Connection to Analyzer)
HP 24542G RS-232 Cable 3 Meter (25 Pin M to 9 Pin F) Option 043 Only (for RS-232 25 Pin PC or Printer Connection to Analyzer)
HP C2932A RS-232 Cable 3 Meter (9 Pin M to 9 Pin F) Option 043 Only (for Serial 9 Pin LaserJet 4P/4Plus Connection to Analyzer)
HP C2950A HP IEEE-1284 A-B Parallel Cable (2 m)

[1] Most options can be retrofitted. Please contact your local HP sales representative.
[2] Some measurement personalities are not supported by all HP 8590 series models. For complete information, please contact the HP Call Center in your region.
[3] HP 11770A required.

HP 8560 EC-Series

- Continuous 30 Hz to 2.9, 6.5, 13.2, 26.5, 40, or 50 GHz sweeps
- Resolution bandwidths of 1 Hz to 100 Hz digitally implemented for measurement speed
- Low phase noise and wide dynamic range
- Precision timebase and 1 Hz counter resolution
- Adjacent channel power, channel power, carrier power and gated video measurements standard
- Class 3 MIL-rugged
- Color screen
- VGA output

HP 8560EC

HP 8560 EC-series Spectrum Analyzers

The HP 8560 EC-series portable spectrum analyzers offer the measurement capabilities and performance traditionally found only in larger, more expensive benchtop analyzers. These spectrum analyzers combine outstanding phase noise, sensitivity, 1 Hz resolution bandwidths and wide dynamic range in a Class 3 MIL-rugged package built to withstand harsh environmental conditions.

Capabilities for RF Communications

The ability to measure adjacent-channel power (ACP) on today's wireless telephones, pagers and other transmitters is critical in both R&D and manufacturing. The HP 8560 EC-series spectrum analyzers offer a complete solution for ACP testing of burst carrier signals using digital modulation such as is used in NADC-TDMA, GSM, DECT, CT2-CAI, PDC and PHS systems. Many of the implementation difficulties of the established standards have been addressed, providing fast, accurate and easy-to-use ACP measurement capability. Measure W-CDMA adjacent channel power ratio (ACPR) with a dynamic range of at least 70 dB using the HP 8563EC Option E35 ACPR test set.

Another standard feature is the ability to measure from .10 to 99.99 percent occupied bandwidth.

Time-gated signal analysis is another standard feature that allows you to easily measure time-varying signals such as pulsed RF, time-division multiple access, interleaved and burst-modulated. The HP 85902A burst carrier trigger can supply a TTL trigger signal.

HP 8560 EC-series specifications have been enhanced. Now, you can get better phase noise, sensitivity, dynamic range and frequency response from this high performance portable spectrum analyzer family.

The HP 8562EC spectrum analyzer provides a 13.2 GHz frequency range with increased dynamic range and third-order intercept (TOI) capability. This allows wireless-communication engineers to test high-performance components in burst operation systems.

With the HP 85672A spurious response measurements utility, you can use HP 8560 EC-series spectrum analyzers to make fast and easy spurious response tests.

For more information on RF communications measurement capabilities, refer to page 361.

Fast Digital Resolution Bandwidths

Digitally-implemented resolution bandwidths of 1, 3, 10, 30 and100 Hz allow the HP 8560 EC-series spectrum analyzers to sweep from 3 to 600 times faster than is possible with comparable analog filters. A narrow 5:1 shape factor allows you to view close-in, low-level signals easily. Digital bandwidths also provide the spectrum analyzer with a full 100 dB on-screen calibrated display.

PC Software for HP 8560 Series

The new HP BenchLink Spectrum Analyzer PC software provides an easy-to-use communications link between your PC and the HP 8560 Series spectrum analyzers. Taking full advantage of the Windows interface, you can easily transfer screen images or trace data via the GPIB interface, thereby making it easy to capture, analyze and document measurement results in your PC. For more information, see page 225.

Precision Frequency and Amplitude

Measure frequencies accurately using the built-in frequency counter. A standard precision frequency reference, with an aging rate of 1×10^{-7} per year, and 1 Hz counter resolution provide confidence in measurement accuracy. At 1 GHz, frequency accuracy of ±135 Hz after a 15-minute warmup is achieved.

Amplitude measurement uncertainty can be reduced using the amplitude correction (AMPCOR) feature. AMPCOR allows you to enter up to 200 amplitude correction points to compensate for sources of amplitude uncertainty, such as cable losses, preamplifier gain and spectrum analyzer frequency response. After developing a table of correction data, amplitudes that have been referenced to a power meter can be read directly on the spectrum analyzer display.

Digitized, Fast Time-Domain Sweeps

Digitization fast time-domain (zero span) sweeps use markers, trace math, trace storage and get hardcopy output, for measurements such as rise/fall times, pulse widths and time between events.

HP 8560EC and 8561EC RF Spectrum Analyzers

The HP 8560EC and 8561EC offer excellent performance for RF design, manufacturing and service applications. The HP 8560EC has a frequency range of 30 Hz to 2.9 GHz, and the HP 8561EC extends this range up to 6.5 GHz. Both have synthesized tuning for drift-free accurate measurements.

HP 8562EC RF Spectrum Analyzer

The HP 8562EC is a high-performance spectrum analyzer that provides the frequency and dynamic range needed for today's high-speed digital wireless communication applications. It allows manufacturing and R&D engineers to test network components with state-of-the-art performance. The HP 8562EC has a frequency range of 30 Hz to 13.2 GHz, which covers the spur-search ranges specified by leading standards organizations in Europe and in the United States.

HP 8563EC Microwave Spectrum Analyzer

The HP 8563EC extends the outstanding features and capabilities of the HP 8560 EC-series RF spectrum analyzers into the microwave frequency range. The HP 8563EC has a standard frequency range of 9 kHz to 26.5 GHz (preselected from 2.75 GHz to 26.5 GHz), with optional low-end frequency coverage to 30 Hz. The image-enhanced, double-balanced harmonic mixer of the HP 8563EC achieves noise-figure performance similar to that of a fundamentally-mixed front end.

HP 8564EC and 8565EC Millimeter Spectrum Analyzers

Whether you want to measure the third harmonic of a 15 GHz oscillator or the noise sidebands of a 38 GHz carrier, the HP 8564EC and 8565EC make spectrum analysis easier than ever before. A single coaxial connection is all you need to measure signals from 30 Hz to 50 GHz. Preselection minimizes images and multiple responses at higher frequencies.

The HP 8564EC has a frequency range of 9 kHz to 40 GHz, the HP 8565EC of 9 kHz to 50 GHz. Both have optional low-end coverage to 30 Hz and are preselected above 2.75 GHz.

HP 8563EC E35 Adjacent Channel Power Ratio Test Set

Use the special option E35 with the HP 8561EC/62EC/63EC/64EC/65EC spectrum analyzers to increase the dynamic range of adjacent channel power measurements. Option E35 uses an alternate first converter mixer with custom filtering to increase the spectrum analyzer's ACPR measurement dynamic range to at least 70 dB for systems with a guard band between channels of 900 kHz or greater. This meets the needs of emerging W-CDMA specifications. Control menus are integrated into the spectrum analyzer softkeys making the test set easy-to-use.

HP 11970 Series and 11974 Series Millimeter Mixers

For millimeter-wave measurements [1], preselection can be extended to 75 GHz using the HP 11974 mixers. Unpreselected frequency range can be extended to 110 GHz using the HP 11970 series mixers, and to 325 GHz using mixers from other manufacturers.

HP 85620A Mass Memory Module

This standard plug-in module adds measurement personality capability, enough memory to store 100 traces, memory-card capability and computer capability without an external controller. Create complex measurement routines and save them as single-key measurements stored on memory cards or in the module's 128 KB of battery-backed RAM. A clock/calendar and automatic save and execute functions let you configure the spectrum analyzer for unattended, automatic measurements.

HP 85629B Test and Adjustment Module

This accessory for the HP 8560EC, 8561EC, and 8563EC (limited use on HP 8562EC/64EC) makes it easier to service your spectrum analyzer. The module plugs into the rear panel of the instrument and automates high-level diagnostics, self tests and adjustment procedures. It performs more than 1,000 troubleshooting adjustments. Readjustments are fast and accurate because the module controls internal analyzer settings as well as external test equipment.

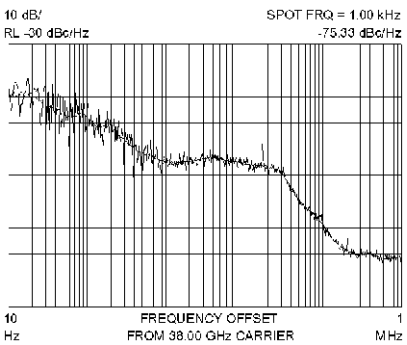
HP 85710A Digital Radio Measurement Personality

The HP 85710A Digital Radio Measurement Personality customizes the HP 8560 EC-series spectrum analyzers for digital radio measurements. It contains five agency masks for testing to U.S. FCC, U.K. and FRG specifications. A compare-to-mask function allows you to characterize spectral emissions. Other functions include mean power level, transient analysis monitoring and frequency-response measurements. You can also create and store your own custom masks.

[1] Millimeter-wave coverage is not available with Option 002 on the HP 8560EC.

HP 85671A Phase Noise Measurement Utility

This downloadable program transforms your HP 8560 EC-series spectrum analyzer into a phase noise tester. It eliminates the task of hand-drawing phase noise plots. To measure oscillator phase noise, you can generate graphs of phase noise (dBc/Hz) versus log offset frequency without having to manually tune to multiple frequency offsets. Other productivity features include direct phase noise readout, variable filtering (for controlling trade-offs between measurement repeatability and speed), calculation of RMS noise (displayed in radians and degrees), spot-frequency measurements (phase noise measurements at a single offset frequency) and digitized hardcopy and storage.



Use the HP 85671A phase noise utility to easily characterize noise sidebands of an oscillator.

HP 85672A Spurious Response Measurements Utility

The HP 85672A is a downloadable program on a card that inserts directly into any HP 8560 EC-series spectrum analyzer. This new test utility provides fast and easy spurious response test capability for all of HP's high-performance spectrum analyzers. Test setup time can be drastically reduced for manufacturing and R & D engineers with this one-button solution. HP 85672A offers five preprogrammed tests: third-order intermodulation product/third order intercept (TOI), harmonics and total-harmonic distortion (THD), discrete sideband spurs, general-spur search and mixing products.

Scalar Network Analysis Capability

The HP 85640A tracking generator and the optional built-in tracking generator for the HP 8560EC both cover 300 kHz to 2.9 GHz . See page 240 for details.

Specifications

Frequency

Frequency Range (internal mixing)
HP 8560EC: 30 Hz to 2.9 GHz
HP 8561EC: 30 Hz to 6.5 GHz
HP 8562EC: 30 Hz to 13.2 GHz
HP 8563EC: 9 kHz to 26.5 GHz; 30 Hz to 26.5 GHz (Option 006)
HP 8564EC: 9 kHz to 40 GHz; 30 Hz to 40 GHz (Option 006)
HP 8565EC: 9 kHz to 50 GHz; 30 Hz to 50 GHz (Option 006)

Frequency Range (external mixing): 18 GHz to 325 GHz in 12 waveguide bands (not available with HP 8560EC Option 002)

Frequency Reference Accuracy		Option 103
Temperature Stability	$\pm 1x10^{-8}$	$\pm 1x10^{-6}$
Aging (per year)	$\pm 1x10^{-7}$	$\pm 2x10^{-6}$
Setability	$\pm 1x10^{-8}$	$\pm 1x10^{-6}$

Warmup (nominal), 5 minute $\pm 1x10^{-7}$; 15 minute $\pm 1x10^{-8}$
Frequency Readout Accuracy (N = L0 Harmonic))
Span > 2 MHz x N: ± (freq. readout x freq. ref. accuracy + 5% x span +15% x RBW +10 Hz)
Span ≤ 2 MHz x N: ± (freq. readout x freq. ref. accuracy +1% x span +15% x RBW +10 Hz)

For more information, visit our web site: **http://www.hp.com/go/8560**

HP 8560 EC-Series

Marker Count Accuracy (S/N ≥ 25 dB): ± (marker freq. x freq. ref. accuracy +2 Hz x N +1 LSD)
Counter Resolution: Selectable from 1 Hz to 1 MHz
Frequency Span
Range: 0 Hz, 100 Hz to maximum frequency
Sweep Time
Range
Span = 0 Hz: 50 µs to 6,000 s
Span ≥ 100 Hz: 50 ms to 100 ks
Accuracy (span = 0 Hz)
Sweep Time > 30 ms: ± 1% digital
Sweep Time < 30 ms: ± 10% analog; ± 0.1% digital
Sweep Trigger: Delayed, free run, single, line, video, external
Resolution Bandwidth
Range (–3 dB): 1 Hz to 1 MHz in a 1, 3, 10 sequence and 2 MHz
Accuracy
1 Hz to 300 kHz: ± 10%; 1 MHz: ± 25%; 2 MHz: +50%, –25%
Selectivity (–60 dB/–3 dB)
RBW ≥ 300 Hz: < 15:1; RBW ≤ 100 Hz: < 5:1
Video Bandwidth Range: 1 Hz to 3 MHz in a 1, 3, 10 sequence

5

Noise Sidebands (center frequency ≤ 1 GHz)

Offset	Non-Option 103	Option 103
100 Hz	< –88 dBc/Hz	< –70 dBc/Hz
1 kHz	< –97 dBc/Hz	< –90 dBc/Hz
10 kHz	< –113 dBc/Hz	< –113 dBc/Hz
100 kHz	< –117 dBc/Hz	< –117 dBc/Hz

Residual FM (zero span): < 1 Hz p-p in 20 ms; < 0.25 Hz p-p in 20 ms (nominal); < 10 Hz p-p in 20 µs (Option 103)

Amplitude

Range: Displayed average noise level to +30 dBm
Maximum Safe Input Level
Average Continuous Power: +30 dBm (1W, input atten. ≥ 10 dB)
Peak Pulse Power (< 10 µs pulse width and < 1% duty cycle): +50 dBm (100 W, input atten. ≥ 30 dB)
DC Volts: < ± 0.2 V (dc-coupled); < ± 50 V (ac-coupled, HP 8560EC, HP 8561EC and HP 8562EC only)
1 dB Gain Compression
10 MHz to 2.9 GHz: mixer level ≤ –5 dBm
2.9 to 6.5 GHz (HP 8561EC): mixer level ≤ –3 dBm
2.9 to 6.5 GHz (HP 8562EC/63EC/64EC/65EC): mixer level ≤ 0 dBm
> 6.5 GHz: ≤ –3 dBm (HP 8562EC/63EC); ≤ 0 dBm (HP 8564EC/65EC)

Displayed Average Noise Level (0 dB input atten., 1 Hz RBW [1])

Frequency	HP 8560EC/ 61EC	HP 8562EC	HP 8563EC	HP 8564EC/ 65EC
30 Hz	–90 dBm	–90 dBm	–90 dBm	–90 dBm
1 kHz	–105 dBm	–105 dBm	–105 dBm	–105 dBm
10 kHz	–120 dBm	–120 dBm	–120 dBm	–120 dBm
100 kHz	–120 dBm	–120 dBm	–120 dBm	–120 dBm
1 to 10 MHz	–140 dBm	–140 dBm	–140 dBm	–140 dBm
10 MHz to 2.9 GHz	–151 dBm[8]	–151 dBm	–149 dBm	–145 dBm
2.9 to 6.5 GHz	–145 dBm[2]	–148 dBm	–148 dBm	–147 dBm
6.5 to 13.2 GHz	—	–145 dBm	–145 dBm	–143 dBm
13.2 to 22.0 GHz	—	—	–140 dBm	–140 dBm
22.0 to 26.5 GHz	—	—	–139 dBm	–136 dBm
26.5 to 31.15 GHz	—	—	—	–139 dBm
31.15 to 40.0 GHz	—	—	—	–130 dBm
40.0 to 50.0 GHz	—	—	—	–127 dBm[3]

[1] 10 Hz RBW (Min. RBW with Option 103) add 10 dB to noise floor
[2] HP 8561EC only
[3] HP 8565EC only
[4] HP 8563EC/64EC/65EC only
[5] HP 8563EC only
[6] HP 8564EC/65EC only
[7] Except HP 8561EC
[8] For HP 8561EC: –145 dBm
[9] TOI reference to single tone

Spurious Responses	Mixer Level	Distortion
General Spurious	–40 dBm	< (–75+20 log N) dBc
Second Harmonic Dist.		
20 MHz to 1.45 GHz [7]	–40 dBm	<–79 dBc
1 MHz to 1.45 GHz	–40 dBm	< –72 dBc
1.45 GHz to 3.25 GHz [2]	–20 dBm	< –72 dBc
1.45 GHz to 2.0 GHz [4]	–10 dBm	< –85 dBc
2 GHz to 6.6 GHz [7]	–10 dBm	<–100 dBc
2.0 GHz to 13.25 GHz [5]	–10 dBm	< –100 dBc
2.0 GHz to 20 GHz [6]	–10 dBm	< –90 dBc
20 GHz to 25 GHz [3]	–10 dBm	< –90 dBc
3rd Order Intermodulation [9]		
20 MHz to 2.9 GHz [7]	–30 dBm	< –82 dBc
1 MHz to 2.9 GHz	–30 dBm	< –78 dBc
2.9 GHz to 6.5 GHz	–30 dBm	< –90 dBc
6.5 GHz to 26.5 GHz	–30 dBm	< –75 dBc
26.5 GHz to 40 GHz [6]	–30 dBm	< –85 dBc (nominal)
40 GHz to 50 GHz [3]	–30 dBm	≤ –85 dBc (nominal)
Images		
10 MHz to 26.5 GHz	–10 dBm	< –80 dBc
26.5 GHz to 50 GHz	–30 dBm	< –60 dBc
Multiples and Out-of-Band Responses		
10 MHz to 26.5 GHz	–10 dBm	< –80 dBc
26.5 GHz to 50 GHz	–30 dBm	< –55 dBc

Residual Responses (> 200 kHz, N=1): < –90 dBm
Display
Viewing area: Approx. 7 cm (V) x 9 cm (H)
Scale calibration: 10 x 10 divisions
Log scale: 10, 5, 2, 1 dB per division
Linear scale: 10% of ref. level per division

Display Scale Fidelity
Log: ± 0.1 dB/dB to a maximum of ± 0.85 dB, 0 to –90 dB; maximum of ± 1.5 dB, 0 to –100 dB (RBW ≤ 100 Hz)
Linear: ± 3% of reference level
Reference Level Range: Log = –120 to +30 dBm in 0.1 dB steps; Linear = 2.2 µV to 7.07 V in 1% steps

Frequency Response, Relative (10 dB input atten.)

Frequency	HP 8560EC	HP 8561EC	HP 8562EC	HP 8563EC	HP 8564EC/ 65EC
100 MHz to 2.0 GHz	± 0.7 dB	± 1.0 dB	± 0.9 dB	± 1.0 dB	± 0.9 dB
30 Hz to 2.9 GHz	± 1.0 dB	± 1.0 dB	± 1.25 dB	± 1.25 dB	± 1.0 dB
2.9 GHz to 6.5 GHz	—	± 1.5 dB	± 1.5 dB	± 1.5 dB	± 1.7 dB
6.5 GHz to 13.2 GHz	—	—	± 2.2 dB	± 2.2 dB	± 2.6 dB
13.2 GHz to 22.0 GHz	—	—	—	± 2.5 dB	± 2.5 dB
22.0 GHz to 26.5 GHz	—	—	—	± 3.3 dB	± 3.3 dB
26.5 GHz to 31.15 GHz	—	—	—	—	± 3.1 dB
31.15 GHz to 40.0 GHz	—	—	—	—	± 2.6 dB
40.0 GHz to 50.0 GHz	—	—	—	—	± 3.2 dB[3]

Calibrator Output: 300 MHz x (1 ± freq. ref. acc'y), –10 dBm: < ± 0.3 dB
Input Attenuator
Range
HP 8560EC/61EC/62EC/63EC: 0 to 70 dB in 10 dB steps
HP 8564EC/65EC: 0 to 60 dB in 10 dB steps
Switching Uncertainty (ref. to 10 dB, 30 Hz to 2.9 GHz): < ± 0.6 dB/10 dB step, ± 1.8 dB max.
Repeatability: ± 0.1 dB (nominal)
IF Gain Uncertainty (10 dB atten., 0 to –80 dBm ref. level): < ± 1 dB
Resolution Bandwidth Switching Uncertainty: < ± 0.5 dB
Pulse Digitization Uncertainty (pulse response mode, PRF ≥ 720/sweep time, RBW ≤ 1 MHz): < 1.25 dB pk-pk (Log); < 4% of reference level pk-pk (Linear)

Time-Gated Spectrum Analysis

Gate Delay	Edge Mode	Level Mode
Range	3 µs to 65.535 ms	≤ 0.5 µs
Resolution	1 µs	

Accuracy (from gate trigger input to pos. edge of gate output): < ± 1 µs

Gate Length
Range: 1 µs to 65.535 ms
Resolution: 1 µs
Accuracy (from pos. edge to neg. edge of gate output): < ± 1 µs

Delayed Sweep

Trigger Modes: Free run, line, external, video
Range: 2 µs to 65.535 µs; Option 007, Sweeptime < 30 µs; –9.9 µs to +65.535 µs; Sweeptime ≥ 30 µs, +2 µs to +65.535 µs
Resolution: 1 µs
Accuracy: ± 1 µs

Demodulation (Spectrum)

Modulation Type: AM and FM
Audio Output: Speaker and phone jack with volume control

Inputs and Outputs (All values nominal)

Front-Panel Connectors
- **RF Input** (50 Ω)
  HP 8560EC/61EC/62EC/63EC, Type-N female
  HP 8563EC Option 026, APC-3.5 male
  HP 8564EC/65EC, 2.4-mm male
  VSWR (≥ 10 dB atten.): < 1.5:1 below 2.9 GHz; < 2.3:1, ≥ 2.9 GHz
  LO Emission Level (average with 10 dB atten.): < – 80 dBm
  Second IF Input (SMA female, 50 Ω)
    Frequency: 310.7 MHz
    Full Screen Level: –30 dBm
    Gain Compression: –20 dBm
  First LO Output (SMA female, 50 Ω)
    Frequency: 3.0 to 6.8107 GHz
    Amplitude:+16.5 dBm ± 2 dB;+14.5 dBm ± 3 dB (Option 002)
  Cal Output: BNC female, 50 Ω
  Probe Power: +15 Vdc,–12.6 Vdc, and GND (150 mA maximum each)

Rear Panel Connectors
- **10 MHz Reference In/Out** (shared BNC female, 50 Ω)
  Output Freq. Accuracy: 10 MHz ± (10 x MHz freq. ref. acc'y)
  Output Amplitude: 0 dBm
  Input Amplitude: –2 to +10 dBm
- **Video Output** (BNC, 50 Ω)
  Amplitude (RBW ≥ 300 Hz): 0 to +1 V full scale
- **LO Sweep I FAV Output** (shared BNC female, 2 kΩ)
  Amplitude (LO sweep): 0 to 10 V, no load
- **Blanking/Gate Output:** Shared BNC female, 50 Ω, TTL output
- **External/Gate Trigger Input** (shared BNC female, > 10 kΩ): settable to high TTL or low TTL
- **GP-IB** (IEEE-488 bus connector)
- **Interface Functions:** SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C1, C28, E1
- **Interface Functions** (For HP 8562EC): SH1, AH1, T6, LE0, RL1, PP1, DC1, DT1, C1, C28, TE0, SR1

General Specifications

Environmental
- **Military Specs:** Class 3 MIL-rugged
- **Calibration Interval:** Two years (HP 8560EC/61EC/62EC/63EC); one year (HP 8564EC/65EC)
- **Warmup Time:** 5 minutes in ambient conditions
- **Temperature:** –10° to +55° C (operating); –51° to +71° C (not operating)
- **Humidity:** 95% at 40° C for five days
- **Rain Resistance:** Drip-proof at 16 liters/hour/sq. ft.
- **Altitude:** 15,000 ft. (operating); 50,000 ft. (not operating)
- **Pulse Shock** (half sine): 30 g for 11 ms duration
- **Transit Drop:** 8-inch drop on six faces and eight corners

Electromagnetic Compatibility: Conducted and radiated interference in compliance with CISPR Pub. 11 (1990). Meets MIL-STD-461C, part 4, with certain exceptions.

Power Requirements
- **115 Vac Operation:** 90 to 140 V rms, 3.2 A rms max., 47 to 440 Hz
- **230 Vac Operation:** 180 to 250 V rms, 1.8 A rms max., 47 to 66 Hz

Maximum Power Dissipation: 180 W (HP 8560EC/61EC/62EC/63EC); 260 W (HP 8564EC/65EC)
Audible Noise (nominal): < 5.0 Bels power at room temp. (ISO DP7779)
Dimensions (w/o handle, feet, cover): 337 mm W (13 ¼ in.) x 187 mm H (7 ⅜ in.) x 461 mm D (18 ⅛ in.)
Weight (carrying, nominal): 20 kg (44 lb)

Option 002 Built-in Tracking Generator (HP 8560EC only)

Frequency
- **Range:** 300 kHz to 2.9 GHz
- **Accuracy** (after peaking): ± (freq. ref. accuracy x tuned freq. + 5% x span + 295 Hz)
- **Tracking Drift** (nominal): Usable in 1 kHz RBW after 5-min. warmup; usable in 300 Hz RBW after 30-min. warmup
- **Minimum RBW:** 300 Hz

Amplitude
- **Output Level:** –10 to +1 dBm; –10 to 2.8 dBm, typical
- **Resolution:** 0.1 dB
- **Accuracy** (25° C ± 10° C)
  Vernier: ± 0.2 dB/dB, ± 0.5 dB max.
  Absolute: ± 0.75 dB
  Level Flatness: ± 2.0 dB
- **Dynamic Range:** 95 dB at 300 kHz to 1 MHz; 115 dB at 1 MHz to 2.0 GHz; 110 dB at 2.0 GHz to 2.9 GHz
- **Power Sweep:** 10 dB range, 0.1 dB resolution

Inputs/Outputs
- **RF Output** (front panel): Type-N female, 50 Ω (nominal)
- **Ext. ALC Input** (rear panel): BNC female; use with negative detector

Key Literature

HP 8560 EC-Series Configuration Guide, p/n 5963-6831E
HP 8560 EC-Series Brochure, p/n 5966-3559E
HP 8563EC E35 Product Overview, p/n 5966-2913E
HP 8560 EC-Series Technical Specifications, p/n 5965-8078E
HP 85671A Technical Data, p/n 5091-7089E
HP 85672A Product Overview, p/n 5965-1337E
HP 85710A Technical Data, p/n 5952-1452

For more information on compatible printers, visit our web site:
http://www.hp.com/go/pcg

Ordering Information

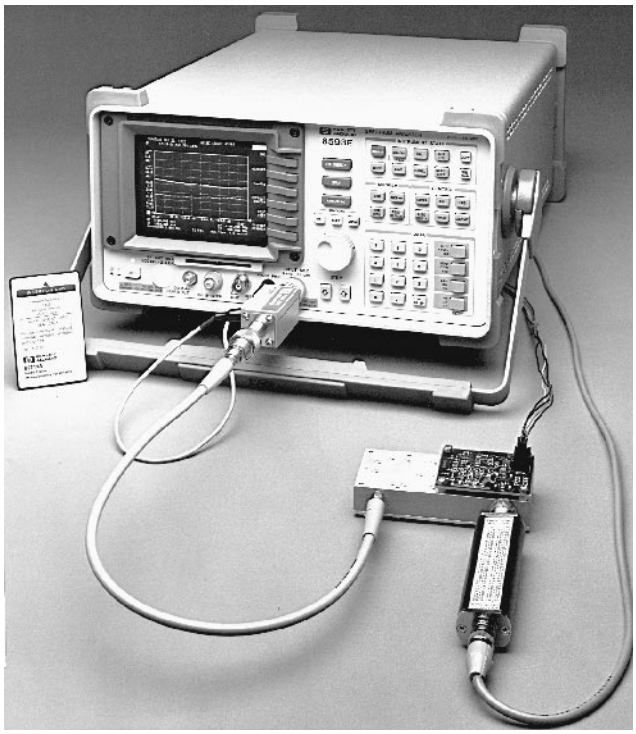
HP 8560EC Spectrum Analyzer, 30 Hz to 2.9 GHz
HP 8561EC Spectrum Analyzer, 30 Hz to 6.5 GHz
HP 8562EC Spectrum Analyzer, 30 Hz to 13.2 GHz
HP 8563EC Spectrum Analyzer, 9 kHz to 26.5 GHz
HP 8564EC Spectrum Analyzer, 9 kHz to 40 GHz
HP 8565EC Spectrum Analyzer, 9 kHz to 50 GHz
- **Opt 001** Second IF Output (310.7 MHz)
- **Opt 002** Built-In Tracking Generator (HP 8560EC)
- **Opt 005** Alternate Sweep Out (cannot be used with Opt 002)
- **Opt 006** 30 Hz to Freq. Coverage (HP8563EC/64EC/65EC)
- **Opt 008** Signal Identification
- **Opt 026** APC-3.5 mm Input Connector (HP 8563EC)
- **Opt 042** Protective Soft Carrying Case/Backpack
- **Opt 0Q8** Service Training (HP 8562EC)
- **Opt 103** Delete Precision Frequency Reference, and 1 Hz and 3 Hz RBWs
- **Opt 104** Delete Mass Memory Module
- **Opt 908** Rackmount Kit without Handles
- **Opt 909** Rackmount Kit with Handles
- **Opt 910** Extra Manual Set
- **Opt 915** Service Guide
- **Opt 916** Extra Quick Reference Guide (English)
- **Opt 1BN** MIL-STD-45662A Calibration (no data)
- **Opt 1BP** MIL-STD-45662A Calibration (with data)
- **Opt E35** ACPR Test Set (HP 8561EC/62EC/63EC/64EC/65EC)
- **Opt UK6** Commercial Calibration (with data)

Accessories
HP 85620A Mass Memory Module
HP 85629B Test and Adjustment Module
HP 85640A Tracking Generator (300 kHz to 2.9 GHz)
HP 8449B 1 to 26.5 GHz Preamplifier
HP 83050A 2 to 50 GHz Power Preamplifier
HP 83051A 45 MHz to 50 GHz Preamplifier
HP 85700A 32 KB RAM Memory Card
HP 85702A 128 KB RAM Memory Card
HP 85671A Phase Noise Measurements Utility
HP 85672A Spurious Response Measurements Utility
HP 85710A Digital Radio Measurement Personality
HP 85901A Portable AC Power Source
HP 85902A Burst Carrier Trigger
HP 41800A Active Probe (5 Hz to 500 MHz)
HP 85024A High-Frequency Probe (300 kHz to 3 GHz)

Accessories for Noise Figure and Scalar Measurements

HP 85630A
HP 85640A
HP 85714A
HP 85719A

- Noise-figure measurement personality
- High-performance tracking sources
- Scalar measurement personality
- Scalar test set for transmission/reflection measurements



HP 85719A

Accessories for Noise-Figure Measurements

The HP 85719A noise-figure measurements personality adds unique capability to an HP 8590 E-series spectrum analyzer with the Option 119 noise-figure card. Combined with the HP 346B noise source and HP 87405A preamplifier, the measurement personality and spectrum analyzer provide displayed swept noise-figure and gain measurements from 10 MHz to 2.9 GHz. Features include one-point measurement capability for quick results, noise-figure and spectrum analyzer mode-switching for stray signal detection, selectable measurement bandwidths to directly measure narrowband devices, and a repeatability calculator to determine measurement time and repeatability tradeoffs.

The noise-figure personality makes use of many features found in the spectrum analyzer. For example, the save/recall functions and the memory-card reader are used to store measurement data, states, displays and ENR data tables. Marker functions make it easy to read noise-figure and gain measurements for the entire sweep, and a menu-driven interface makes the entire system easy to use.

Accessories for Scalar Network Analysis

A variety of accessories are designed to enhance HP spectrum analyzers by adding scalar measurement capability. These powerful solutions allow you to meet both your scalar-network analysis and spectrum analysis needs.

HP 85640A Portable Tracking Generator

This portable tracking generator provides the HP 8560 EC-series spectrum analyzers with scalar measurement capability from 300 kHz to 2.9 GHz. See page 262.

HP 85630A and HP 85714A

HP 85714A Scalar Measurement Personality
HP 85630A Scalar Transmission/Reflection Test Set

The HP 85714A is a downloadable program that enhances an HP 8590 series spectrum analyzer and tracking generator for transmission measurements. The addition of an HP 85630A scalar test set provides the user interface with a powerful yet economical transmission/reflection measurement system.

The scalar measurement personality adds a number of useful features to the scalar/spectrum analyzer system. These include guided OPEN/SHORT and THRU calibration, pass/fail limit line testing, an enhanced 120 dB display for high, dynamic-range measurements, a tabular display format and one-button measurements for 3 or 6 dB bandwidth, insertion loss/gain, shape factor, Q, and center frequency measurements.

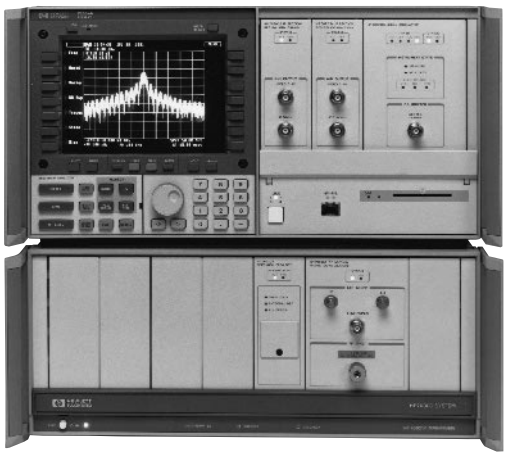
The scalar test set allows you to view transmission and reflection data simultaneously on the screen, so you can make adjustments on a device-under-test while monitoring the results. You can also make calibrated transmission and reflection measurements on a device using a single setup, without the usual need to recalibrate and reconfigure as with spectrum-analyzer-only systems.

Other capabilities provided by the test set include a reflection coefficient measurement marker, VSWR measurement markers, return loss measurement, automatic switching between transmission and reflection mode and source attenuation.

Ordering Information

HP 85630A Scalar Transmission/Reflection Measurement Test Set
HP 85640A Portable Tracking Generator
HP 85714A Scalar Measurement Personality
HP 85719A Noise-Figure Measurements Personality
HP 8590 E-Series Spectrum Analyzers
  Opt 119 Noise-Figure Card
HP 346B Noise Source
HP 87405A Preamplifier

- Superb performance from 100 Hz to 40 GHz
- Automated, reconfigurable systems
- HP 8566B code compatibility



HP 71209A

HP 70000 Series Spectrum Analyzers

The HP 70000 series spectrum analyzers are part of the growing modular measurement system (MMS) family at HP. Four factory-configured spectrum analyzers combine high performance, ease of use and the benefits of modularity for RF and microwave applications:

- HP 71100C/P RF spectrum analyzer, 100 Hz to 2.9 GHz
- HP 71200C/P microwave spectrum analyzer, 50 kHz to 22 GHz
- HP 71209A/P microwave spectrum analyzer, 100 Hz to 26.5 GHz, with an outstanding set of performance features
- HP 71210C/P microwave spectrum analyzer, 100 Hz to 22 GHz, with ultimate sensitivity and a dynamic tracking preselector

New "P" Series Feature PC Display

The "P" series spectrum analyzer systems replace the mainframe display with a high performance HP Vectra PC and the display software. The key features of the "P" systems are capability for output to PC printers and mass storage devices and lower system price. While performing measurements, you can copy the virtual screen and cut and paste data to spreadsheets or reports. Test data can be logged and stored in a data file limited in size only by the computer's disk capacity.

All A/C spectrum analyzers feature a color display with color editor, a custom hardkey panel with the most commonly-used spectrum-analyzer functions, downloadable programming capability and a memory card reader.

HP 71209A/P Microwave Spectrum Analyzer

The HP 71209A/P is the MMS standard for microwave spectrum analysis, offering exceptional performance for a lower price. Special features include a built-in mixer interface for completely preselected coverage from 100 Hz to 75 GHz (using HP 11974 series mixers), programming code compatibility with the HP 8566B spectrum analyzer, similar performance to that of the HP 71210C/P, an IF output with AGC, a 5 dB step attenuator and a built-in baseband limiter. Option 001 includes a preselector bypass and increases the front-end bandwidth to aid upgrading to the bandwidth receiver system.

HP 70875A Noise-Figure Measurement Personality

The HP 70875A noise-figure measurement personality customizes HP 70000 series spectrum analyzers for displayed swept noise-figure and gain measurements from 10 MHz to 26.5 GHz. Features include one-point measurement capability for quick results, noise-figure and spectrum analyzer mode switching for stray signal detection, selectable measurement bandwidths to directly measure narrowband devices and marker functions with limit lines.

Key Literature

A complete list of all MMS products with full descriptions, specifications and services is available. For a free copy of the *HP 70000 Modular Measurement System* catalog, contact the HP Call Center in your region. Ask for HP p/n 5965-2818E.

Ordering Information

Price

HP 71100C/P Spectrum Analyzer, 100 Hz to 2.9 GHz
HP 71200C/P Spectrum Analyzer, 50 kHz to 22 GHz
HP 71209A/P Spectrum Analyzer, 100 Hz to 26.5 GHz
Opt 001 Wide Bandwidth RF Section
Opt Z40 Spectrum Analyzer, 100 Hz to 40 GHz
HP 71210C/P Spectrum Analyzer

HP 70000 Series Spectrum Analyzer Specification Summary

	HP 71100C HP 71100P	HP 71200C HP 71200P	HP 71209A HP 71209P	HP 71210C HP 71210P
Frequency range (tunable in 1 Hz increments)	100 Hz to 2.9 GHz (dc-coupled); 100 kHz to 2.9 GHz (ac-coupled)	50 kHz to 22 GHz	100 Hz to 26.5 GHz (100 Hz to 40 GHz Option Z40)	100 Hz to22 GHz
With external mixers	75 GHz with HP 11974 preselected mixers; 110 GHz with HP 11970 harmonic mixers; 325 GHz with other mixers			
Resolution bandwidth range	10 Hz to 300 kHz; 3 MHz option		10 Hz to 3 MHz	
Phase noise	–108 dBc/Hz at 10 kHz offset	–108 dBc/Hz at 10 kHz offset, to 6.2 GHz		
Optimum dynamic range (2nd/3rd order)	82 dB/92 dB	70 dB/88 dB	99 dB/96 dB	96 dB/98 dB
Amplitude accuracy (relative frequency + lesser of scale fidelity or IF gain accuracy)	± 2 dB (± 0.9 dB) [1]	± 2 dB (± 0.9 dB) [1]	± 2 dB (± 0.9 dB) [1]	± 2.5 dB (± 0.9 dB) [1]
Displayed average noise level, 10 Hz RBW				
at 2.9 GHz	–131 dBm	<–129 dBm	–136 dBm	–139 dBm
at 22 GHz	—	<–116 dBm	–128 dBm	–133 dBm
at 26.5 GHz	—	<–115 dBm	–126 dBm	—
Displayed average noise level with HP 70620 Series preamplifiers				
at 2.9 GHz	–156 dBm	–140 dBm	–155 dBm	–155 dBm
at 22 GHz	—	–119 dBm	–148 dBm	–150 dBm
at 26.5 GHz	—	–155 dBm	–145 dBm	—

[1] ± 0.9 dB transfer accuracy using the HP 70100A–H01 modular power meter.

HP 71910A
HP 71910P

HP 71910A and 71910A Option 11 configurations

HP 71910A and HP 71910P Receiver

Modular Receiver for Surveillance and Signal Monitoring

5

The HP 71910A/P is a receiver in the MMS format for monitoring signals from 100 Hz to 26.5 GHz. The receiver provides cost-effective combination search and wide-bandwidth collection capabilities for surveillance and signal monitoring of satellite, digital radio and radar/EW transmissions.

The wide-bandwidth receiver consists of the HP 71209A/P Option 001 spectrum analyzer plus the HP 70911A ultra-wide bandwidth IF module. System options include a preamplifier module for enhanced noise figure and smaller-size, single-mainframe configurations.

Search and Collection Modes of Operation

The HP 71910A/P receiver has two modes of operation: search and collection. To search for signals, the receiver relies on its fast spectrum analyzer tuning. It sweeps over user-specified spans up to 26.5 GHz wide using bandwidths up to 3 MHz. Wide dynamic range ensures that signals of various amplitudes can be quickly identified.

Once a signal is located, the receiver is fixed-tuned and the wide IF bandwidths in the HP 70911A IF module are used for signal collection. The HP 70911A provides IF bandwidths up to 100 MHz (in 10% increments) and up to 70 dB IF step gain. A linear IF signal path provides good signal fidelity with standard outputs of 321.4 MHz IF and linear video. Optional outputs include 70 and 140 MHz IF, analog I/Q and demodulated FM.

HP 71910A and HP 89410 VSA

Pulse Shape Characterization

Traditional shape measurements of pulsed microwave signals using a spectrum analyzer are significantly enhanced by the 100 MHz bandwidth. Using an oscilloscope connected to the video output, pulse rise and fall times of microwave signals are easily measured to 7 ns.

I/Q Signal Identification

The optional analog I/Q demodulator provides I and Q outputs which will produce a constellation display on an oscilloscope when the HP 71910A/P is tuned to a suitable digitally modulated signal. Sub-Hz tuning (minimum of 1 Hz resolution on-screen) allows ultrafine adjustments to compensate for phase offsets when it is not possible to phaselockthe receiver to the source, such as in off-the-air monitoring. By stopping the spinning caused by a non-phaselocked system, modulation formats are easily identified.

HP 71910P

When more thorough analysis is required, the I and Q outputs can be connected to a dual-channel vector signal analyzer (VSA). This configuration can provide full-signal demodulation of microwave signals with double the bandwidth normally provided by the VSA alone.

Digital Demodulation and Vector Signal Analysis

Add high performance digital demodulation and vector signal analysis capability by combining the HP 71910A/P and HP 89410A VSA. Measurements such as error vector magnitude (EVM) along with constellation, eye diagram and time domain analysis as well as group delay, AM to PM and phase versus drive, for example, can be made on microwave communication signals.

System Specification Summary

Frequency Range: 100 Hz to 26.5 GHz (110 GHz with external mixers)
Noise Figure at 12 GHz: 32 dB (13 dB with preamplifier module)
TOI at 12 GHz: +2.0 dBm (without preamplifier module)
Tuning Resolution: 1 Hz
LO Phase Noise at 6 GHz: –108 dBc/Hz at 10 kHz offset
IF Bandwidths: 10 Hz to 100 MHz (continuously variable in 10% increments in most cases)
- **Spectrum Analyzer RBW:** 10 Hz to 3 MHz
- **Receiver IF Bandwidth:** 10 MHz to 100 MHz

IF Filter Type: 5-pole, synchronously tuned
Optional Filter Type: 6-pole, Chebyshev channel filters
IF Step Gain: 70 dB (in 1 dB steps)

Outputs
321.4 MHz IF
- **Bandwidth:** 10 MHz to 100 MHz (preselector bypass)
- **Bandwidth:** > 36 MHz for 2.7 to 26.5 GHz RF path (preselector ON)
- **Bandwidth:** > 48 MHz for 100 Hz to 2.9 GHz RF path

Video: AM, FM (optional), pulse (bandwidth same as 321.4 MHz IF)
- **Optional 70 MHz** IF (bandwidth ≥ 40 MHz)
- **Optional 140 MHz** IF (bandwidth ≥ 70 MHz)
- **Optional Analog I/Q** (I bandwidth ≥ 50 MHz; Q bandwidth ≥ 50 MHz)

Key Literature

MMS Catalog, p/n 5965-2818E
HP 71910A/P Wide Bandwidth Receiver, p/n 5965-7916E
HP 89410A Vector Signal Analyzer, p/n 5964-3586E

Ordering Information

HP 71910A Wide Bandwidth Receiver
HP 71910P Wide Bandwidth Receiver
- **Opt 001** 70 MHz IF Output
- **Opt 002** 140 MHz IF Output
- **Opt 004** Analog I/Q Output
- **Opt 005** FM Output
- **Opt 007** Channel Filters
- **Opt 011** Delete Display, NB IFs, PFR (71910A only)
- **Opt 016** HP 7060B Option 001 Preamplifier Module

HP 70911A Ultra-Wide Bandwidth IF Module

- Preselected mixers to eliminate signal identification
- State-of-the-art technology
- Easier automated measurements
- Low conversion loss
- Individually amplitude calibrated
- No bias or tuning adjustments
- High 100 mW safe input level

HP 11970, 11974 Series Mixers

HP 11974 Series Preselected Millimeter Mixers

Eliminate the need for signal identification at millimeter frequencies. The HP 11974 series mixers are preselected from 26.5 to 75 GHz for faster, easier testing of millimeter devices and systems. Preselection reduces mixer overload from broadband signals and reduces radiation of local oscillator harmonics back to the device-under-test. Equipment operators can quickly locate true signals, and software development for automated measurements is greatly simplified.

These mixers feature advanced barium-ferrite technology and come with a standalone power supply. They are particularly useful for broadband millimeter signal analysis, millimeter electromagnetic-interference (EMI) measurements, and unattended monitoring of millimeter signals.

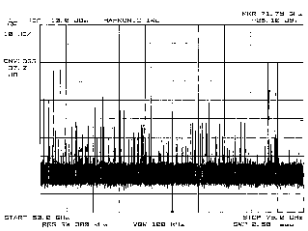
HP 11974 series preselected mixers are available in four bands

HP model	Frequency range (GHz)	Sensitivity[1] (displayed avg. noise level/10 Hz) (dBm)	Calibration accuracy[1] (dB)	Image rejection[1] (dB)	1 dB Gain compression (dBm)
11974A	26.5 to 40	–111	< ±2.3	–54	+6
11974Q	33 to 50	–106	< ±2.3	–50	+0
11974U	40 to 60	–109	< ±2.6	–50	+0
11974V	50 to 75	–100	< ±4.5	–40	+3

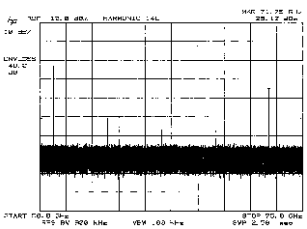
[1] Specifications apply when connected to the HP 8566B or 70000 series spectrum analyzers.

Compatibility

Upgrade kits are available to assure the compatibility of HP 8566A/B spectrum analyzers and the HP 70907A external mixer interface module. Consult your HP sales representative to determine requirements. All HP 8560 EC-series spectrum analyzers and the HP 70907B external mixer interface modules are fully compatible with the HP 11974 series.



50 to 75 GHz Sweep Without Preselection



50 to 75 GHz Sweep Using HP 11974 Series Mixer

HP 11970 Series Harmonic Mixers

The HP 11970 series waveguide mixers are general-purpose harmonic mixers. They employ a dual-diode design to achieve flat-frequency response and low conversion loss. These are achieved without external dc bias or tuning stubs. Manual operation and computer-controlled hardware operation are simplified because mixer bias and tuning adjustments are not required.

HP 11970 series harmonic mixers are available in six bands

HP model	Frequency range (GHz)	LO harm number	Conversion loss (dB)	Noise level (dB) 1 kHz RBW	Freq.[1] response (dB)	Gain compression (dBm)
11970K	18 to 26.5	6+	24	–105	± 1.9	–3
11970A	26.5 to 40	8+	26	–102	± 1.9	–5
11970Q	33 to 50	10+	28	–101	± 1.9	–7
11970U	40 to 60	10+	28	–101	± 1.9	–7
11970V	50 to 75	14+	40	–92	± 2.1	–3
11970W	75 to 110	18+	47	–85	± 3.0	–1

[1] Frequency response of the mixers is reduced by 1 dB for LO range of 14 to 18 dBm.

Compatibility

The HP 11970 series mixers extend the frequency range of the HP 8560 EC-series portable spectrum analyzers, of the HP 8566B spectrum analyzer (used with the HP 11975A amplifier) and of the HP 70000 modular measurement system (used with the HP 70907A/B external mixer interface modules).

HP 11970 and 11974 Series Specifications

IF Range: dc to 1.3 GHz
LO Amplitude Range: +14 dB to +16 dB; +16 dB optimum
Calibration Accuracy: +2 dB for HP 11970 series with optimum LO amplitude
Typical RF Input SWR: < 2.2:1, < 3.0:1 for HP 11974 series
Bias Requirements: None
Typical Odd-Order Harmonic Suppression: > 20 dB (does not apply to HP 11974 series)
Maximum CW RF Input Level: +20 dBm (100 mW), +25 dBm for HP 11974 series
Maximum Peak Pulse Power: 24 dBm (250 mW) with < 1 µs pulse (avg. power = +20 dBm)
Bandwidth: 100 MHz minimum (HP 11974 series only)
Environmental: Meets MIL-T-28800, Type III, Class 3, Style C
IF/LO Connectors: SMA (female)
TUNE IN Connector: BNC
LO Range: 3 to 6.1 GHz

Key Literature

HP 11970 Series Technical Data, p/n 5954-2714
HP 11974 Series Technical Data, p/n 5952-2748

Ordering Information

HP 11974A 26.5 to 40 GHz Preselected Mixer
HP 11974Q 33 to 50 GHz Preselected Mixer
HP 11974U 40 to 60 GHz Preselected Mixer
HP 11974V 50 to 75 GHz Preselected Mixer
  Opt 003 Delete Power Supply (HP 11974 series only)
HP 11970K 18 to 26.5 GHz Mixer
HP 11970A 26.5 to 40 GHz Mixer
HP 11970Q 33 to 50 GHz Mixer
HP 11970U 40 to 60 GHz Mixer
HP 11970V 50 to 75 GHz Mixer
HP 11970W 75 to 110 GHz Mixer
HP 11970
  Opt 009 Mixer Connection Set adds three 1-m low-loss SMA cables, wrench, Allen driver for any HP 11970 series mixer
HP 11975A 2 to 8 GHz Amplifier
HP 281A/B Coaxial to Waveguide Adapters
  R281A 26.5 to 40 GHz, 2.4 mm (f)
  R281B 26.5 to 40 GHz, 2.4 mm (m)
  Q281A 33 to 50 GHz, 2.4 mm (f)
  Q281B 33 to 50 GHz, 2.4 mm (m)

HP 85640A Portable Tracking Generator

This portable, rugged tracking generator adds scalar analysis capability from 300 kHz to 2.9 GHz to an HP 8560 series portable spectrum analyzer. Use the HP 85640A to measure gain, frequency response, compression, flatness and return loss on components and subsystems. A built-in attenuator gives output power of –80 to 0 dBm. Together, the spectrum analyzer and tracking generator have a dynamic range greater than 100 dB.

HP 85902A Burst Carrier Trigger

For performing transmitter tests, this accessory provides a TTL time reference that allows an HP 8590 A/E-series or 8560 EC-series spectrum analyzer to trigger reliably off the RF signal. It has an input range of 60 dB and a separate built-in preamplifier for greater sensitivity. The HP 85902A works with all digital communication formats: NADC-TDMA, E-TDMA, PDC, GSM900, DCS-1800, PCS1900, CT2-CAI, DECT and PHS. Frequency range is 10 to 2000 MHz.

HP 85671A Phase Noise Measurement Utility

Characterize the phase noise of VCOs and varactor oscillators easily using this downloadable program with an HP 8560 EC-series portable spectrum analyzer. It provides fast measurements of phase noise versus log offset frequency. Results are displayed graphically and can be stored in the analyzer, printed, or plotted.

HP 85672A Spurious Response Measurements Utility

This test utility provides fast and easy spurious response test capability for all of HP's high-performance spectrum analyzers. HP 85672A offers five programmed tests. These are: third-order intermodulation product/third order intercept (TOI), harmonics and total-harmonic distortion (THD), discrete sideband spurs, general-spur search and mixing products.

HP 8447 Series RF Amplifiers

These amplifiers, with a frequency range of 9 kHz to 1.3 GHz, have low noise, and wide bandwidths and improve spectrum analyzer sensitivity and noise figure while providing input isolation. See page 315.

HP 8449B, 83050A and 83051A Preamplifiers

The HP 8449B high-gain, low-noise preamplifier has a frequency range of 1 to 26.5 GHz. It increases the sensitivity of any microwave spectrum analyzer for detection and analysis of very low-level signals. Its improved sensitivity can reduce measurement time. See page 316.

The HP 83050A and HP 83051A microwave system amplifiers are compact, off-the-shelf amplifiers designed for system designers and integrators. These amplifiers provide power to recover system losses and to boost available power in RF and microwave ATE systems. The ultra broad bandwidth from 2 to 50 GHz (45 MHz to 50 GHz 83501A) allows the designer to replace several narrow bandwidth amplifiers with a single HP amplifier, eliminating the need for crossover networks or multiple bias supplies.

HP 87405A Preamplifier

The HP 87405A preamplifier has a frequency range of 0.01 to 3 GHz. Compact size, 22 to 27 dB gain, 6.5 dB noise figure and convenient probe-power bias connection make it ideal for use with a number of instruments.

HP 85901A Portable AC Power Source

This easy-to-carry power source can be used as a standalone battery for over 1 hour of operation at 100 W continuous load, or can be connected to an external 12 Vdc source for longer use. It shuts off automatically when the charge gets low, and can be recharged in six hours or less. Over-voltage, short-circuit, and overload protection on the inverter output are built in. Also included are over-voltage protection on the inverter input and over-charge and over-discharge protection on the internal battery.

HP 85629B Test and Adjustment Module

This accessory for the HP 8560E, 8561E and 8563E makes it easier to service your spectrum analyzer. The HP 85629B test and adjustment module plugs into the rear panel of the instrument and automates high-level diagnostics, self-tests and adjustment procedures. It performs more than 1,000 troubleshooting adjustments. Readjustments are fast and accurate because the module controls internal analyzer settings as well as external test equipment.

HP 11867A, 11693A and 11930B Limiters

Protect the input circuits of spectrum analyzers, counters, amplifiers and other instruments from high power levels with minimal effect on measurement performance. The HP 11867A RF limiter (dc to 1.8 GHz) reflects signals up to 10 W average power and 100 W peak power. Insertion loss is less than 0.75 dB. The HP 11693A microwave limiter (100 MHz to 12.4 GHz, usable to 18 GHz) guards against input signals over 1 mW up to 1 W average power and 10 W peak power. For information on the HP 11930 limiter, see page 25.21.

HP 11694A 75 Ω Matching Transformer

From 3 to 500 MHz, this transformer allows measurements in 75 Ω systems while retaining amplitude calibration with a 50 Ω spectrum analyzer input. VSWRs are less than 1.2; insertion loss is less than 0.75 dB.

HP 86205A and 86207A RF Bridges

These bridges combine the directivity and broadband frequency range of directional bridges with the low insertion loss and flat coupling factor of directional couplers. Directivity is 40 dB, and the wide RF frequency ranges are 300 kHz to 6 GHz for the 50 Ω HP 86205A and 300 kHz to 3 GHz for the 75 Ω HP 86207A. Low insertion loss is nominally ± 1.5 dB. Frequency response of the coupled arm is within ± 0.2 dB of the nominal 16 dB value. The RF bridges are ideal for use with spectrum analyzers, scalar network analyzers and vector network analyzers.

HP 41800A Active Probe

This probe offers high-input impedance from 5 Hz to 500 MHz. It works with many HP spectrum analyzers to evaluate the quality of circuits by measuring spurious level, harmonics and noise. Low-input capacitance offers probing with negligible circuit loading for precise, in-circuit measurements of audio, video, HF and VHF bands.

HP 85024A High-Frequency Probe

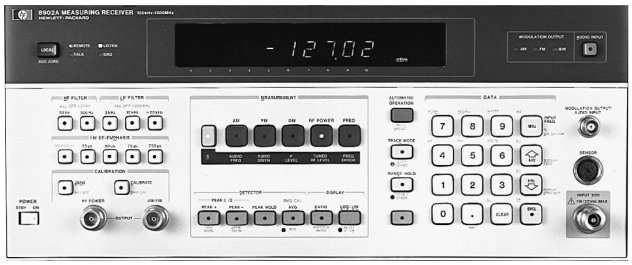
In-circuit measurements are easy with this 300 kHz to 3 GHz probe. Input capacitance of 0.7 pF shunted by 1 MΩ resistance permits high-frequency probing without adverse loading of the circuit under test. Excellent frequency response and unity gain guarantee highly-accurate swept measurements. High sensitivity and low distortion levels allow measurements that take advantage of full analyzer dynamic range. See page 274.

Ordering Information

HP 85902A Burst Signal Trigger
HP 85671A Phase Noise Measurement Utility
HP 85672A Spurious Response Measurements Utility
HP 85640A Portable Tracking Generator
HP 8447A Preamplifier (100 kHz to 400 MHz)
HP 8447D Preamplifier (100 kHz to 1.3 GHz)
HP 8449B Preamplifier
HP 87405A Preamplifier
HP 85901A Portable AC Power Source
HP 11867A RF Limiter
HP 11693A Microwave Limiter
HP 41800A Active Probe
HP 11694A 75 Ω Matching Transformer
HP 85024A High-Frequency Probe
HP 86205A RF Bridge (50 Ω)
HP 86207A RF Bridge (75 Ω)
HP 856298 Test and Adjustment Module
HP 83050A 2 to 50 GHz Power Preamplifier
HP 83051A 45 MHz to 50 GHz Preamplifier

HP 8902A

- RF power: digital power meter accuracy
- Tuned RF level: 0 to –127 dBm dynamic range
- Carrier noise: AM and phase noise measurements to –140 dBc/Hz
- AM and FM: 1% accuracy; ØM: 3% accuracy
- RF frequency: 10 Hz resolution
- Audio: level, frequency, and distortion



HP 8902A

HP 8902A Measuring Receiver

The HP 8902A measuring receiver combines 6 precise measurement functions into one fully automatic, GPIB programmable instrument. It accurately measures RF power, tuned RF level , carrier noise/adjacent channel power, modulation, and RF frequency, and it characterizes audio signals. For precise signal analysis, the HP 8902A measuring receiver provides the performance you need.

Metrology and Calibration

The HP 8902A measuring receiver makes signal generator and attenuator calibration easier than ever before. The HP 8902A provides exceptional accuracy, wide dynamic range, and a broad range of measurements.

It quickly and accurately measures your signal generator's RF frequency, RF level flatness, output level accuracy to –127 dBm, AM and FM with 1% accuracy, incidental and residual AM, FM and phase modulation, and carrier noise down to –140 dBc/Hz, and characterizes the demodulated audio signals.

For attenuator calibration and other relative measurements, the HP 8902A gives you great accuracy and dynamic range. Option 050 provides ±(0.015 db + 0.005 dB/10 dB) relative power accuracy to test attenuators to the most stringent specificaations.

RF Signal Characterization

The HP 8902A measuring receiver is an excellent lab and production tool for accurately characterizing RF signals from 150 kHz to 1300 MHz.

Level measurements down to –127 dBm with superb accuracy make the HP 8902A ideal for testing devices such as multiplexers, log/linear amplifiers, filters, and mixers. Unlike diode detectors, the HP 8902A's power meter accurately measures signals with harmonics and spurious.

The HP 8902A makes accurate AM-to-ØM and FM-to-AM conversion measurements of phase- and amplitude-sensitive devices, such as bandpass filters and multiple-channel receivers. Excellent isolation between AM and FM makes it simple to separate the AM and ØM of AM stereo, the incidental AM of FM transmitters, and the AM, FM, and ØM components of complex signals.

Automatic Test Systems

The HP 8902A is an important component of automatic RF test systems. All functions—power, level, frequency count, carrier noise, modulation, audio analysis—are fully automatic and easily programmed. With these measurements combined in one instrument, interfacing requirements, hardware costs, and software development time are reduced.

HP 8902A Specifications

RF Power (with HP 11722A Sensor Module)

Range: + 30 dBm (1W) to –20 dBm (10 μW)
Frequency Range: 0.1 MHz to 2.6 GHz
Linearity: ± 0.02 dB (within range) ± 0.02 dB per range change from reference range ± 1 count LSD
Input SWR: < 1.15

Tuned RF Level

Range: 0 to –127 dBm
Frequency Range: 2.5 to 1300 MHz
Relative Accuracy: ± 0.02 dB ± 0.02 dB per IF range change ± 0.04 dB per RF range change ± 1 digit
Worst-Case Cumulative Relative Power Accuracy (with Option 050[1,2]):
± 0.005 dB/10 dB step (0 to –100 dBm)
± 0.050 dB/10 dB step (–100 to –120 dBm)
± 0.015 dB ± 1 digit

Selective Power Measurements (Carrier Noise, Options 030 to 037)

Frequency Range: 10 to 1300 MHz
Carrier Power Range:
+ 30 dBm to –20 dBm: 12.5 kHz, 25 kHz and 30 kHz filters
± 30 dBm to –10 dBm: carrier noise filter
Relative Measurement Accuracy:
± 0.5 dB; levels > –95 dBc: 12.5 kHz, 25 kHz and 30 kHz filters
± 0.5 dB; levels > –129 dBc/Hz: carrier noise filter
Filter Bandwidths: 2.5 kHz, carrier noise filter; 8.0 kHz, 12.5 kHz filter; 16.0 kHz, 25 kHz filter; 30.0 kHz, cellular radio filter

RF Frequency

Range: 150 kHz to 1300 MHz
Maximum Resolution: 10 Hz

Amplitude Modulation

Rates: 20 Hz to 100 kHz
Depths: To 99%
Accuracy: ± 1% of reading ± 1 digit, for rates 50 Hz to 50 kHz and depths ≥ 5%

Frequency Modulation

Rates: 20 Hz to 200 kHz
Deviations: To 400 kHz
Accuracy: ± 1% of reading ± 1 digit, for rates 50 Hz to 100 kHz

Phase Modulation

Rates: 200 Hz to 20 kHz
Deviations: To 400 radians
Accuracy: ± 3% of reading ± 1 digit

Audio Level, Frequency, and Distortion Capability

Audio Level Accuracy: ± 4% of reading, 100 mV to 3 V
Audio Frequency Display Resolution: 6 digits, to 250 kHz
Audio Distortion Accuracy: ± 1 dB, 400 Hz and 1 kHz

[1] Specifications are warrented when using a Hewlett-Packard synthesized source with less than 100 Hz peak residual FM measured in a 3 kHz post-detection bandwidth over a 30-second period.
[2] Accuracy specifications do not include mismatch uncertainty.

Ordering Information

HP 8902A Measuring Receiver
- **Opt 001** Rear-Panel Instead of Front-Panel Connectors for Input, Modulation Output, and Calibrators
- **Opt 002** 1x10^{-9}/Day Internal Reference Oscillator
- **Opt 003** Rear-Panel External LO Connectors
- **Opt 004** Operation from 48 to 440 Hz Power Line (temp. < 40° C)
- **Opt 021** Add HP 11722A Sensor Module
- **Opt 030** High Selectivity (select only two filter options) Options 032 to 037 require Option 030. Option 030 includes Option 003 connections for external local oscillator.
- **Opt 032** 12.5 kHz Filter
- **Opt 033** 25.0 kHz Filter
- **Opt 035** Cellular Radio Filter
- **Opt 037** Carrier Noise Filter
- **Opt 050** Increased Power Measurement Accuracy
- **Opt 907** Front Handle Kit (5061-9690)
- **Opt 908** Rack Flange Kit (5061-9678)
- **Opt 909** Rack Flange Kit (5061-9684) with Front Handles
- **Opt 910** Additional Operation and Calibration Manual (08902-90029) and 2 Service Manuals (08902-90031)
- **Opt 915** Add Service Manual (08902-90031)
- **Opt W30** Extended Repair Service
- **Opt W32** Calibration Service

Indicates QuickShip availability.

HP 11812A

HP 11812A Verification Kit

The HP 11812A verification kit is available to verify the performance of the HP 8902A Option 050 tuned RF level function to ±(0.015 dB + 0.010 dB/10dB step). The kit consists of a step attenuator, two 10 dB pads semi-permanently attached, a cable, and a case.

HP 11812A Specifications

Frequency: 30 MHz
HP 11812A Accuracy: ± (0.003 dB + 0.003 dB/10 dB step)
Option 050 Worst-Case Cumulative Tuned RF Level Accuracy Verified with the HP 11812A:
- ± 0.010 dB/10dB step (0 to –100 dBm)
- ± 0.050 dB/10 dB step (–100 to –120 dBm)
- ± 0.015 dB ±1 digit

Ordering Information Price

HP 11812A Verification Kit

HP 11722A Sensor Module (100 kHz to 2.6 GHz)[1]

The HP11722A sensor module was designed for use with the HP 8901B modulation analyzer and the HP 8902A measuring receiver. The HP 11722A contains a silicon monolithic thermocouple as a power-sensing element.

With the HP 11722A sensor module, you get all the performance of the HP 8901B or HP 8902A, plus superb power-measurement accuracy, at a single connector. You can characterize a signal without switching back and forth between the power sensor and the analyzer's RF input.

Ordering Information

HP 11722A Sensor Module (100 kHz to 1300 MHz)

Extend the HP 8902A to Microwave with the HP 11792A and HP 11793A Converter

HP 11792A and HP 11793A

The HP 11793A microwave converter and the HP 11792A sensor module combined with an external signal generator extends the HP 8902A's measurement range into the microwave region. They allow the HP 8902A to deliver accuracy and resolution of a high performance power meter up to 26.5 GHz from +30 to –100 dBm. The extended system counts signals to 26.5 GHz with 10 Hz resolution and excellent long-term frequency stability.

HP 11793A Microwave Converter

The HP 11793A microwave converter downconverts microwave signals to the frequency range of the HP 8902A measuring receiver. For signals above 1.3 GHz, the HP 11793A routes the signal through its internal mixer. Below 1.3 GHz, signals are routed directly to the input of the HP 8902A. The HP 11793A requires an external signal generator with +8 dBm leveled output. For signal generators with insufficient power above 18 GHz, the HP 11793A offers an optional 18 to 25.5 GHz amplifier to provide the necessary mixer drive.

HP 11792A Sensor Module (50 MHz to 26.5 GHz)[1]

The HP 11792A sensor module gives you all the performance of the HP 8902S system, plus superb power-measurement accuracy, at a single connector. You can characterize a signal without manually switching between the power sensor and the receiver input.

Ordering Information

HP 11793A Microwave Downconverter
- **Opt 001** Add 18 to 26.5 GHz Amplifier
- **Opt 010** Front Right LO Input Connector
- **Opt 011** Amplifier and Front Right LO Connector
- **Opt 020** Rear-Panel Connector
- **Opt 021** Amplifier and Rear-Panel Connector
- **Opt 907** Front Handle Kit (5062-3988)
- **Opt 908** Rackmount Flange Kit (5062-3974)
- **Opt 909** Handles w/Rackmount Flange Kit (5062-3975)

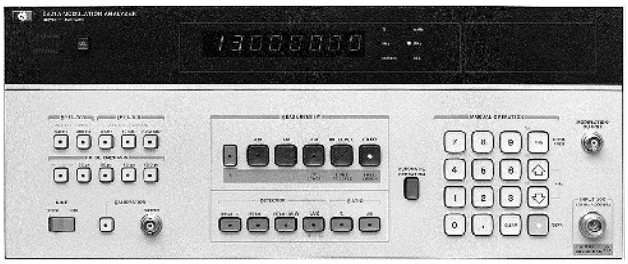
HP 11792A Sensor Module (50 MHz to 26.5 GHz)[1]

For complete ordering information, see HP 8902S Measurement System Ordering Information Guide, or contact the HP Call Center in your region.

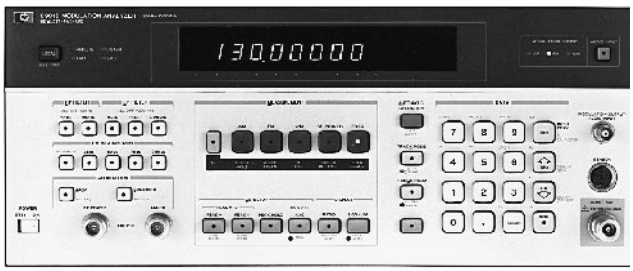
[1] Each HP 11722A and HP 11792A sensor module is individually calibrated, traceable to the U.S. National Institute of Standards and Technology. The calibration factors are printed on the sensor module for fast reference. Enter these factors into the HP 8902A's non-volatile memory and the instrument automatically compensates for the power sensor's efficiency and mismatch loss at each frequency.

HP 8901A
HP 8901B
HP 11715A

- Measures AM and FM to 1% accuracy
- Measures RF frequency
- Measures RF power
- Low internal noise
- Completely automatic



HP 8901A



HP 8901B

HP 8901A and HP 8901B Modulation Analyzers

GPIB

The HP 8901A and HP 8901B modulation analyzers combine the capabilities of several RF instruments to give complete, accurate characterization of modulated signals in the 150 kHz to 1300 MHz frequency range. Both instruments very accurately measure modulation and recover the modulation signal. They determine RF frequency and measure RF power. The major additional capabilities of the HP 8901B are its improved power-meter accuracy, its ability to use external power sensors, its ability to make adjacent-channel power measurements or carrier-noise measurements (with Options 030 through 037), and its ability to count audio frequencies and measure distortion on 400 Hz and 1 kHz signals. Both instruments are fully automatic and make all major measurements at the press of a key or under GPIB control.

Transmitter Testing

The HP 8901A/B have the features required to perform standard transmitter measurements. They measure transmitter power, count frequency, and measure the signal modulation very accurately. The HP 8901B also characterizes the demodulated audio signal's frequency, level, and distortion. With Option 030 the HP 8901B can quickly and accurately make adjacent-channel power measurements to CEPT standards.

RF Signal Characterization

The HP 8901A/B are excellent lab and production tools for accurately characterizing RF signals.

Use the HP 8901A/B to make accurate AM/FM and FM/AM conversion measurements of phase- and amplitude-sensitive devices such as bandpass filters and multiple-channel receivers. Excellent isolation between AM and FM make it simple to separate the AM and FM of AM stereo, the incidental AM of FM transmitters, and the AM, FM, and FM components of complex signals.

Automatic Test Systems

The HP 8901A/B are important components of automatic RF test systems. All functions are fully automatic and easily programmed. With these measurements combined into one instrument, interfacing requirements, hardware costs, and software-development time are reduced.

HP 8901A and HP 8901B Specifications

RF Input
Frequency Range: 150 kHz to 1300 MHz
Operating Level: 12 mV rms to 7 V rms
Input Impedance: 50 Ω nominal
Tuning: Manual frequency entry, automatic, or track
Acquisition Time (automatic operation): ~1.5 s
Maximum Safe Input Level (typical): 35 V rms (25 W for source SWR <4), ac; 40 V, dc

Frequency Modulation
Rates: 20 Hz to 200 kHz
Deviations: To 400 kHz
Accuracy:
±2% of reading ±1 digit, 20 Hz to 10 kHz rates, 250 kHz to 10 MHz;
±1% of reading ±1 digit, 50 Hz to 100 kHz rates, 10 to 1300 MHz
Demodulated Output Distortion: <0.1% THD
AM Rejection (for 50% AM at 400 Hz and 1 kHz rates): <20 Hz peak deviation measured in a 50 Hz to 3 kHz BW
Residual FM (50 Hz to 3 kHz BW): <8 Hz rms @ 1300 MHz, decreasing linearly with frequency to <1 Hz rms for 100 MHz and below
Maximum Deviation Resolution: 1 Hz
Stereo Separation (50 Hz to 15 kHz): >47 dB typical

Phase Modulation
Carrier Frequency: 10 to 1300 MHz
Rates: 200 Hz to 20 kHz; typically usable from 20 Hz to 100 kHz with degraded performance
Deviation: To 400 radians
Maximum Deviation Resolution: 0.001 radian
Accuracy: ±3% of reading ±1 digit
Demodulated Output Distortion: <0.1% THD
AM Rejection (for 50% AM at 1 kHz rate): <0.03 radian peak deviation (50 Hz to 3 kHz BW)

Amplitude Modulation
Rates: 20 Hz to 100 kHz
Depth: To 99%
Accuracy
±2% of reading ±1 digit, 50 Hz to 10 kHz rates, 150 kHz to 10 MHz;
±1% of reading ±1 digit, 50 Hz to 50 kHz rates, 10 to 1300 MHz
Flatness (variation in indicated AM depth for constant depth on input signal): ±0.3% of reading ±1 digit
Demodulated Output Distortion: <0.3% THD
FM Rejection (at 400 Hz and 1 kHz rates, 50 Hz to 3 kHz BW): <0.2% AM
Residual AM (50 Hz to 3 kHz BW): <0.01% rms
Maximum Depth Resolution: 0.01%

Frequency Counter
Range: 150 kHz to 1300 MHz
Accuracy: ±3 counts of least significant digit ± reference accuracy
Internal Reference
Frequency: 10 MHz
Aging rate: <1 x 10^{-6}/month (optional: 1 x 10^{-9}/day)
Maximum Resolution
HP 8901A: 10 Hz for frequencies <1 GHz;
100 Hz for frequencies ≥1 GHz
HP 8901B: 1 Hz

HP 8901A RF Level (Peak Voltage Responding, RMS Sine Wave Power Calibrated)

Range: 1 mW to 1 W
Instrumentation Accuracy: ±1.5 dB
SWR: ≤1.3, 150 kHz to 650 MHz; ≤1.5, 650 to 1300 MHz
Maximum Resolution: 0.001 mW for levels <0.01 W

5

HP 8901A
HP 8901B
HP 11715A

HP 8901B RF Level (True RMS)

Frequency Range with HP 11722A: 100 kHz to 2.6 GHz
Power Range: –20 to +30 dBm
RF Range-to-Range Change Error: ±0.02 dB/RF range change from reference range
Input SWR: <1.15, using HP 11722A sensor module
Zero Set (digital settability of zero): ±0.5% ±1 digit of full scale on lowest range (decrease by a factor of 10 for each high range)
RF Power Resolution: 0.1% of full scale in watts or volts mode; 0.001 in dBm or dB relative mode

HP 8901B Selective Power Measurements (Options 030 through 037)

Frequency Range: 10 MHz to 1.3 GHz
Carrier Power Range: +30 to –20 dBm, 12.5, 25 and 30 kHz filters; +30 to –10 dBm, carrier noise filter
Dynamic Range: 115 dB
Carrier Rejection (temp. ≤35° C): >90 dB for offsets ≥1 channel spacing or 5 kHz, whichever is larger
Relative Accuracy: ±0.5 dB, levels ≥–95 dBc or levels ≥–129 dBc/Hz

5

Power Reference
Power Output: 1.00 mW, factory set to ±0.7%, traceable to the U.S. National Institute of Standards and Technology
Accuracy: ±1.2% worst case (±0.9% rss) for one year (0° to 55° C)

Audio Filters
High-Pass (3 dB cutoff frequency): 50 Hz and 300 Hz
Low-Pass (3 dB cutoff frequency except >20 kHz filter): 3 kHz, 15 kHz, >20 kHz
De-emphasis Filters: 25 μs, 50 μs, 75 μs, and 750 μs

Calibrators (Standard HP 8901B, Option 010 HP 8901A)
AM Calibrator Depth and Accuracy: 33.33% depth, nominal; internally calibrated to an accuracy of ±0.1%
FM Calibrator Deviation and Accuracy: 34 kHz peak deviation, nominal; internally calibrated to an accuracy of ±0.1%

General Characteristics

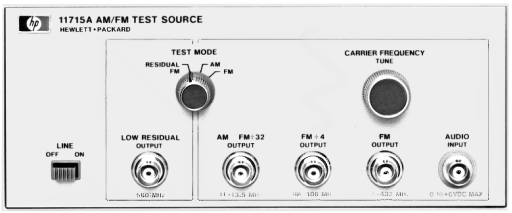
Operating Temperature Range: 0° to 55° C
Power Requirements: 100, 120, 220, or 240 V (+5%, –10%); 48 to 66 Hz; 200 VA max.
Size: HP 8901A: 425 mm W x 190 mm H x 468 mm D (16.8 in x 7.5 in x 18.4 in); HP 8901B: 425 mm W x 190 mm H x 551 mm D (16.8 in x 7.5 in x 21.7 in)
Weight: HP 8901A: Net, 20 kg (44 lb); shipping, 25 kg (55 lb); HP 8901B: Net, 23 kg (52 lb); shipping, 31 kg (69 lb)

Ordering Information

HP 8901A Modulation Analyzer[1]
- **Opt 001** RF Connectors on Rear Panel Only
- **Opt 002** 1x10^{-9}/Day Internal Reference
- **Opt 003** Connections for External Local Oscillator
- **Opt 004** Operation from 48 to 440 Hz Power (temp. <40° C)
- **Opt 010** AM and FM Calibrators
- **Opt 907** Front Handle Kit (5061-9690)
- **Opt 908** Rack Flange Kit (5061-9678)
- **Opt 909** Front Handle and Rack Flange Kit (5061-9684)
- **Opt 910** Two Sets of Operating (08901-90135) and Service Manuals (08901-90136)
- **Opt 915** Service Manual (08901-90136)
- **Opt W30** Extended Repair Service
- **Opt W32** Calibration Service

HP 8901B Modulation Analyzer[1]
- **Opt 021** Add HP 11722A Sensor Module
- **Opt 030** High Selectivity (select only 2 filter options) (Options 032 through 037 require Option 030; Option 030 includes Option 003 connections for external local oscillators)
- **Opt 032** 12.5 kHz Adjacent Channel Filter
- **Opt 033** 25.0 kHz Adjacent Channel Filter
- **Opt 035** 30.0 kHz Adjacent Channel Filter
- **Opt 037** Carrier Noise Filter
- **Opt 910** Two Sets of Operation/Calibration (08901-90113) and Service Manuals (08901-90114)
- **Opt 915** Service Manual (08901-90114)
- **Opt W30** Extended Repair Service
- **Opt W32** Calibration Service

[1]GPIB cables not included.



HP 11715A

HP 11715A AM/FM Test Source

The HP 11715A AM/FM test source provides very flat, wide-bandwidth, and low-distortion amplitude- or frequency-modulated RF signals. Designed primarily for performance tests and adjustments of the HP 8901A/B modulation analyzer and HP 8902A measuring receiver, it will also serve as a high-quality modulated test oscillator where its frequency ranges apply.

The major components of the HP 11715A are a low-noise voltage-controlled oscillator (VCO), 2 digital dividers, and a double-balanced mixer. The VCO is the primary signal source, with a typical frequency range of 330 to 470 MHz at the FM output. FM is produced by directly coupling the external modulation source to the VCO's tune input, providing very wide bandwidth modulation with low phase shift. This design also ensures very little incidental AM.

The HP 11715A can also be used in conjunction with an HP 8901A/B and an HP 8902A as a calibrated signal source for special applications. In particular, the U.S. commercial FM broadcast band of 88 to 108 MHz is covered by the FM 4 4 output of the HP 11715A.

HP 11715A Specifications

FM Outputs
Frequency Range:
11 to 13.5 MHz, AM FM 4 32 output
88 to 108 MHz, FM 4 4 output
352 to 432 MHz, FM output
Peak Deviation:
>12.5 kHz, 11 to 13.15 MHz carrier
>100 kHz, 88 to 108 MHz carrier
>400 kHz, 352 to 432 MHz carrier
Distortion: <0.025% THD (<–72 dB) for

Carrier frequency	Peak deviation	Modulation rate
12.5 MHz	12.5 kHz	<10 kHz
100 MHz	100 kHz	<100 kHz
400 MHz	400 kHz	<100 kHz

Flatness: ±0.1%, dc to 100 kHz rates ±0.25%, dc to 200 kHz rates
Stereo Separation (88 to 108 MHz carrier, 75 kHz peak deviation, 1 kHz rate): >60 dB typical

AM Output
Frequency Range (AM/FM ÷ 32 output): 11 to 13.5 MHz
Depth: To 99%
Distortion:
<0.05% THD (<–66 dB), 50% AM, 20 Hz to 100 kHz rates
<0.1% THD (<–60 dB), 95% AM, 20 Hz to 100 kHz rates
Flatness: ±0.1%, 50 Hz to 50 kHz rates; ±0.25%, 20 Hz to 100 kHz rates
Linearity: ±0.1%, <95% AM; ±0.2%, <99%

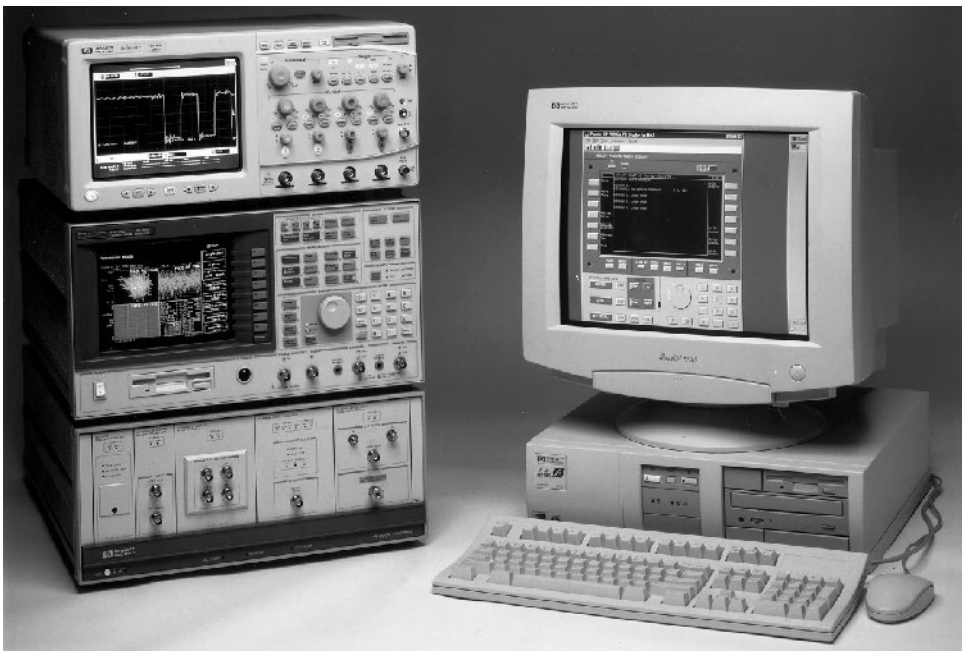
Ordering Information — Price

HP 11715A AM/FM Test Source
- **Opt 910** A Total of Two Sets of Operating and Service Manuals (11715-90004)

Indicates QuickShip availability.

Wide Bandwidth Signal Analysis System, 100 MHz Bandwidth, 26.5 GHz and 40 GHz Range

- High performance microwave spectrum analysis
- High performance vector signal analysis
- HP 71910 plus HP 89410 based systems
- Spectrum analysis 100 Hz to 40 GHz
- 100 MHz bandwidth on the HP 89410A
- Digital modulation analysis and EVM



Wide Bandwidth Signal Analysis System

R&D Tool for Today's Modern Signals

Many of today's wide bandwidth applications require signal analysis capability for both carrier parameter measurements and modulation quality measurements. Applications in microwave wireless include LMDS, W-CDMA and broadband satellite systems.

100 MHz Bandwidth on the HP 89410A

The HP 71000E series wide bandwidth signal analyzer systems are high performance custom designed systems to measure RF and microwave signals, such as those used in many wireless communication systems . The flexible architecture includes the HP 71910 wideband receiver and the HP 89410A vector signal analyzer. The HP 71910 provides high performance microwave spectrum analysis while the HP 89410A vector signal analyzer provides high performance digital modulation analysis, in custom system configurations providing 100 MHz of information bandwidth on the HP 89410A.

Full Measurement Capability

The HP 71000E series offers the following features:

- Frequency coverage from 100 Hz to 26.5 GHz, extendable to 40 GHz and higher with external mixers.
- Information bandwidths of 20 MHz or 100 MHz
- Full HP 89410A vector signal analyzer capability
- Custom system specified to your application needs

Key Literature

100 MHz Bandwidth Microwave Vector Signal Analysis p/n 5968-0123E

A Modular, Reusable Architecture

The HP 71000E series wide bandwidth signal analyzer systems use the industry standard HP 89410A vector signal analyzer as the measurement engine for the advanced analysis of complex signals. The HP 71910 provides flexible, high-performance spectrum analysis on the RF and microwave carrier, including out-of-band performance, interference and spurious signal measurements, as well as providing the wide bandwidth IF output to the HP 89410A or to an HP 54845A infinium oscilloscope.

Adding the HP 54845A infinium oscilloscope as a high-speed digitizer provides the 100 MHz wide bandwidth signal capture. The 100 MHz bandwidth signals are ported to the HP 89410A for complex signal analysis, providing true 100 MHz information bandwidth signal analysis on the HP 89410A. The HP 71910, 89410A and 54845A are all usable individually, providing maximum flexibility, and protecting your investment in measurement assets.

Calibration Software and Customization

System calibration software is a key feature of all HP 71000E series wide bandwidth signal analyzers. Specifications are provided for each custom application, and individual instruments are programmable via GPIB. Custom application software is available. In addition, HP will develop, procure and integrate specialized signal routing and signal conditioning as well as other customized equipment to optimize the system for your needs.

Ordering Information

HP 71000E Series Custom Systems[1]

[1] Price on Application. For more information, please contact the HP Call Center in your region.

Vector Signal Analyzers, DC to 10 MHz, and DC to 2.65 GHz

HP 89410A
HP 89441A
HP 89441V
HP 89411A
HP 89450A
HP 89451A

- Option UTH 20 MB RAM now included free! NEW
- Advanced, optimized time-gated spectrum analysis
- Digital modulation analysis (optional)
- Adaptive equalization for digital modulated signals (optional)
- W-CDMA ARIB 1.0-1.2, EDGE formats supported (optional) NEW
- Precision digital AM, FM, PM demodulation
- Flexible internal RF signal source (optional)
- Narrowband spectrum speed to 60 updates/s
- Simultaneous time and frequency measurement
- 1 MSample time capture with postprocessing (optional)
- High-resolution, high-accuracy time domain
- Second 10 MHz input channel (optional)

HP 89410A DC to 10 MHz Vector Signal Analyzer

HP 89441A DC to 2.65 GHz Vector Signal Analyzer

HP 89400 Series Vector Signal Analyzers

Advanced Measurements on Complex Signals

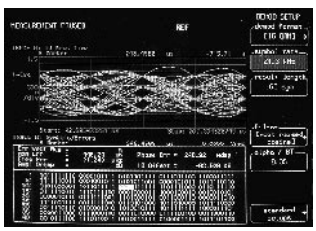
Hewlett-Packard's Vector Signal Analyzers integrate frequency-domain and time-domain analysis to provide the most advanced measurements of complex and time-varying signals. Using state-of-the-art digitizing and signal processing technology, these analyzers offer complex signal analysis, such as digital modulation analysis and AM/FM/PM demodulation, vector spectrum analysis and time-gated spectrum analysis. Simultaneous time-domain and frequency-domain measurements and displays improve productivity and enhance ease of use.

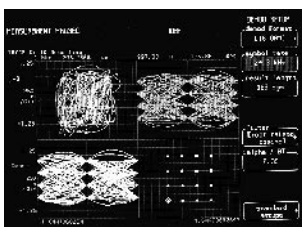
The Vector Signal Analyzers are ideally suited for the following technologies:

- RF Communications
- Video Broadcast
- Satellite
- Radar
- Sonar
- Ultrasound Imaging

The HP 89400 series can easily capture and analyze the burst, pulsed, transient, hopping, analog modulated and digitally modulated complex signals from these technologies.

The HP 89410A covers baseband frequencies from dc to 10 MHz with one or two full-bandwidth input channels. The HP 89441A covers baseband through RF frequencies of dc to 2.65 GHz, with a single RF input and an (optional) dc to 10 MHz second baseband channel. The HP 89441V bundles all necessary options for digital video test.





Troubleshoot Designs with Digital Modulation Analysis

A vector signal analyzer with optional vector modulation analysis provides all the tools necessary to test and troubleshoot throughout a system block diagram.

Measurements are made on baseband, IF, or RF signals with a selection of modulation formats, variable number of symbols and a variety of filters shapes. A wide range of display formats is available including constellation, eye, or vector diagrams, in addition to numerous error and other signal quality analysis results.

Adaptive equalization removes linear errors from I-Q modulated signals by dynamically creating and applying a compensating filter. These errors include group delay distortion, frequency response errors (tilt, ripple) and reflections or multipath distortion. Measure impaired channels and isolate linear vs. non-linear error mechanisms. This general purpose equalizer does not require symbol lock or prior knowledge of the signal (such as a training sequence). Added measurement data types include the derived channel frequency response and the impulse (time domain) response of the compensating filter.

Uncover carrier frequency, symbol clock, filtering and DSP errors with powerful EVM versus time and EVM spectrum displays. Identify noise sources and paths with advanced math analysis. Capture, identify and reanalyze transients with time capture. Share data with the HP Advanced Design System simulation software.

New options let you make measurements on W-CDMA, ARIB 1.0–1.2 and EDGE 3π/8 shifted 8PSK formatted signals. Combined with the instrument's base functionality, these new capabilities bring the industry's best troubleshooting tools to R&D designers.

The same tools are available for digital video with Option AYH or HP 89941V for characterizing both QAM and VSB modulated signals. See page 511 for video applications.

For more information, visit our web site: **http://www.hp.com/go/89400**

Precision AM, FM, and PM Demodulation

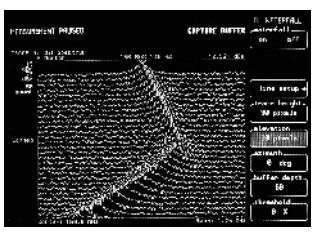
Precision, high-resolution digitized time-series data allows for advanced signal analysis, such as AM, FM and PM demodulation. Signals can be analyzed for instantaneous amplitude, frequency, or phase versus time, and the resulting time-domain results can be translated into the frequency domain for further analysis. This is useful for characterizing phenomena such as phase noise, oscillator frequency transitions and the amplitude or frequency behavior of transmitters at turn-on. Both deliberate and unintentional (or incidental) modulation can be characterized completely. Demodulation is selective, so that the type of modulation can be uniquely determined and separated from other types. FM and PM demodulation are made easier with an auto-carrier function.

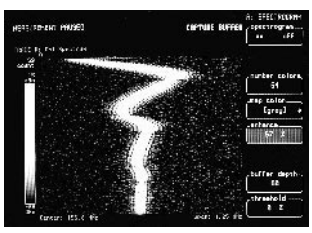
High-Speed, Narrow-Resolution Vector Spectrum

Using high-speed signal processing, these analyzers can measure both the magnitude and phase (in the frequency domain) of CW and nonstationary or burst signals. Multiple-signal processors and microprocessors display signal and circuit behavior in real time, and produce fast averaged measurements with enhanced signal-to-noise ratio.

High-measurement speed is preserved even in narrowband measurements, with display updates orders of magnitude faster than traditional analyzers performing equivalent measurements. Resolution is also better, with resolution bandwidths less than 0.001 Hz over the entire frequency range.

Optional waterfalls display up to 300 successive spectra and scroll them through the display, while spectrograms use colors to indicate signal amplitudes. Both formats make it easy to monitor signal trends of short or long duration.





High-Resolution, High-Dynamic Range Time Domain

All measurements are made with a state-of-the-art A/D subsystem and proprietary signal processing. All frequency spans are image and alias protected, offering band-limited time-domain analysis not available in traditional oscilloscopes and waveform analyzers.

These products feature a deep-data memory of up to one million samples (optional). This memory can be used for long duration time capture, where the time-capture data can be selectively postprocessed (internally) or transferred via GPIB to an external computer for further analysis.

Advanced Time-Selective Spectrum Analysis

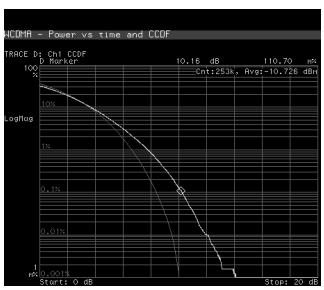
For burst or time-varying signals, it may be necessary to examine only a selected part of the waveform. Time-selective spectrum analysis in the HP 89400 series vector signal analyzers allows the entire time-domain signal to be viewed and a specific portion selected for frequency-domain analysis. The selected data is identified clearly with gate markers and all of its traditional frequency-domain parameters (including noise or signal/noise) can then be measured. In addition, this time-selective analysis does not require a repetitive signal.

Powerful, Flexible Triggering

These vector signal analyzers have extremely flexible triggering to make the most of their time-selective analysis and demodulation features including IF trigger. The IF trigger allows the analyzer to establish a trigger from a selected frequency band of the input signal, ensuring that the trigger event can always be seen. Both analyzers also provide pre-trigger and post-trigger delays, along with manual, external, or automatic arming with programmable delay.

Advanced Data Analysis

The high-resolution time-domain data of the HP 89400 analyzers allows for advanced data analysis functions. The built-in math functions can be used for scalar arithmetic and complex operations. Other advanced analysis capabilities include correlation functions, useful in uncovering hidden periodic signals and analyzing multipath or other signal delays.



Statistical Peak/Average Power Measurements

Precision statistical measurements of peak, average, and peak-to-average power including CCDF can now be made automatically. A time domain marker function simplifies measurements by allowing direct entry of the peak percentage and quickly accumulating thousands of measurement samples.

Accurately setting signal levels is simplified by taking advantage of the analyzer's ability to recalculate results using different peak percentages without taking new data. It is even possible to simultaneously display multiple power parameters based on a single block of measured data.

The new Complementary Cumulative Distribution Function (CCDF) allows statistical power measurements on noise-like signals. Use it to set amplifier operating points and determine headroom.

Measurement Automation and Convenience Features

Optional HP Instrument BASIC (a subset of HP BASIC) runs inside the analyzers to make repetitive measurements, to create custom displays and test sequences, and even to control other instruments in a test system. Automatic program generation is available with the "keystroke recording" feature, which creates complete executable programs by remembering keys pressed during an actual measurement.

Adjacent channel power, occupied bandwidth, and modulation accuracy are among the measurements that can be made with the ease of "one-button" setups using the HP 89451A Radio Test Personality. The measurements can be made on burst or continuous signals of NADC, CDMA, PDC, PHS, or user-defined systems.

LAN Access and Virtual Front Panel

For remote control from across the building or across the world, the standard unit allows direct transfer of instrument commands and measurement results to a LAN-equipped PC or workstation. Option UG7 adds access to instrument memory and file storage via FTP, along with an X-Windows-based "virtual front panel." This display, which can be sent to an X-compatible server anywhere on your network, shows not only the measurement display but also the complete instrument front panel. Press keys with your mouse or pointing device, and operate the analyzer just as if it were in front of you.

HP 89410A Baseband Vector Signal Analyzer

The HP 89410A covers a frequency range of dc to 10 MHz and offers an optional second channel. The second channel makes it possible to measure frequency response or perform vector network analysis, and the built-in math functions facilitate measurement calibration and correction.

Two-channel statistical measurements such as cross-correlation and coherence can also be made. Cross-correlation is also useful in analyzing multipath distortions.

Coherence is useful for troubleshooting noise or signal propagation through a circuit or system. It is also a good indication of the quality of a network measurement in a noisy environment.

Flexible Source

The HP 89410A provides a flexible source for circuit stimulation. Sine waves, periodic chirps (sine-wave sweeps), and pseudo-random noise are available, along with user-definable arbitrary waveforms. The arbitrary waveforms operate on a block of up to 16,384 complex points.

Any of these signals can be used as a stimulus while spectrum measurements are made elsewhere in the circuit. Source level and dc offset of the pattern are all controllable by the user.

HP 89441A RF Vector Signal Analyzers

The HP 89441A covers baseband through RF frequencies of dc to 2.65 GHz, in scalar and vector analysis modes. The scalar RF instrument mode allows full-frequency coverage in spans to 2648 MHz in the HP 89441A. Vector RF mode offers exceptional speed and additional signal processing for enhanced time-domain characterization and demodulation. Vector spans as wide as 7 MHz (8 MHz with Option AYH) can be selected anywhere in 2.65 GHz frequency range. A vector baseband mode is also available to provide all of the features and functionality of the HP 89410A.

In vector RF mode, both phase and amplitude characteristics are captured in the time-series data. This information can be processed for narrow-resolution spectrum analysis, AM/FM/PM demodulation, time-selective analysis, vector modulation analysis (optional) and many other types of measurements.

HP 89410A
HP 89441A
HP 89441V
HP 89411A
HP 89450A
HP 89451A

RF Signal Source

In vector RF mode, the HP 89441A offers an optional flexible source with up to 7 MHz bandwidth, settable to any frequency in the 2.65 GHz frequency range. As with the HP 89410A, sine waves, periodic chirps (sine-wave sweeps), and pseudo-random noise are available, along with user-definable arbitrary waveforms.

Microwave Measurements with Downconverter

The HP 89411A IF downconverter works with the HP 89410A to provide narrowband vector signal analysis at RF and microwave frequencies. The HP 89411A converts a 21.4 MHz IF output from an external receiver to the input frequency range of the HP 89410A. This downconverter is also compatible with the HP 89441A.

This downconverter is designed for use with various HP microwave spectrum analyzers and other devices with compatible 21.4 MHz IF outputs. Frequency coverage is thus available over the complete frequency range of the microwave receiver or analyzer.

Specifications Summary

Refer to the HP 89410A/89441A/89411A technical data sheets for full specifications. The following specifications apply from 0° to 55° C.

	HP 89410A	HP 89441A
Frequency		
Frequency range	dc to 10 MHz	2 MHz to 2650 MHz
Frequency span		
Scalar mode	1.0 Hz to 10 MHz	1.0 Hz to 2648 MHz
Vector mode	1.0 Hz to 10 MHz	1.0 Hz to 7 MHz (8 MHz with Option AYH)
Center frequency tuning resolution	0.001 Hz	0.001 Hz
Accuracy-initial	± 10 ppm (± 0.2 ppm optional)	± 0.1 ppm
Resolution bandwidth	312.5 µHz to 3 MHz (1, 3, 10 sequence or arbitrary)	312.5 µHz to 3 MHz (1, 3, 10 sequence or arbitrary)
Phase noise	(at center frequency = 10 MHz)	1000 MHz ≤ center frequency ≤ 2650 MHz
100 Hz offset	–106 dBc/Hz	–87 dBc/Hz
1 kHz offset	–110 dBc/Hz	–97 dBc/Hz
10 kHz offset	–120 dBc/Hz	–116 dBc/Hz (–124 dBc/Hz typ.)
100 kHz offset	–120 dBc/Hz	–116 dBc/Hz
Amplitude		
Input range		
50 Ω	–30 dBm to +24 dBm	–50 dBm to +25 dBm
75 Ω	–31.7 dBm to +22.2 dBm	—
1 M Ω (referenced to 50 Ω)	–30 dBm to +24 dBm	—
Accuracy-absolute full-scale	± 0.5 dB	± 2.0 dB (±0.5 dB typical)
Accuracy-amplitude linearity		—
0 to –30 dBfs	<0.10 dB	< 0.10 dB
–30 to –50 dBfs	<0.15 dB	< 0.15 dB
–50 to –70 dBfs	<0.20 dB	< 0.20 dB
Input noise density (50 Ω)	–114 dBfs/Hz	–112 dBfs/Hz
Sensitivity (lowest range, 50 Ω)	–144 dBm/Hz	–159 dBm/Hz
Spurious responses		
General spurious	≤ –75 dBfs (≥1 MHz)	< –70 dBc
Second harmonic distortion	< –75 dBc (–80 dBc typical)	< –75 dBc
Intermodulation (third order relative to two tones at –6 dBfs)	≤ –75 dBc (–85 dBc typical)	< –75 dBc
Residual responses	< –75 dBfs (<1 MHz) –80 dBfs (≥1 MHz)	< –80 dBfs —
Analog demodulation		
Maximum bandwidth (typical)	10 MHz	7 MHz
Demodulation accuracy		
–AM	± 1% (typical)	± 1% (typical)
–PM	± 3 degrees (typical)	± 3 degrees (typical)
–FM	± 1% of span (typical)	± 1% of span (typical)
Trigger		
Scalar mode	Free run, input channel, internal source, GPIB, external	Free run, GPIB, internal source, external
Vector mode	Free run, input channel, IF channel, internal source, GPIB, external	Free run, IF channel, internal source, GPIB, external
Input		
Coupling	dc/ac	ac
Source		
Scalar mode	Fixed sine, arbitrary	—
Vector mode	Fixed sine, random noise, periodic chirp, arbitrary	Fixed sine, random noise, periodic chirp, arbitrary
Arbitrary source	Up to 16,384 – 32,768-real/complex points, depending on span	Up to 16,384 – 32,768-real/complex points, depending on span
Source level (fixed sine)	–110 dBm to +23.9 dBm	–40 dBm to +13 dBm

Note: specifications apply with the RF receiver selected. All HP 89410A specifications also apply for dc to 10 MHz measurements. RF source optional, HP 89441A.

HP 89410A
HP 89441A
HP 89441V
HP 89411A
HP 89450A
HP 89451A

5

Combined HP 89410A/89441A Specifications

Two Channel
Note: Requires second 10 MHz input channel (Option AY7)
Channel Match: (dc to 10 MHz): ± 0.25 dB, ± 2.0˚
Real-Time Bandwidth
Single-Channel Vector Mode Real-Time Bandwidth: 78.125 kHz (with frequency spans of $10^n/2$ Hz, arbitrary auto-coupled resolution bandwidth, markers off, averaging off, one displayed trace with calculations off on other traces, log-magnitude spectrum measurement, 1601 frequency points, channel 2 off)
Measurement Speed
Vector Mode Maximum Display Update Rate: 60 traces/second
Averaging
Scalar Mode: rms (video), rms (video) exponential, peak hold
Vector Mode: rms (video), rms (video) exponential, time, time exponential, peak hold
Number of Averages: 1 to 99,999
Time-Gating
Minimum Gate Length: < 400 ns (dependent on span and RBW window selected)
Time-Capture
Time-Capture Memory: 64 K sample (1 M sample with Option AY9)
Trace Math
Operands: Measurement data, data register, constant, other trace math functions, jϖ
Operations: +, –, x, ÷, cross correlation, conjugate, magnitude, phase, real, imaginary, square root, FFT, inverse FFT, natural logarithm, exponential
Marker Functions: Peak signal track, frequency counter, bandpower
Interfaces: Active probe power, sync output, external reference input/output, GPIB, RS-232, Centronix, external multi-sync monitor (A second GPIB and LAN interface are now standard.)
Memory and Data Storage: Nonvolatile RAM disk (100 KB), volatile RAM disk (20 MB), internal 3.5-inch flexible disk (1.44 MB LIF or DOS format), external disk (GPIB interface)
Standard Instrument Includes: Manuals, Standard Data Format Utilities (LIF to DOS conversions, SDF conversions, data and instrument state display, PC-MATLAB and MATRIXx conversions)
Vector Modulation Analysis (Option AYA)
Continuous or TDMA Formats: BPSK, QPSK, Offset QPSK, DQPSK, π/4 DQPSK, 8PSK, 16QAM, 32QAM, MSK, 2 and 4 level FSK
Digital Video Formats (Option AYH): 64-256QAM, 8-16VSB
Data Block Lengths: Adjustable up to 4096 symbols (2048 symbols max. with Offset QPSK demodulation)
User Selection of Filters: Raised cosine, root-raised cosine, IS-95 base phase eq., IS-95 Chebyshev, Gaussian, low pass, user-defined
Adjustable Alpha (BT): 0.05 to 100
Trace and Table Formats: Constellation, vector diagram, eye diagrams, trellis diagrams, continuous I or Q vs. time, continuous error vector magnitude vs. time, modulation quality summary, detected symbol table
Analysis Types: Error vector magnitude, phase error, magnitude error, amplitude droop, carrier frequency error, IQ offset, error vector spectrum, measured IQ spectrum, channel frequency response, impulse response of equalizer filter
One-Button Measurements (HP 89451A): Adjacent and alternate channel power, occupied bandwidth, modulation accuracy, power due to modulation (or full signal)

General Specifications

Environmental
Calibration Interval: 1 year
Warmup Time: 30 minutes
Temperature: 0˚ to 55˚ C (operating), –20˚ to 65˚ C (not operating)
Power Requirements
115 Vac Operation: 90 to 140 V rms, 47 to 440 Hz (47 to 63 Hz for HP 89441A)
230 Vac Operation: 198 to 264 V rms, 47 to 63 Hz
Maximum Power Dissipation: 750 VA (HP 89410A), 1025 VA (HP 89441A)
Audible Noise: LpA ≤ 50 dB (HP 89410A), ≤ 55 dB (HP 89441A) typical at 25˚ C
Physical
HP 89410A:
Size: 426 mm W x 230 mm H x 530 mm D (16.7 in x 9.1 in x 20.9 in)
Weight: 25 kg (55 lb)
HP 89441A IF section:
Size: 426 mm W x 230 mm H x 530 mm D (16.7 in x 9.1 in x 20.9 in)
Weight: 25 kg (55 lb)
HP 89441A RF section:
Size: 419 mm W x 173 mm H x 495 mm D (16.5 in x 6.8 in x 19.5 in)
Weight: 25 kg (55 lb)

HP 89411A 21.4 MHz Downconverter Specifications

Bandwidth
With HP 8566A/B: Approx. 3 MHz
With HP 70902A/70903A: Approx. 8 MHz
Power Requirements
115 Vac Operation: 90 to 132 V rms, 47 to 440 Hz
230 Vac Operation: 198 to 264 V rms, 47 to 63 Hz
Maximum Power Dissipation: 100 VA
Physical
Weight: 11.1 kg (25 lb)
Size: 426 mm W x 90 mm H x 520 mm D (16.7 in x 3.5 in x 20.5 in)

The HP 89400 series vector signal analyzers were designed with expandability in mind and the ability to keep up with customers' growing measurement needs. As performance is improved and features added, firmware upgrades are simple using the analyzer's internal disk drive.
Recent new features include:

- Offset QPSK demodulation, CDMA filters, and ρ (rho) added to Option AYA
- Adaptive equalization added to Option AYA and AYH
- 8 MHz information bandwidth for HP 89441A via Option AYH
- Peak-to-average power measurements, including new CCDF
- Arb waveform block length expanded 4X to 16,384 complex points
- DC offset can be removed in the DC-coupled Ch1 + Ch2 mode
- New EDGE and W-CDMA demodulation options

Key Literature

A videotaped demonstration, several Product Notes, and Technical Datasheets are available for the HP 89400 series vector signal analyzers. To receive a current literature index and order form via e-mail, send a message containing the single word "HP 89400" to: **lit_index@lsid.hp.com** or contact the HP Call Center in your region.

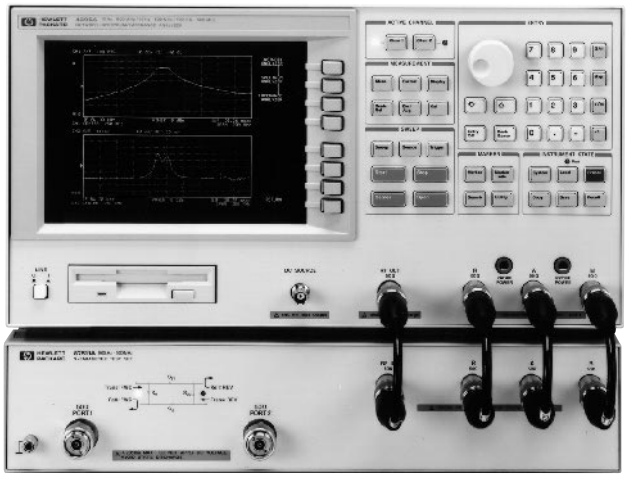
Ordering Information

HP 89410A DC to 10 MHz Vector Signal Analyzer
HP 89441A DC to 2.65 GHz Vector Signal Analyzer
Opt AY4 Delete High-Precision Frequency Reference (HP 89441A only)
Opt AY5 Precision Frequency Reference (HP 89410A only)
Opt AY7 Second 10 MHz Input Channel
Opt AY8 Internal RF Source (HP 89441A only)
Opt AY9 Extend Time Capture to 1 Msample
Opt AYA Vector Modulation Analysis
Opt AYB Waterfall and Spectrogram
Opt AYH Digital Video Modulation Analysis
Opt UG7 Advanced LAN Support
Opt 1C2 HP Instrument BASIC
Opt 1D7 50 to 75 Ω Minimum Loss Pad (HP 89441A only)
Opt 1F0 PC-Style Keyboard–U.S. Version (other options available for German, Spanish, French, U.K., Italian, and Swedish)
Opt B73 CDP for W-CDMA Experimental System
Opt B7A EDGE Modulation Analysis
Opt B79 ARIB 1.0-1.2 W-CDMA Analysis
HP 89441V VSB/QAM Signal Analyzer
HP 89450A DMCA Radio Test Application Personality
HP 89451A Radio Test Personality
HP 89411A 21.4 MHz Downconverter
HP 89431A 2.65 GHz RF section (converts 89410A to 89441A)
HP 89400A +24C User Training (scheduled)
HP 89400A +24Y User Training (dedicated)
HP E9285A Opt K01 DVB-T COFDM Measurement Software

Baseband, IF Network/Spectrum/Impedance Analyzer, 10 Hz to 500 MHz/10 Hz to 500 MHz/100 kHz to 500 MHz

HP 4395A

- Full-vector network and spectrum measurement and analysis
- Wide dynamic range network measurement with fast sweep speeds
- ±0.05 dB /±0.3° dynamic magnitude/phase accuracy
- Extremely fast narrowband spectrum measurement
- Impedance analysis option and test kit available
- –145 dBm/Hz sensitivity for spectrum analysis
- Built-in HP Instrument BASIC for easy test automation
- Time-gated spectrum analysis option
- Color TFT display and built-in disk drive/RAM disk



HP 4395A with HP 87511A

HP 4395A Network/Spectrum/Impedance Analyzer

The HP 4395A provides excellent vector network, spectrum and optional impedance measurements for audio, baseband, HF, VHF, and IF applications. Gain, phase, group delay, distortion, spurious, CN ratio, and noise measurements often required for evaluating components and circuits can be measured using one instrument. When combined with a test set, the HP 4395A provides reflection measurements, such as return loss, and SWR, and S parameters. As a vector network analyzer, the HP 4395A operates from 10 Hz to 500 MHz with 1 mHz resolution and its integrated synthesized source provides –50 to +15 dBm of output power with 0.1 dB resolution. The dynamic magnitude and phase accuracy are ±0.05 dB and ±0.3° so that it can accurately measure gain and group delay flatness, which are becoming more important in modern electronics systems.

As a spectrum analyzer, the HP 4395A operates from 10 Hz to 500 MHz with resolution bandwidths (RBWs) spanning 1 Hz to 1 MHz in a 1-3-10 steps. A fully-synthesized local oscillator allows stable and accurate frequency analysis. Direct A/D conversion (no LOG amplifier is used) results in ±0.8 dB level accuracy (@50 MHz, –20 dBm). Noise sidebands fall below –110 dBc/Hz @ 100 kHz offset from carriers, while sensitivity is –145 dBm/Hz at 10 MHz.

Extremely Fast Spectrum Measurement

The HP 4395A features Fast Fourier Transform (FFT) digital-signal-processing (DSP) technique for 20 to 100 times faster narrowband spectrum measurement than swept-tuned spectrum analyzers. The stepped FFT is performed for all RBW settings. For example, with 100 Hz RBW and 100 kHz span, the HP 4395A has a sweep time of 300 ms, while swept-tuned spectrum analyzers take a few tens of seconds. The stepped FFT can greatly improve the efficiency of narrowband spectrum measurement.

Time-Gated Spectrum Analysis

With Option 1D6, the HP 4395A offers time-gated spectrum analysis capability to capture and measure repetitive burst signals in video. disk drives, communication equipment, and more. The minimum gate length is 6µ sec so that even narrow-burst signals can be analyzed.

Impedance Measurement Function and RF Impedance Test Kit

A full-featured impedance measurement function (useful for quick-check general-purpose impedance applications) can be added to the HP 4395A by adding Option 010 and the HP 43961A RF impedance test kit. Covering from 100 kHz to 500 MHz, impedance parameters $|Z|$, θ, C, L, Q, D, and more, are directly measured and displayed on the TFT color display. The basic impedance measurement accuracy is 3%. An APC-7® connector is mounted on this kit for easy connection to an appropriate impedance test fixture. A wide variety of HP fixtures can be used with this test kit, including the surface-mount-device (SMD) fixtures used with the HP 4291B RF impedance/material analyzer. The Option 001 DC source is useful in applying DC voltage to the device up to 40 V.

HP 4395A Specifications Summary

Network Measurement

Frequency Characteristics
- **Range:** 10 Hz to 500 MHz
- **Resolution:** 1 mHz
- **Accuracy:** < ±5.5 ppm (Option 1D5: < ±0.13 ppm)

Output Characteristics
- **Power Range:** –50 to +15 dBm
- **Resolution:** 0.1 dB
- **Level Accuracy:** ±1.0 dB @ 0 dBm, 50 MHz

Receiver Characteristics
- **Frequency Range:** 10 Hz to 500 MHz
- **Noise Level** (referenced to full scale input level, 23 ±5° C):
  –85 dB (typical) @ 10 Hz ≤ f <100 Hz, IFBW=2 Hz
  –85 dB @ 100 Hz ≤ f <100 kHz, IFBW=10 Hz
  (–115 + f/100 MHz) dB @ 100 kHz ≤ f, IFBW=10 Hz

IF Bandwidth (Hz): 2, 10, 30, 100, 300, 1k, 3k, 10k, 30k

Dynamic Accuracy

Input Level (relative to full scale input level –10 dB)	Dynamic Accuracy Frequency ≥100 Hz
Magnitude Dynamic Accuracy	
0 dB ≥ input level ≥ –10 dB	±0.4 dB
–10 dB > input level ≥ –60 dB	±0.05 dB
–60 dB > input level ≥ –80 dB	±0.3 dB
–80 dB > input level ≥ –100dB	±3 dB
Phase Dynamic Accuracy	
0 dB ≥ input level ≥ –10 dB	±3°
–10 dB > input level –60 dB	±0.3°
–60 dB > input level –80 dB	±1.8°
–80 dB > input level –100dB	±18°

@ R port input level=full scale input level –10 dB, IFBW=10 Hz, 23 ±5° C

Spectrum Measurement

Frequency Characteristics
- **Frequency Range:** 10 Hz to 500 MHz

Frequency Reference
- **Accuracy:** < ±5.5 ppm (Option 1D5: < ±0.13 ppm)

Resolution Bandwidth (RBW)
- **Range:** 1 Hz to 1 MHz, 1-3-10 step @ span >0
  3k, 5k, 10k, 20k, 40k, 100k, 200k, 400k, 800k, 1.5 M, 3 M, 5 MHz @ span=0

Selectivity (60 dB/3 dB): <3 @ span >0

Noise Sidebands

Offset

1 kHz	–97 dBc/Hz
10 kHz	–97 dBc/Hz
100 kHz	–110 dBc/Hz
1 MHz	–110 dBc/Hz

Displayed Average Noise Level

Frequency

1 kHz ≤ f < 100 kHz	–120 dBm/Hz
100 kHz ≤ f < 10 MHz	–133 dBm/Hz
10 MHz ≤ f	(–145 + f/100 MHz) dBm/Hz

Spurious Response

Second Harmonic Distortion: –70 dBc @ –16 dB full scale

Third-Order Intermodulation Distortion: –70 dBc @ –16 dB full scale

Other Spurious: –70 dBc @ –16 dBc full scale

Scale Fidelity

±0.05 dB @ 0 to –30 dB from full scale input level –10 dB

Impedance Measurement (Option 010)

Measurement Parameters: |Z|, θz, |Y|, θy, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, |Γ|, θγ, Γx, Γy

Frequency Range: 100 kHz to 500 MHz

Measurement Port: APC-7 on the HP 43961A Test Kit

Source Level at Measurement Port: –56 to +9 dBm @ 50 Ω

Calibration: OPEN/SHORT/LOAD calibration, OPEN/SHORT/LOAD compensation on test fixtures, port extension

Accuracy (Supplemental Performance Characteristics):
± 3% basic accuracy @ 23 ±5° C, after OPEN/SHORT/LOAD calibration

General Characteristics

Full Scale Input Level

Attenuator setting (dB)	Full Scale Input Level Network	Spectrum
0	–10 dBm	–20 dBm
10	0 dBm	–10 dBm
20	+10 dBm	0 dBm
30	+20 dBm	+10 dBm
40	+30 dBm	+20 dBm
50	+30 dBm	+30 dBm

Option 001 DC Voltage/Current Source
- **Voltage Range:** –40 V to + 40 V
- **Current Range:** –20 MA to –100 mA, 20 MA to 100 mA

Operating Temperature/Humidity
- **Disk Drive Non-Operating Condition:** 0° to 40° C, 15% to 95% RH
- **Disk Drive Operating Condition:** 10° to 40° C, 15% to 80% RH

Storage Temperature/Humidity: –20° to 60° C, 15% to 95% RH

Power Requirement: 100/120/220/240 V ±10%, 47 to 66 Hz, 300 VA max.

Weight: 21 kg (typical)

Size: 425 mm W x 235 mm H x 553 mm D

Key Literature

HP 4395A/96B Awareness Brochure, p/n 5965-9374E
HP 4395A Network/Spectrum/Impedance Analyzer, Technical Specifications, p/n 5965-9340E
HP 4395A/HP 4396B Special Option U01 (Education package), p/n 5968-2251E
Dramatic Speed Improvement for Narrow RBW Sweeps by Audio/Video/IF/RF/Specturm Analyzers, p/n 5966-4099E
Network, Spectrum, and Impedance Evaluation of Electronic Circuits and Components, p/n 5967-5942E
How to Measure Noise Accurately Using the HP Combination Analyzers, p/n 5966-2292E
ADSL Copper Loop Measurements, p/n 5968-1196E

Ordering Information

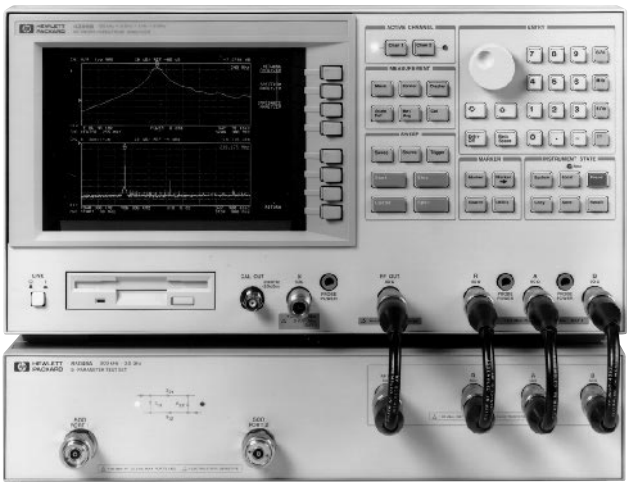
HP 4395A Network/Spectrum/Impedance Analyzer
- **Opt 001** Add DC Source
- **Opt 010** Add Impedance Measurement Function (Requires HP 43961A)
- **Opt 1A2** Delete Keyboard
- **Opt 1D5** Add High Stability Frequency Reference
- **Opt 1D6** Add Time-Gated Spectrum Analysis
- **Opt 1D7** 50 Ω to 75 Ω Minimum Loss Pad

HP 87511A 50 Ω S-Parameter Test Sets
HP 87511B 75 Ω S-Parameter Test Sets
HP 87512A 50 Ω Transmission/Reflection Test Kits
HP 87512B 75 Ω Transmission/Reflection Test Kits
HP 43961A RF Impedance Test Kit (add test fixture listed below)
HP 16191A Side Electrode SMD Test Fixture
HP 16192A Parallel Electrode SMD Test Fixture
HP 16193A Small Side Electrode SMD Test Fixture
HP 16092A Spring Clip Test Fixture

RF Network/Spectrum/Impedance Analyzer, 100 kHz to 1.8 GHz/2 Hz to 1.8 GHz/100 kHz to 1.8 GHz

HP 4396B

- Full-vector network and spectrum measurement and analysis
- Wide dynamic range network measurement with fast sweep speeds
- ±0.05 dB/±0.3° C dynamic magnitude/phase accuracy
- Extremely fast narrowband spectrum measurement
- Impedance analysis option and test kit available
- ±1.0 dB level accuracy for spectrum analysis
- –150 dBm/Hz sensitivity for spectrum analysis
- Built-in HP Instrument BASIC for easy test automation
- Time-gated spectrum analysis option
- Color TFT display and built-in disk drive/RAM disk



HP 4396B with HP 85046A

HP 4396B RF Network/Spectrum Impedance Analyzer

The HP 4396B provides excellent RF vector network, spectrum, and optional impedance measurements for lab and production applications. Gain, phase, group delay, distortion, spurious, CN, and noise measurements often required for evaluating components and circuits can be measured using one instrument. When combined with a test set, the HP 4396B provides reflection measurements, such as return loss, and SWR, and S parameters. As a vector network analyzer, the HP 4396B operates from 100 kHz to 1.8 GHz with 1 mHz resolution and its integrated synthesized source provides –60 to +20 dBm of output power with 0.1 dB resolution. The dynamic magnitude and phase accuracy are ±0.05 dB and ±0.3° so that it can accurately measure gain and group delay flatness, which are becoming more important in modern electronics systems.

As a spectrum analyzer, the HP 4396B operates from 2 Hz to 1.8 GHz with resolution bandwidths (RBWs) spanning 1 Hz to 3 MHz in a 1-3-10 sequence. A fully-synthesized local oscillator allows stable and accurate frequency analysis. Direct A/D conversion (no LOG amplifier is used) results in ±1.0 dB overall level accuracy. Noise sidebands fall below –105 dBc/Hz offset 10 kHz from carriers below 1 GHz, while sensitivity is –150 dBm/Hz at 10 MHz and –147 dBm/Hz at 1 GHz. In addition, with two independent display channels available, you can simultaneously view network and spectrum (or transmission and reflection) characteristics of the device under test in split-screen format. For example, an amplifier's frequency response (network measurement) and distortion (spectrum measurement) can be shown at the same time.

Extremely Fast Spectrum Measurement

The HP 4396B features a stepped Fast Fourier Transform (FFT) digital-signal-processing (DSP) technique for 20 to 100 times faster narrowband spectrum measurement than swept-tuned spectrum analyzers. The stepped FFT is performed when the resolution bandwidth (RBW) is set at 3 kHz or below. For example, with a 30 Hz RBW and 10 kHz span, the HP 4396B has a sweep time of 400 ms, while swept-tuned spectrum analyzers take a few tens of seconds. The stepped FFT can greatly improve the efficiency of narrowband spectrum measurement such as frequency tuning of a VCO or CN measurements.

Time-Gated Spectrum Analysis

With Option 1D6, the HP 4396B offers time-gated spectrum analysis capability to capture and measure repetitive burst signals in video, disk drives, communication equipment, and more. The minimum gate length is 2μ sec so that even narrow-burst signals can be analyzed.

Impedance Measurement Function and RF Impedance Test Kit

A full-featured impedance measurement function (useful for quick-check general-purpose impedance applications) can be added to the HP 4396B by adding Option 010 and the HP 43961A RF impedance test kit. Covering from 100 kHz to 1.8 GHz, impedance parameters |Z|, θ, C, L, Q, D, and more, are directly measured and displayed. The basic impedance accuracy (typical value) is 3%. The HP 43961A RF impedance test kit is designed for the HP 4396B and is required to utilize the features of Option 010. An APC-7® connector is mounted on this kit for easy connection to an appropriate impedance test figure. A wide variety of HP fixtures can be used with the test kit, including the new surface-mount-device (SMD) fixtures used with the new HP 4291B RF impedance/material analyzer. For higher accuracy, complete impedance analysis over the widest impedance ranges, and temperature effects evaluation, the HP 4291B impedance/material analyzer is recommended. See pages 472 and 473.

HP 4396B Specifications Summary

Network Measurement

Frequency Characteristics
- **Range:** 100 kHz to 1.8 GHz
- **Resolution:** 1 mHz
- **Accuracy:** <±5.5 ppm (Option 1D5: <±0.13 ppm)

Output Characteristics
- **Power Range:** –60 to +20 dBm
- **Resolution:** 0.1 dB
- **Level Accuracy:** ±0.5 dB

Receiver Characteristics
- **Frequency Range:** 100 kHz to 1.8 GHz
- **Noise Level** (10 Hz IFBW, ≥10 MHz, f=frequency in GHz):
  < (–125+3 x f) dBm (A, B inputs);
  < (–100+3 x f) dBm (R input)
- **Full Scale Input Level:** –5 dBm (A, B), +20 dBm (R)
- **IF Bandwidth** (Hz): 10, 30, 100, 300, 1k, 3k, 10k, 40k

Dynamic Accuracy

Input level (relative to full scale input level)	
Magnitude Dynamic Accuracy	
0 dB	<±0.3 dB
–10 to –70 dB	<±0.05 dB
–80 dB	<±0.1 dB
–90 dB	<±0.3 dB
–100 dB	<±1.0 dB
–110 dB	<±0.7 dB typical
–120 dB	<±2.3 dB typical
Phase Dynamic Accuracy	
0 dB	<±3°
–10 dB	<±0.6°
–20 to –70 dB	<±0.3°
–80 dB	<±0.7°
–90 dB	<±2°
–100 dB	<±7°
–110 dB	<±8° typical
–120 dB	<±25° typical

@ 23 ± 5° C, IFBW 10 Hz, R input= –35 dBm

Measurement Throughput Summary (IFBW 40 kHz, ms)

Measurement (with THRU Cal)	Number of points 51	201	401	801
(1) Magnitude	62	138	239	443
(2) Magnitude and phase	84	227	417	798

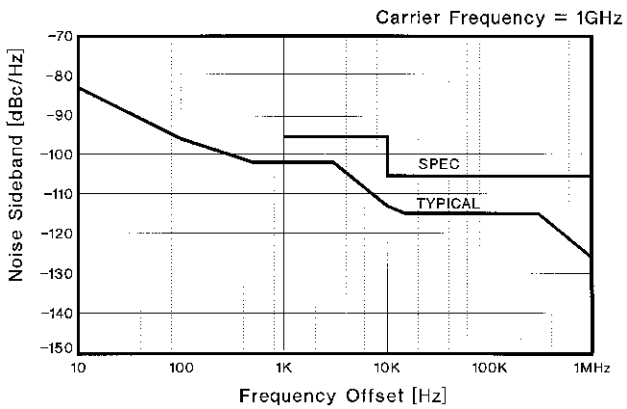
Spectrum Measurement

Frequency Characteristics
- **Frequency Range:** 2 Hz to 1.8 GHz

Frequency Reference
- **Accuracy:** <±5.5 ppm (Option 1D5: <±0.13 ppm)

Resolution Bandwidth (RBW)
- **Range:** 1 Hz to 3 MHz, 1-3-10 step
- **Selectivity** (60 dB/3 dB): RBW ≥10 kHz: <10; RBW ≤3 kHz: <3

Noise Sidebands



Noise sidebands normalized to 1 Hz RBW versus offset from carrier (typical)

Displayed Average Noise Level
(@ frequency ≥10 MHz, ref. level ≤–40 dBtm, att.=0 dBm):
< (–150 + 3f (GHz)) dBm/Hz

Spurious Response
- **Second Harmonic Distortion** (@ ≥10 MHz, –35 dBm mixer input): < –70 dBc
- **Third-Order Intermodulation Distortion** (@ ≥10 MHz, –30 dBm, separation >20 kHz): < –75 dBc

Other Spurious (@ –30 dBm mixer input, offset ≥1 kHz): < –70 dBc

Scale Fidelity: ±0.05 dB @ 0 to –30 dB from ref. level

Impedance Measurement (Option 010)

Measurement Parameters: |Z|, θz, |Y|, θy, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, |Γ|, θγ, Γx, Γy
Frequency Range: 100 kHz to 1.8 GHz
Measurement Port: APC-7 on the HP 43961A Test Kit
Source Level at RF out: –60 to +20 dBm (6 dB lower at 43961A port)
DC Bias: ±40 V (20 mA maximum). A 2 kΩ ±5% internal resistor is used for dc bias current limitation. An external dc bias source is required.
Connector: BNC (f) on HP 43961A.
Calibration: OPEN(0 S)/SHORT (0 Ω)/LOAD(50 Ω) calibration, OPEN/SHORT/LOAD compensation on test fixtures, port extension compensation
Accuracy (Supplemental Performance Characteristics):
3% basic accuracy at 23° ±5° C, after OPEN/SHORT/LOAD calibration

General Characteristics

Operating Temperature/Humidity: 0° C to 40° C, 15% < RH <95%
Storage Temperature: –20° to 60° C
Power Requirement: 90 to 132 V, 198 V to 264 V, 47 to 63 Hz, 300 VA max.
Weight: 21.5 kg (47.4 lb) typical
Size: 425 mm W x 235 mm H x 553 mm D

Key Literature

HP 4895A/96B Awareness Brochure, p/n 5965-9374E
HP 4396B 1.8 GHz Network/Spectrum Analyzer Technical Data, p/n 5965-6311E
Combining Network and Spectrum Analyses and IBASIC to improve device characterization and test time, p/n 5965-7656E
Configuring the HP 4396B for O/E Testing, p/n 5965-7657E
Using the HP4396B for Digital VTR Testing, p/n 5965-7658E
How to Characterize CATV Amplifires Effectively, p/n 5965-9434E
Dramatic Speed Improvement for Narrow RBW Sweeps by Audio/Video/IF/RF/Spectrum Analyzers, p/n 5966-4099E
Network, Spectrum, and Impedance Evaluation of Electronic Circuits and Components, p/n 5967-5942E
How to Measure Noise Accurately Using the HP Combination Analyzers, p/n 5966-2292E
HP 4395A/HP 4396B Special Option U01 (Education package), p/n 5968-2251E

Ordering Information

HP 4396B RF Network/Spectrum/Impedance Analyzer
- **Opt 1A2** Delete keyboard
- **Opt 1D5** High-Stability Frequency Reference
- **Opt 1D6** Time-Gated Spectrum Analysis
- **Opt 1D7** 50 Ω to 75 Ω Spectrum Input Impedance Conversion
- **Opt 010** Impedance Measurement Function (Requires HP 43961A)

HP 85046A 50 Ω S-Parameter Test Sets
HP 85046B 75 Ω S-Parameter Test Sets
HP 87512A 50 Ω Transmission/Reflection Test Kits
HP 87512B 75 Ω Transmission/Reflection Test Kits
HP 43961A RF Impedance Test Kit (add test fixtures listed below)
HP 16191A Side Electrode SMD fixture (dc to 2 GHz)
HP 16192A Parallel Electrode SMD fixture (dc to 2 GHz)
HP 16193A Small Side Electrode SMD fixture (dc to 2 GHz)
HP 16092A Spring-Clip Fixture (dc to 500 MHz)

HP 43961A
HP 87511A
HP 87511B
HP 87512A
HP 87512B
HP 41800A

HP 43961A

5

HP 43961A RF Impedance Test Kit

The HP 43961A RF Impedance Test Kit provides the capability to measure impedance parameters of 1-port devices with the HP 4395A Option 010 (100 kHz to 500 MHz) or the HP 4396B Option 010 (100 kHz to 1.8 GHz). The test port of the HP 43961A is a 7-mm connector and can be used with the HP 16191A, HP 16192A, or HP 16193A test fixture. The HP 43961A includes OPEN/SHORT/LOAD calibration standards, and the test fixtures such as HP 16192A are optional.

Frequency Range: 100 kHz to 1.8 GHz (100 kHz to 500 MHz with HP 4395A)
Measurement Parameters: |Z|, |Y|, θ, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, |Γ|

HP 87511A

HP 87511A/B S-Parameter Test Sets

The HP 87511A/B S-Parameter Test Sets provide the capability to measure S-parameters of 2-port devices from 100 kHz to 500 MHz with an HP network analyzer. The test ports of the HP 87511A are 50 Ω precision 7-mm connectors (Option 001: type N(f)), and the test ports of the HP 87511B are 75 Ω type N(f) connectors. Calibration kits are not included.

Frequency Range: 100 kHz to 500 MHz
Test Port Impedance: HP 87511A, 50 Ω; HP 87511B, 75 Ω

	HP 87511A	HP 87511B
Directivity		
100 kHz to 300 kHz	30 dB	30 dB
300 kHz to 200 MHz	40 dB	33 dB
200 MHz to 500 MHz	35 dB	33 dB
Nominal Insertion Loss		
RF IN to port 1, 2	13 dB	19 dB
RF IN to R, A, B	19 dB	31 dB

Size: 432 mm W x 90 mm H x 495 mm D
Weight: Approx. 5.7 kg

HP 87512A

HP 87512A/B Transmission/Reflection Test Kits

The 87512A/B Transmission/Reflection Test Kits provide the capability to measure the reflection and transmission characteristics of 50 or 75 Ω devices up to 2 GHz with an HP network analyzer. The test port of the HP 87512A is a 50 Ω type N(f) connector, and the test port of the HP 87512B is a 75 Ω type N(f) connector. The HP 87512A/B include precision SHORT/LOAD termination for calibration.

Frequency Range: DC to 2 GHz
Test Port Impedance: HP 87512A, 50 Ω; HP 87512B, 75 Ω
Equivalent Directivity: 40 dB (typical)
Insertion Loss: 10 dB ± 1 dB

HP 41800A

HP 41800A Active Probe

The HP 41800A Active Probe provides high input impedance from 5 Hz to 500 MHz. The HP 41800A is a valuable tool when used with a network and spectrum analyzer for circuit signal analysis.

Specifications

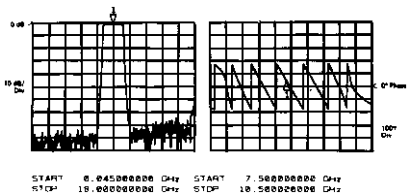
Bandwidth: 5 Hz to 500 MHz
Output Connector: 50 Ω type N male
Input R,C (typical):100 k Ω, 3 pF (probe alone); 1 MΩ, 1 pF (with 10:1, 100:1 divider)
Frequency Response relative to 50 MHz: ±1 dB @ 50 Hz to 200 MHz
Average Noise Level: 10 nV/√Hz @ ≥300 kHz
Second Harmonic Distortion (typical): <–50 dBc @ 20 dBm (250 MHz) input
Third-Order Intermodulation Distortion (typical): <–70 dBc @ –26 dBm two signal input
1 dB Gain Compression: >+3 dBm input @ 500 MHz

Why Network Analysis?

Characterizing the behavior of linear electrical networks that will be stimulated by arbitrary signals and interfaced with a variety of other networks is a fundamental problem in both synthesis and test processes. For example, the engineer designing a multi-component network must predict with some certainty the final network performance from knowledge of the individual components. Similarly, a production manager must know allowable tolerances on the products manufactured and whether the final products meet the specified tolerances. Network analysis offers a solution to these problems through complete description of linear network behavior in the frequency domain. Additionally, some network analyzers offer the capability to transform measurement data, taken in the frequency domain, to the time domain, providing further insight into the behavior of linear networks.

Network analysis accomplishes the description of both active and passive networks by creating a data model of such component parameters as impedances and transfer functions. However, these parameters not only vary as a function of frequency but are also complex variables in that they have both magnitude and phase. Swept network analyzers now measure magnitude and phase (the total complex quantity) as a function of frequency with less difficulty than conventional CW measurements. Impedance and transfer functions then can be displayed conveniently on an internal display, or on peripherals such as a printer and/or a plotter.

Thus, network analysis satisfies the engineering need to characterize the behavior of linear networks quickly, accurately, and completely over broad frequency ranges. Hewlett-Packard manufactures a full line of scalar network analyzers (magnitude only) and vector network analyzers (both magnitude and phase).



45 MHz to 18 GHz measurement of magnitude and phase in a single sweep.

What is Network Analysis?

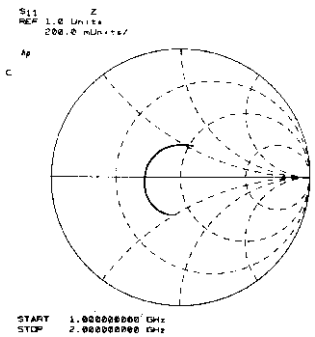
Network analysis is the process of creating a data model of the transfer and/or impedance characteristics of a linear network through stimulus-response testing over the frequency range of interest. All network analyzers in the HP product line operate according to this definition.

At frequencies above 1 MHz, lumped elements actually become "circuits" consisting of the basic elements plus parasitics like stray capacitance, lead inductance, and unknown absorptive losses. Since parasitics depend on the individual device and its construction, they are almost impossible to predict. Above 1 GHz component geometries are comparable to a signal wavelength, intensifying the variance in circuit behavior due to device construction.

Network analysis has classically been limited to the definition of linear networks. Since linearity constrains networks stimulated by a sine wave to produce a sine-wave output, sine-wave testing is an ideal method for characterizing magnitude and phase response as a function of frequency. While modern network analyzers use sine-wave power sweeps to characterize certain parameters of nonlinear behavior, such as gain compression and AM-to-PM conversion, this discussion will be limited to linear characterization of devices. For a more complete discussion of nonlinear measurements, refer to the sections on spectrum analyzers, wave analyzers (signal analyzers) and vector modulation products in this catalog.

Network Analyzers

Hewlett-Packard network analyzers are instruments that measure transfer and/or impedance functions of linear networks through sine-wave testing. A network analyzer system accomplishes these measurements by configuring its various components around the device-under-test. The first requirement of the measurement system is a sine-wave signal source to stimulate the device-under-test. Since transfer and impedence functions are ratios of various voltages and currents, a means of separating the appropriate signals from the measurement ports of the device-under-test is required. Finally, the network analyzer itself must detect the separated signals, form the desired signal ratios and display the results.



Input impedance of microcircuit amplifier is read directly with Smith Chart overlay for polar display.

Signal Sources and Signal Separation

In the general case, any sine-wave source meeting the network analyzer's specifications can be used to stimulate the device-under-test. If the analyzer is capable of swept measurements, great economies in time can be achieved by stimulating the device-under-test with a sweep oscillator or synthesized sweeper. Many Hewlett-Packard network analyzers contain internal, synthesized sources with excellent frequency resolution. Swept measurements allow quick and easy characterization of devices over broad frequency ranges.

At high frequencies the problem of signal separation usually involves traveling waves on transmission lines and becomes correspondingly more difficult. Hewlett-Packard network analyzers employ both internal and external test sets applicable for separating the appropriate traveling waves in a variety of high- frequency measurements.

Broadband and Narrowband Detection

After the desired signals have been obtained from the test set, they must be detected by the network analyzer; HP network analyzers can use one of two detection methods. Broadband detection accepts the full-frequency spectrum of the input signal, while narrowband detection involves tuned receivers that convert CW or swept-RF signals to a constant-IF signal. There are certain advantages to each detection scheme.

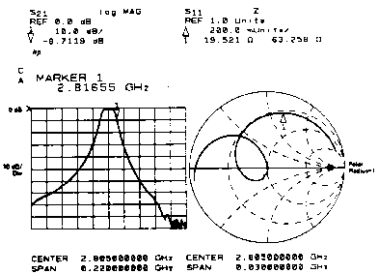
Scalar analyzers usually employ broadband detection techniques. Broadband detection reduces instrument cost by eliminating the IF section required by narrowband analyzers but sacrifices noise and harmonic rejection. However, noise is not a factor in many applications. Finally, broadband systems can make measurements where the input and output signals are not of the same frequency, as in the measurement of the insertion loss of mixers and frequency doublers.

Vector network analyzers normally employ narrowband detection techniques. Narrowband detection makes a more sensitive low noise detection of the constant IF possible. This allows increased accuracy and dynamic range for frequency-selective measurements (as compared to broadband systems).

Some newer vector network analyzers employ both broadband and narrowband detection. The detection method is selectable by the user so that device measurements can be optimized.

Signal Processing and Display

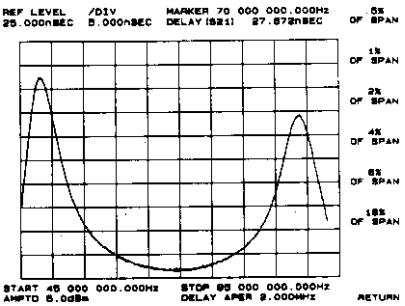
Once the RF has been detected, the network analyzer must process the detected signals and display the measured quantities. All HP network analyzers are multi-channel receivers utilizing a reference channel and at least one test channel; absolute signal levels in the channels, relative signal level (ratios) between the channels, or relative phase difference between channels can be measured, depending on the analyzer.



Simultaneous measurement of transmission response and passband reflection coefficient.

Relative ratio measurements are usually made in dB, which is the log ratio of an unknown signal (Test Channel) with a chosen reference signal (Reference Channel). This allows the full dynamic range of the instrumentation to be used in measuring variations of both high and low level circuit responses. For example, 0 dB implies the two signal levels have a ratio of unity, while ± 20 dB implies a 10:1 voltage ratio between two signals.

All network analyzer phase measurements are relative measurements with the reference channel signal considered to have zero phase. The analyzer then measures the phase difference of the test channel with respect to the reference channel.



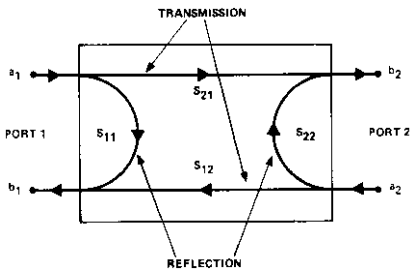
Direct measurement of group delay with digital readout at marker.

Phase information complements amplitude data in the measurement of device parameters. Phase is more sensitive to network behavior and it is a required component of complex impedance and transfer functions.

Phase data is also required to measure delay distortion or group delay of networks. Delay distortion occurs when different frequency components of a complex waveform experience nonlinear phase shifts as they are transmitted through a network. Group delay is a measure of this distortion and is defined as:

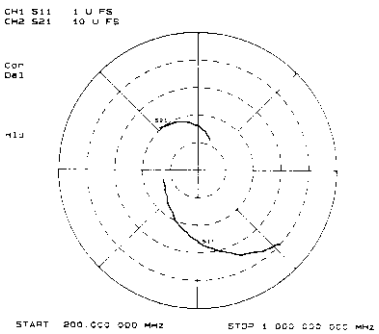
$$T_{gd} = \frac{-d\Theta}{d\omega}$$

An alternative method for measuring phase distortion is deviation from linear phase or differential phase. Deviations from linear phase can be measured by introducing enough electrical length in the network analyzer's reference channel to linearize a device's phase shift. This is usually accomplished by using the electrical-delay feature of the network analyzer, which cancels the average electrical length of a device mathematically.



S-parameter model for a two-port linear network.

Scattering parameters, or S-parameters, were developed to characterize linear networks at high frequencies. S-parameters define the ratios of reflected and transmitted traveling waves measured at the network ports. A two-port device is modeled with S-parameters (see diagram at bottom of page). S_{11} is the complex reflection coefficient at port 1, and is the ratio of b_1/a_1, if $a_2 = 0$ (port 2 terminated in its characteristic impedance). S_{21} is the complex transmission coefficient from port 1 to port 2, b_2/a_1, if $a_2 = 0$. The "a" and "b" signals represent the amplitude and phase of the incident and emerging or reflected traveling waves. By reversing the ports and terminating port 1 in its characteristic impedance, S_{22} and S_{12} can be similarly defined.



Simultaneous measurement of transistor S-parameters.

Additional Capabilities

Precision design work and manufacturing tolerances demand highly-accurate measurements, but most errors in network measurements are complex quantities that vary as a function of frequency. By characterizing and virtually removing these systematic errors, measurement accuracies are improved by several orders of magnitude. Hewlett-Packard network analyzers contain built-in, high-speed computational hardware that can perform the complex mathematics required for sophisticated error correction.

Computer-controlled network analyzers can be programmed to set up and make many measurements automatically. The measurement process is further accelerated by the computer's ability to store, transform, summarize, and output data in a variety of formats to a number of peripherals. These capabilities make the computer-controlled network analyzer ideal for both computer-aided design or automatic production testing. Several products have built-in automation features, including sequencing and GP Instrument BASIC.

Network Analyzer Selection Guide

HP Model	Frequency range	Source	Measurement capabilities
HP 35670A Dynamic Signal Analyzer (page 546)	122 µHz to 102.4 kHz (2 channel) 122 µHz to 51.2 kHz (4 channel)	Swept and fixed sine, random (white and pink) noise, burst random, chirp, burst and periodic chirp, and arbitrary waveform	Transfer functions–magnitude/phase, curve fit, spectrum analysis, octave analysis, order domain spectrum analysis, order tracking, histogram analysis. GPIB programmable.
HP E5100A/B Network Analyzer (page 281)	10 kHz to 180/300 MHz	Integrated synthesized source	Transfer functions–magnitude/phase, insertion loss/gain, group delay, attenuation. Impedance-magnitude/phase. Electrical delay. GP IBASIC capability. Built-in 3 ½-in flexible disk (DOS format). GPIB capability.
HP 4395A Network/Spectrum/ Impedance Analyzer (page 268)	10 Hz to 500 MHz (network) 100 kHz to 500 MHz (impedance)	Integrated synthesized source	Transfer functions–magnitude/phase, insertion loss/gain, attenuation, S-parameters, group delay, return loss, r+jx. Impedance-magnitude/ phase. Electrical delay. Spectrum analysis. Complex impedance and GP Instrument BASIC optional. Built-in 3 ½-in flexible disk (LIF/DOS format). GPIB programmable.
HP 4396B Network/Spectrum/ Impedance Analyzer (page 269)	100 kHz to 1.8 GHz (network) 2 Hz to 1.8 GHz (spectrum) 100 kHz to 1.8 GHz (impedance)	Synthesized source	Transfer functions–magnitude/phase, insertion loss/gain, attenuation, S-parameters, group delay, return loss, r + jx. Impedance-magnitude/ phase. Electrical delay. Spectrum analysis. Complex impedance and GP Instrument BASIC optional. Built-in 3½-in flexible disk (LIF/DOS format). GPIB programmable.
HP 8712ET/8712ES **HP 8714ET/8714ES** RF Economy Network Analyzers (page 285)	300 kHz to 1.3 GHz (8712ET, 8712ES) 300 kHz to 3 GHz (8714ET, 8714ES)	Integrated synthesized source, T/R test set (ET models), S-parameter test set (ES models)	Transmission/reflection and S-parameter measurements of magnitude and phase. 50 Ω and 75 Ω measurements. GP Instrument BASIC (IBASIC). Narrowband/broadband receivers. Internal calibration, averaging, limit testing, internal disk, and storage registers. LAN interface. VGA output. Fault location/SRL. GPIB programmable.
HP 8753ET/ES Network Analyzers (page 291)	30 kHz to 3/6 GHz	Integrated synthesized source, T/R test set (ET models), S-parameter test set (ES models)	Transfer functions–magnitude/phase, insertion loss/gain, attenuation, S-parameters, gain compression, 50 Ω and 75 Ω measurements, 4 simultaneous-parameter display, electrical length, group delay, deviation from linear phase. Impedance-magnitude/phase, return loss, r + jx. Full accuracy enhancement. Time-domain capability. Frequency-offset mode. Harmonic-measurement capability. Sequencing. VGA output. GPIB programmable.
HP 8719ET/8719ES **HP 8720ET/8720ES** **HP 8722ET/8722ES** Network Analyzers (page 296)	50 MHz to 13.5 GHz (8719ET/ES) 50 MHz to 20 GHz (8720ET/ES) 50 MHz to 40 GHz (8722ET/ES)	Integrated synthesized source T/R test set (ET models), S-parameter test set (ES models)	Transfer functions–magnitude/phase, insertion loss/gain, attenuation, S-parameters, gain compression, 4 simultaneous-parameter display, electrical length, group delay, deviation from linear phase. Impedance-magnitude/phase, return loss, r + jx. Full accuracy enhancement. Time-domain capability. Frequency-offset mode. Sequencing. VGA output. GPIB programmable.
HP 8510 Series Network Analyzers (page 299)	45 MHz to 110 GHz (SS-SC)	HP 8360 Series Synthesized Sweepers	Transfer functions–magnitude/phase, insertion loss/gain, attenuation, S-parameters, electrical length, group delay, deviation from linear phase, impedance, return loss, r + jx. Active device characterization. Full accuracy enhancement. Time domain capability. GPIB programmable.
HP 8757D/E Scalar Network Analyzers (page 276)	10 MHz to 110 GHz	HP 83751A/83752A Synthesized Sweepers HP 8360 Series Synthesized Sweepers	Scalar transmission/reflection measurements, 50 Ω coax measurements 10 MHz to 50 GHz, waveguide measurements 26.5 to 110 GHz, open/short averaging, normalization, averaging, limit testing, storage registers. GPIB programmable.

Vector Voltmeter

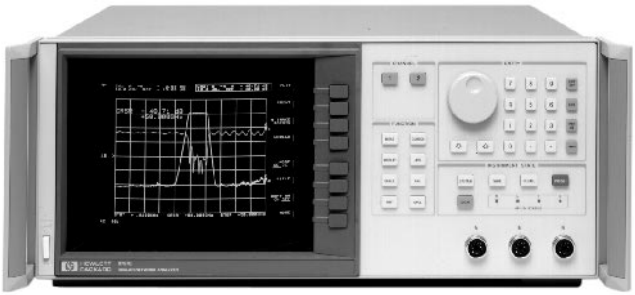
HP Model	Frequency range	Source	Measurement capabilities
HP 8508A Vector Voltmeter (page 298)	0.1 MHz to 1 GHz 0.3 MHz to 2 GHz	None	Voltage, impedance, transfer functions, phase and amplitude, GPIB programmable.

For a complete network analyzer selection guide, please ask for HP literature numer 5968-5260E, or visit us on the web: **www.hp.com/go/na.**

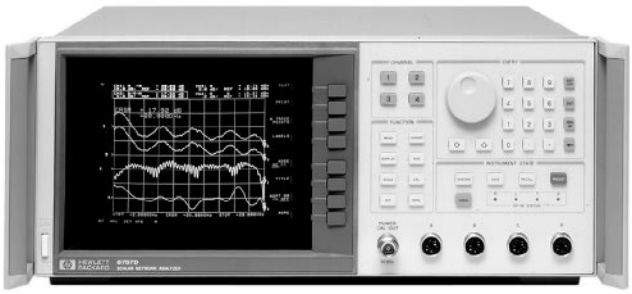
Scalar Network Analyzers, 10 MHz to 110 GHz

HP 8757D/E

- 75 dB dynamic range
- Optional power calibrator
- 40 dB directivity bridges
- 40 GHz in coax, 110 GHz in waveguide
- Buffered plotter/printer output
- External disk and internal register save/recall
- Built-in limit testing
- Color display



HP 8757E



HP 8757D Opt 001, Opt 002

HP 8757D/E Scalar Network Analyzers

Measure insertion loss, gain, return loss, SWR and power quickly and accurately with either the HP 8757D or HP 8757E scalar network analyzers. With high-performance detectors and directional bridges, and a companion HP source and digital plotter, the HP 8757D and 8757E become the basis of a complete measurement system with superb performance.

A Choice of Two Analyzers

For an economical measurement solution, choose the HP 8757E scalar network analyzer. The HP 8757E features three detector inputs and two independent display channels, allowing simultaneous ratioed or nonratioed measurement of your device's transmission and reflection characteristics, 75 dB dynamic range (+20 to –55 dBm) for measuring high-rejection devices, and a choice between ac (square wave modulated) or dc detection techniques. The internal plotter/printer buffer allows you to send your measurement data directly to a plotter and then proceed to the next measurement, typically in less than five seconds. The HP 8757E includes a user-friendly interface, and menu-driven, direct-access softkeys, which simplify its operation.

When your application demands maximum system versatility, choose the HP 8757D scalar network analyzer. It offers all of the performance of the HP 8757E, plus more standard features, better measurement speed, limit testing, external disk save/recall and a color display. Limit testing reduces test time by letting the analyzer make quick and objective pass/fail decisions. External disk save/recall allows your measurement state to be preconfigured by an engineer or skilled specialist and then automatically recalled by production technicians. The result is reduced set-up time and greater test integrity at each production station. The precision color display simplifies the separation of measurement information while providing a pleasant display for the technician.

Increase Absolute Power Measurement Accuracy

For near power meter measurement accuracy, configure a system that includes the HP 8757D Option 002 and the HP 85037 series precision detectors. Option 002 on the HP 8757D adds an internal power calibrator used to characterize the HP 85037 series detectors' accuracy versus power. In addition, each HP 85037 series precision detector incorporates a dual-diode detector to improve power measurement accuracy when harmonics are present, plus internal frequency correction factors, read by the HP 8757D, for more accurate power versus frequency measurements. The result is a system optimized for swept absolute power measurements.

Systems from 10 MHz to 110 GHz

You can conveniently obtain a 20 GHz coaxial measurement system by ordering the HP 8757XC (10 MHz to 20 GHz) scalar measurement system. Or, you can configure your own system to 50 GHz in coax or to 110 GHz in waveguide.

The HP 83750 series synthesized sweeper family offers the accuracy and performance of a synthesized source at an affordable price. When you test narrowband, frequency-selective devices, choose a synthesized sweeper from the HP 8360 series. These sweepers provide excellent frequency stability and up to 1 Hz frequency resolution.

Feature	HP 8757D	HP 8757E
Display	Color	Monochrome
Display channels	4	2
Detector inputs	3 standard 4 with Option 001	3
Dynamic range	75 dB	75 dB
AC/DC detection mode	Yes	Yes
Measurement points:		
Selectable values	101, 201, 401, 801, 1601	101, 201, 401
Channels displayed	3 or 4 2 1	1 or 2
Max. points per channel	401 801 1601	401
Plotter/printer buffer	Yes	Yes
Noise figure display capability*	Yes	Yes
External disk save/recall	Yes	No
Internal save/recall registers	9	9
Limit testing (channels 1 and 2)	Yes	No
Adaptive normalization	Yes	No
Cursor search functions	Max., Min., bandwidth, n dB	Max., Min.
SWR display mode	Yes	Yes
Non-standard sweep mode	Yes	Yes
Auxiliary voltage display mode	Yes	Yes
Optional power calibrator	Yes	No
Compatible with HP 85037 series precision detectors	Yes	No

* Product Note 8970 B/S-4, HP Literature 5959-8742

Key Literature

HP 8757D/E Scalar Network Analyzers Brochure, p/n 5091-2469E
HP 8757D/E Scalar Network Analyzers Technical Data, p/n 5091-2471E
HP 8757D/E Scalar Network Analyzers Configuration Guide, p/n 5967-6177E

HP 85037 Series Precision Detectors (ac/dc)

The HP 85037 series precision detectors are designed specifically for operation with the HP 8757D scalar network analyzer and may be used in either ac or dc detection modes. These dual diode detectors contain internal frequency correction factors in an internal EE PROM (read automatically by the HP 8757D) for improved measurement accuracy versus frequency. When used in conjunction with the HP 8757D's internal power calibrator (Option 002), these detectors provide the maximum absolute power measurement accuracy. The HP 85037 series detector is not compatible with the HP 8757E.

Absolute Power Measurement Uncertainty Examples

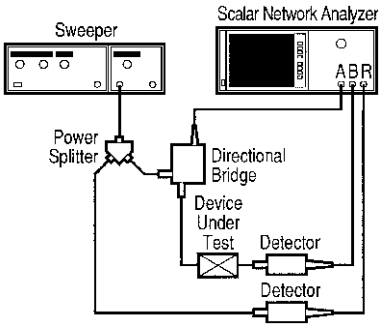
Assumptions:

- Measurement frequency = 10 GHz
- DUT input/output SWR = 1.5
- Measured power = 0 dBm

Uncertainty component	HP 85037B detector	HP 85025E detector
Absolute power accuracy at 50 MHz (±dB)	0.11	0.40
Frequency response (±dB)	0.18	0.50
Mismatch (±dB)	0.18	0.10
Uncertainty Total (±dB)	0.47	1.00

Reflection Measurement Accuracy

Uncertainties due to calibration error and the frequency response of the source, detectors, and bridges are removed via open/short averaging. The remaining uncertainties are primarily the sum of directivity uncertainty, effective source match uncertainty and dynamic power accuracy. See Technical Data Sheet for further information.



Basic scalar coaxial system configured for ratio reflection and transmission measurements.

Precision Detector Summary, HP 85037 Series For use with the HP 8757D in either ac or dc detection modes

Model	Frequency range	Connector type	Dynamic range	Frequency	Return loss	Frequency response	Power (at 50 MHz)	Dynamic accuracy[4]	Absolute accuracy[5]
HP 85037A[1]	10 MHz to 18 GHz	Type-N (m) 7 mm[2]	ac mode +20 to –55 dBm dc mode +20 to –50 dBm	0.01 to 0.04 GHz 0.04 to 18.0 GHz	10 dB 20 dB	±0.35 dB ±0.18 dB	20 dBm 10 dBm –30 dBm –50 dBm	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB
HP 85037B[1]	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +20 to–55 dBm dc mode +20 to –50 dBm	0.01 to 0.04 GHz 0.04 to 18.0 GHz 18 to 26.5 GHz	10 dB 20 dB 18 dB	±0.35 dB ±0.18 dB ±0.22 dB	20 dBm 10 dBm –30 dBm –50 dBm	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB

HP 85025 and 85026 Series Detectors (ac/dc)

The HP 85025 and 85026 series detectors are designed specifically for operation with the HP 8757 scalar network analyzer. The HP 85025/26 detectors detect either a modulated (ac) or an unmodulated (dc) microwave signal.

HP 85025C Detector Adapters

The HP 85025C adapter matches the scalar analyzer display to most standard crystal, silicon and gallium arsenide detectors. This enables the user to operate up to 110 GHz with the HP 8757. The HP 85025C detector adapter is designed for use with the HP 8757 only, and can operate in either ac or dc detection modes.

Coaxial Detector Summary, HP 85025 Series For use with the HP 8757 only in either ac or dc detection modes

Model	Frequency range	Connector type	Dynamic range	Frequency	Return loss	Frequency response	Power (at 50 Mhz)	Dynamic accuracy[4]	Absolute accuracy[5]
HP 85025A[3]	10 MHz to 18 GHz	Type-N (m) 7 mm[2]	ac mode +16 to –55 dBm dc mode +16 to –50 dBm	0.01 to 0.04 GHz 0.04 to 4 GHz 4 to 18 GHz	10 dB 20 dB 17 dB	±0.8 dB ±0.5 dB ±0.5 dB	16 dBm 6 dBm –35 dBm –50 dBm	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB
HP 85025B[3]	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +16 to –55 dBm dc mode +16 to –50 dBm	0.01 to 0.04 GHz 0.04 to 4 GHz 4 to 18 GHz 18 to 26.5 GHz	10 dB 20 dB 17 dB 12 dB	±0.8 dB ±0.5 dB ±0.5 dB ±2.0 dB	16 dBm 6 dBm –35 dBm –50 dBm	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB
HP 85025D[3]	10 MHz to 50 GHz	2.4 mm (m)	ac mode +16 to –55 dBm dc mode +16 to –50 dBm	0.01 to 0.1 GHz 0.1 to 20 GHz 20 to 26.5 GHz 26.5 to 40 GHz 40 to 50 GHz	10 dB 20 dB 20 dB 15 dB 9 dB	±0.8 dB ±0.5 dB ±1.0 dB ±2.5 dB ±3.0 dB	16 dBm 6 dBm –35 dBm –50 dBm	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB
HP 85025E[3]	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +16 to –55 dBm dc mode +16 to –50 dBm	0.01 to 0.1 GHz 0.1 to 18 GHz 18 to 25 GHz 25 to 26.5 GHz	10 dB 25 dB 25 dB 23 dB	±0.8 dB ±0.5 dB ±0.5 dB ±1.4 dB	16 dBm 6 dBm –35 dBm –50 dBm	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB

[1]The HP 85037A/B specifications are applicable when used with the HP 8757D scalar network analyzer. The absolute power accuracy and dynamic power accuracy specifications apply after a calibration via the HP 8757D Option 002's internal power calibrator.

[2]Option 001 changes to a 7-mm connector.

[3]The HP 85025 and 85026 series detectors and the HP 85025C detector adapter require HP 8757A firmware revision 2.0 or higher. To upgrade previous revisions, order the HP 11614A firmware enhancement.

[4]Dynamic accuracy refers to measurement accuracy as power varies (in dB) from a 0 dBm reference. 25° ±5°C, 50 MHz.

[5]DC mode, 25° ±5° C.

HP R85026A
HP Q85026A
HP U85026A
HP 85027A
HP 85027B
HP 85027C
HP 85027D
HP 85027E

Waveguide Detectors and Detector Adapters Summary For use with the HP 8757 only in either ac or dc detection modes

Model	Frequency range	Connector type	Dynamic range	Return loss	Frequency response	Dynamic accuracy
HP R85026A[1]	26.5 to 40 GHz	WR-28	+10 to –50 dBm (ac mode) +10 to –45 dBm (dc mode)	12 dB	±1.5 dB	±(0.3 dB + 0.03 dB/dB)
HP Q85026A[1]	33 to 50 GHz	WR-22	+10 to –50 dBm (ac mode) +10 to –45 dBm (dc mode)	12 dB	±2.0 dB	±(0.3 dB + 0.03 dB/dB)
HP U85026A	40 to 60 GHz	WR-19	+10 to –50 dBm (ac mode) +10 to –45 dBm (dc mode)	12 dB	±2.0 dB	±(0.3 dB + 0.03 dB/dB)
HP 85025C Option K57[3]	50 to 75 GHz	WR-15	+10 to –45 dBm (typical)	9.5 dB (typical)	—	—
HP 85025C Option K71[3]	75 to 110 GHz	WR-10	+10 to –45 dBm (typical)	9.5 dB (typical)	—	—
HP 85025C[1]	[2]	SMA (m)	[2]	[2]	[2]	[2]

[1]The HP 85025 and 85026 series detectors and the HP 85025C detector adapter require HP 8757A firmware revision 2.0 or higher. To upgrade previous revisions, order the HP 11614A firmware enhancement.

[2]Depends upon the particular detector being used.

[3]Must be used with the HP 85025C detector adapter.

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HP 85027 Series Directional Bridges (ac/dc)

The HP 85027 series directional bridges are designed to operate with either the HP 8757 in ac or dc detection modes. These bridges offer high directivity, excellent test port match, and a measurement range of up to 50 GHz in coax.

HP 8757D Option 002 Power Calibrator

The HP 8757D's internal power calibrator provides a 50 MHz reference standard for characterizing the absolute power accuracy and dynamic power accuracy of the HP 85037 series precision detectors.
Frequency: 50 MHz ±0.2 MHz
Accuracy at 0 dBm: ±0.05 dB
Linearity: (over any 10 dB range)
±0.08 dB (+20 to +10 dBm)
±0.04 (+10 to –30 dBm)
±0.06 (–30 to –50 dBm)

Directional Bridge Summary For use with the HP 8757 in ac or dc detection mode

Model	Frequency range	Nominal impedance	Connector–input	Connector–test port	Frequency	Directivity (dB)	Frequency	Test port match (SWR)
HP 85027A	10 MHz to 18 GHz	50 Ω	Type-N (f)	7 mm	0.01 to 18 GHz	40 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
HP 85027B	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (f)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78
HP 85027C	10 MHz to 18 GHz	50 Ω	Type-N (f)	Type-N (f)	0.01 to 12.4 GHz 12.4 to 18 GHz	36 dB 34 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
HP 85027D	10 MHz to 50 GHz	50 Ω	2.4 mm (f)	2.4 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz 26.5 to 40 GHz 40 to 50 GHz	36 dB 32 dB 30 dB 25 dB	0.01 to 16 GHz 16 to 30 GHz 30 to 40 GHz 40 to 50 GHz	<1.18 <1.27 <1.57 typically <2.00
HP 85027E	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78

System Accuracy

Transmission Loss or Gain Measurement Accuracy

Transmission loss or gain measurements are made relative to a 0 dB reference point established at calibration. Transmission measurement uncertainty = dynamic power accuracy + mismatch uncertainty.

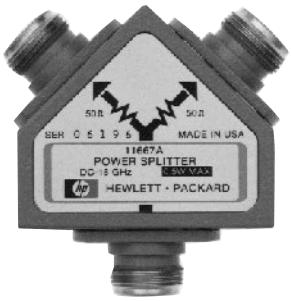
Dynamic power accuracy is the measurement uncertainty due to the change in power level between calibration and the measurement. Mismatch uncertainty is the uncertainty due to reflections in the measurement setup. The frequency response errors of the source, detectors, bridge and power splitter are removed via calibration.

Transmission Measurement Uncertainty Examples
Assumptions:
- Measurement frequency = 10 GHz
- DUT input/output SWR = 1.5
- Change in power after calibration <30 dB (+0 to –30 dBm range)

Uncertainty component	HP 85037B precision detector	HP 85025E detector
Dynamic accuracy (±dB)	0.11	0.40
Mismatch (±dB)	0.45	0.33
Uncertainty Total (±dB)	0.56	0.73

HP 11679A

HP 85022A



HP 11667A

HP 11667C

HP 11679A/B Extension Cables

Function

These cables extend the distance between the scalar network analyzer and the detector or bridge to a maximum of 200 feet without degradation of performance.

HP 11679A: 7.6 m (25 ft) extension cable
HP 11679B: 61 m (200 ft) extension cable

HP 85022A System Cable Kit

The HP 85022A contains all the BNC and GPIB cables to connect an HP sweep oscillator (HP 8360 series, HP 83750, or 83751 synthesized sweepers), an HP computer and a printer to the HP 8757. This kit contains three one-meter GPIB cables (HP 10833A), three two-foot BNC (m-m) cables (HP 11170B) and one four-foot BNC (m-m) cable (HP 11170C).

BNC Impedance: 50 Ω
Weight: Net, 0.5 kg (1.2 lb); shipping, 1.2 kg (2.9 lb)

HP 8757D Upgrade Kits

Increase your analyzer's measurement capability and performance with an HP 8757 upgrade kit. Upgrade kits are available for the HP 8757D.

The HP 86383C upgrade kit allows you to add the fourth detector input to your HP 8757D (86383C Option 001) and/or the internal power calibrator (HP 86383C Option 002). Installation is not included with this kit.

HP 11636A/B Power Dividers

The HP 11636A/B power dividers/combiners are recommended when making wideband comparison measurements without ratioing.

HP 11613B Calibrator

The HP 11613B is a dedicated transfer standard for calibration of the HP 8757D/E scalar network analyzers. The HP 11613B provides a standard, a 27.778 kHz source and a series of precision attenuators. The calibrator includes software that verifies (and adjusts if necessary) the internal calibration parameters stored in the nonvolatile memory of the analyzer.

HP 11852B 50 Ω/75 Ω Minimum-Loss Pad

The HP 11852B is a low SWR minimum-loss pad required between 75 Ω devices and 50 Ω sources and detectors. For more information, see page 294.

HP 11667A/B/C Power Splitters

The HP 11667A/B/C power splitters are recommended when making wideband ratio measurements using the HP 8757 scalar network analyzer. These two-resistor type splitters provide excellent output SWR at the auxiliary arm when used for source leveling or ratio measurement applications. The tracking between output arms over a frequency range from dc to 50 GHz allows wideband measurements to be made with a minimum of uncertainty.

Frequency Range
- **HP 11667A:** DC to 18 GHz
- **HP 11667B:** DC to 26.5 GHz
- **HP 11667C:** DC to 50 GHz

Impedance: 50 Ω nominal
Insertion Loss
- **HP 11667A/B:** 6 dB nominal
- **HP 11667C:** 8.5 dB nominal

Max. Input Power: +27 dBm
Connectors
- **HP 11667A:** N-female on all ports
- **HP 11667B:** 3.5-mm female on all ports
- **HP 11667C:** 2.4-mm female on all ports

HP 8757 System
HP 8757XC

The HP 8757 scalar network analyzer is ordered with multiple line items to give you maximum flexibility in specifying a system that meets your needs. Consult your local Hewlett-Packard sales office if you would like assistance.

Ordering Information

Complete Measurement System
HP 8757XC 20 GHz Coaxial Synthesized Scalar System
Includes:
HP 8757D Scalar Network Analyzer
HP 83752A Synthesized Sweeper[1]
HP 85022A Cable Kit
- **Opt 001** Adds Fourth Detector Input to Analyzer
- **Opt 002** Adds 50 MHz Calibrator to Analyzer
- **Opt 1E1** Adds 70 dB Step Attenuator to Source
- **Opt 1E5** Adds High-Stability Timebase to Source
- **Opt 1ED** Adds Type-N Connector to Source
- **Opt 57E** Substitutes HP 8757E Analyzer
- **Opt 51A** Substitutes HP 83751A Source (2 to 20 GHz)
- **Opt 51B** Substitutes HP 83751B Source (2 to 20 GHz, high power)
- **Opt 52B** Substitutes HP 83752B Source (0.01 to 20 GHz, high power)

Analyzer
HP 8757D Scalar Network Analyzer
- **Opt 001** Fourth Detector Input
- **Opt 002** Internal Power Calibrator
- **Opt 802** HP 9122C Disk Drive and an HP 10833A GPIB cable
- **Opt W03*** 90-Day On-Site Warranty Conversion
- **Opt W30** Two-Year Extended Service
- **Opt 1BN** MIL-STD-45662A Calibration Certificate
- **Opt 1BP** MIL-STD-45662A Calibration with Test Data
- **Opt UK6** Commercial Calibration Certificate w/data

HP 8757E Scalar Network Analyzer
- **Opt 1BP** MIL-STD-45662A Calibration with Test Data

Sweepers
Choose the HP 83752A/B synthesized sweepers for applications from 10 MHz to 20 GHz, or the HP 8360 seriessynthesized sweepers for measurements up to 50 GHz in coax or 110 GHz in waveguide.

Precision Detectors
HP 85037A 0.01 to 18 GHz, Type-N(m)
- **Opt 001** 7-mm Connector

HP 85037B 0.01 to 26.5 GHz, 3.5 mm(m)

Directional Bridges
HP 85027A 0.01 to 18 GHz, 7 mm, 50 Ω
HP 85027B 0.01 to 26.5 GHz, 3.5 mm (f), 50 Ω
HP 85027C 0.01 to 18 GHz, Type-N (f), 50 Ω
HP 85027D 0.01 to 50 GHz, 2.4 mm (m), 50 Ω
HP 85027E 0.01 to 26.5 GHz, 3.5 mm (m), 50 Ω

[1]In addition to the options listed, the HP 83752A can be substituded with any other HP synthesized source. For more information contact the HP Call Center in your region.

Detectors
HP 85025A 0.01 to 18 GHz, Type-N (m)
- **Opt 001** 7-mm Connector

HP 85025B 0.01 to 26.5 GHz, 3.5 mm (m)
HP 85025D 0.01 to 50 GHz, 2.4 mm (m)
HP 85025E 0.01 to 26.5 GHz, 3.5 mm (m)
HP R85026A 26.5 to 40 GHz, WR-28 Waveguide
HP Q85026A 33 to 50 GHz, WR-22 Waveguide
HP U85026A 40 to 60 GHz, WR-19 Waveguide
HP 85025C Detector Adapter

System Cable Kit
HP 85022A System Cable Kit

GPIB/Centronics Bus Converter
US/Canada Version (ITEL 45CHVUC)
International Version (ITEL 45CHVEC)

Optional Accessories
(For ratio and/or modulation measurements)
HP 11636A Power Divider dc to 18 GHz
HP 11636B Power Divider dc to 26.5 GHz
HP 11667A Power Splitter dc to 18 GHz
- **Opt 001** N-male on Input Port; N-female on Output Ports
- **Opt 002** N-female on Input Port; 7 mm on Output Ports

HP 11667B Power Splitter dc to 26.5 GHz
HP 11667C Power Splitter dc to 50 GHz
HP 11679A Detector Extension Cable, 7.6 m (25 ft)
HP 11679B Detector Extension Cable, 61 m (200 ft)
HP 11852B 50 to 75 Ω Minimum Loss Pad

Upgrade Kits
HP 86383C Upgrade Kit for HP 8757D
- **Opt 001** Adds Fourth Detector Input
- **Opt 002** Adds Internal Power Calibrator

For information on compatible printers, visit:
http://www.hp.com/go/pcg

*Only where available.

Indicates QuickShip availability.

- 10 kHz to 300 MHz
- 0.04 ms/point measurement speed
- Fine resolution IFBW
- List sweep function
- Stable measurements
- High-speed evaluation using the waveform analysis commands
- Evaporation Monitoring Function (Option)
- Phase Tracking Function (Option)
- Supports active probes (Option)
- GP Instrument BASIC for easy automation

HP E5100A/B

HP E5100A/B Network Analyzers

The HP E5100A/B network analyzer is a 10 kHz to 300 MHz network analyzer best fitted for production lines of electronic component manufacturers, especially resonator and filter manufacturers, who require extra-high throughput.

The HP E5100A/B improves production line productivity with its fast measurement speed (fastest sweep speed is 0.04 ms/point), fast waveform analysis commands, and speedier processor. It provides faster measurements with lower fluctuations because of its low-noise performance and fine selection IFBW.

HP E5100A

The HP E5100A is a versatile network analyzer with many functions and options to fit your needs with a minimum investment. During final tests, both precision and high speed are required for better yield and better productivity. The HP E5100A makes high-quality and high-speed tests with its fine IFBW selection and low-noise circuitry. Its convenient analysis and processing functions improve the productivity of the final test processes.

HP E5100A 180MHz Version

The HP E5100A 180MHz version (option 118/218/318/618) is the economical solution for lower frequency applications. The frequency range is 10kHz to 180MHz. The HP E5100A 180MHz version provides the same measurement performance as the 300MHz version with lower price.

HP E5100B

The HP E5100B is best for in-process testing of filters and resonators. The requirement of in-process testing is different from that of final tests; they need fast measurements and low price. The HP E5100B has the same measurement quality and speed as the HP E5100A, but has reduced functionality. The HP E5100B reduces production costs and is a valuable tool for in-process testing.

Model	HP E5100A 300MHz version	HP E5100A 180MHz version	HP E5100B
Frequency range	10kHz to 300MHz	10kHz to 180MHz	10kHz to 300MHz
Number of receivers	1 to 4	1 to 3	1 to 2
Number of points	1601	1601	401
List sweep	yes	yes	no
Dynamic range	120dB	120dB	100dB
Phase tracking function	yes (opt 023)	yes (opt 823)	no
Evaporation monitor function	yes (opt 022)	no	yes (Opt 022)

Specifications

Source Characteristics

Frequency

Range: 10 kHz to 300 MHz, 10 kHz to 180 MHz (HP E5100A with Opt. 118/218/318/618)

Output

Power range (at SINGLE): –48 to +22 dBm (option), –9 to +11 dBm (standard)

Resolution: 0.1 dB

Receiver Characteristics

Frequency

Range: 10 kHz to 300 MHz, 10 kHz to 180 MHz(HP E5100A with Opt. 118/218/318/618)

IFBW: 10 Hz to 30 kHz (1, 1.5, 2, 3, 4, 5, 8 steps)
Input Impedance (nominal): 50 Ω (std.), 50 Ω /1M Ω , 30 pF (option)
Dynamic Range: >120 dB (IFBW = 1 kHz)
Dynamic Accuracy: ±0.05 dB, ±0.3 deg
Measurement Speed: 0.04 ms/point (IFBW = 30 kHz, ramp-sweep)

General Characteristics

Measurement Parameters: Gain (Amplitude Ratio), Phase, Group-Delay, Amplitude, Gain-Phase, Gain-Delay Impedance, Admittance
Display: 6.5 inch TFT Color LCD
Programming: GP Instrument BASIC
Mass Storage: FDD and internal non-volatile memory
Parallel I/O Port: TTL, 16-bit output, 8-bit input/output (standard)
Size: 425 mm W x 177 mm H x 425 mm D
Weight: Net, 12 kg (typical); shipping, 17 kg (typical)

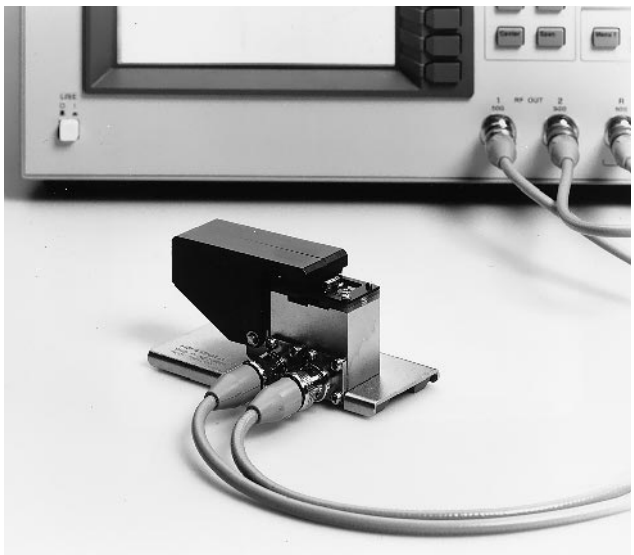
Key Literature

HP E5100A/B Network Analyzer Product Overview, p/n 5966-2889E
HP E5100A/B Technical Specifications, p/n 5966-2888E

HP E5100A/B Accessories

HP 41901A SMD PI-Network Test Fixture

The HP 41901A SMD PI-network test fixture produces the capability to measure surface-mount crystal resonator using the HP E5100A/B or the HP 87510A. Attachment kit (option) is required for measurement. The frequency range of the HP 41901A is 1 MHz to 300 MHz.



Ordering Information

HP E5100A Network Analyzer
- **Opt 100** 300MHz 1 Receiver, Port A
- **Opt 200** 300MHz 2 Receivers, Port R and A
- **Opt 300** 300MHz 3 Receivers, Port R, A and B
- **Opt 400** 300MHz 4 Receivers, Port R, A, B and C
- **Opt 600** 300MHz PI-Network Test Ready Package
- **Opt 118** 180MHz 1 Receiver, Port A
- **Opt 218** 180MHz 2 Receiver, Port R and A
- **Opt 318** 180MHz 3 Receiver, Port R, A and B
- **Opt 618** 180MHz PI-Network Test Ready Package

Note: Choose one Option from 100 to 618 depending on test frequency range and number of receivers.
Note: Options 600 and 618 include power-extended two RF OUT ports and two receivers.
PI-network fixture is not included.
- **Opt 001** One RF OUT port
- **Opt 002** Two RF OUT ports, built-in power splitter
- **Opt 003** Two RF OUT ports, switched single output

Note: Choose one Option from 001 to 003 except the case of Options 600 and 618. Option 003 cannot be ordered with Option 101 or 301.
- **Opt 101** 50Ω/1MΩ selectable input on Port A
- **Opt 102** Type-N input connector on Port A

Note: Options 101 and 102 are for Options 100, 200, 118 and 218 only. Option 101 cannot be ordered with Option 003.
- **Opt 301** 50Ω/1MΩ selectable inputs on Ports A and B
- **Opt 302** Type-N input connector on Port A and B

Note: Options 301 and 302 are for Options 300, 400 and 318 only. Option 301 cannot be ordered with Option 003.
- **Opt 010** Extended Output Power Range
- **Opt 022** Evaporation Monitoring Function

Note: Option 022 cannot be ordered with Options 118, 218, 318 and 618.
- **Opt 023** Phase Tracking Function for 300MHz version

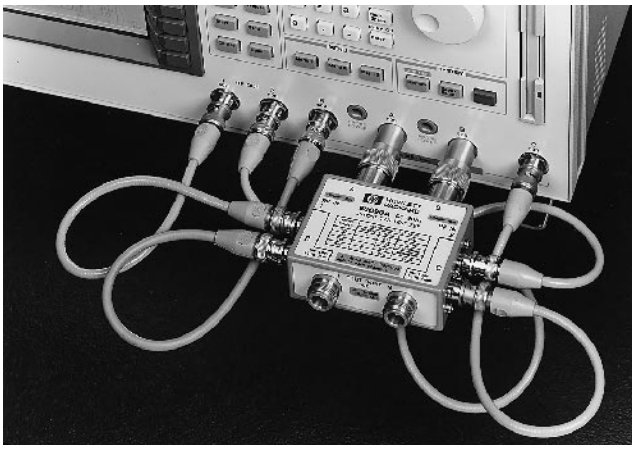
Note: Option 023 is for Options 100, 200, 300, 400 and 600 only. Option 023 cannot be ordered with Options 118, 218, 318 and 618.
- **Opt 823** Phase Tracking Function for 180MHz version

Note: Option 823 is for Options 118, 218, 318 and 618 only. Option 823 cannot be ordered with Options 100, 200, 300, 400 and 600.
- **Opt 1D5** High-stability Frequency Reference
- **Opt 005** Parallel I/O, mode A
- **Opt 006** Parallel I/O, mode B
- **Opt 007** Opto-isolated Parallel I/O

Note: 24-bit parallel I/O is furnished in standard. Select only one of Options 005, 006, 007, or choose none.
- **Opt UKR** Delete HP Instrument BASIC
- **Opt 1F0** Add IBASIC Keyboard
- **Opt UK6** Commercial Calibration Certificate with Test Data

HP E5090A 2-Port Transmission/Reflection Test Kit

The HP E5090A 2-port transmission/reflection test kit provides the capability to measure transmission and reflection characteristics of two port device in either direction with a single connection. The HP E5090A is test set for the HP E5100A with Options 003, 010, 302, and 400. The frequency range of the HP E5090A is dc to 2 GHz.



HP E5100B Network Analyzer
- **Opt 100** 1 Receiver, Port A
- **Opt 200** 2 Receivers, Ports R and A

Note: Must choose either Option 100 or 200.
- **Opt 001** Single RF OUT port
- **Opt 002** Dual RF OUT ports, built-in power splitter

Note: Must choose either Option 001 or 002.
- **Opt 010** Extended output power range, –48 to +22 dBm
- **Opt 022** Evaporation Monitoring Function
- **Opt 101** 50 Ω/1 MΩ selectable input, Port A
- **Opt 102** Type-N input connector, Port A
- **Opt 1D5** High-Stability Frequency Reference
- **Opt 005** Parallel I/O mode A
- **Opt 006** Parallel I/O mode B
- **Opt 007** Opto-isolated Parallel I/O

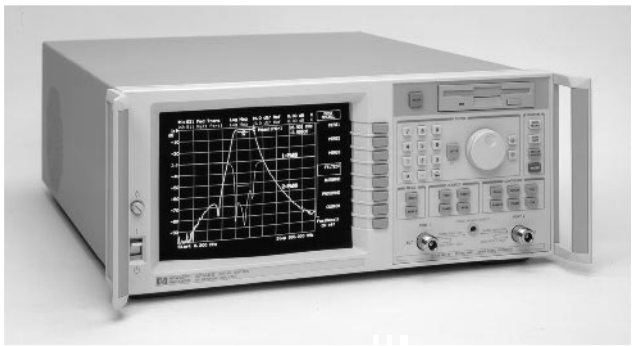
Note: 24-bit parallel I/O is furnished, select only one of Options 005, 006, 007, or choose none.
- **Opt UKR** Delete HP Instrument BASIC
- **Opt 1F0** Add DIN Keyboard
- **Opt UK6** Commercial Calibration Certificate with Test Data

Accessories
HP 41800A Active Probe
HP 41802A 1-MΩ Input Adapter
HP 41900A PI-Network Test Fixture
- **Opt 001** Adapter Kit for Load Capacitor

HP 41901A SMD PI-Network Test Fixture
- **Opt 010** to **060** Attachment Kit

HP E5090A 2-Port Transmission/Reflection Test Kit
HP 11850C 50 Ω Three-Way Power Splitter

- 300 kHz to 1.3 GHz (HP 8712ET/ES) or 3 GHz (HP 8714ET/ES)
- S-parameter measurements (ES models)
- Up to 100 dB dynamic range
- Narrowband and broadband detection
- Real-time sweep speeds
- 50 Ω or 75 Ω system impedance
- 1 Hz resolution synthesized source
- Standard LAN interface
- Standard GP Instrument BASIC (IBASIC)
- Optional fault-location and SRL measurements
- Standard multiport test sets available



HP 8712E RF Network Analyzer Family

HP 8712E RF Network Analyzer Family

Designed for Manufacturing

The HP 8712E family of economical RF network analyzers provide speed, accuracy and automation features in compact, integrated instruments for high-volume RF component manufacturing. These analyzers help reduce tune and test times, increase throughput, and lower your overall cost per component. A choice of transmission/reflection analyzers (ET models) or S-parameter analyzers (ES models) allow you to choose the the optimum level of performance versus price to meet your measurement needs.

Standard Family Features

The HP8712ET and HP 8714ET feature built-in transmission/reflection test sets with a full range of magnitude and phase measurements. These analyzers also employ advanced vector-error correction techniques to enhance measurement accuracy.

The HP 8712ES and HP 8714ES feature S-parameter test sets with full two-port vector-error correction, providing the highest level of measurement accuracy.

All these analyzers provide fast, complete swept-frequency and swept-power characterizarion of RF components. In addition:

- 300 kHz to 1.3 or 3 GHz models are available in both 50 Ω or 75 Ω options
- A synthesized source provides fast, stable, high-resolution (1 Hz) stimulus for accurate measurements on a variety of RF components
- Power sweeps enable testing of amplifier gain compression and AM-PM conversion.
- A 60 dB step attenuator (standard on ES models, optional on ET models) provides a wide range of output power levels for testing active devices
- Real-time sweep speeds with better than 10 updates per second facilitate high device throughput and increase tuning efficiency
- A built-in 3.5-inch DOS-format disk drive provides unlimited data storage
- Serial, parallel, LAN and GPIB interfaces make it easy to print or plot data to all printers and plotters

Flexible, sensitive receivers offer a choice between narrowband and broadband detection. Broadband detection allows scalar characterization of frequency-translating devices, while narrowband detection provides up to 100 dB of dynamic range for vector measurements of high-rejection devices.

The instruments are equipped with a large, 9-inch monochrome display for clear view of measurement data, softkey functions, IBASIC programs, and markers. Display pass/fail indicators and trace data in color by connecting any VGA-compatible monitor. Two independent measurement channels let you display transmission and reflection data simultaneously. Each channel can have independent measurement parameters such as frequency range, IF bandwidth, number of points, and display formats. Display formats include SWR, linear and log magnitude, phase and group delay, Smith chart, polar, real and imaginary, dBW, dBm, dBµW, dBV, dBmV, and dBµV.

Manufacturing Features

A network connection provides an efficient and reliable way to communicate with your test systems. The standard TCP/IP-compliant Ethertwist LAN interface makes connecting to a factory-wide network easy. Use a variety of standard protocols, such as ftp, http, bootp, telnet, sockets, and network file system (NFS) to simultaneously distribute new test programs, test parameters, limit lines, and custom interfaces to all of the instruments on your production lines. With LAN capability, data can be directly imported into your PC applications, such as Microsoft Word and Excel, or sent to a networked printer. You can also remotely troubleshoot test station problems from anywhere on the network by using any standard web browser.

With Instrument BASIC programming language (IBASIC), you can easily create custom test applications and user interfaces that include:

- Special softkey labels, graphical setup diagrams, and tailored user prompts
- Bar-code-reading capability for efficient tracking and documentation of individual device performance
- Control other test instruments via the LAN, GPIB, serial, or parallel interfaces
- For simpler applications, even those without programming expertise can use IBASIC as a keystroke recorder, to easily automate manual measurements.

Many manufacturing tests can be accomplished by merely recalling the appropriate instrument state, eliminating the need to change measurement parameters manually. Hundreds of instrument states can be programmed for a variety of uses. With HP's "fast-recall" feature, one of seven instrument states can be quickly recalled with a single softkey, or with a footswitch for hands-free switching during aligning or assembly operations.

Instrument states can include user-defined limit lines which let you easily and consistently compare measured data to test limits, providing automated pass/fail testing. The pass/fail results are displayed clearly on the instrument screen or external monitor to minimize operator errors or misinterpretation. Automated pass/fail testing eliminates the guesswork from your test processes and helps ensure that your components are aligned and tested to the same specifications at all test stations.

Speed up component test times by using the power of built-in data markers. Use the eight markers per channel to display data in absolute or relative terms. Or, perform automatic, real-time calculations of device characteristics such as maximum/minimum, center frequency, mean and standard deviation, peak-to-peak excursion, gain, slope and flatness, and filter 3-dB bandwidth, loss, and Q.

Comprehensive, Fast Cable Test

Option 100 adds fault-location and structural-return-loss (SRL) measurement capability for characterizing 50 Ω or 75 Ω cables that are still on a spool in a warehouse, or already installed on a cellular tower.

HP's fault-location option is easy to use and has many advantages over traditional time-domain reflectometry (TDR) techniques. You can also use the option to easily characterize the loss and velocity factors of your cables, and to accurately check the effect of cable damage by measuring SRL. Option 101 combines Option 100 with a rugged transport case to protect your instrument in the field during transport and operation.

HP 8712ET
HP 8712ES
HP 8714ET
HP 8714ES
HP 87050E
HP 87075C

NEW

HP 87050E Option 12 and HP 8714ES

HP 87050E and HP 87075C Multiport Test Sets

The HP 87050E (50 ohm) and the HP 87075C (75 ohm) multiport test sets are designed to work with the HP 8712E family of RF vector network analyzers to provide complete multiport measurement systems. The HP 87050E has specified performance from 3 MHz to 2.2 GHz, with typical performance to 3 GHz. The 50 ohm test set is offered in 4, 8 and 12-port options. The HP 87075C has a frequency range of 3 MHz to 1.3 GHz and is offered in 6 and 12-port options.

These systems dramatically increase measurement throughput by minimizing RF connections. Connect your device one time to measure all signal paths and ports. Reduce operator fatigue, misconnection rates, and the wear on cables, fixtures, and connectors as well. In addition, the HP 8712E family of network analyzers provide many productivity features that speed tune and test times, increase throughput, and simplify automation.

An HP 87050E or an HP 87075C coupled with an HP 8712E series network analyzer is the only low-cost, multiport test system with fully specified performance at the actual test ports, whether you measure in a fixture or at the end of test cables. Specified performances means you get the same measurement results on any test station, reduce measurement uncertainty to tighten your product specifications, and increase customer confidence in your products.

Innovative new calibration techniques save time and increase accuracy

Test Set Cal is an advanced calibration technique that eliminates the redundant connection of standards during a system calibration. Calibrating a multiport test set using two-port error correction and a traditional network analyzer requires a unique instrument state for each measurement path, forcing many redundant connections of calibration standards. As the number of ports increases, so does the number of connections required to calibrate all possible measurement paths. Full calibration of the HP 87050E and HP 87075C multiport test systems is quick and simple when performing a Test Set Cal:

- Connect short, open, and load standards only once to each measurement port
- Minimize the number of through standards required during calibration

In between Test Set Cals, the system can quickly re-calibrate itself by using SelfCal. SelfCal is an internally automated calibration technique that uses solid-state switches to measure calibration standards located inside the test set. The network analyzer's firmware automatically controls the SelfCal process at an interval you define. SelfCal re-calibrates your multiport system to the same measurement accuracy achieved immediately after performing a Test Set Cal, thus reducing the effects of test-system drift and improving overall measurement accuracy between Test Set Cals. Using Test Set Cal and SelfCal, you can:

- Easily reduce your overall calibration times by a factor of twenty or more
- Increase the amount of time a test station can be used for measuring devices — typically, by three days per month!

Key Literature

HP 8712ET/ES and 8714ET/ES Brochure, p/n 5967-6316E
HP 8712ET/ES and 8714ET/ES Technical Specifications, p/n 5967-6314E
HP 8712ET/ES and 8714ET/ES Configuration Guide, p/n 5967-6315E
HP 87050E Brochure, p/n 5968-4763E
HP 87050E Technical Specifications, p/n 5968-4764E
HP 87050E Configuration Guide, p/n 5968-4765E
HP 87075C Brochure, p/n 5968-4766E
HP 87075C Technical Specifications, p/n 5968-4767E
HP 87075C Configuration Guide, p/n 5968-4768E

For more information, visit our web site: **http://www.hp.com/go/ena**

Calibration Kits

Accuracy enhancement removes systematic errors by measuring know devices (standards) over the frequency range of interest. Kits for the HP 8712E family contain standards to characterize these errors.

HP 85032 50 Ω Type-N Family

The HP 85032B 50 Ω type-N calibration kit contains male and female open circuit, short circuit, and fixed termination standards. Order Option 001 to delete the 7-mm to type-N adapters. The HP 85032E is a more economical version of this kit which contains only male standards.

HP 85033D Option 002 3.5mm Calibration Kit

The HP 85033D Option 002 50 Ω 3.5-mm calibration kit contains male and female open circuit, short circuit, and fixed termination standards. The HP 85033D Option 002 also contains four type-N to 3.5 mm adapters.

HP 85038 7-16 Family

The HP 85038A 7-16 calibration kit contains male and female open circuit, short circuit, and fixed termination standards. More economical versions of this kit are available: the HP 85038M contains only male standards, and the HP 85038F provides only female standards. Each kit contains a floppy disk with the calibration kit definition for use with the HP 8712, 8714, 8753, 8719, 8720, 8722, and 8510C network analyzers. The HP 11906B 7-16 to 50 Ω type-N adapter kit is recommended.

HP 85036 75 Ω Type-N Family

The HP 85036B 75 Ω type-N calibration kit contains both male and female open circuit, short circuit, and fixed termination standards. The HP 85036E is a more economical version of this kit which contains only male standards.

HP 85039 Type-F Family

The HP 85039B 75 Ω type-F calibration kit contains both male and female open circuit, short circuit, and fixed termination standards. The following adapters are also included: type-F (f-f), type-F (m-m), type-N (f) to type-F (m), and type-N (m) to type-F (f). A complete male set of standards (fixed-load, open, short) and (m-m) adapter can be ordered as HP 85039B Option 00M, and a complete female set as HP 85039B Option 00F.

Additional type-F adapters available: type-F (m) to type-N (m) (85039-60010), type-F (m) to type-F (f) (85039-60012), and type-F (f) to type-N (f) (85039-60014).

Detectors and Bridges

External detectors (50 Ω and 75 Ω) are available for remote device measurements.

HP 86200B 50 Ω Scalar Detector

An external scalar detector for measuring 50 Ω devices.

HP 86201B 75 Ω Scalar Detector

An external scalar detector for measuring 75 Ω devices.

HP 86205A 50 Ω Bridge Detector

An external directional bridge that offers high directivity and excellent port match and is designed for 50 Ω device measurements.

HP 86207A 75 Ω Bridge Detector

An external directional bridge that offers high directivity and excellent port match and is designed for 75 Ω device measurements.

Upgrade Kits

The following upgrade kits add optional measurement capability to existing HP 8712E series RF network analyzers.

HP 8712ET, HP 8712ES, HP 8714ET and HP 8714ES Upgrade Kits

To order, add a "U" to the end of the model number of the instrument to be upgraded, and specify one or more of these options:

Option 1E1 50 Ω Step Attenuator

Provides the necessary components to retrofit an HP 8712ET or HP 8714ET with a 60 dB step attenuator (for 50 ohm models only).

Option UNE 75 Ω Step Attenuator

Provides the necessary components to retrofit an HP 8712ET or HP 8714ET with a 60 dB step attenuator (for 75 ohm models only).

Option 099 Firmware Upgrade

Upgrade to the latest version of firmware.

Option 100 Fault Location/SRL

Provides cable-measurement software. Does not include transport case.

Option 101 Transport and Operating Case and Fault Location/SRL

Combines transport and operation case with Option 100.

Test Port Cables

Replacement test port cables are available as HP part numbers. One economy cable is standard for the HP 8712E series analyzer.
HP 8120-6469 Economy Cable; type-N, 50 Ω (included)
HP 8120-4781 Precision Cable; type-N, 50 Ω
HP 8120-6468 Economy Cable; type-N, 75 Ω (included with Opt 1EC)
HP 8120-2408 Precision Cable; type-N, 75 Ω

Specifications Summary

Source Characteristics

Frequency Range
HP 8712ET/ES: 300 kHz to 1.3 GHz
HP 8714ET/ES: 300 kHz to 3 GHz
Frequency Resolution: 1 Hz
Frequency Accuracy: < 5ppm
Harmonics
< 1 MHz
HP 8712ET/ES: < -20 dBc
HP 8714ET/ES: < -30 dBc
>1 MHz: < - 30 dBc

	HP 8712ET	HP 8712ES	HP 8714ET	HP 8714ES
Source Power Range				
No attenuator, 50Ω				
< 1 GHz	0 to +16 dBm	–	–5 to +11 dBm	–
> 1 GHz	0 to +13 dBm	–	–5 to +10 dBm	–
No attenuator, 75 Ω	reduces output by 3 dB			
With attenuator, 50 Ω				
< 1 GHz	-60 to + 15 dBm	-60 to + 13 dBm	-60 to + 10 dBm	-60 to + 9 dBm
> 1 GHz	-60 to + 12 dBm	-60 to + 10 dBm	-60 to + 9 dBm	-60 to + 7 dBm
No attenuator, 75 Ω	reduces output by 3 dB			
Source Level Accuracy				
No attenuator, 50 Ω	± 1 dB			
No attenuator, 75 Ω	± 1.5 dB			
With attenuator, 50 Ω	± 2 dB			
With attenuator, 75 Ω	± 3 dB			

Receiver Characteristics

Minimum Frequency (all models)
Narrowband: 300 kHz
Broadband: 10 MHz
Maximum Frequency
HP 8712ET/ES: 1.3 GHz
HP 8714ET/ES: 3 GHz

	HP 8712ET	HP 8712ES	HP 8714ET	HP 8714ES
Dynamic Range				
Narrowband, 50 Ω	>115 dB	>108 dB	>115 dB	>109 dB
Broadband, 50 Ω	>66 dB	>54 dB	>66 dB	>54 dB
Maximum input (0.5 dB compression)				
Narrowband	+10 dBm	+10 dBm	+10 dBm	+10 dBm
Broadband	+16 dBm	+16 dBm	+16 dBm	+16 dBm
Input damage level	+20 dBm	+26 dBm	+20 dBm	+26 dBm

System Specifications (Type-N, 50 Ω)

	300 MHz to 1.3 GHz	1.3 GHz to 3 GHz
Directivity (corrected)	50 dB	47 dB
Source Match (corrected)	42 dB	36 dB
Load Match (corrected, ES models)	50 dB	47 dB
Load Match (uncorrected)	18 dB	15 dB

Cycle Time (201 points, 1-port response cal, wide bandwidth): 72 ms

Trace Transfer (201 points, real format): 20 ms

Physical Characteristics

Test-port Connectors: 50 Ω or 75 Ω type-N female
Size: 179 mm H x 425 mm W x 514 mm D (7.0 in. x 16.75 in x 20.25 in)
Weight
Net: 20.5 kg (45 lb)
Shipping: 27 kg (59 lb)

HP 8712ET
HP 8712ES
HP 8714ET
HP 8714ES
HP 87050E
HP 87075C

Ordering Information

HP 8712ET Network Analyzer
HP 8712ES Network Analyzer
HP 8714ET Network Analyzer
HP 8714ES Network Analyzer
- **Opt 1EC** 75 Ω Impedance
- **Opt 1E1** 60 dB Attenuator (ET models only)
- **Opt 1CL** DIN Keyboard
- **Opt 1CM** Rackmount Kit
- **Opt 100** Fault Location/SRL
- **Opt 101** Transport and Operating Case plus Fault Location/SRL
- **Opt AFN** 50 Ω Economy Cable
- **Opt AFP** 75 Ω Economy Cable
- **Opt B20** 50 Ω Precision Cable
- **Opt B21** 75 Ω Precision Cable

87050E Multiport Test Sets
- **Opt 004** 4 ports
- **Opt 008** 8 ports
- **Opt 012** 12 ports

87075C Multiport Test Sets
- **Opt 006** 6 ports
- **Opt 012** 12 ports

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Upgrades for ET and ES models (Add "U" to model number)
- **Opt 1E1** 50 Ω Step Attenuator (ET only)
- **Opt UNE** 75 Ω step attenuator (ET only
- **Opt 099** Firmware Upgrade Kit
- **Opt 100** FL/SRL Upgrade Kit
- **Opt 101** Transport Operating Case plus FL/SRL Upgrade Kit

Upgrades for C models
HP 86224B IBASIC Upgrade Kit
HP 86226C Firmware Upgrade Kit
HP 86227C LAN Upgrade Kit

Accessories
HP 85032E Type-N Calibration Kit, 50 Ω
HP 85036E Type-N Calibration Kit, 75Ω
HP 85032B Type-N Standard Calibration Kit, 50 Ω
- **Opt 001** Delete 7 mm to Type-N adapters

HP 85036B Type-N Standard Calibration Kit, 75 Ω
HP 85033D 3.5-mm Calibration Kit
- **Opt 002** Type-N to 3.5 mm adapter

HP 85038A 7-16 Standard Calibration Kit
HP 85038M 7-16 Male Standard Calibration Kit
HP 85038F 7-16 Female Standard Calibration Kit
HP 11906B 7-16 to Type-N Adapter Kit
HP 85039B 75 Ω Type-F Calibration Kit
- **Opt 00F** Female Standards Set
- **Opt 00F** Female Standards Set

HP 11853A Type-N Accessory Kit, 50 Ω
HP 11854A BNC Accessory Kit, 50 Ω
HP 11855A Type-N Accessory Kit, 75 Ω
HP 11856A BNC Accessory Kit, 75 Ω
HP 11853A Type-N Accessory Kit, 50 Ω
HP 86211A Type-F Accessory Kit, 75 Ω
HP 86200B 50 Ω Scalar Detector
HP 86201B 75 Ω Scalar Detector
HP 86205A 50 Ω Bridge
HP 86207A 75 Ω Bridge
HP 8120-1839 BNC Test Port Cable, 50 Ω
HP 5063-0061 BNC Test Port Cable, 75 Ω
HP 8120-6469 Economy Cable; Type-N, 50 Ω
HP 8120-6468 Economy Cable; Type-N, 75 Ω
HP 8120-4781 Precision Cable; Type-N, 50 Ω
HP 8120-2408 Precision Cable; Type-N, 75 Ω
HP 9211-2656 Transit Shipping Case

Channel Partners for Network-Analyzer Applications

Several HP Channel Partners provide measurement solutions that combine hardware and/or software with HP network analyzers. Please contact the following companies directly for more information about their products and services.

Antenna Test

Nearfield Systems offers a complete line of antenna-measurement solutions including measurement-automation software and antenna-positioning products.
Phone: (310) 518-4277
Fax: (310) 518-4279
Web: www.nearfield.com

Differential Measurements of Balanced Components

ATN Microwave's ATN-4000 series of multiport test systems provide differential measurements of three- or four-port, fully balanced or single-ended-to-balanced components, across the entire RF and microwave frequency range. They incorporate full four-port error correction to provide exceptional measurement accuracy. The test systems include a four-port test set, an HP 8753 or 8720 family network analyzer, and Windows-based software. For more information, please ask for HP literature number 5968-5480E or contact ATN Microwave directly.
Phone: (978) 667-4200 X16
Fax: (978) 667-8548
E-mail: sales@atn-microwave.com
Web: www.atn-microwave.com

On-Wafer Probing and Package/Interconnect Characterization

Cascade Microtech is the world leader in advanced microelectronic probing solutions. They offer a wide range of RF and microwave probes, probe stations, and software for on-wafer and module test, and for characterizing packages and interconnects.
Phone: (503) 601-1000
Toll free: 1-800-550-3279
Fax: (503) 601-1002
E-mail: sales@cmicro.com
Web: www.cascademicrotech.com

Test Fixtures and Device Handlers

Inter-Continental Microwave offers an extensive line of standard RF and microwave test fixtures and non-coaxial calibration standards. They also provide custom design services to satisfy unique customer requirements. ICM also designs and manufactures custom automatic-device-handling systems to maximize production throughput.
Phone: (408) 727-1596
Fax: (408) 727-0105
E-mail: icmfixture@aol.com
Web: www.icmicrowave.com

For HP's disclaimer regarding third-party products, please see page 37.

HP 8753ET
HP 8753ES

NEW

- 30 kHz to 3 or 6 GHz frequency range
- Integrated T/R or S-parameter test set
- Up to 110 dB dynamic range
- Fast measurement speeds and data-transfer rates
- Large LCD display with VGA output for external monitors
- Display up to four parameters at the same time
- Save/recall instrument states and data to built-in floppy-disk drive
- Optional time-domain and swept-harmonic measurements

The HP 8753ET and 8753ES RF network analyzers offer an unbeatable combination of speed, performance and ease-of-use to meet your measurement needs, whether in the R&D laboratory or on the production floor. With an integrated test set covering to 3 or 6 GHz, up to 110 dB of dynamic range, and both frequency and power sweeps, the HP 8753ET and 8753ES give you a powerful solution for characterizing the linear and nonlinear behavior of active and passive networks, devices, components and subsystems.

Family Features

Selecting the transmission/reflection analyzers (ET model) or S-parameter analyzers (ES model) allows you to choose the optimum level of performance versus cost for your application. The network analyzers feature two independent measurement channels that can measure and display up to four parameters simultaneously. You can choose to display any combination of reflection and transmission parameters, with magnitude, phase, group-delay, Smith-chart, polar, SWR, or time-domain formats. Easy-to-use softkeys let you access measurement functions quickly, and you can view results in overlay or split-screen format on the crisp, LCD color display using up to four graticules. A VGA-compatible output has been added to drive larger external monitors for enhanced viewing.

Test sequencing allows rapid, repeated execution of complex measurements with a single keystroke. In test-sequence mode, you make a measurement once from the front panel, and the analyzer stores the keystrokes so that the measurement can be repeated without any additional programming. You can also use a test sequence to control external devices through the parallel or GPIB port.

For measurements of mixers, tuners, and other frequency-translating devices, the frequency-offset mode allows the network analyzer source to be tuned independently from the receiver. Measurements of conversion loss, phase, group-delay, and mixer-tracking can easily be done, with either fixed or swept-IF testing.[1]

Power-meter calibration provides leveled absolute power to devices that are sensitive to absolute input or output levels. The HP 8753ET/ES automatically controls an HP 436A, 437B, 438A, E4418B or E4419B power meter to set the power anywhere in the test setup with power-meter accuracy, or to calibrate the network analyzer receivers for accurate absolute-power measurements.

Other productivity features include a built-in floppy-disk drive supporting LIF and DOS formats, non-volatile memory, serial and parallel interfaces, a DIN keyboard interface, and a real-time clock for time-stamping of printouts and files. Limit testing, arbitrary frequency testing, and marker-tracking functions are included. You can reduce measurement time by using swept-list mode to choose specific frequencies to test, and to set independent IF bandwidths and power levels in each frequency range. Segmented calibration and interpolated error correction allow you to apply vector-accuracy enhancement over a subset of the analyzer's calibrated frequency range. The HP 8753ET/ES code compatibility with the HP 8753D/E enables you to leverage your existing software.

With Option 010, you can view reflection or transmission responses in the time domain. The analyzer computes the inverse FFT of the frequency-domain data to display the reflection or transmission coefficient versus time. Two time-domain analysis modes enable you to view the step or impulse response of your device. Time gating can be used to remove unwanted responses such as connector mismatch, and the gated results can be displayed in either the time or frequency domains.

Combine an S-parameter network analyzer with the time domain capability to provide a simple, deterministic method for tuning cavity-resonator bandpass filters. Comparing the filter's reflection response in time-domain with the response of a properly tuned filter reveals which resonators or coupling adjustments need to be tuned. With time-domain filter tuning, you can easily train new personnel for this complex task and greatly simplify fine-tuning and troubleshooting procedures.

Powerful measurement solutions NEW

For more advanced characterization of devices, Option 002 adds harmonic-measurement capability. Swept second and third-harmonic levels of an amplifier can be displayed absolutely or in dBc relative to the fundamental. With the press of a button, you can measure harmonics down to -40 dBc.

A high-stability frequency reference, Option lD5, improves the frequency accuracy of measurements of high-Q devices such as SAW and crystal resonators or dielectric-resonance filters.

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ET Models

The HP 8753ET features a built-in 50-ohm transmission/reflection (T/R) test set providing a full range of magnitude and phase measurements. Frequency coverage is from 300 kHz to 3 or 6 Ghz. The T/R capability provides a very high level of accuracy and convenience in making forward measurements of the device under test. New enhanced response calibration corrects for the effects of source match in a transmission measurement. Option 004 extends the standard -20 to +5 dBm source power range to -85 to +10 dBm.

ES Models

The HP 8753ES features a built-in 50-ohm or 75-ohm S-parameter test set providing a full range of magnitude and phase measurements. Full two-port error correction capability provides the highest level of accuracy and the S-parameter test set provides the convenience of making both forward and reverse sweep measurements without reversing the device under test. For configuration flexibility, Option 011 deletes the built-in test set so that you can select your own. The HP 8753ES Option 011 works with the HP 85046A/B and 85047A S-parameter test sets, and other specialized test sets for specific applications. Option 014 provides a configurable test set for maximum flexibility. For convenient, accurate measurements in noncoaxial environments, TRL*/LRM* [2] calibration is available. Highly accurate measurements of non-insertable devices can also be achieved using the built-in adapter-removal calibration technique.

Key Literature

HP 8753ET/ES Network Analyzer Brochure, p/n 5968-5159E
HP 8753ET/ES Network Analyzer Technical Specifications, p/n 5968-5160E
HP 8753ET/ES Network Analyzer Configuration Guide, p/n 5968-5158E

For more information, visit our web site: **www.hp.com/go/8753.**

[1] phase measurements require reference mixer
[2] TRL* and LRM* are three-sampler implementations of the through-reflect-line and line-reflect-match calibration techniques.

Specifications Summary

Test Sets

HP 8753ET provides an integrated transmission/reflection test set with complete forward measurements in 50 ohm. HP 8753ES provides an integrated S-parameter test set with complete forward and reverse measurements in 50-ohm (standard) or 75-ohm (Option 075). External test sets supported with the HP 8753ES Option 011.

Test Port Output

Frequency Characteristics

HP 8753ET Range
300 kHz to 3 GHz (standard)
300 kHz to 6 GHz (Option 006)
HP 8753ES Range
30 kHz to 3 GHz (standard)
30 kHz to 6 GHz (Option 006)
300 kHz to 3 GHz (Option 011)
30 kHz to 6 GHz (Option 011 and 006)
Resolution: 1 Hz
Accuracy: ±10 ppm at 25° C ± 5° C

Output Characteristics

HP 8753ET Power Range: –20 to 5 dBm; –85 to 10 dBm (Option 004)
HP 8753ES Power Range: –85 to 10 dBm; –85 to 8 dBm (Option 075 or Option 014)
Resolution: 0.01 dB
Sweep Range: 25 dB
Level Accuracy: ±1.0 dB relative to 0 dBm output level
Level Linearity (typical 30 kHz to 300 kHz)
(–15 to +5 dBm): ±0.2 dB
(+5 to +10 dBm): ±0.5 dB
HP 8753ET Impedance: 50Ω
HP 8753ES Impedance: 50Ω (standard); 75Ω (Option 075)
Harmonics: (Option 002)
2nd Harmonic: <–25 dBc at +10 dBm (16 MHz to 3 GHz)
3rd Harmonic: <–25 dBc at +10 dBm (16 MHz to 2 GHz)
Nonharmonic Spurious: (typical)
Mixer-Related: <–30 dBc at +10 dBm

Test Port Input Characteristics

Frequency Characteristics
HP 8753ET Range
300 kHz to 3 GHz (standard)
300 kHz to 6 GHz (Option 006)
HP 8753ES Range
30 kHz to 3 GHz (standard)
30 kHz to 6 GHz (Option 006)
30 kHz to 3 GHz (Option 011)
30 kHz to 6 GHz (Option 011 and 006)
Average Noise Level
3 kHz BW: –82 dBm (<3 GHz), –77 dBm (3 to 6 GHz)
10 Hz BW: –102 dBm (<3 GHz), –97 dBm (3 to 6 GHz)
HP8753ET Maximum Input Level
Transmission: 0 dBm
Reflection: +10 dBm
HP 8753ET Damage Level: +20 dBm or 35 Vdc
HP 8753ET Impedance: 50Ω
HP 8753ES Maximum Input Level: +10 dBm
HP 8753ES Damage Level: +26 dBm or 35 Vdc
HP 8753ES Impedance: 50Ω (standard); 75Ω (Option 075)
Harmonics (Option 002)
2nd Harmonic: <–15 dBc at +8 dBm
3rd Harmonic: <–30 dBc at +8 dBm
Harmonic Measurement Accuracy (25 ± 5° C)
300 kHz to 3 GHz: ± 1.5 dB;
3 GHz to 6 GHz: ± 3 dB (with Option 006)
Harmonic Measurement Dynamic Range: (typical)
–40 dBc (output= –10 dBm, input < –15 dBm)

Group Delay Characteristics

Range: 1/(2 x minimum aperture)
Aperture: (selectable)
Maximum: 20% of frequency span
Minimum: (frequency span)/(no. of pts. –1)
Group Delay Accuracy (in seconds): ± (phase accuracy in degrees)/(360 x aperture in Hz)

Physical Characteristics

Size: 425 mm W x 222 mm H x 457 mm D (16.75 in x 8.75 in x 18 in)
Weight: 21 kg (46 lb) net; 35 kg (77 lb) shipping

Upgrade Kits for the HP 8753ET and 8753ES

Upgrade kits retrofit the latest operating system or add optional measurement capability to existing network analyzers. To order, add a "U" to the end of the model number of the instrument to be upgraded, and specify the desired option(s):

Option 002 Harmonic-Measurements Upgrade

This upgrade kit adds harmonic-measurement capability (Option 002) to an HP 8753ET or HP 8753ES network analyzer. This kit includes installation at an HP service center.

Option 004 Step Attenuator Upgrade

This upgrade kit adds a step attenuator to the HP 8753ET network analyzer. This enables the output power range to operate from -85 to +10 dBm instead of the standard -20 to +5 dBm. This kit includes installation at an HP Service Center.

Option 006 6 GHz Upgrade for Standard Units

This kit extends the operating frequency range of the standard HP 8753ET or HP 8753ES from 3 GHz to 6 GHz. Includes installation at an HP service center. Not compatible with HP 8753ES Option 075 or Option 011.

Option 611 6 GHz Upgrade for Option 011 Units

This kit extends the operating frequency range of the HP 8753ES Option 011 from 3 GHz to 6 GHz. Includes installation at an HP service center. Not compatible with Option 075.

Option 010 Time-Domain Upgrade

This upgrade kit adds time-domain-analysis capability (Option 010) to an existing HP 8753ET or HP 8753ES network analyzer. This kit is user-installable.

Option 099 Firmware Upgrade Kit

This kit provides the latest version of firmware for the HP 8753ET or HP 8753ES network analyzer. The kit is user-installable. This kit may be optionally downloaded from the HP 8753 network analyzer web page.

Option 1D5 High-Stability Frequency Reference Upgrade

This option adds a high-stability frequency reference (Option 1D5) to an HP 8753ET or HP 8753ES network analyzer. Includes installation at an HP service center.

HP 8753DU Option 000 Processor Upgrade

This upgrade kit replaces the CPU board in the HP 8753D Standard or Option 011 with the CPU board from the HP 8753E. This upgrade significantly improves the measurement and data-transfer speed of the HP 8753D. It does not provide the most current software functionality such as 4-parameter display capability.

External S-Parameter Test Sets

The S-parameter test sets provide the capability to measure reflection and transmission characteristics (including S-parameters) of two-port devices in either direction with a single connection. The test sets are controlled from the analyzer and include programmable step attenuators. These test sets are used with the HP 8753A/B/C or the HP 8753D/E/ES Option 011 only.

HP 85046A/B S-Parameter Test Sets

The HP 85046A/B test sets provide the capability to simultaneously measure the transmission and reflection characteristics of 50-ohm and 75-ohm devices, respectively.

Specifications Summary

	HP 85046A	HP 85046B
Impedance	50Ω	75Ω
Frequency Range	300 kHz to 3 GHz	300 kHz to 2 GHz
Directivity	35 dB to 1.3 GHz 30 dB to 3.0 GHz	35 dB to 1.3 GHz 30 dB to 2.0 GHz
Typical Tracking Transmission Magnitude, Phase [1,2,3]		
0.3 MHz to 2.0 MHz	±1.5 dB, ±20°	±1.5 dB, ±20°
2.0 MHz to Fmax	±1.5 dB, ±10°	±1.5 dB, ±10°
Reflection Magnitude, Phase [1,2,3]		
0.3 MHz to 2.0 MHz	±1.5 dB, ±25°	±1.5 dB, ±25°
2.0 MHz to Fmax	±1.5 dB, ±10°	±1.5 dB, ±10°
Effective Source Match[3] **(test ports)**		
0.3 MHz to 2.0 MHz	14 dB	14 dB
2.0 MHz to 1.3 GHz	20 dB	17 dB
2.0 MHz to Fmax	16 dB	16 dB
RF Connectors		
Test Ports	Precision 7 mm	75Ω type-N (female)
All Others	50Ω Type-N (female)	50Ω Type-N (female)

[1]Degrees, specified as deviation from linear phase.
[2]Fmax is the upper frequency limit of the associated test set.
[3]Can be improved through accuracy enhancement.

Includes: Four 190-mm (7.5 in) cables with Type-N (male) connectors for connection to the HP 8753. One HP 8753 test set interconnect cable.

Physical Characteristics
Size: 426 mm W x 90 mm H x 508 mm D (16.75 in x 3.5 in x 20 in)
Weight: Net, 6.8 kg (15 lb); shipping, 9.1 kg (20 lb)

HP 85047A S-Parameter Test Set

The HP 85047A test set includes a frequency doubler that can be switched in to measure 3 MHz to 6 GHz in a single sweep or switched out to measure 300 kHz to 3 GHz in a single sweep. The HP 8753B/C controls the frequency doubler. (The HP 8753D/E/ES Option 006 and 011 with built-in 6 GHz source does not use the frequency doubler,but is still compatible with the HP 85047A.) Option 006 (6 GHz receiver) is required to activate the HP 85047A.

Specifications Summary

Impedance: 50Ω
Frequency Ranges
300 kHz to 3 GHz and 3 MHz to 6 GHz (HP 8753B/C);
300 kHz to 6 GHz (HP 8753D/E/ES Option 006 and 011)
Directivity
300 kHz to 1.3 GHz: 35 dB;
1.3 GHz to 3 GHz: 30 dB
3 GHz to 6 GHz: 25 dB

Typical Tracking
Transmission Magnitude, Phase
300 kHz to 3 GHz: ±1.5 dB, ±10°;
3 GHz to 6 GHz: +0.5, – 2.5 dB, ±20°
Reflection Magnitude, Phase
00 kHz to 3 GHz: ±1.5 dB, ±10°;
3 GHz to 6 GHz: ±1.5 dB, ±20°

Effective Source Match
300 kHz to 1.3 GHz: 20 dB;
1.3 GHz to 3 GHz: 16 dB
3 GHz to 6 GHz: 14 dB

RF Connectors
Test Ports: Precision 7 mm
All Others: 50Ω Type-N (female)
Includes: Four 190 mm (7.5 in) cables with Type-N (male) connectors for connection to the HP 8753, one HP 8753 test set interconnect cable.

Physical Characteristics
Size: 426 mm W x 90 mm H x 508 mm D (16.75 in x 3.5 in x 20 in)
Weight: Net, 10 kg (22 lb); shipping, 15 kg (33 lb)

External Test Set Switching

Option 009 replaces the standard solid-state RF test port switch with a mechanical RF switch. HP 8753 system specifications for standard and Option 009 test sets are identical. Nominal insertion loss of the solid-state switch is less than 2 dB (at 3 GHz) or 3 dB (at 6 GHz), relative to a mechanical switch.

Special Test Sets

Special test sets are available to configure the HP 8753ES for specific applications. Some examples are listed below. Contact HP for details about these products or for information about additional special options for HP 8753 network analyzers.

Option H16 Low Noise Floor
Adds the ability to reverse the port 2 coupler to increase the forward dynamic range by about 13 dB.

Option H36 Duplexer Test Set
Adds a third test port to enable single-connection duplexer measurements. Does not provide Tx-to-Rx and Rx-to-Tx measurements.

Option H39 Three-Port Test Set
Adds a third test port and switching to provide all transmission and reflection measurements for three-port devices.

Option H68 Extended frequency range above 6 GHz
Allows characterization of components up to 6.8 GHz. Higher frequencies up to 8 GHz can be quoted upon request (may be ordered for HP 8753ET or HP 8753ES).

Option H85 High power test set
Adds access to signal paths to allow the addition of an external amplifier, high power attenuators or isolators for handling up to 20 watts of power at the test ports. Standard solid-state transfer switch is replaced by mechanical switch and internal attenuators are added.

Accessories

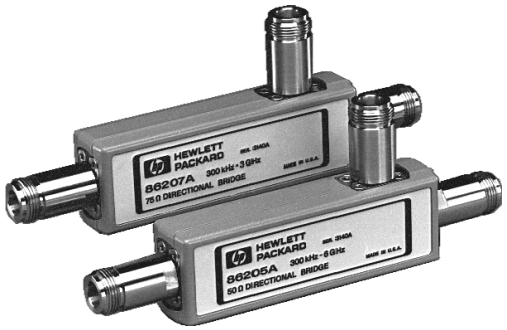
HP 11930A/B Power Limiters
The HP 11930A/B limiters protect the input circuits of network analyzers, spectrum analyzers and sources from transients and short-duration overloads.

Specifications Summary

	HP 11930A	HP 11930B
Frequency Range	DC to 6 GHz	5 MHz to 6.5 GHz
Input/output Connector	APC-7	Type-N
Insertion Loss	1.0 dB (dc to 3 GHz) 1.5 dB (3 to 6 GHz)	1.0 dB (16 MHz to 3 GHz) 1.5 dB (3 to 6.5 GHz)
Return Loss	22 dB (30 kHz to 3 GHz) 20 dB (3 to 6 GHz)	21 dB (16 MHz to 3 GHz) 17 dB (3 to 6.5 GHz)
Impedance	50-ohm nominal	50-ohm nominal

Fax-on-demand (24 hr) **1-800-800-5281** Internet URL **www.hp.com/go/tmc00** Product and order Information 8am-8pm EST **1-800-452-4844.**

HP 86205A/
86207A
HP 11850C/D
HP 11851B
HP 11852B
HP 85024A



HP 86205A/86207A

HP 86205A/86207A RF Bridges

The HP 86205A/86207A high directivity RF bridges offer unparalleled performance in a variety of general-purpose applications. They are ideal for accurate reflection measurements and signal leveling applications.

Specifications Summary

	HP 86205A	HP 86207A
Impedance	50Ω	75Ω
Frequency Range	300 kHz to 6 GHz	300 kHz to 3 GHz
Directivity	30 dB, 0.3 MHz to 5 MHz	30 dB, 0.3 MHz to 5 MHz
	40 dB, 5 MHz to 2 GHz 30 dB, 2 GHz to 3 GHz 20 dB, 3 GHz to 5 GHz (typ.) 16 dB, 5 GHz to 6 GHz (typ.)	40 dB, 5 MHz to 1.3 GHz 35 dB, 1.3 GHz to 2 GHz 30 dB, 2 GHz to 3 GHz
Coupling Factor	(< 3 GHz) 16.0 dB, + 0.15 dB/GHz (> 3 GHz) 16.5 dB, – 0.20 dB/GHz	
Insertion Loss	1.5 dB, + 0.1 dB/GHz	
Maximum Input	25 dBm	
RF Connectors	50Ω Type-N (female)	75Ω Type-N (female)

Physical Characteristics
Size: 93 mm H x 160 mm W x 23 mm D (3.7 in x 6.3 in x 1 in)
Weight: Net, 0.57 kg (1.3 lb); shipping, 1.8 kg (4 lb)

HP 11850C/D Three-Way Power Splitters

Specifications Summary

	HP 11850C	HP 11850D
Impedance	50Ω	75Ω
Frequency Range	DC to 3 GHz	DC to 2 GHz
Tracking	±0.25 dB, ±3°	±0.2 dB, ± 2.5°
Equivalent Source Match (ratio or leveling)	30 dB at 1.3 GHz 20 dB at 3 GHz	30 dB at 1.3 GHz 20 dB at 3 GHz
Nominal Insertion Loss	9.5 dB + 1 dB/GHz	7.8 dB
Input Port Match DC to 1.3 GHz 1.3 GHz to Fmax	 20 dB 10 dB	 20 dB 10 dB
RF Connectors RF Input: (female) All Others: (female)	 50 Ω Type-N 50Ω Type-N	 50Ω Type-N 75Ω Type-N

[1]Fmax is the upper frequency limit of the associated power splitter.

HP 11851B RF Cable Kit

This kit includes three 610-mm (24-in) 50 cables phase matched to 4° at 1.3 GHz and one cable 860 mm (34-in). Connectors are type-N (male).

HP 11852B 50 ohm/75 ohm Minimum Loss Pad

The HP 11852B is a low SWR minimum loss pad used to transform 50-ohm port impedance to 75-ohm or 75-ohm to 50-ohm.
Frequency Range: DC to 3.0 GHz
Insertion Loss: 5.7 dB
Return Loss: 75Ω: typically ≥ 30 dB, 50 Ω: typically ≥26 dB
Maximum Input Power: 250 mW (+24 dBm)
RF Connectors
50Ω type-N (f) and 75Ω type-N (m) standard,
50Ω type-N (m) and 75Ω type-N (f) Option 004

HP 85024A High-Frequency Probe

HP 85024A

The HP 85024A high-frequency probe makes it easy to perform in-circuit measurements. An input capacitance of only 0.7 pF shunted by 1 megaohm of resistance permits high-frequency probing without adversely loading the circuit-under-test. Excellent frequency response and unity gain guarantee high accuracy in swept measurements with this probe. High probe sensitivity and low distortion levels allow measurements to be made while taking advantage of the full dynamic range of HP RF analyzers.

RF network analyzers such as the HP 8753ET/ES, 8753E, 8752C, 8751A, 3577A, and 4195A are also directly compatible. You can use the HP 1122A probe power supply or any dual ± 15 V, 130 mA supply.

Specifications Summary

Input Capacitance (at 500 MHz): <0.7 pF (nominal)
Input Resistance: 1 MΩ (nominal)
Bandwidth: 300 kHz to 3 GHz (usable to 100 kHz)
Gain (at 500 MHz): 0 dB ±1 dB
Average Noise Level (10 Hz to 10 MHz): <1 mV
Frequency Response
±1 dB (300 kHz to 1 GHz)
+2, –3 dB (1 GHz to 3 GHz)
Input Voltage for 1 dB Compression: 0.3 V peak
Maximum Safe RF Voltage: 1.5 V peak (with 10:1 divider 15 V peak)
Noise Figure (nominal): <50 dB (<100 MHz); <25 dB (100 MHz to 3 GHz)
Distortion (at 0.3 V): <–30 dBc nominal
Includes: Type-N male adapter, 10:1 divider, spare probe tips, (5) 2.5 - inch ground leads, hook tip, spanner tip, and probe tip nut driver.

Type-N Accessory Kits

Each kit contains a type-N (female) short, a type-N (male) short, two type-N (male) barrels, two type-N (female) barrels, and a storage case.

HP 11853A 50-ohm Type-N Accessory Kit
Accessory kit furnishes components for measurement of devices with 50-ohm type-N connectors.

HP 11855A 75-ohm Type-N Accessory Kit
Accessory kit furnishes components for measurement of devices with 75-ohm type-N connectors. This kit also contains a 75-ohm type-N (male) termination.

BNC Accessory Kits

The BNC accessory kit contains two type-N (male) to BNC (female) adapters, two type-N (male) to BNC (male) adapters, two type-N (female) to BNC (female) adapters, two type-N (female) to BNC (male) adapters, a BNC (male) short, and a storage case.

HP 11854A 50-ohm BNC Accessory Kit
Accessory kit furnishes components for measurement of devices with 50-ohm BNC connectors.

HP 11856A 75-ohm BNC Accessory Kit
Accessory kit furnishes components for measurement of devices with 75-ohm BNC connectors. This kit also contains a 75 ohm BNC (male) termination.

7-16 Adapter Kits

The HP 11906 family adapter kits.

HP 11906A 7-16 to 7-16 Adapter Kit

Accessory kit contains:	quantity
7-16 male to male adapter	1
7-16 female to female adapter	1
7-16 male to female adapter	2

HP 11906B 7-16 to 50-ohm type-N Adapter Kit

Accessory kit contains:	quantity
Type-N male to 7-16 male adapter	1
Type-N female to 7-16 female adapter	1
Type-N female to 7-16 male adapter	1
Type-N male to 7-16 female adapter	1

HP 11906C 7-16 to 7-mm Adapter Kit

Accessory kit contains:	quantity
7-mm to 7-16 male adapter	2
7-mm to 7-16 female adapter	2

HP 11906D 7-16 to 3.5-mm Adapter Kit

Accessory kit contains:	quantity
3.5-mm male to 7-16 male adapter	1
3.5-mm female to 7-16 female adapter	1
3.5-mm female to 7-16 male adapter	1
3.5-mm male to 7-16 female adapter	1

Test Port Cables

HP 11857D 50-ohm APC-7 Test Port Cables
The HP 11857D includes two precision 61-cm (24-in) cables, phase matched to 2° at 1.3 GHz for use with the HP 8753D/E, 85046A or 85047A S-parameter test sets. Connectors are 50-ohm APC-7.

HP 11857B 75-ohm Type-N Test Port Cables
The HP 11857B includes two precision 61-cm (24-in) cables, phase matched to 2° at 1.3 GHz for use with the HP 8753D/E Option-075 or HP 85046B S-parameter test set. One cable has 75 type-N (male) connectors on both ends; the other has one type-N (male) and one type-N (female) connector.

Transit Cases

HP offers a complete line of sturdy transit cases that protect your instrument from shock, vibration, moisture, impact, and contamination, providing a secure enclosure for shipping. Model 9211-2657 fits the HP 8753ET/ES.

Calibration Kits

The calibration kits in the HP 8753 family contain precision standards used in accuracy enhancement procedures to characterize the systematic errors of an HP 8753 measurement system. Option 001 removes the 7-mm adapters included in certain kits, which are not necessary for use with an HP 8753ET.

HP 85031B 7-mm Calibration Kit
The HP 85031B calibration kit contains a set of precision 7-mm fixed terminations, and a one-piece open/short circuit used to calibrate the HP 8753 and its 50-ohm test sets for measurement of devices with precision 7-mm connectors. This kit is specified from 300 kHz to 6 GHz.

HP 85032B 50-ohm Type-N Calibration Kit
The HP 85032B calibration kit contains precision 50-ohm type-N Standards. Precision phase-matched 7-mm to 50-ohm type-N adapters are included for accurate measurements of non-insertable devices. Standards include fixed terminations, open circuits, and short circuits in both sexes. This kit is specified from dc to 6 GHz. Option 001 removes the precision phase-matched 7 mm to type-N adapters.

HP 85032E 50-ohm Type-N Economy Calibration Kit
The HP 85032E calibration kit contains a type-N (m) fixed termination and a one-piece type-N (m) open/short circuit. This kit is specified from dc to 6 GHz.

HP 85033D 3.5-mm Calibration Kit
The HP 85033D calibration kit contains fixed loads and open and short circuits in both sexes to calibrate the HP 8753 and 50-ohm test sets for measurement of devices with precision 3.5-mm and SMA connectors. Phase-matched 7-mm to 3.5-mm adapters for male and female connectors are included for use with 7-mm test port cables. This kit is specified from dc to 6 GHz. Option 001 removes the precision phase-matched 7 mm to 3.5 mm adapters.

HP 85036B 75-ohm Type-N Calibration Kit
The HP 85036B calibration kit contains precision 75-ohm type-N standards used to calibrate the HP 8753 and its 75-ohm test sets for measurement of devices with 75 type-N connectors. Standards include fixed terminations, open circuits, and short circuits in both sexes. Precision phase-matched adapters are included for accurate measurements of non-insertable devices. This kit is specified from dc to 3 GHz.

HP 85039B Type-F Calibration Kit
The HP 85039B contains 75-ohm type-F calibration standards, both male and female, to calibrate the HP 8753 for measurements of common broadband and CATV components. Standards include a fixed load, open circuit, and short circuit. The following adapters are also included: type-F (f-f), type-F (m-m), type-N (f) to type-F (m) and type-N (m) to type-F (f). A male set of standards (fixed load, open, short) and (m-m) adapter can be ordered as HP 85039B Option 00M and a female set as HP 85039B Option 00F.

Additional type-F adapters available: type-F (m) to type-N (m) (85039-60010), type-F (m) to type-F (f) (85039-60012), and type-F (f) to type-N (f) (85039-60014).

HP 85038A 50-ohm 7-16 Calibration Kit
The HP 85038A calibration kit contains precision 50-ohm 7-16 standards used to calibrate the HP 8753 for measurement of devices with 7-16 connectors. Standards include fixed terminations, open circuits, and short circuits in both sexes. Adapters are no included with the HP 85038A. This kit is specified from dc to 7.5 GHz, the HP 11906 series adapter kits are available for 7-16 to 50 Ohm type-N, 7-16 to 7 mm, and 7-16 to 3.5-mm. An economy kit containing only the female standards can be ordered as HP 85038F, and a kit with the male standards can be ordered as HP 85038M.

HP 85090 Series Electronic Calibration System

Electronic calibration (ECal) replaces the usual calibration kit standards with a solid-state calibration module. The module is controlled by PC software to present different impedances to the test ports. A full two-port calibration can be done with a single connection in just a few minutes, with less chance for error and less wear on connectors.

An ECal system requires an external PC (not supplied), an HP 85097A PC interface kit and one of these calibration modules: HP 85091A 7-mm, HP 85092A 50Ω type-N, HP 85093A 3.5-mm, HP 85096A 75Ω type-N, HP 85098A 7-16, or HP 85099A type-F. These modules may be configured with male and female ports, 2 male ports, or 2 female ports (except for HP 85091A).. The HP 85097A includes software for Windows 95 and NT 4.0 systems, and it is compatible with the HP 8753C/D/E/ES.

Verification Kits

Measuring known devices, other than the calibration standards, is a convenient way of verifying that the HP 8753 measurement system is operating properly.

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HP 85029B 7-mm Verification Kit

The HP 85029B verification kit contains a set of precision 7-mm devices, with data traceable to NIST, used to verify the calibrated performance of an HP 8753A/B/C/D/E/ES measurement system. The devices have precision 7-mm connectors and include a 20-dB pad, a 50-dB pad, and a mismatch attenuator. The verification process requires only an HP 85031B calibration kit and an HP 85029B verification kit. Option 001 is intended solely for use with the HP 8702B lightwave component analyzer. Option 001 adds verification data that is compatible with the HP 8702B.

Ordering Information

HP 8753 ET Network Analyzer, 300 kHz to 3 GHz 50Ω Type-N test ports.
- **Opt 002** Harmonic Measurement Capability
- **Opt 004** Built-in Step Attenuator
- **Opt 006** 6 GHz Frequency Extension
- **Opt 010** Time-Domain Capability
- **Opt 1D5** High-Stability Frequency Reference

HP 8753ES Network Analyzer, 30 kHz to 3 GHz 50Ω 7-mm test ports.
- **Opt 002** Harmonic Measurement Capability
- **Opt 006** 6 GHz Frequency Extension
- **Opt 010** Time-Domain Capability
- **Opt 011** Delete Built-in Test Set
- **Opt 014** Configurable Test Set
- **Opt 075** 75Ω Impedance
- **Opt 1D5** High-Stability Frequency Reference

HP 85047A 50Ω S-Parameter Test Set, 6 GHz
- **Opt 009** Mechanical Test Port Switch
- **Opt 913** Rackmount Kit (5062-4069)

HP 85046A 50Ω S-Parameter Test Set, 3 GHz
- **Opt 009** Mechanical Test Port Switch
- **Opt 913** Rackmount Kit (5062-4069)

HP 85046B 75Ω S-Parameter Test Set—300 kHz–2 GHz
- **Opt 009** Mechanical Test Port Switch
- **Opt 913** Rackmount Kit (5062-4069)

HP 85029B Precision 7-mm Verification Kit
- **Opt 001** Data for HP 8702B

HP 85031B Precision 7-mm Calibration Kit
HP 85032B 50Ω Type-N Calibration Kit
- **Opt 001** Deletes 7 mm to Type-N Adapters

HP 85032E 50Ω Type-N Economy Calibration Kit
HP 85033D 3.5-mm Calibration Kit
- **Opt 001** Deletes 7-mm to 3.5-mm Adapters
- **Opt 002** Replaces 7-mm with Type-N Adapters

HP 85036B 75Ω Type-N Calibration Kit
HP 85038A 50Ω 7-16 Calibration Kit
HP 85038F 50Ω 7-16 Calibration Kit
HP 85038M 50Ω 7-16 Calibration Kit
HP 85039B Type-F Calibration Kit
- **Opt 00F** Female standards only
- **Opt 00M** Male standards only

HP 85091A 7-mm Electronic Calibration Module
HP 85092A Type-N Electronic Calibration Module
HP 85093A 3.5-mm Electronic Calibration Module
HP 85096A 75Ω Type-N Electronic Calibration Module
HP 85097A ECal PC Interface Kit
HP 85098A 7-16 Type-N Electronic Calibration Module
HP 85099A Type-F Electronic Calibration Module
HP 86205A 50Ω Bridge
HP 86207A 75Ω Bridge
HP 11850C 50Ω Power Splitter
HP 11850D 75Ω Power Splitter
HP 11851B 50Ω /Type-N RF Cable Kit
HP 11852B50Ω /75Ω Minimum Loss Pad
HP 11853A 50Ω Type-N Accessory Kit
HP 11854A 50Ω BNC Accessory Kit
HP 11855A 75Ω Type-N Accessory Kit
HP 11856A 75Ω BNC Accessory Kit
HP 11857B 75Ω Type-N Test Port Extension Cables
HP 11857D 50Ω APC-7 Test Port Extension Cables
HP 11906A 50Ω 7-16 Accessory Kit
HP 11906B 50Ω 7-16 Accessory Kit
HP 11906C 50Ω 7-16 Accessory Kit
HP 11906D 50Ω 7-16 Accessory Kit
HP 11930A RF Limiter, APC-7
HP 11930B RF Limiter, Type-N
HP 8753ET Upgrade Kits
- **Opt 002** Harmonic Measurements Upgrade
- **Opt 004** Step Attenuator Upgrade
- **Opt 006** 6 GHz Upgrade for Standard Units
- **Opt 010** Time-Domain Upgrade
- **Opt 099** Firmware Upgrade Kit
- **Opt 1D5** High-Stability Frequency Reference Upgrade

HP 8753ES Upgrade Kits
- **Opt 002** Harmonic Measurements Upgrade
- **Opt 006** 6 GHz Upgrade for Standard Units
- **Opt 010** Time-Domain Upgrade
- **Opt 099** Firmware Upgrade Kit
- **Opt 1D5** High-Stability Frequency Reference Upgrade
- **Opt 611** 6 GHz Upgrade for Option 011 Units

HP 8753DU Option 000 Processor Upgrade

Indicates QuickShip availability.

For more information on compatible printers, visit our web site: **www.hp.com/go/pcg**

Fax-on-demand (24 hr) **1-800-800-5281** Internet URL **www.hp.com/go/tmc00 Product** and order Information 8am-8pm EST **1-800-452-4844**

HP 8719ET
HP 8720ET
HP 8722ET
HP 8719ES
HP 8720ES
HP 8722ES

NEW

5

HP 8720E Family Microwave Network Analyzers

GPIB NEW

- 50 MHz to 13.5, 20, or 40 GHz frequency coverage
- Choice of transmission/reflection or S-parameter test sets
- Fast measurement speeds and data-transfer rates
- Display up to four parameters at the same time
- Up to 105 dB dynamic range
- Optional time domain, frequency offset, and high power measurements

HP 8720E Family of Network Analyzers

The HP 8720E family features six vector network analyzers to meet your measurement needs. The new HP 8719ET, 8720ET, and 8722ET models offer economical transmission/reflection test sets, while the HP 8719ES, 8720ES, and 8722ES models offer S-parameter test sets and a wide selection of configurations for your applications. The ET models provide transmission and reflection measurements in the forward direction at an affordable price. The ES models provide both forward and reverse measurements and full two-port calibration for the best measurement accuracy.

Both ET and ES models combine a fast, synthesized source with an integrated test set covering frequencies from 50 MHz to 13.5, 20, or 40 GHz. Compact, economical, and easy to use, the HP 8720E family provides accurate and fast testing of microwave linear and nonlinear devices. These instruments are excellent tools for improving your designs in R&D or maximizing your measurement throughput in manufacturing.

ET Models

The HP 8719ET, 8720ET, and 8722ET feature a built-in transmission/reflection test set for a full range of magnitude and phase measurements in the forward direction. Built-in vector accuracy enhancement techniques include one-port, response, and enhanced response calibrations. Enhanced response calibration improves the accuracy of transmission measurements by correcting for source match effects, which a regular response calibration cannot do. The optional 55-dB step attenuator provides a wider range of output power levels for testing active devices.

ES Models

The HP 8719ES, 8720ES, and 8722ES feature solid-state switching S-parameter test sets with full two-port error correction. The ES models contain a 55-dB step attenuator as a standard feature for wide output power range. Enhanced response calibration provides improved accuracy for transmission measurements by correcting for source match without the speed penalty of a full two-port calibration. Adapter-removal calibration provides greater accuracy for measurements of non-insertable devices, such as devices with the same sex connectors on both ports or different connector types on ports 1 and 2. Electronic calibration (ECal) provides fast and simple calibration with a single connection, using the HP 85097A ECal PC Interface Kit and Windows-compatible software, with the appropriate HP 85060 series calibration modules.

Affordable Analyzers with Outstanding Performance

The HP 8720 analyzers have a fast source that is fully synthesized, in either swept or stepped modes, with stability and accuracy within 10 ppm (typical). Frequency resolution is 1 Hz standard for accurate measurements of narrowband or long-delay devices. The tuned receivers with variable bandwidth IF filters provide up to 105 dB of dynamic range.

Two independent channels can measure and display up to four S-parameters simultaneously. Reflection and transmission measurements can be displayed in a variety of formats, including magnitude, phase, group delay, SWR, and Smith charts. The analyzer's display can be shown on a larger external monitor using the VGA-compatible display output.

Built-in vector accuracy enhancement provides excellent error-corrected accuracy in common coaxial connectors. A user kit supports user-defined standards, and allows calibration in waveguide (including effects of dispersion).

Time Domain for Fault Location and Filter Tuning

Time domain capability (Option 010) computes and displays the response versus time or distance (instead of frequency) of the device under test. Use time domain to locate and quantify individual faults or mismatches in your device, fixture, or cable. Apply the gating feature to remove the effects of unwanted reflections (separated in time), then view the device's true response versus frequency.

Combine an S-parameter network analyzer with time domain capability to provide a simple, deterministic method for tuning cavity-resonator bandpass filters. Comparing the filter's reflection response in time-domain with the response of a properly tuned filter reveals which resonators or coupling adjustments need to be tuned. With time-domain filter tuning, you can easily train new personnel for this complex task and greatly simplify fine-tuning and troubleshooting procedures.

Powerful Features for Active Devices

The HP 8720E family has plenty of power for testing amplifiers. Option 007 (ES models only) provides 5 dB more output power by replacing the solid-state transfer switch with a mechanical switch (although Option 007 does not provide continuous updating of all four S-parameters). For sensitive small-signal devices, the built-in step attenuator can reduce power to –65 or –70 dBm (Option 004 adds the step attenuator on ET models). Absolute power levels can be set accurately anywhere in the system, using the power meter calibration feature. Power-sweep capability and 0.01 dB power resolution make it easy to test the gain-compression characteristics of active components. The power level during retrace is controllable for safe testing of AGC amplifiers.

In-Fixture and On-Wafer Device Characterization (ES models only)

Use TRL*/LRM* calibration to minimize fixture errors for measuring non-coaxial devices such as microstrip. For even better accuracy, Option 400 adds a fourth sampler and full TRL/LRM calibration. Electronic port extensions and gating are also available to enhance accuracy.

Productivity Features

Swept-list mode reduces measurement time by allowing you to choose the frequencies you want to test, and to set independent IF bandwidths and power levels in each frequency range. Fast two-port tuning mode speeds up 12-term error correction by allowing the user to specify the number of forward sweeps to take before updating the reverse sweep.

Automate repeated measurements with test sequencing. Create test sequences with keystroke recording, then repeat the measurements with a single keystroke. No programming expertise is needed. You can also use test sequencing to control external devices such as part handlers through the parallel port.

Additional productivity features include limit testing for consistent pass/fail results, up to 5 markers per channel, serial and parallel interfaces for connecting to printers, 2 MB of internal non-volatile memory for storing up to 31 test configurations, and S2P-compatible data files for exchanging data with CAD programs such as HP EEsof's Touchstone, Libra, and Advanced Design System.

Programming code compatibility with the previous HP 8720D series of network analyzers allows you to protect and leverage your investment in test software.

Key Literature

HP 8720E Family Microwave Network Analyzers Brochure, p/n 5968-5161E
HP 8720E Family Microwave Network Analyzers Technical Specifications, p/n 5968-5163E
HP 8720E Family Microwave Network Analyzers Configuration Guide, p/n 5968-5162E

HP 8719ET
HP 8720ET
HP 8722ET
HP 8719ES
HP 8720ES
HP 8722ES

NEW

Flexible Configuration for Applications

Option 004 adds a 55-dB step attenuator to expand the output power range. (ET models only; step attenuator is included in all ES models)
Option 007 replaces the standard solid-state transfer switch with a mechanical switch to provide 5 dB more power at the test port, and 5 dB more dynamic range. The mechanical transfer switch does not provide continuous updating of all four S-parameters for full two-port calibration. (ES models only)
Option 010 adds time-domain capability, which allows fault location and gating of fixture responses. (ET and ES models)
Option 012 provides direct sampler access, enabling the user to eliminate coupler loss and increase sensitivity by 16 dB. Option 012 allows filter rejection measurements to greater than –120 dB and allows insertion of attenuation between coupler and sampler. By using separate transmit and receive antennae, Option 012 can improve signal-to-noise in free-space measurements. (ES models only)
Option 085 is a high-power S-parameter test set modification allowing device test up to +43 dBm (20 watts) input and output. It deletes the bias tees, replaces the solid-state switch with a mechanical switch, and adds internal attenuators. It also includes the direct sampler access provided by Option 012. (ES models only)
Option 089 offers a frequency offset mode for simple mixer conversion loss measurements without the need for a reference mixer. (ES models only)
Option 1D5 adds a high-stability frequency reference to improve measurement accuracy of narrowband or high-Q devices. (ET and ES models)
Option 400 adds a fourth sampler to the receiver and improves TRL calibration accuracy for in-fixture and on-wafer applications. Not compatible with Option 007 or 085. (ES models only)

Materials Measurements

Measure the dielectric properties of materials quickly and non-destructively with the HP 85070C dielectric probe kit (including software). For greater accuracy and flexibility, use the HP 85071C materials measurement software, for samples loaded into waveguide or coaxial fixtures, and for free space measurements.

Accessories

Configure a complete measurement system with test port cables, calibration kits, verification kits, and adapters. Waveguide calibration kits are available in X, P (Ku), K, and R (Ka) bands, covering 8.2 to 40 GHz. The HP 8720 family of network analyzers uses the same precision calibration standards, electronic calibration system, and rugged, flexible cables as the industry standard HP 8510.

Upgrade Kits for the HP 8720E Family

Options may be added to an HP 8720E family analyzer after initial purchase by ordering the instrument's model number followed by a "U" to indicate an upgrade, along with the option(s) you want to retrofit. See "Ordering Information" for available upgrade options.

Upgrading the HP 8720D Family

Customers with HP 8719D, 8720D, or 8722D analyzers can upgrade their analyzers to include the firmware features of the ES models with one of the following upgrades.

HP 8719DU, 8720DU, or 8722DU Option 099 Firmware Upgrade

Customers who have analyzers with firmware revision above 7.0 can order the latest firmware with this upgrade. The firmware can also be downloaded from HP's Web site. Go to **www.hp.com/go/8720.**

HP 8719DU, 8720DU, or 8722DU Option 000 Performance Upgrade

Customers who have analyzers with firmware revisions below 7.0 can install the updated CPU board to provide significant measurement and data-transfer speed improvements and the latest firmware features.

Specifications Summary

	HP 8719ET HP 8719ES	HP 8720ET HP 8720ES	HP 8722ET HP 8722ES
Minimum Frequency	50 MHz	50 MHz	50 MHz
Maximum Frequency	13.5 GHz	20 GHz	40 GHz
Frequency Resolution	1 Hz	1 Hz	1 Hz
Frequency Accuracy	10 ppm	10 ppm	10 ppm
Max. Source Power:			
ET models	+10 dBm	+10 dBm	0 dBm, < 20 GHz; –5 dBm, 20 to 40 GHz
ES models (std)	+5 dBm	+5 dBm	–5 dBm, < 20 GHz; –10 dBm, 20 to 40 GHz
ES models with Option 007	+10 dBm	+10 dBm	0 dBm, < 20 GHz; –5 dBm, 20 to 40 GHz
Min. Source Power:			
ET models (std)	–10 dBm	–10 dBm	–15 dBm
ET models with Option 004	–65 dBm	–65 dBm	–70 dBm
ES models (std)	–70 dBm	–70 dBm	–75 dBm
ES models with Option 007	–65 dBm	–65 dBm	–70 dBm
Power Resolution	0.01 dB	0.01 dB	0.01 dB
Power Flatness	± 2 dB	± 2 dB	± 3 dB
Power Sweep Range	20 dB	20 dB	15 dB to 20 GHz; 10 dB, 20-40 GHz
System Dynamic Range (>2 GHz)			
ET	104 dB (ET)	104 dB (ET)	84 to 97 dB (ET)
ES	100 dB (ES)	100 dB (ES)	80 to 93 dB (ES)
ES with Option 007	105 dB	105 dB	85 to 98 dB
Test Port Connector	3.5 mm	3.5 mm	2.4 mm

Data applies at 23° ± 3°C. See product literature for more complete specifications and for total measurement uncertainty after error correction.

Size: 222 mm H x 425 mm W x 457 mm D (8.75 in x 16.750 in x 18.00 in)
Weight: Net, 22.7 to 27.7 kg (50 to 60 lb); shipping, 31.8 to 36.7 kg (70 to 81 lb)

HP 8719ET
HP 8720ET
HP 8722ET
HP 8719ES
HP 8720ES
HP 8722ES

Ordering Information

HP 8719ET Network Analyzer, 50 MHz to 13.5 GHz
HP 8720ET Network Analyzer, 50 MHz to 20 GHz
HP 8722ET Network Analyzer, 50 MHz to 40 GHz
The following options apply to all three network analyzers:
- **Opt 004** Step Attenuator
- **Opt 010** Time Domain Capability
- **Opt 1D5** High-Stability Frequency Reference
- **Opt 1CM** Rackmount Kit
- **Opt 1CP** Rackmount and Handle Kit
- **Opt W01** Convert 3 yr. return to HP to 1 yr. on-site warranty

HP 8719ES Network Analyzer, 50 MHz to 13.5 GHz
HP 8720ES Network Analyzer, 50 MHz to 20 GHz
HP 8722ES Network Analyzer, 50 MHz to 40 GHz
The following options apply to all three network analyzers:
- **Opt 007** Mechanical Transfer Switch
- **Opt 010** Time Domain Capability
- **Opt 012** Direct Sampler Access
- **Opt 085** High-Power Test Set
- **Opt 089** Frequency Offset Mode
- **Opt 1D5** High-Stability Frequency Reference
- **Opt 400** Four-Sampler Test Set
- **Opt 1CM** Rackmount Kit
- **Opt 1CP** Rackmount and Handle Kit
- **Opt W01** Convert 3 yr. return to HP to 1 yr. on-site warranty

HP 85070C High-Temperature Dielectric Probe Kit
HP 85071C Materials Measurement Software
HP 9211-2657 Transit Case

Upgrades and Retrofit Kits

To add options to an HP 8720E family analyzer after initial purchase, order the analyzer's model number followed by a "U", with one of the following upgrade options. All upgrade/retrofit kits include installation at an HP service center or the factory.
The following upgrade options are available for the HP 8719ET, 8720ET, and 8722ET.
- **Opt 004** Add Step Attenuator
- **Opt 010** Add Time Domain Capability
- **Opt 1D5** Add High-Stability Frequency Reference

The following upgrade options are available for the HP 8719ES, 8720ES, and 8722ES.
- **Opt 007** Add Mechanical Transfer Switch
- **Opt 010** Add Time Domain Capability
- **Opt 012** Add Direct Sampler Access
- **Opt 085** Add High-Power Test Capability
- **Opt 089** Add Frequency Offset Mode
- **Opt 1D5** Add High-Stability Frequency Reference
- **Opt 489** Add Frequency Offset for Opt 400 Analyzers
- **Opt 589** Add Frequency Offset for Opt 085 Analyzers
- **Opt 400** Add Four-Sampler Test Set

The following upgrades are only available for the specified models. For HP 8719ET only:
- **Opt 020** Upgrades HP 8719ET to HP 8720ET
- **Opt 040** Upgrades HP 8719ET to HP 8722ET

For HP 8720ET only:
- **Opt 040** Upgrades HP 8720ET to HP 8722ET

For HP 8719ES only:
- **Opt 020** Upgrades HP 8719ES to HP 8720ES
- **Opt 040** Upgrades HP 8719ES to HP 8722ES

For HP 8720ES only:
- **Opt 040** Upgrades HP 8720ES to HP 8722ES

The following kits offer upgrades for older HP 8720 family network analyzers. Installation is not included.
HP 8719DU, 8720DU, or 8722DU Option 099
Firmware Upgrade
HP 8719DU, 8720DU, or 8722DU Option 000
Performance Upgrade

HP 8508A
HP 85081B
HP 85082A
HP 11570A

- RF voltage and phase measurements
- 100 kHz to 1 GHz high-impedance probe inputs
- 300 kHz to 2 GHz 50 Ω inputs

HP 8508A Vector Voltmeter

The HP8508A vector voltmeter is a fully-automatic tuned receiver that makes RF voltage and phase measurements easy. The narrowband measuring technique gives a dynamic range of over 90 dB and a sensitivity of 10 μV to trace even the smallest signal. The vector voltmeter also measures the difference between the two input channels with at least 0.1 degree resolution over a full +180 to –180 degree range, so it can be used for another complete set of measurements—such as electrical length, phase distortion, or impedance. The standard unit is supplied with the HP 85081B input module, which has two high-impedance probe inputs that operate from 100 kHz to 1 GHz. Its ability to store reference and use it in later measurements means individual circuit sections can be characterized and adjusted independently. Any CW source can be used as a stimulus—even a source that is part of the device being tested—so measurements can be made under normal operating conditions. To adapt the probe inputs for measurements in a 50 Ω environment, the HP 11570A accessory kit provides two HP 11536A probe tees, an HP 11549A power splitter, and two HP 908A 50 Ω terminations. Option 050 is supplied with the HP 85082A input module. Its 50 Ω inputs operate from 300 kHz to 2 GHz, and provide the accuracy and dynamic range to make measurements on active and passive components.

HP 8508A with HP 85081B High-Impedance Input Module Specifications

Frequency Range: 100 kHz to 1 GHz (300 kHz to 2 GHz[1])
Maximum Input: 2 V peak ac (+16 dBm[1]), ±50 Vdc
A- (ref) Channel Minimum: 10 mV (–47 dBm[1]), 100 kHz to 300 kHz 1mV (–47 dBm[1]), 300 kHz to 3 MHz 300 μV, 3 MHz to 1 GHz (–57 dBm, 3 MHz to 2 GHz[1])
B-Channel Noise Level: 10 μV (–87 dBm[1])
Input Crosstalk: >100 dB, 1 MHz to 500 MHz > 80 dB, 500 MHz to 1 GHz (>70 dB, 1 GHz to 2 GHz[1])

Magnitude Accuracy

Absolute Accuracy
(A,B 100 mV, 15° to 30°C)
+1/–1.5 dB, 100 kHz to 300 kHz
±.5 dB, 300 kHz to 1 MHz
±.3 dB, 1 MHz to 100 MHz
±.6 dB, 100 MHz to 300 MHz
±1 dB, 300 MHz to 1 GHz
(±1 dB, 300 MHz to 1.5 GHz[1])
(+1/–2 dB, 1.5 GHz to 2 GHz[1])

Ratio Accuracy
(A,B 100 mV, 15° to 30° C)
±1 dB, 100 kHz to 300 kHz
±.4 dB, 300 kHz to 1 MHz
±.2 dB, 1 MHz to 100 MHz
±.4 dB, 100 MHz to 300 MHz
±.6 dB, 300 MHz to 1 GHz
(±.6 dB, 300 MHz to 1.5 GHz[1])
(±1 dB, 1.5 GHz to 2 GHz[1])

Phase Accuracy (in degrees)
(A,B 100 mV, 15° to 30° C)
±4, 300 kHz to 1 MHz
±1, 1 MHz to 100 MHz
±4, 100 MHz to 300 MHz
±6, 300 MHz to 1 GHz
(±6, 300 MHz to 1.5 GHz[1])
(±12, 1.5 GHz to 2 GHz[1])

Search and Lock Time: Lockup (within one range): 40 ms, frequencies up to 3 MHz; 20 ms, frequencies greater than 3 MHz

General: HP 8508A only

Power: 100, 120, 220 or 240 V +5%/–10%, 48 to 440 Hz, 40 VA
Size: 425.5 mm W x 133 mm H x 473.3 mm D (16.75 in x 5.25 in x 18.65 in)
Option 001: 524.5 mm W x 158.8 mm H x 524.5 mm D (19.75 in x 6.25 in x 20.65 in)
Weight: net, 8.1 kg (18 lb); shipping, 11 kg (24 lb).
Option 001: net, 9.4 kg (21 lb); shipping 12.5 kg (28 lb).

HP 11570A Accessory Kit

50 Ω Tees: For monitoring signals on 50 Ω transmission line. Kit contains two 50 Ω tees, both with type-N female connectors.
50 Ω Power Splitter: All connectors type-N female
HP 908A 50 Ω Termination: For terminating 50 Ω coaxial systems in their characteristic impedance. Kit contains two 50 Ω terminations, both with type-N male connectors.
HP 11512A Short: Type-N male

Key Literature

Product Overview, p/n 5952-1750
Application Note: Vector Voltmeter Automatic Group Delay Measurements, p/n 5952-3522

Ordering Information

HP 8508A Vector Voltmeter (includes HP 85081B)
Opt 001 Bail Handle and Front Protective Cover
Opt 801 Two each HP 11576A 10:1 Divider and HP 10216A Isolators
HP 85081B Input Module (100 kHz to 1 GHz, high-impedance probe inputs)
HP 85082A Input Module (300 kHz to 2 GHz, 50 Ω Type-N inputs)
HP 11570A Accessory Kit (for measurement of 50 Ω systems with standard HP 8508A)

[1]Specifications apply to HP 85082A 50 Ω input module only.

- 45 MHz to 110 GHz frequency range
- Real-time error-corrected measurements
- 60 dB effective directivity and source match
- Up to 100 dB dynamic range
- 0.001 dB, 0.01 degree, 0.01 ns measurement resolution
- Time-domain analysis

HP 85107B

HP 8510 Series Microwave Network Analyzers

The HP 8510 Series Microwave Vector Network Analyzers provide a complete solution for characterizing the linear behavior of either active or passive coaxial networks over the 45 MHz to 50 GHz frequency range. A complete system consists of the HP 8510C network analyzer, an S-parameter test set, and a compatible RF source. The HP 8510E (45 MHz to 20 GHz) is an unracked system. The HP 8510SX (45 MHz to 26.5 GHz) and the HP 85107B (45 MHz to 50 GHz) systems are fully integrated in an HP 85043C system rack, tested, and verified at the factory prior to shipment. They come with a one year on-site warranty. For millimeter wave measurements the HP 8510XF (45 MHz to 110 GHz) and HP 85106D (Q, U, V, and W band) are available. For pulse measurements the HP 85108A (2 GHz to 20 GHz, specials 0.5 to 20 GHz, and 2 GHz to 50 GHz) and HP 85108L (45 MHz to 2 GHz) are available.

HP 8510C Network Analyzer

At the heart of the system is the HP 8510C vector network analyzer. Measurement results can be displayed on a large color CRT on one of two independent, yet identical, channels. The channels may be displayed individually, or simultaneously, with results presented in either log/linear magnitude, phase, or group delay format on rectangular or polar coordinates. Direct measurement of impedance is possible with the Smith chart format.

Real-Time Error Correction

The HP 8510's built-in, high-speed computer provides the capability to characterize and effectively remove the impact of systematic errors through accuracy enhancement techniques. Effective directivity and source match can be improved to as much as 60 dB. The data processing speed of the system is such that a fully error-corrected, 401 point trace of data is updated in under one second. This virtual "real-time" display of error-corrected data means that you can easily adjust your test device while it's being measured, with the assurance that you are viewing the data at the highest possible accuracy.

Time-Domain Analysis

The HP 8510 (with Option 010) has the capability of displaying the time-domain response of a network, obtained by computing the Inverse Fourier Transform of the frequency-domain response. The time-domain response displays the reflection coefficient of the network versus time, which displays the magnitude and location of each individual discontinuity, or else the transmission coefficient versus time, which displays each individual transmission path.

Pulsed-RF Measurement Capability

For the measurement of pulsed-RF devices, the HP 8510C can be equipped with wideband IF detectors (Option 008). When configured with a compatible test set (HP 85110A/L), the system can measure pulse widths as narrow as 1 μs on devices with output power up to 20 W (CW) [50 W (CW) for the HP 85110L]. Measurement formats include magnitude and phase versus frequency or time (pulse profile).

Test Sets

The test set is the system component that determines the frequency range of the system and is the main contributor to system specifications. Depending on the test set used, up to 100 dB of dynamic range is available. The precision IF processing and detection system contributes as little as ±0.05 dB and ±0.5 degree measurement uncertainty at a level of 50 dB below the reference. Meaningful resolutions of 0.001 dB, 0.01 degree, and 0.01 ns are easily available. Refer to page 284 for more information.

RF Sources

The recommended system sources for the HP 8510C are the HP 83621B (20 GHz), 83631B (26.5 GHz), and 83651B (50 GHz). These sources provide 1 Hz frequency resolution, stepped CW, phase-locked narrowband sweeps, and fully-synthesized start frequencies for broadband ramp sweeps. Other models of the HP 8360 series synthesized sweeper, the HP 8340 series synthesized sweeper, and HP 8350B series sweep oscillators, are also compatible with the HP 8510C.

System Software

HP 85161B Measurement Automation Software

The HP 85161B measurement automation software leads the operator through the measurement sequence one step at a time, from system setup and calibration, to device measurement and hardcopy output. Complete measurement configurations can be saved to disk for later recall. Also, data printout formats can be customized by the operator.

The HP 85161B software is designed for use with a PC running HP Basic Rev 6.3 or higher under Windows (3.1/95/NT), or HP 9000 Series 200 or 300 computers and Basic Operating System 5.0 or later.

Key Literature

HP 8510 Systems Solutions Brochure, p/n 5965-8837E
HP 8510C Family Network Analyzer Technical Data, p/n 5091-8484E
HP 8510C Family Network Analyzer Configuration Guide, p/n 5091-8967E
HP 8360 B/L Series Synthesized Sweeper Technical Data, p/n 5964-6062E

Ordering Information

HP 8510C Microwave Vector Network Analyzer
Opt 008 Pulsed-RF Measurement Capability
Opt 010 Time-Domain Capability
HP 85043C System Rack Kit
HP 85161B Measurement Automation Software

S-Parameter Test Sets

Several S-parameter test sets are available for the HP 8510C network analyzer for broadband coaxial measurements from 45 MHz to 50 GHz. The HP 8514B, 8515A, and 8517B test sets have an architecture that develops a separate reference channel for each incident port. RF switching is done with a built-in electronic switch. For active device measurements, the test sets include the ability to apply dc bias (external) to the test port center conductors. Also available are two 90 dB step attenuators (60 dB in the HP 8517B) which allow control of the port 1 and port 2 signal levels.

Pulsed-RF Measurement Test Sets

The HP 85110A/L test sets are specially configured for operation in pulsed-RF measurement systems (HP 85108). Four 90 dB step attenuators protect each input of the fundamentally-mixed down converter to allow measurement of test devices with output power of 20 watts CW or 50 watts CW (HP 85110L). Special options are available to 50 GHz.

Coaxial Test Set General Information

	HP 8514B	HP 8515A	HP 8517B	HP 85110A	HP 85110L
Frequency range (GHz)	0.045 to 20	0.045 to 26.50	0.045 to 50	2 to 20[2]	0.045 to 2
Test ports (port 1 or 2) Nominal operating power level (dBm)	2 to –6	–5 to –25	+2 to –29 +5 to –16[1]	0 to –3	0
Test ports (port 1 or 2) Max. power in (CW)	+20 dBm	+2 dBm	+13 dBm	+43 dBm (20 W)	+47 dBm (50 W)
Test port connector type	3.5 mm (m)	3.5 mm (m)	2.4 mm (m)	3.5 mm (m)	7 mm

[1]HP 8517B Option 007
[2]Special test sets options are available from 0.5 to 20 GHz and 2 to 50 GHz

Frequency Converters

With the HP 8511A (26.5 GHz) and 8511B (50 GHz) frequency converters, the HP 8510 becomes a general-purpose four-channel magnitude/phase receiver. Add your own power splitters for transmission measurements, and bridges or directional couplers for reflection measurements. Since one input is used for system phase-lock, the other three inputs are available for measurements of multi-port devices, subsystems, and antennas. All four inputs have precision 3.5 mm (HP 8511A) or 2.4 mm (HP 8511B) connectors.

Multiple Test Set Operation

A single HP 8510C system may be configured with two test sets. In this configuration the test sets have different addresses, and the user may select between them from the front panel of the HP 8510 without reconnections. This capability is useful, for example, when combining a microwave coaxial test set with a millimeter-wave test set in the same HP 8510 system or in manufacturing to increase throughput, one test set can be used to make a measurement while a device is being connected to a second test set.

IF switching (Option 001): In the multiple test set configuration, the 20 MHz IF signal is daisy-chained from the test sets to the HP 8510. This capability requires test set Option 001 in one of the two test sets.

The RF signal must be routed to the desired test set using a coaxial RF switch and an HP 11713A switch driver. The switch driver is controlled automatically by the HP 8510C over the HP 8510 system interface bus.

Ordering Information

HP 8511A Frequency Converter
HP 8511B Frequency Converter
HP 8514B S-Parameter Test Set
HP 8515A S-Parameter Test Set
HP 8517B S-Parameter Test Set
HP 85110A Pulsed-RF S-Parameter Test Set
HP 85110L Pulsed-RF S-Parameter Test Set
HP 85105A Millimeter-Wave Controller

Key Literature

HP 8510 Systems Solutions Brochure, p/n 5965-8837E
HP 8510C Family Network Analyzer Technical Data, p/n 5091-8484E
HP 8510C Family Network Analyzer Configuration Guide, p/n 5091-8967E

Test Port Cables and Adapters

Test port cables and adapter sets are available for various connector types. The cable/adapter configurations are described below. All cables are designed with one end that connects directly to the special rugged ports of the network analyzer test set, and one end that connects to the device-under-test.

Special test port adapter sets are also available to convert the rugged ports of the network analyzer test set to the desired connector interface. Each kit contains two adapters, one male and one female.

Both the cables and the special adapters have one special female connector which is designed to connect directly to the 3.5 mm test port (2.4 mm for HP 8517B and 8722C). This side of the cable or adapter can only be connected to the test set port, and cannot be mated to a standard 3.5 mm (or 2.4 mm) male connector. The male test set ports, however, can be mated to a standard 3.5 mm (or 2.4 mm) female connector.

For HP 8719D/8720D Network Analyzer or HP 8514B/8515A Test Sets (3.5 mm test port)

	Cable/adapters	Connector type (on device side of cables/adapter)
For 3.5 mm devices	HP 85131C Semi-rigid Cable	3.5 mm (f)
	HP 85131E Flexible Cable	3.5 mm (f)
	HP 85130D Adapter Set	3.5 mm (m and f)
For 7 mm devices	HP 85132C Semi-rigid Cable	7 mm
	HP 85132E Flexible Cable	7 mm
	HP 85130B Adapter Set	7 mm
For Type-N devices	Use 7-mm cables and the 7 mm-to-Type-N adapters included in the HP 85054B/D calibration kit.	
	HP 85130C Adapter Set	Type-N (m and f)

For HP 8722D Network Analyzer or HP 8517B Test Set (2.4 mm test port)

	Cable/adapters	Connector type (on device side of cables/adapter)
For 2.4 mm devices	HP 85133C Semi-rigid Cable	2.4 mm (f)
	HP 85133E Flexible Cable	2.4 mm (f)
	HP 85130G Adapter Set	2.4 mm (m and f)
For 3.5 mm devices	HP 85134C Semi-rigid Cable	3.5 mm (f)
	HP 85134E Flexible Cable	3.5 mm (f)
	HP 85130F Adapter Set	3.5 mm (m and f)
For 7 mm devices	HP 85135C Semi-rigid Cable	7 mm
	HP 85135E Flexible Cable	7 mm
	HP 85130E Adapter Set	7 mm

For HP 8719D/8720D Network Analyzer or HP 8514B/8515A Test Sets (3.5 mm test port)

	Cable set	Connector type (on device side of cables/adapter)
For 3.5 mm devices	HP 85131D Semi-rigid Cable Set or HP 85131F Flexible Cable Set	3.5 mm (one male, one female) 3.5 mm (one male, one female)
For 7 mm devices	HP 85132D Semi-rigid Cable Set	7 mm
	HP 85132F Flexible Cable Set	7 mm
For Type-N devices	Use 7-mm cables and the 7 mm-to-Type-N adapters in the HP 85054B/D calibration kit.	

For HP 8722D Network Analyzer or HP 8517B Test Set (2.4 mm test port)

	Cable set	Connector type (on device side of cables/adapters)
For 2.4 mm devices	HP 85133D Semi-rigid Cable Set or HP 85133F Flexible Cable Set	2.4 mm (m, f) 2.4 mm (m, f)
For 3.5 mm devices	HP 85134D Semi-rigid Cable Set or HP 85134F Flexible Cable Set	3.5 mm (m, f) 3.5 mm (m, f)
For 7 mm devices	HP 85135D Semi-rigid Cable Set or HP 85135F Flexible Cable Set	7 mm 7 mm

For HP 8510XF Systems (1.0 mm test port connectors)

Cables/Adapters	Connector Type
HP 11500I 1.0 mm test port cable	1.0 mm (f-f) (88 mm long)
HP 11500J 1.0 mm test port cable	1.0 mm (m-f) (160 mm long)
HP 11500K 1.0 mm test port cable	1.0 mm (m-f) (200 mm long)
HP 11500L 1.0 mm test port cable	1.0 mm (m-f) (240 mm long)
HP 11920A/B/C[1] adapters	1.0 mm series adapters
HP 11921A/B/C/D[1] adapters	1.0 mm to 1.85 mm series adapters
HP 11922A/B/C/D[1] adapters	1.0 mm to 2.4 mm series adapters
HP 11923A adapters	1.0 mm (f) to circuit card launch
HP V281C/D[2] adapters	1.0 mm to V-band waveband guide
HP W281C/D[2] adapters	1.0 mm to W-band waveband guide

[1]Suffix 'A' denotes male-to-male, 'B' denotes female-to-female, 'C' denotes male-to-female and 'D' denotes female-to-male.
[2]Suffix 'C' denotes 1.0 mm female and 'D 'denotes 1.0 mm male.

Microwave Network Analyzer Accessories

Microwave accessories for the HP 8720D and the HP 8510C series network analyzers include calibration kits, verification kits, cables, and adapters for 7-mm, 3.5-mm, Type-N, 2.4-mm, 1.85-mm, and 1-mm coaxial, WR-90, WR-62, WR-42, and WR-28 waveguide. Millimeter-wave accessories for the HP 8510C series network analyzers include WR-22, WR-29, WR-15, and WR-10 waveguide connector interfaces. The standards used in the 3.5-mm, Type-N, and 2.4-mm kits use precision, slotless connectors (PSC-3.5, PSC-N, and PSC-2.4).

Calibration Kits

Error-correction procedures require that the systematic errors in the measurement system be characterized by measuring known devices (standards) on the system over the frequency range of interest. HP offers two types of calibration kits: mechanical and electronic.

Electronic Calibration (ECal)

ECal modules have two-ports. Modules are available with 3.5mm, 7mm, Type-N, Type-F and 7-16 connectors. The Type-N, Type-F, 7-16 and 3.5mm ECal modules have one male and one female connector. Options exist for modules with two male or two female connectors. To interface the ECal module with your computer and your network analyzer, please order an HP 85097A.

HP 85097A PC Interface Module with Control Software

The HP 85097A consists of a PC interface module, control software, and power supply. The PC interface module is the interface between the parallel port on your computer, the ECal module, and the external power supply. The control software has two interfaces: the graphical user interface (GUI) and the software programming interface (SPI). The GUI allows users to perform an electronic calibration in manual mode via the softkeys on your network analyzer. The SPI allows the calibration to be performed automatically by a user program. The software runs on a PC under Windows 95 or Windows NT 4.0 operating system or higher. The HP 85097A requires a PC with a GPIB (IEEE-488) interface card connected to the network analyzer. The HP 85097A interfaces with the HP 8510B (firmware revision 6.0 or higher), 8510C, 8719C/D, 8720C/D, 8722C/D. and 8753C/D/E.

Mechanical Calibration Kits

All network analyzer mechanical calibration kits contain precision standard devices to characterize the systematic errors of the HP 8720 series or 8510C network analyzer system.

Each mechanical calibration kit also contains adapters to change the sex of the test port and a torque wrench for proper connection. Each kit contains standards definitions on disk for the HP 8510C. (These definitions are already included in the HP 8720 series.)

Verification Kits

Measuring known devices, other than the calibration standards, is a straightforward way of verifying that the network analyzer system is operating properly. HP offers verification kits that include precision airlines, mismatch airlines, and precision fixed attenuators. Traceable measurement data is shipped with each kit on disk.

Verification kits may be recertified by Hewlett-Packard. This recertification includes a new measurement of all standards, as well as new data and uncertainties. Certification in compliance with MIL-STD-45662A is also available.

Verification Kit Summary

Verification kit	Connector type	Frequency range (GHz)
85051B	7 mm	0.045 to 18
85053B	3.5 mm	0.045 to 26.5
85055A	Type-N	0.045 to 18
85057B	2.4 mm	0.045 to 50
R11645A	WR-28	26.5 to 40
Q11645A	WR-22	33 to 50
U11645A	WR-19	40 to 60
V11645A	WR-15	50 to 75
W11645A	WR-10	75 to 110

Mechanical Calibration Kits

Calibration kit	Connector type	Frequency range (GHz)
85050B	7 mm	0.045 to 18
85050C	7 mm	0.045 to 18
85050D	7 mm	0.045 to 18
85052B	3.5 mm	0.045 to 26.5
85052C	3.5 mm	0.045 to 26.5
85052D	3.5 mm	0.045 to 26.5
85054B	Type-N	0.045 to 18
85054D	Type-N	0.045 to 18
85056A	2.4 mm	0.045 to 50
85056D	2.4 mm	0.045 to 50
85056K	2.92 mm	0.045 to 40
85059A	1.0 mm	0.045 to 110
X11644A	WR-90	8.2 to 12.4
P11644A	WR-62	12.4 to 18.0
K11644A	WR-42	18.0 to 26.5
R11644A	WR-28	26.5 to 40
Q11644A	WR-22	33 to 50
U11644A	WR-19	40 to 60
V11644A	WR-15	50 to 75
W11644A	WR-10	75 to 110

HP 85097A PC Interface Module

ECal Modules

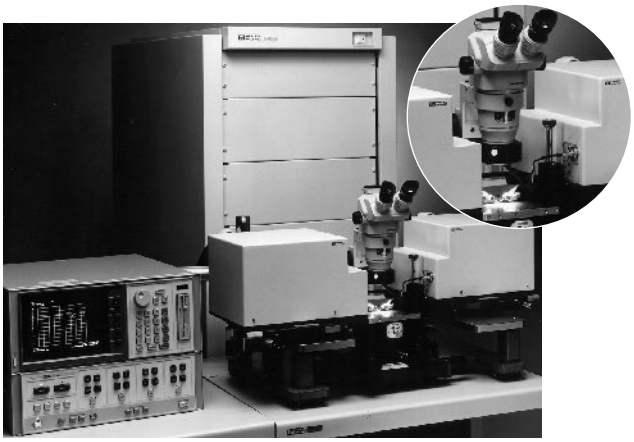
ECal Module	Connector Type	Frequency Range[1]	
85091A	7 mm	30 kHz to 6 GHz	
85060B Option 001	7 mm	1 GHz to 18 GHz Add 30 kHz to 6 GHz Module	
85099A	Type-F	30 kHz to 3 GHz	
85098A	7-16	30 kHz to 7.5 GHz	
85096A	Type-N 75 ohms	30 kHz to 3 GHz	
85092A	Type N 50 ohms	30 kHz to 6 GHz	
85064B Option 001	Type N 50 ohms	1 GHz to 18 GHz Add 30 kHz to 6 GHz Module	
85093A	3.5 mm	30 kHz to 6 GHz	
85062B Option 001	3.5 mm	1 GHz to 26.5 GHz Add 30 kHz to 6 GHz Module	

[1]The 30 kHz to 6 GHz module is specified to operate from 300 kHz, with typical performance down to 30 kHz.

HP 8510XF
HP E7340A
HP E7350A

Millimeter-Wave Solutions

The HP 8510C system can easily be configured for making measurements at millimeter-wave frequencies. Hewlett-Packard offers two fully integrated systems for making millimeter measurements in coax, waveguide and on-wafer. The HP 8510XF is a single-connection, single-sweep, 45 MHz to 110 GHz network analyzer system. This system is designed for on-wafer and coaxial (1.0 mm) measurements. The HP 85106D offers hardware for configuring systems in the 33 to 50 GHz, 40 to 60 GHz, 50 to 75 GHz and 75 to 110 GHz waveguide bands. These systems are fully integrated, tested and verified at the factory prior to shipment. System installation at your facility and one year, on-site service are included at no additional cost.



HP 8510XF configured with a wafer probing station and 1.0 mm probes

HP 8510XF Single-Connection, Single-Sweep, .045 to 110 GHz Network Analyzer System

Covering a broadband frequency range in millimeter-wave has been virtually impossible due to the frequency limitations of each waveguide band. The recent development from Hewlett-Packard of a broadband connector, coaxial calibration kit and directional couplers allows broadband devices to be measured over a wide frequency range, 45 MHz to 110 GHz, in one frequency sweep. All frequency band switching is performed internally by the HP 8510C, making it extremely convenient when measuring broadband devices on-wafer or in coax.

The HP 8510XF systems have been designed to measure broadband devices to 110 GHz in coax (1.0 mm) or on-wafer, fully calibrated, in a single sweep. By building on the HP 8510C network analyzer, the HP 8510XF provides excellent measurement performance in frequency coverage, dynamic range and measurement accuracy.

Broadband Calibration Improves Productivity

By performing a broadband calibration, from 45 MHz to 110 GHz, you are able to make measurements over the entire frequency range. Productivity is improved because you no longer need to connect, and disconnect banded coaxial test sets or waveguide modules as your measurements move from one frequency band to the next. In addition, the system was designed with the user in mind, making it suitable for both first-time and experienced users with minimal system training.

Convenient On-Wafer Calibration and Measurements with 1.0 mm Wafer Probes

The HP 8510XF system is designed for convenient on-wafer measurements. You no longer have to struggle with waveguide connection. The new test heads are especially designed to mount on the probe stations. A short, flexible 1.0 mm coaxial cable connects the test head to the wafer probe tip. Mounting the test heads on the probe station allows the test heads to move with the wafer probe tips so that there is no relative movement between the two. This configuration eliminates cable flexing and improves measurement performance.

Probing equipment and accessories are available from Cascade Microtech Inc., Beaverton, Oregon, USA.

Millimeter-Wave Measurements Made in 1.0 mm Coax

With the recent development and availability of the Hewlett-Packard designed 1.0 mm coaxial connectors and calibration kits, you can now make fully error-corrected measurements to 110 GHz. Measurements made in 1.0 mm coax deliver uncompromised performance with improved productivity, as compared to making measurements in waveguide. The 1.0 mm connector is a sturdy, long life, precision connector that will provide repeatable connections. It has been accepted as a worldwide standard by the IEEE and IEC (the published standards are forthcoming).

There is no longer a need to struggle with waveguide; the measurement setup for 1.0 mm coax is configured with the test heads placed close to the device-under-test (DUT). You simply connect the short, flexible 1.0 mm coax cables between the test heads and your DUT. This configuration allows maximum flexibility while minimizing cable losses at 110 GHz.

Upgrade Your Current HP 8510 System to Grow Your Measurement Capability

Your HP 8510-based system can be upgraded to an HP 8510XF to meet your new design and test challenges. HP offers pre-configured upgrades for your standard HP 85107B, 85106C/D and 85109C systems. Upgrades include hardware and firmware and are installed on-site. Customized upgrades are also available for other HP 8510 systems. Calibration kits and cables must be purchased separately.

Key Literature

HP 8510 System Solutions Brochure, p/n 5965-8837E
HP 8510C Family Network Analyzer Technical Data, p/n 5091-8484E
HP 8510C Family Network Analyzer Configuration Guide, p/n 5091-8967E
HP 8510XF Family, Single-Sweep Systems Product Overview, p/n 5965-9888E
HP 85106D Millimeter-wave Network Analyzer System Product Overview, p/n 5964-4229E

Ordering Information

Complete HP 8510XF Systems
HP E7340A Single-Connection, Single-Sweep Network Analyzer System (2 to 85 GHz)
- **Opt 005** Extend Low Frequency to 45 MHz
- **Opt 006** RF pass thru
- **Opt 010** Add time domain capability to 8510C

HP E7350A Single-Connection, Single-Sweep Network Analyzer System (2 to 110 GHz)
- **Opt 005** Extend Low Frequency to 45 MHz
- **Opt 006** RF pass thru
- **Opt 010** Add time domain capability to 8510C

HP 85106D Millimeter-Wave Network Analyzer Subsystem

The HP 85106D millimeter-wave network analyzer subsystem includes an HP 8510C network analyzer, an HP 85105A millimeter-wave controller, an HP 83621B synthesized source as the RF and an HP 83621B synthesized source as the LO, all mounted in a single bay rack with extendable worksurface.

Two HP 85104A series test set modules are required to complete the system. With these configurations, both forward and reverse measurements can be made with a single connection to the device under test. The greatest convenience and highest accuracy is assured through the TRL (through-reflect-line) calibration technique. Precision calibration kits and verification kits are also available for these waveguide bands.

The HP 85106D can be configured as a combination microwave/millimeter-wave S-parameter system with Option 001. This option adds an HP 8517B microwave test set, 50 GHz source (HP 83651B), HP 85133F test port return cable set, HP 85056A calibration kit and appropriate cabling for convenient switching between millimeter-wave operation and microwave operation with no re-connections required.

HP 85108A/L Pulsed-RF Network Analyzer Systems

High Power Device Characterization

The HP 8510C can be configured for convenient single-connection, multiple-measurements of high-volume, high-power and pulsed testing of IF, RF, and microwave frequency ranges. By pulsing the RF, the average power through the device is reduced, thereby reducing thermal effects on the device and making accurate characterization possible. These systems also include on-site installation, and a one-year, on-site warranty to ensure that the systems remain up and running.

HP 85108A Pulsed-RF Network Analyzer System

The HP 85108A is a factory-integrated system that provides the entire instrument configuration required to make pulsed-RF measurements from 2 to 20 GHz. Special options are available to add frequency coverage to 50 GHz.

The system is built around the HP 8510C with the pulsed-RF measurement option (Option 008) already installed. The system also includes the HP 85110A S-parameter test set. HP 83622B and HP 83624B synthesized sweepers provide, respectively, the RF and LO signals needed to operate the fundamentally mixed test set.

HP 85108L Pulsed-RF Network Analyzer System

The HP 85108L with the HP 85110L pulsed-RF test set provides improvements to pulsed-RF network analysis in many areas, but specifically extends the frequency coverage down to 45 MHz and up to 2 GHz. Special options are available to extend the upper frequency. The HP 85108L system is built around the same HP 8510C and includes two HP 83620B Option H80 synthesizers. The system is optimized for component testing in applications such as cellular, direct broadcast satellite, and VHF/UHF.

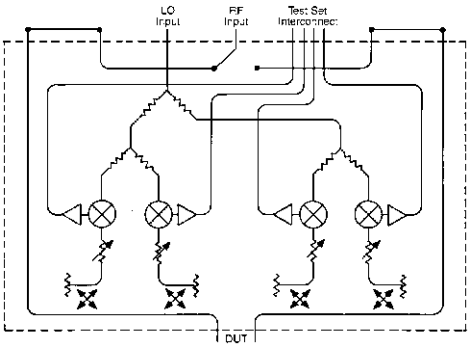
The HP 85110L has excellent pulsed-RF and CW performance with system dynamic range greater than 70 dB when using the wideband detectors and better than 95 dB when using the standard narrowband detectors. Both detectors are included in the HP 85108 systems.

HP 8510C Option 008

The HP 8510C pulsed-RF measurement capability (Option 008) consists of an additional receiver subsystem for the HP 8510. This pulsed-RF measurement capability, which exists in parallel with the standard HP 8510C operation, provides you with the ability to measure and display the relative magnitude and phase shift of the component as a function of time with equivalent bandwidth of 1.5 MHz. This allows the evaluation of the dynamic pulsed-RF characteristics for pulse widths down to 1 microsecond. Using the repetitive sampling method, point-to-point display resolution of 100 ns is available.

High Power CW or Pulsed-RF Measurements

An HP 85110A or 85110L S-parameter test set is a required system component for the HP 8510C pulsed-RF measurement capability. The figure below shows a simplified block diagram of this test set.



The block diagram provides some distinct advantages, whether using the HP 8510C for pulsed-RF or standard S-parameter measurements. Because of the coupler-based measurement path and attenuators, the test set can handle high powers, up to 20 w (HP 85110A) or 50 w (HP 85110L) CW.

Key to the pulse performance of the test sets are the fundamental mixers used to provide the low noise IF necessary to make accurate, pulsed-RF measurements with the pulsed-RF receiver subsystem. Two external synthesizers act as the RF and LO sources for the four-channel downconverter. This approach eliminates the need to dedicate one channel for phase-lock, making full two-port, pulsed-RF S-parameter measurements available. Also, the internal pulse modulator of the RF synthesizer can be used to pulse the device-under-test.

The connections available on the rear panel provide access to the measurement path, making it easy to configure test systems that use a single measurement connection for making multiple types of measurements such as spectrum analysis, noise figure and load-pull. Special versions of the HP 85110A and 85110L test sets are available for even higher power applications or other frequency ranges.

To Upgrade an Existing HP 8510C System for Pulsed-RF Measurements

Your existing HP 8510 system can be upgraded to perform pulsed-RF measurements. This upgrade can be performed on-site or integrated into a full system at the factory.

Key Literature

HP 8510 System Solutions Brochure, p/n 5965-8837E
HP 8510C Family Network Analyzer Technical Data, p/n 5091-8484E
HP 8510C Family Network Analyzer Configuration Guide, p/n 5091-8967E
HP 85108 Series Network Analyzer Systems Data Sheet, p/n 5091-8965E
HP 85106D Millimeter-Wave Network Analyzer System Product Overview, p/n 5964-4229E

Ordering Information

HP 85108A Pulsed-RF Network Analyzer System
HP 85108L Pulsed-RF Network Analyzer System
Opt 010 Add Time-Domain Capability to HP 8510C (applies to both HP 85108A and 85108L)
HP 85106D Millimeter-Wave Network Analyzer Subsystem
Opt 001 Add Microwave Test Set (HP 8517B), 50 GHz Source (HP 83651B), and 2.4 mm Accessories
Opt 007 High Dynamic Range Configuration (to 50 GHz)
Opt 010 Add Time-Domain Capability to HP 8510C
HP Q85104A Test Set Module (33 GHz to 50 GHz)
HP U85104A Test Set Module (40 GHz to 60 GHz)
HP V85104A Test Set Module (50 GHz to 75 GHz)
HP W85104A Test Set Module (75 GHz to 110 GHz)

For more information, including custom configurations, contact the HP Call Center in your region.

Single- and Dual-Channel Power Meters

HP E4418B
HP E4419B

- Fast measurement speed (up to 200 readings per second with the E4418B, and 100 readings per second with the E4419B, over the GPIB, with E-series sensors)
- Speed improvement of x2 using the HP 8480-series power sensor (compared to HP 437B)
- Code-compatible with the HP 437B (E4418B) and HP438B (E4419B)
- Operates with the new E-series plus all HP 8480 series power sensors
- No range-switching delays with HP 8480-series sensors (over a 50 dB range), and only one fast-range switch point with E-series sensors (over a 90 dB range)
- High-resolution LCD display with backlighting for a wide viewing angle of data
- Same height and width as the HP 437B and the HP438A
- Conformity to CE and CSA standards
- Standard 3-year global warranty
- RS-232/422 serial interfaces as standard
- Internal rechargeable battery option

HP EPM Series Power Meters

HP E4418B Single-Channel Power Meter

The HP E4418B is a low-cost, high-performance, single-channel, programmable power meter. It is fully compatible with the HP 8480 series of power sensors and the E-series of power sensors. Depending upon which sensor is used, the HP E4418B can measure from –70 dBm to +44 dBm at frequencies from 100 kHz to 110 GHz. Designed for bench and automatic test equipment (ATE) use, the E4418B makes fast (up to 200 readings per second with E-series sensors), accurate and repeatable power measurements.

The E4418B power meter has a high-resolution LCD display with LED backlighting and contrast control. This allows users to see the power readings from a distance, at a wide viewing angle and in a variety of lighting conditions. The user interface is easy to learn and use, with hardkeys for the most frequently used functions, and softkey menus to simplify instrument configuration for different applications. Ten instrument configurations can be saved and recalled, reducing the need to repeat setup sequences.

The E4418B is ideal for service and maintainence applications. The internal rechargeable battery option (option 001), which provides up to 3 hours of continuous operation, brings HP's accuracy to field applications. Front and rear panel bumpers protect the E4418B from everyday knocks. The meter weighs only 4 kg (9lbs), and a bail handle makes it easy to carry.

Because the E4418B power meter is designed to be code-compatible with the previous-generation HP 437B power meter, a user's investment in automatic-test procedures, software generation and verification is protected.

HP E4419B Dual-Channel Power Meter

The HP E4419B is a low-cost, high-performance, dual-channel, programmable power meter. It is fully compatible with the HP 8480 series of power sensors and the new E series of power sensors. Depending upon which sensor is used, the HP E4419B can measure from –70 dBm to +44 dBm at frequencies from 100 kHz to 110 GHz.

Designed for bench and automatic test equipment use (ATE), the E4419B makes fast (up to 100 readings per second with E-series sensors), accurate and repeatable power measurements. The HP E4419B is a true dual-channel power meter, which means that you get two simultaneous power readings on the display.

The E4419B power meter has a high-resolution LCD display with LED backlighting and contrast control. This allows users to see the power readings from a distance, at a wide viewing angle and in a variety of lighting conditions. Users can display both the digital and analog types of readout on the meter's split screen facility. The analog peaking meter allows users to make accurate adjustments.

The user interface is easy to learn and use, with hardkeys for the most frequently used functions, and softkey menus to simplify instrument configuration for different applications. Difference (A-B, B-A) and ratio (A/B, B/A) functions are provided, and ten instrument configurations can be saved and recalled, reducing the need to repeat setup sequences.

Because the E4419B power meter is code compatible with the HP 438A and is the same height (88.5 mm /3.5 in) and width (212.6 mm/8.5 in) as the HP 438A, this makes it easy to substitute into rackmount automatic-test-equipment systems.

Specifications

Frequency Range: 100 kHz to 110 GHz, sensor dependent
Power Range: –70 dBm to +44 dBm (100 pW to 25 W), sensor dependent
Power Sensors: Compatible with all HP 8480 series and HP E-series sensors
Single Sensor Dynamic Range
90 dB maximum (HP E-series sensors)
50 dB maximum (HP 8480 series sensors)
Display Units
Absolute: Watts or dBm
Relative: Percent or dB
Display Resolution: Selectable resolution of 1.0, 0.1, 0.01, and 0.001 dB in log mode, or 1 to 4 digits in linear mode
Default Resolution: 0.01 dB in log mode, 3 digits in linear mode

Accuracy
Instrumentation
Absolute: ± 0.02 dB (log) or ± 0.5% (linear). Add the corresponding power sensor linearity percentage
Relative: ± 0.04 dB (log) or ± 1.0% (linear). Add the corresponding power sensor linearity percentage

Power Reference
Power Output: 1.00 mW (0.0 dBm). Factory set to ± 0.7%, traceable to the U.S. National Institute of Standards and Technology (NIST)
Accuracy: ± 1.2% worst case (± 0.9% rss) for one year

Key Literature

Brochure, p/n 5965-6380E
Technical Specifications, p/n 5965-6382E
Configuration Guide, p/n 5965-6381E
Fundamentals of RF and Microwave Power Measurements
Application Note 64-1A, p/n 5965-6630E

Ordering Information

HP E4418B Power Meter
HP E4419B Power Meter
Opt 001 Supplies internal rechargable battery
Opt 002 Supplies rear-panel sensor input (power reference calibrator is on front panel)
Opt 003 Supplies rear-panel sensor input (power reference calibrator is on rear panel)
Opt 004 Deletes the HP 11730A sensor cable
Opt 908 Supplies a one-instrument rackmount kit
Opt 909 Supplies a two-instrument rackmount kit
Opt 1BN Supplies MIL-STD-45662A Certificate of Calibration
Opt 1BP Supplies MIL-STD-45662A Certificate of Calibration with data
Opt UK6 Supplies commercial calibration certificate with test data

HP 70100A

HP E1416A

HP 70100A and E1416A MMS and VXI Power Meters

The HP 70100A is a full-featured single-channel power meter module for the modular measurement system. It has all the capability of the HP 437B power meter in a one-eighth rack-width module. The HP 70100A features the same modern and flexible feature set as the HP 437B, the same state-of-the-art accuracy, and is also fully compatible with the HP 8480 series of power sensors. The HP E1416A power meter is a VXI version of the HP 70100A.

HP 70100A, and E1416A Specifications

Frequency Range: 100 kHz to 110 GHz, sensor dependent
Power Range: –70 to +44 dBm (100 pW to 25 W), sensor dependent
Power Sensors: Compatible with all HP 8480 series power sensors
Dynamic Range: 50 dB in 10 dB steps
Display Units: Absolute: watts, dBm; relative: percent, dB
Resolution: Selectable resolution of 0.1, 0.01, and 0.001 dB in logarithmic mode; or 1% and 0.01% of full scale in linear mode

Accuracy
Instrumentation: ±0.02 dB or ±0.5%
In REL Mode: ±0.02 dB or ±0.5% within measurement range; ±0.04 dB or 1% outside measurement range
Zero Set: ±0.5% of full scale on most sensitive range

Power Reference
Power Output: 100 mW, factory-set to ±0.7%, traceable to US National Institute of Standards and Technology
Accuracy: ±1.2% worst case (±0.9% RSS) for 1 year

Key Literature

HP E1416A Technical Specifications, p/n 5965-5564E

Ordering Information

HP 70100A Power Meter Module
- **Opt 003** Moves Reference Oscillator from Front to Rear Panel
- **Opt 004** Deletes the HP 11730A Power Sensor Cable
- **Opt 005** Deletes Reference Oscillator
- **Opt W30** Extended Repair Service (see page 584)

HP E1416A Power Meter C-Size VXI
- **Opt 004** Delete Sensor Cable
- **Opt 915** Service Support Kit
- **Opt 916** Additional User's Manual
- **Opt W01** 3 Year Return-to-HP to 1 Year On-site Warranty
- **Opt W32** 3 Year Customer Return Calibration Service
- **Opt W34** 3 Year Customer Return Standards Compliant Calibration Service
- **Opt W50** 5 Year Return Repair Service
- **Opt W52** 5 Year Customer Return Calibration Service
- **Opt W54** 5 Year Customer Return Standards Compliant Calibration Service

HP 8900C

HP 8900D

HP 8900C/D Peak Power Meters

The HP 8900C and 8900D peak power meters directly display the peak power of RF pulses over a 100 MHz to 18 GHz frequency range. Measurements can be made on pulses with widths from 1 µs (100 ns in compare mode) to CW, and repetition rates from 100 Hz (0 Hz in compare mode) to 100 kHz.

The HP 8900C is an economical analog meter calibrated in watts and dBm. The analog display with its large, easy-to-read scale makes it simple to peak or null pulsed power systems. The HP 8900D has a high-resolution 3½-digit digital display calibrated in watts. The direct reading display and range annunciators make the digital version a good choice for production and field applications where unambiguous or frequent readings are required.

HP 84811A Peak Power Sensor

The HP 84811A peak power sensor works with the HP 8900C/D peak power meters to measure the peak power of RF pulses. It is supplied with a 4-foot flexible cable to easily reach the pulse source being measured. The HP 84811A also conveniently detaches from the meter for storage, recalibration, or replacement.

HP 8900C/D Peak Power Meters Specifications

Frequency Range: 100 MHz to 18 GHz
Dynamic Range: 20 dB (0 to +20 dBm)
- **HP 8900C:** 4 ranges of 3, 10, 30, and 100 mW full scale
- **HP 8900D:** 2 ranges of 10 and 100 mW full scale

Pulse Response:
- **Direct Mode**
  Pulse Width: 1 µs to CW
  Repetition Rate: 100 Hz to 100 kHz
- **Compare Mode**
  Pulse Width: 100 ns (typical) limited by rise-time specification
  Repetition Rate: 0 to 100 kHz
- **Rise Time:** 75 ns
- **Fall Time:** 125 ns (as measured on video output)

Power Consumption: 100 and 120 Vac +5, –10%, 48 to 66 Hz and 360 to 440 Hz; 220 and 240 Vac +5, –10%, 48 to 66 Hz

Meter accuracy	CW	Pulse	Transfer accuracy CW to pulse
Direct	±0.2 dB	±0.35 dB	±0.2 dB
Compare	±0.2 dB	±0.25 dB	±0.1 dB

HP 84811A Peak Power Sensor Specifications

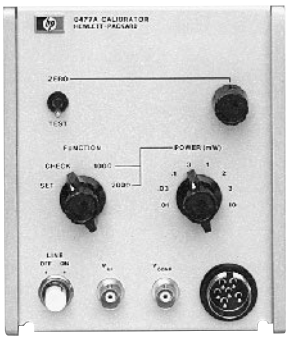
Power Range: 0 to +20 dBm (1 mW to 100 mW)
Frequency Range: 100 MHz to 18 GHz
SWR: 100 MHz to 12 GHz <1.5. 12 GHz to 18 GHz <2.0
Maximum Peak Power: +24 dBm (250 mW) for 5 minutes
Connector Type: Type-N (male)
Calibration Accuracy: (+10° to +40° C), ±0.7 dB 0.1 to 12 GHz, ±1.0 dB to 18 GHz. 0° to 10° C and 40° to 55° C: add ±0.2 dB

Ordering Information

HP 8900C Analog Peak Power Meter
HP 8900D Digital Peak Power Meter
- **Opt W30** Extended Repair Service (for HP 8900C/D) (see page 565)
- **Opt W32** Calibration Service (see page 71)

HP 84811A Peak Power Sensor
- **Opt W30** Extended Repair Service (see page 71)
- **Opt W32** Calibration Service (see page 71)

HP 432A



HP 8477A

HP Thermistor Mounts

HP 432A Power Meter

- High accuracy—no thermoelectric error: High accuracy over a wide temperature range is featured on the HP 432A power meter. By measuring the output voltage of the thermistor bridges and computing the corresponding power, even higher accuracy of ±0.2 percent ±0.5 µW can be obtained. Accuracy can be maintained on even the most sensitive range because the error due to thermoelectric effect is reduced to a negligible level.
- Calibrated mounts: Each thermistor mount is furnished with data stating the calibration factor and effective efficiency at various frequencies across the operating range. For easy and accurate power measurements, the front panel of the HP 432A has a calibration-factor control, calibrated in one-percent steps from 88 percent to 100 percent, that compensates for losses in the mount and eliminates the need for calculation.
- Instrument type: Automatic, self-balancing power meter for use with temperature-compensated thermistor sensor.

Specifications (Partial)

Power Range: 7 ranges with full-scale readings of 10, 30, 100, and 300 µW, 1, 3, and 10 mW; also calibrated in dBm from –20 dBm to +10 dBm full scale in 5 dB steps
Noise: Less than 0.25% of full scale peak (typical)
Response Time: At recorder output, 35 ms time constant (typical)
Fine Zero: Automatic, operated by front-panel switch
Zero Carryover: Less than 0.50% of full scale when zeroed on most sensitive range
Meter: Taut-band suspension, individually calibrated, mirror-backed scales. Milliwatt scale more than 108 mm (4.25 in) long
Calibration Factor Control: 13-position switch normalizes meter reading to account for thermistor sensor calibration factor. Range 100% to 88% in 1% steps.
Thermistor Sensor: Thermistor sensors are required for operation of the HP 432A. For microwave sensors HP 478A, 8478B, and 486 series, see next column.
Recorder Output: Proportional to indicated power with 1 volt corresponding to full scale. 1 kΩ output impedance.
BCD Output: 8, 4, 2, 1 code: "1" positive. TTL compatible logic. Operates with HP 5150A, Option 002 (BCD) digital recorder.
Power Consumption: 115 or 230 Vac ±10%, 50 to 400 Hz, 1.5 watts
Size: 130 mm W x 155 mm H x 279 mm D (5.2 in x 6.1 in x 11.0 in)
Weight: Net, 2.3 kg (5.5 lb); shipping, 4.6 kg (10 lb)

HP 8477A Power Meter Calibrator

The HP 8477A power meter calibrator is specifically designed for use with the HP 432A power meter. It allows you to verify full-scale meter readings on all ranges, and meter tracking. Simply connect three cables between the power meter and calibrator; no charts or additional instruments are required.

Power: 115 or 230 Vac ±10%, 50 to 400 Hz, 3 watts

Temperature-Compensated Thermistor Mounts

High efficiency and good radio frequency (RF) match are characteristic of the HP 478A and 8478B coaxial and 486A series waveguide thermistor mounts. Used in conjunction with the HP 432A power meter, they provide high accuracy even in routine power measurements. These thermistor mounts are temperature compensated for low drift, even in the presence of thermal shocks, permitting measurement of microwave power as low as one microwatt. Each mount contains data showing calibration factor and effective efficiency at six frequencies, directly traceable to the U.S. National Institute Standards and Technology at those frequencies where NIST provides calibration service.

HP 486A, 478A, 8478B Specifications

HP model	Frequency range, GHz	Maximum SWR	
478A	10 MHz to 10 GHz	1.75, 10 to 25 MHz 1.3, 25 MHz to 7 GHz 1.5, 7 to 10 GHz	
8478B[1]	10 MHz to 18 GHz	1.75, 10 to 30 MHz 1.35, 30 to 100 MHz 1.1, 0.1 to 1 GHz 1.35, 1 to 12.4 GHz 1.6, 12.4 to 18 GHz	
X486A	8.20 to 12.4	1.5	
P486A	12.4 to 18.0	1.5	
K486A	18.0 to 26.5	2.0	
R486A	26.5 to 40.0	2.0	

[1] Option 011: Furnished with APC-7 RF connector

Ordering Information

HP 432A Power Meter
Opt 001 Rechargeable battery installed, provides up to 20 hours of continuous operation (HP 432A only)
Opt 002 Input connector placed on rear panel in parallel with front
Opt 003 Input connector on rear panel only
Opt 009 3.1 m (10 ft) Cable for 100 Ω or 200 Ω Sensor
Opt 010 6.1 m (20 ft) Cable for 100 Ω or 200 Ω Sensor
Opt 011 15.2 m (50 ft) Cable for 100 Ω or 200 Ω Sensor
Opt 012 30.5 m (100 ft) Cable for 100 Ω or 200 Ω Sensor
Opt 013 61 m (200 ft) Cable for 100 Ω or 200 Ω Sensor
Opt 100 100 Vac Operation, 48 to 66 Hz
Opt 910 Extra Operating and Service Manual (HP432A: p/n 00432-90009)
Opt W30 Extended Repair Service (see page 71)
Opt W32 Calibration Service (see page 71)
HP 8477A Power Meter Calibrator
Opt W30 Extended Repair Service (see page 71)
Opt W32 Calibration Service (see page 71

Indicates QuickShip availability.

HP E4412A
HP E4413A
HP E9300A
HP E9301A

NEW

- Operates with the new HP E4418B and HP E4419B power meters
- Wide dynamic range sensors
- Fast measurement speed (up to 200 readings per second, over the HP-IB, with the HP E4418B power meter)
- Calibration factors stored in EEPROM

HP E-Series Power Sensors

HP E-Series Power Sensors

The HP E-series power sensors are wide dynamic range (up to 90dB) sensors which operate with the HP EPM series power meters.

The HP E-series power sensors provide fast measurement speed (up to 200 readings per second with the HP E4418B single channel power meter) and sensor calibration factors stored in EEPROM.

The HP E4412A (10MHz to 18GHz) and HP E4413A (50MHz to 26.5GHz) are designed for measuring CW signals over the power range –70 dBm to +20dBm.

The HP E9300A (10MHz to 18GHz) and HP E9301A (10MHz to 6GHz) power sensors measure the average power of RF and microwave signals, regardless of modulation format, over a wide 80dB dynamic range (–60dBm to +20dBm)

Specifications

Wide Dynamic Range Sensors:
100 pW to 100 mW (–70 dBm to +20 dBm): E4412A, E4413A
1nW to 100mW (–60dBm to + 20dBm): E9300A, E9301A

Frequency Range	Maximum SWR[1]	Maximum Power	Connector Type
HP E4412A			
10 MHz to 18 GHz	10 MHz to 30 MHz: 1.22* 30 MHz to 2 GHz: 1.15 2 GHz to 6 GHz: 1.17 6 GHz to 11 GHz: 1.2 11 GHz to 18 GHz: 1.27	200 mW (+23 dBm)	N (m)
HP E4413A			
50 MHz to 26.5 GHz	50 MHz to 100 MHz: 1.21 100 MHz to 8 GHz: 1.19 8 GHz to 18 GHz: 1.21 18 GHz to 26.5 GHz: 1.26	200 mW (+23 dBm)	APC-3.5 mm (m)
HP E9301A			
10MHz-6GHz	10MHz-30MHz: 1.21 (1.15) 30MHz-2GHz: 1.15 (1.13) 2GHz-6GHz: 1.20 (1.19)	320mW (+25dBm) avg. 2W (+33dBm) peak (<10usec)	N(m)
HP E9300A			
10MHz to 18GHz	10MHz-30MHz: 1.21 (1.15) 30MHz-2GHz: 1.15 (1.13) 2GHz-6GHz: 1.20 (1.19) 6GHz-11GHz: 1.23 (1.22) 11GHz-18GHz: 1.27 (1.26)	320mW (+25dBm) avg. 2W (+33dBm) Peak (<10usec)	N(m)

*Applies to sensors with serial prefix US3848 or greater.
[1]Specifications in brackets apply over temperature range 25+10°C. All other specifications apply over temperature range 0 to 55°C, unless otherwise stated.

Power Linearity: E4412A/13A
100 pW to 10 mW (–70 dBm to +10 dBm)
Temperature: (25° C ± 5° C): ±4%; (0 to 55° C): ±8%
10 mW to 100 mW (+10 dBm to +20 dBm)
Temperature: (25° C ± 5° C): ±5.5%; (0 to 55° C): ±11%
Power Linearity: E9300A/E9301A
–60dBm to 10dBm: Temperature (25 ± 10°C): ± 3%; (0 to 55°C) :± 3.5%
–10dBm to 0dBm: Temperature (25 ± 10°C): ± 2.5%; (0 to 55°C): ± 3%
0dBm to +10dBm: Temperature (25 ± 10°C): ± 2%; (0 to 55°C): ± 2.5%

HP 8480 Power Sensor Family

The HP 8480 power sensors are designed for use with the E4418B, E4419B, HP 435B, 436A, 437B, 438A, 70100A and E1416A power meters. These thermocouple and diode power sensors provide extraordinary accuracy, stability, and SWR over a wide range of frequencies (100 kHz to 110 GHz) and power levels (–70 to +44 dBm).

Best SWR in the Industry

Mismatch uncertainty is usually the largest single source of error in power measurements. The HP 8480 power sensor family gives you extremely low SWR even at mm-wave frequencies. For example, the HP W8486A power sensor has a specified SWR of less than 1.08:1 over its entire 75 to 110 GHz frequency range. This low SWR translates into minimum mismatch uncertainty and optimum measurement accuracy.

Accurate Calibration and Traceability

Each power sensor in the HP 8480 family is individually calibrated and traceable to the U.S. National Institute of Standards and Technology (NIST, formerly NBS). The uncertainty in this calibration factor is your link to NIST. The cal factor measurement system used by HP Standards Lab provides you with minimum cal factor uncertainty.

Millimeter-Wave Sensor Calibration

A 50 MHz calibration port is included in HP waveguide power sensors for calibration with the power meter. This calibration provides traceability to NIST at millimeter-wave frequencies, and it eliminates the uncertainties due to temperature changes and the variance in making measurements with different meter/sensor combinations.

HP 11683A Range Calibrator

The HP 11683A range calibrator is specifically designed for use with the E4418A/B, E4419A/B, HP 435B, 436A, 437B, 438A, 70100A and E1416A power meters. It allows verification of full-scale meter readings on all ranges, as well as meter tracking. Simply connect the cable between the power meter and calibrator. The CAL ADJ control on the power meter is used to set the meter to full scale on the 1 mW range. The calibrator and meter are then stepped through the other ranges verifying accuracy within ±1 percent plus noise and drift. The HP 11683A also has a polarity switch that tests the auto-zero circuit. The HP 11683A is not GPIB compatible.

Key Literature

Technical Specifications, p/n 5965-6382E
Brochure, p/n 5965-6380E
Configuration Guide, p/n 5965-6381E
HP E-Series E9300 Power Sensors, Product Overview, p/n 5968-4960E

Ordering Information

HP E4412A CW Power Sensor (10MHz to 18GHz)
Opt A6J ANSI/NCSL Z540-1-1994
Certificate of Calibration
HP E4413A CW Power Sensor (50MHz to 26.5 GHZ)
Opt A6J ANSI/NCSL Z540-1-1994
Certificate of Calibration
HP E9301A Power Sensor (10MHz to 6GHz)
Opt A6J ANSI/NCSL Z540-1-1994
Certificate of Calibration
HP E9300A Power Sensor (10MHz to 18GHz)
Opt A6J ANSI/NCSL Z540-1-1994
Certificate of Calibration

HP 8480 Series Specifications

HP model	Frequency range	Maximum SWR	Power linearity[1]	Maximum power	Connector type	Weight	
25 Watt Sensors 1 mW to 25 W (0 to +44 dBm)							
8481B	10 MHz to 18 GHz	10 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.18 12.4 to 18 GHz: 1.28	+35 to +44 dBm; ±4%	0° to 35° C: 30 W avg[2] 35° to 55° C: 25 W avg 0.01 to 5.8 GHz: 500 W pk	Type-N(m)	Net 0.8 kg (1.75 lb) Shipping 1.5 kg (3.25 lb)	
8482B	100 kHz to 4.2 GHz	100 kHz to 2 GHz: 1.10 2 to 4.2 GHz: 1.18		5.8 to 18 GHz: 125 W pk 500 W-µs per pulse	Type-N(m)		
3 Watt Sensors 100 µW to 3 W (–10 to +35 dBm)							
8481H	10 MHz to 18 GHz	10 MHz to 8 GHz: 1.20 8 to 12.4 GHz: 1.25 12.4 to 18 GHz: 1.30	+25 to +35 dBm; ±5%	3.5 W avg, 100 W pk 100 W-µs per pulse	Type-N(m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)	
8482H	100 kHz to 4.2 GHz	100 kHz to 4.2 GHz: 1.20			Type-N(m)		
100 mW Sensors 1 µW to 100 mW (–30 to +20 dBm)							
8485A	50 MHz to 26.5 GHz	50 to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 to 2.4 GHz: 1.15 12.4 to 18 GHz: 1.20 18 to 26.5 GHz: 1.25	+10 to +20 dBm; +2, –4%	300 m W avg, 15 W pk 30 W-µs per pulse	APC-3.5 mm (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)	
Option 033	50 MHz to 33 GHz	26.5 to 33 GHz: 1.40					
8481A	10 MHz to 18 GHz	10 to 30 MHz: 1.40 30 to 50 MHz: 1.18 50 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.18 12.4 to 18 GHz: 1.28			Type-N(m)		
8482A	100 kHz to 4.2 GHz	100 to 300 kHz: 1.60 0.3 to 1 MHz: 1.20 1 MHz to 2 GHz: 1.10 2 to 4.2 GHz: 1.30			Type-N(m)		
8483A (75 Ω)	100 kHz to 2 GHz	100 to 600 kHz: 1.80 600 kHz to 2 GHz: 1.18		300 mW avg, 10 W pk	Type-N(m) 75 Ω		
R8486A	26.5 to 40 GHz	1.4	+10 to +20 dBm; +2, –4%	300 mW avg, 15 W pk 30 W-µs per pulse	Waveguide Flange UG-599/U	Net 0.26 kg (0.53 lb) Shipping 0.66 kg (1.3 lb)	
Q8486A	33 to 50 GHz	1.5			Waveguide Flange UG-383/U		
V8486A	50 to 75 GHz	1.04	+10 to +20 dBm; ±2% –30 to +10 dBm <±1%	200mV avg 40 W pk 10 us pulse 0.5% duty cycle	Waveguide Flange UG-385/U	Net 0.4 kg (0.91 lb) Shipping 1kg (2.11 lb)	
W8486A	75 to 110 GHz	1.08	+1, –3%	200 mW avg 40 W peak	Waveguide Flange UG-387/U	Net 0.4 kg (0.9 lb) Shipping 1.0 kg (2.1 lb)	
8487A	50 MHz to 50 GHz	50 to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.15 12.4 to 18 GHz: 1.20 18 to 26.5 GHz: 1.25 26.5 to 40 GHz: 1.30 40 to 50 GHz: 1.50	+10 to +20 dBm; +2,– 4%	300 mW avg, 15 W pk 30 W-µs per pulse	2.4 mm (m)	Net 0.14 kg (0.28 lb) Shipping 0.5 kg (1 lb)	
High Sensitivity Sensors 100 pW to 10 µW (–70 to –20 dBm)							
8481D[3,4]	10 MHz to 18 GHz	10 to 30 MHz: 1.40 30 MHz to 4 GHz: 1.15 4 to 10 GHz: 1.20 10 to 15 GHz: 1.30 15 to 18 GHz: 1.35	–30 to –20 dBm; ±1%	100 mW avg 100 mW pk	Type-N(m)	Net 0.18 kg (0.41 lb) Shipping 0.9 kg (2 lb)	
8485D[3]	50 MHz to 26.5 GHz	0.05 to 0.1 GHz: 1.19 0.1 to 4 GHz: 1.15 4 to 12 GHz: 1.19 12 to 18 GHz: 1.25 18 to 26.5 GHz: 1.29	–30 to –20 dBm; ±2%	100 mW avg 100 mW pk	APC-3.5 mm (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)	
Option 033	50 MHz to 33 GHz	26.5 to 33 GHz: 1.35					
8487D[3]	50 MHz to 50 GHz	0.05 to 0.1 GHz: 1.19 0.1 to 2 GHz: 1.15 2 to 12.4 GHz: 1.20 12.4 to 18 GHz: 1.29 18 to 34 GHz: 1.37 34 to 40 GHz: 1.61 40 to 50 GHz: 1.89	–30 to –20 dBm; ±2%	100 mW pk 100 mW avg	2.4 mm (m)	Shipping 0.5 kg (1 lb) Net 0.2 kg (0.38 lb)	
R8486D[3]	26.5 to 40 GHz	1.4	–30 to –25 dBm; ±3%	100 mW avg or pk 40 Vdc max	Waveguide Flange UG-599/U	Net 0.26 kg (0.53 lb) Shipping 0.66 kg (1.3 lb)	
Q8486D[3]	33 to 50 GHz	1.4	–25 to –20 dBm; ±5%		Waveguide Flange UG-383/U		

[1] Negligible deviation except for those power ranges noted.
[2] For pulses greater than 30 W the maximum average power (P_a) is limited by the energy per pulse (E) in W – µs according to P_a=30-0.02E.
[3] Includes HP 11708A 30 dB attenuator for calibrating against a 0 dBm, 50 MHz power reference. HP 11708A is factory set to 30 dB ±0.05 dB at 50 MHz, traceable to NIST. SWR <1.05 at 50 MHz.
[4] This sensor directly replaces the popular HP 8484A power sensor.

Indicates QuickShip availability.

HP 8970B

- 10 to 1600 MHz (2047 MHz with Option 020)
- Accurate and simple, swept or CW measurements
- Second-stage correction
- Noise figure and gain display
- Calibrated display on oscilloscope, recorder, or plotter
- Powerful special-function enhancements
- Lo control for downconverter test

HP 8970B

HP 8970B Noise Figure Meter

With the HP 8970B noise figure meter, noise figure measurements are easy, accurate, and repeatable. Automatic second-stage correction makes accurate noise figure readings possible even for low-gain devices. The HP 8970B's dynamic range allows gain measurements of at least 40 dB (higher in some cases) or loss measurements to –20 dB, with no external attenuation or amplification. The HP 8970B can store up to four Excess Noise Ratio (ENR) noise source calibration tables. It also properly interpolates ENR values at each measurement frequency.

Microprocessor and Controller Functions

The HP 8970B takes the mystery out of noise figure measurements. It uses a microprocessor to make the calculations and corrections necessary for truly accurate, convenient, and flexible noise figure measurements. The meter also controls external local oscillators (such as the HP 8370 series synthesizers, the HP 8340 or HP 8360 series synthesized sweepers, or the HP 8350 sweep oscillator) and the HP 8971C noise figure test set. This makes accurate, broadband microwave measurements of amplifiers, mixers, and transistors as simple as RF measurements.

Virtually all of the HP 8970B's front-panel keys and functions are accessible over GPIB, Hewlett Packard's enhanced version of IEEE-488. The noise figure meter has an independent system interface bus (SIB) to control the HP 8971C and local oscillator. This additional bus frees you from having to write computer code to control an instrument on the SIB (such as the local oscillator) when used in an automated setup. Pass-through capability allows other instrument controllers to send messages through the noise figure meter to any other instrument on the SIB.

Simple Calibration and Second-Stage Correction

Noise figure measurement accuracy is enhanced because the meter measures its own noise figure (and that of the rest of the measurement system) at up to 181 points. It stores this information, interpolates where necessary, and corrects for it when displaying the device under test noise figure. It also measures the test device gain.

Display

The HP 8970B's front-panel LEDs display frequency, gain, and noise figure. Rear-panel BNC connectors allow swept display of noise figure and gain versus frequency on an oscilloscope or x-y recorder. You can also have the noise figure and gain vs. frequency display sent to a digital plotter over the HP 8970B's system interface bus. All display modes are easily and accurately scaled to the desired resolution from the meter's front panel. The swept oscilloscope display allows you to optimize your test device in real time for both noise figure and gain. You can easily change the noise figure display from noise figure to effective noise temperature (Te) or Y factor.

Front Panel and Special Functions

The HP 8970B front-panel keys control number entry, calibration, and measurement. STORE, RECALL, and SEQ keys allow up to nine front-panel settings to be stored and sequenced automatically or manually to save setup time. Smoothing INCREASE and DECREASE keys are used to average up to 512 readings before display. This increases accuracy and eliminates display flicker.

For those who need greater measurement power than that provided by the HP 8970B's simple front panel, more than 200 special functions can be selected by pressing a numerical code and a special function key. Two examples are hot-cold measurements and automatic compensation for losses at the input of the test device. One of the special functions is a catalog that quickly shows you the current special functions being used. Three pull-out cards serve as a mini-reference manual for the instrument. They include most of the special functions, the HP-IB formats and codes, error messages, and typical measurement setups.

HP 8970B Partial Specifications

(See Technical Data Sheet p/n 5091-6049E for complete specifications.)
Noise Figure (Gain) Measurement Range: 0 to 30 dB (–20 to at least 40 dB)
Noise Figure (Gain) Instrumentation Uncertainty: ± 0.1 dB for 0° to 55° C (±.15 dB)
Noise Figure Resolution: 0.01 dB (0.001 dB over GPIB)
Gain Resolution: 0.01 dB (0.001 dB over GPIB)
Frequency Range: Tunable from 10 to 1600 MHz (2047 MHz with Option 020)
Tuning Accuracy (from 10° to 40° C): ± (1 MHz + 1% of frequency), ±6 MHz maximum
Frequency Resolution: 1 MHz
Noise Figure (for input power levels below –60 dBm): <7 dB + 0.003 dB/MHz (+0.002 dB/MHz with option 020)
Input SWR, 50 Ω reference impedence
<1.7 10 MHz to 1600 MHz (SWR< 1.8 with Opt 020)
<2.0 1600 MHz to 2047 MHz (Opt 020 only)
Maximum Operating Input Power: –10 dBm
Maximum Net External Gain: >65 dB between noise source and HP 8970B RF input
Noise Source Drive: 28.0 ± 0.1 V
Operating Temperature: 0° to 55° C
Storage Temperature: – 55° to 75° C
Power: 100, 120, 220, or 240 V (+ 5%, – 10%); 48 to 66 Hz; 150 VA maximum
Size: 425 mm W x 143 mm H x 476 mm D (16.75 in x 5.68 in x 18.38 in)
Weight: net, 15.5 kg (34 lb); shipping, 18.5 kg (40 lb)

Key Literature

HP 8970B, 8970S/V, 8971C Noise Figure Measurement Products Technical Data, p/n 5091-6049E

Noise Figure Meters

Noise Sources

HP 346A
HP 346B
HP 346C
HP R347B
HP Q347B

HP 346A, 346B, 346C

HP 346A/B/C Broadband Noise Sources

The ideal companion to HP's noise figure meter and systems is the HP 346 family of noise sources. Since they are broadband (10 MHz to either 18 or 26.5 GHz), they eliminate the necessity for several sources at different frequency bands. Each source has individually-calibrated ENR values at specific frequencies. The calibration is printed on its label (see illustration) for easy loading into the HP 8970B. The low SWR of each noise source reduces a major source of measurement uncertainty—reflections of test signals. In addition, the variety of available connectors reduces the need for degrading accuracy with connector adapters.

The HP 346 family of noise sources are designed for a broad range of measurement applications. The HP 346C covers the broadest frequency range—10 MHz to 26.5 GHz. The HP 346B's high ENR, low SWR, and variety of connectors make it a general-purpose noise source. The HP 346A is designed especially for accurate characterization of input-impedance-sensitive devices (like GaAsFETs and many UHF amplifiers). Its very small change in reflection coefficient (<0.01) from ON to OFF minimizes errors when measuring noise figure and gain as a function of input impedance.

HP 346A/B/C Partial Specifications

(See Technical Data Sheet for complete specifications.)
Frequency Range
HP 346A/B: 10 MHz to 18 GHz
HP 346C: 10 MHz to 26.5 GHz
Excess Noise Ratio (ENR) Limits
HP 346A: 5 to 7 dB
HP 346B: 14 to 16 dB
HP 346C: 12 to 16 dB (10 MHz to 12 GHz) and
14 to 17 dB (12.0 to 26.5 GHz)
Maximum SWR (reflection coefficient) On and Off
HP 346A/B: 10 to 30 MHz – 1.3 (0.13); 30 to 5000 MHz – 1.15 (0.07);
5 to 18 GHz – 1.25 (0.11)
HP 346C: 10 MHz to 18 GHz – 1.25 (0.11); 18 to 26.5 GHz – 1.35 (0.15)
Power Required: 28 ±1 Vdc
Size: 21 mm W x 140 mm H x 30 mm D (0.8 in x 5.5 in x 1.2 in)
Weight: net, 0.108 kg (3.5 oz); shipping, 0.5 kg (1 lb)
Standard Connector: APC-3.5 (male)

HP 346C Option K01 Broadband Noise Source

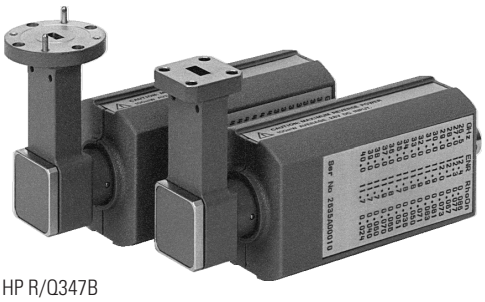
This coaxial noise source features coverage from 1 to 50 GHz with the 2.4-mm coaxial connector. ENR is nominally 20 dB at 1 GHz and 7 dB at 50 GHz. Contact Hewlett-Packard for technical specifications.

HP 346B Option H01 High ENR Noise Source

The HP 346B Option H01 has high ENR (21 dB typical), suitable for measuring high noise figure devices. Contact Hewlett-Packard for technical specifications.

HP 346B Option H42 DBS Noise Source

The 346B Option H42 was developed especially to test low noise block converters (LNB) used for Direct Broadcast Satellite (DBS). WR75 waveguide output, 5 dB ENR, low ENR calibration uncertainty, and low SWR improve the noise figure measurement accuracy of DBS LNBs. Contact HP for technical specifications.



HP R/Q347B

HP R347B and Q347B Noise Sources Partial Specifications

(See Technical Data Sheet for complete specifications.)
Frequency Range
HP R347B: 26.5 to 40 GHz
HP Q347B: 33 to 50 GHz
Excess Noise Ratio (ENR) Range
HP R347B: 10 to 13 dB
HP Q347B: 10 to 13 dB (33 to 42 GHz); 6 to 12.5 dB (42 to 50 GHz)
Maximum SWR (reflection coefficient)
HP R347B: <1.42 (0.17)
HP Q347B: <1.57 (0.22)

Key Literature

HP 346A/B/C Broadband Noise Sources Technical Data,
p/n 5953-6452

Ordering Information

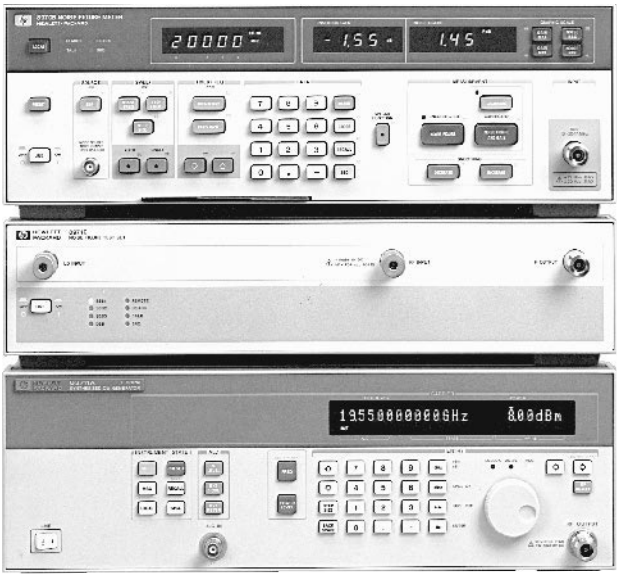
HP 8970B Noise Figure Meter
Opt 020 2047 MHz Upper Frequency
Opt 907 Front-Panel Handle Kit (5061-9689)
Opt 908 Rackmounting Flange Kit (5061-9677)
Opt 909 Both Options 907 and 908 (5061-9683)
Opt 915 Service Manual (08970-90023)
Opt 916 Additional Operating Manual (08970-90048)
Opt 700 External Mate Translator
Opt W30 Extended Repair Service
Opt W32 Calibration Service
HP 8971C Noise Figure Test Set
Opt 001 Add L.O. Power Amplifier
Opt 002 Delete RF Preamplifier
Opt 907 Front-Panel Handle Kit (5062-3988)
HP 8970S Noise Figure Measurement System
HP 8970V Noise Figure Measurement System
(10 MHz to 20 GHz)
Opt W30 Extended Repair Service
Opt W32 Calibration Service
HP 346A Noise Source
Opt 001 Type-N (male) Connector
Opt 002 APC-7 Connector
Opt 004 Type-N (female) Connector
Opt 910 Extra Operating Manual
Opt W30 Extended Repair Service
Opt W32 Calibration Service
HP 346B Noise Source
Opt 001 Type-N (male) Connector
Opt 002 APC-7 Connector
Opt 004 Type-N (female) Connector
Opt H01 High ENR
Opt H42 DBS Noise Source
Opt 910 Extra Operating Manual
Opt W30 Extended Repair Service
Opt W32 Calibration Service
HP 346C Noise Source
Opt 910 Extra Operating Manual
Opt W30 Extended Repair Service
Opt W32 Calibration Service
HP 346C Opt K01 Noise Source
HP R347B Noise Source
HP Q347B Noise Source

[1] Price on application.

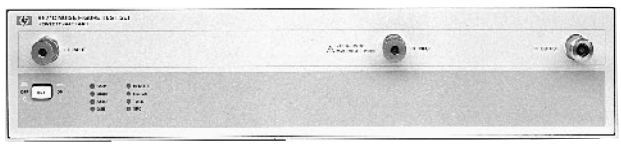
Indicates QuickShip availability.

HP 8970S
HP 8970V
HP 8971C

- 10 MHz to 26.5 GHz
- Fully specified system
- Removes double-sideband inaccuracies
- As easy to operate as the HP 8970B



HP 8970S/V



HP 8971C

HP 8970S/V Microwave Noise Figure Measurement Systems

The HP 8970S/V systems remove the burden of designing, building, and supporting a microwave noise figure measurement system. You can now spend your time designing and building products, not test systems.

Each system consists of the HP 8970B noise figure meter, the HP 8971C noise figure test set, and a synthesized local oscillator. The HP 8970V system, which operates 10 MHz to 20 GHz, uses the HP 83711B synthesized CW generator as its local oscillator. The HP 8970S allows you to select the LO from the list below. Frequency operation depends on the LO selected, but can be configured to measure 10 MHz to 26.5 GHz with the HP 83630B synthesized sweeper. The HP 8971C with Option 001 is recommended for operation above 20 GHz.

The HP 8970B acts as the controller, so all system operation is transparent to the user. To ensure specified performance, the HP 8970S/V systems are given specifications just like an RF noise figure meter (i.e., the HP 8970B).

HP 8970S/V Partial Specifications

(See HP 8970S/V Technical Data for complete specifications.)
Frequency Range
HP 8970S: 10 MHz to 26.5 GHz
HP 8970V: 10 MHz to 20 GHz
Noise Figure Measurement Range: 0 to 30 dB
Noise Figure Instrumentation Uncertainty (for a 14 to 16 dB ENR noise source in a 10° to 40° C environment and for device under test noise figure plus gain greater than 10 dB)
10 MHz to 18 GHz: ±0.2 dB (plus typical drift of ±0.015 dB/° C)
18 to 26.5 GHz: ±0.4 dB (plus typical drift of ±0.08 dB/° C)
Gain Instrumentation Uncertainty: ±0.28 dB (plus typical drift of ±0.05 dB/° C), 10 MHz to 18 GHz; ±0.07 dB/° C, 18 to 26.5 GHz
Noise Figure (maximum)
10 to 30 MHz: 18 dB
30 to 100 MHz: 13 dB
0.1 to 12 GHz: 10 dB
12 to 18 GHz: 11.5 dB
18 to 26.5 GHz: 14 dB
Input SWR: 10 MHz to 18 GHz: 2.25; 18 to 26.5 GHz: 2.7
Recommended Local Oscillators: HP 83620B, 83622B, 83623B/L, 83624B, 83630B/L, 83640B/L, 83650B/L, 83711B, 83712B, 83731B, 83732B, 83751A/B, 83752 A/B

HP 8971C Noise Figure Test Set

The HP 8971C noise figure test set brings the simplicity of double-sideband measurements and the accuracy of single-sideband measurements together in one package. Careful design and high-performance components, including a stable YIG filter, allow broadband single-sideband measurements from 10 MHz to 26.5 GHz with a single calibration and sweep. A low-noise preamplifier built into the noise figure test set lowers the second-stage noise figure, thereby reducing a major source of measurement uncertainty.

Measurement modes in the HP 8970B allow for double downconversion using the HP 8971C as the second downconverter. These modes can be used for millimeter-wave measurements of amplifiers and transistors and measurements of receivers and mixers with IFs above 1.6 GHz.

HP 8971C Partial Specifications

(See HP 8971C Technical Data for complete specifications.)
Frequency Range: 10 MHz to 26.5 GHz
Input SWR: 10 MHz to 18 GHz: 2.25; 18 to 26.5 GHz: 2.7
Image and Odd-Harmonic Rejection: 20 dB
Accessories Supplied
One LO-to-HP 8971C cable, SMA(female), 300 mm
One HP 8971C-to-HP 8970B cable, Type-N (male), 190 mm
One Type-N (male)-to-SMA (male) adapter
Two HP-IB cables, 0.5 m

Key Literature

HP 8970B, 8970S/V, 8971C Noise Figure Measurement Products Technical Data, p/n 5091-6049E

HP 8347A
HP 8447A
HP 8447D
HP 8349B
HP 8449B
HP 8348A

HP 8347A and HP 8447A/D Amplifiers

Specifications Summary

	HP 8347A RF Amplifier	HP 8447A Preamplifier	HP 8447D Preamplifier
Frequency range	100 kHz to 3 GHz	0.1 to 400 MHz	100 kHz to 1.3 GHz
Typical 3 dB bandwidth	—	50 kHz to 700 MHz	75 kHz to 1.7 GHz
Maximum leveled output power	≥ +20 dBm	—	—
Output power leveling range	(≥300 kHz): +2 to +20 dBm	—	—
Gain (mean, per channel)	≥25 dB	20 dB ± 1.0 dB at 10 MHz (20° to 30° C)	>25 dB (20° to 30° C)
Gain flatness across full frequency range	Internally leveled, ±300 kHz: ±1.5 dB	±1.8 dB (0° to 55° C) ±0.7 dB (20° to 30° C) characteristic	±1.5 dB
Noise figure	10 MHz to 3 GHz: 15 dB Below 10 MHz: 20 dB	<7 dB	<8.5 dB
Output power for 1 dB gain compression	+22 dBm	> +6 dBm	> +7 dBm typical
Third-order intercept	+30 dBm	—	—
Harmonic distortion	(at +20 dBm output) Internal level off (ALC off): ≤–25 dBc Internal level on (ALC on): ≤–20 dBc	–32 dB for 0 dBm output	–30 dB for 0 dBm output (typical)
Maximum input for minimum internally leveled output	–14 dBm	—	—
Output for <–60 dB harmonic distortion	–	–25 dBm (characteristic)	–30 dBm
VSWR	2.0: 1 input 1.5: 1 output internally leveled 2.0: 1 output unleveled below 2 GHz 3.0: 1 output unleveled 2 GHz to 3 GHz	<1.7	<2.0 input <2.2 output 1 to 1300 MHz
Reverse isolation	60 dB	>30 dB	>40 dB
Maximum dc voltage output	—	±10 V	±10 V
Size	213 mm W x 102 mm H x 298 mm D (8.4 in x 4.0 in x 11.8 in)	130 mm W x 85.8 mm H x 261 mm D (5.1 in x 3.4 in x 8.5 in)	130 mm W x 85.8 mm H x 216 mm D (5.1 in x 3.4 in x 8.5 in)
Weight	Net, 4 kg (8 lb); Shipping, 5 kg (11 lb)	Net, 1.56 kg (3.4 lb); Shipping, 2.3 kg (5.1 lb)	Net, 1.56 kg (3.4 lb); Shipping, 2.3 kg (5.1 lb)
Power requirements	—	110 or 230 Vac + 10%, 48 to 440 Hz, 15 W	110 or 230 Vac + 10%, 48 to 440 Hz, 15 W
Options available		**Option 001:** Dual-channel amp, BNC (f) connectors	**Option 001:** Dual-channel amp, BNC (f) connectors **Option 010:** Single-channel amp, Type-N (f) connectors **Option 011:** Dual-channel amp, Type-N (f) connectors

Key Literature

HP 8346A, 8347A, 8348A, 8349A Amplifiers Technical Data, p/n 5091-0370E

Ordering Information

HP 8347A RF Amplifier
HP 8447A Preamplifier
HP 8447D Preamplifier

HP 8348A Microwave Amplifier

Specifications

Frequency Range: 2.0 to 26.5 GHz
Maximum Output Power (at 0 dBm input):
1.0 to 2.0 GHz: ≥+20 dBm (typical)
2.0 to 20.0 GHz:≥+25 dBm
20.0 to 26.5 GHz: ≥+23 dBm
Power Flatness (at 0 dBm input): ±4 dB (typical)
Minimum Small Signal Gain (at –15 dBm input):
1.0 to 2.0 GHz: ≥20 dB (typical)
2.0 to 20.0 GHz: ≥25 dB
20.0 to 26.5 GHz: ≥23 dB

Spectral Purity
Harmonics (typical, at maximum specified output power):
1.0 to 2.0 GHz: <–20 dBc
2.0 to 26.5 GHz: <–15 dBc
Third-Order Intercept
2.0 to 20.0 GHz: +36 dBm, nominal
20.0 to 26.5 GHz: +31 dBm, nominal
Maximum Continuous Input
Microwave power:+22 dBm
DC voltage:±10 V
Input and Output Impedence: 50 Ω, nominal
Input SWR: 3:1 (typical)
Output SWR (typical):
1.0 to 2.0 GHz: 6:1
2.0 to 20.0 GHz: 4.5:1
20.0 to 26.5 GHz: 2:1
Reverse Isolation: >50 dB (typical)
Noise Figure (typical):
1.0 to 20 GHz: <10 dB
20 to 26.5 GHz: <13 dB

Pulse Transmission Capability
Rise/Fall Time: <5 ns (typical)
Delay Time: <5 ns (typical)

General
Input and Output Connectors: 3.5 mm male
Power Requirement: 50 to 400 Hz, 100, 120, 200, or 240 volts ac (±10%); 85 VA maximum
Size: 133 mm H x 214 mm W x 366 mm D (5.2 in x 8.4 in x 14.4 in)
Weight: Net, 7 kg (15 lb); shipping, 14 kg (31 lb)

Ordering Information

HP 8348A 2 to 26.5 GHz Microwave Preamplifier

HP 8349B Microwave Amplifier

Frequency Specifications

Frequency Range: 2 to 20 GHz

Output and Input Specifications (25° C ± 5° C)

Minimum Output Power (at +5 dBm input)

Frequency Range (HGz)	Output Leveled	Output Unleveled
2.0 to 18.6	19 dBm (80 mW)	20 dBm (100 mW)
18.6 to 20.0	17 dBm (50 mW)	18 dBm (63 mW)

1 dB Compression Point: +21 dBm, nominal
Power Flatness (leveled): ±1.25 dB
Minimum Small Signal Gain (at –5 dBm input):
2.0 to 18.6 GHz: 15 dB
18.6 to 20.0 GHz: 13 dB
Noise Figure: <13 dB, typical
Input and Output Impedence: 50 Ω, nominal

VSWR

Frequency Range (GHz)	Input	Output Leveled	Output Unleveled (typical)
2.0 to 5.0	≤2.8	≤2.5	≤4.8
5.0 to 11.0	≤2.8	≤2.5	≤3.8
11.0 to 18.0	≤2.8	≤2.5	≤3.2
18.0 to 20.0*	≤2.8	≤2.5	≤3.2

*VSWR from 18.0 to 20.0 GHz is typical

Maximum Continuous Input, to the Input or Output Ports:
+27 dBm (RF), ±10 Vdc

Spectral Purity
Harmonics (at +20 dBm output): 2.0 to 11.0 GHz: <–20 dBc; 11.0 to 20.0 GHz: <–30 dBc typical
Non-Harmonic Spurious: ≤–55 dBc
Third-Order Intercept: +33 dBm, nominal

Pulse Transmission Capability
Rise/Fall Time: <10 ns typical

General
Reverse Isolation: >50 dB, typical
RF Input and Output Connectors: Type-N female
Size: 214 mm W x 133 mm H x 366 mm D (8.36 in x 5.2 x 13.6 in)
Weight: Net, 7 kg (15 lb); shipping, 14 kg (31 lb)

Ordering Information

HP 8349B 2 to 20 GHz Microwave Amplifier
Opt 001 Rear Panel RF Input/Output
Opt 002 Rear Panel RF Input w/Front Panel RF Output
Opt W30 Extended Repair Service (see page 70)

HP 8449B Preamplifier

Specifications

Frequency range	1.0 to 26.5 GHz		
Gain (mean, per channel)	≥ 26 dB (20° to 30° C)		
Gain flatness across full freq. range	1 to 26.5 GHz ± 4.5 dB (0° to 55° C); 2 to 22 GHz ± 2.4 dB (20° to 30° C)		
Noise figure	**Band**	**Typical**	
	1.0 to 12.7 GHz	≤8.5 dB	7 dB
	12.7 to 22.0 GHz	12.5 dB	9 dB
	22.0 to 26.5 GHz	≤14.5 dB	12 dB
Output power for 1 dB gain compression	≤+7 dBm (characteristic)		
Harmonic distortion	–30 dB for 0 dBm output (characteristic)		
Output for <–60 dB harmonic distortion	–30 dBm (characteristic)		
VSWR	**Input**	1.0 to 2.0 GHz	2.0:1
		2.0 to 12.5 GHz	1.5:1
		12.5 to 26.5 GHz	2.0:1
	Output	1.0 to 26.5 GHz	2.0:1
Reverse isolation	>75 dB		
Maximum dc voltage	±20 V		

Displayed average noise level, 0 dB atten. (characteristic)

HP 8563E (1 Hz RBW)	HP 8566B (10 Hz RBW)
1.0 to 6.46 GHz, –165 dBm	1.0 to 2.5 GHz, –55 dBm
5.86 to 13.0 GHz, –163 dBm	2.0 to 5.8 GHz, –154 dBm
12.4 to 26.5 GHz, –160 dBm	5.8 to 12.5 GHz, –150 dBm
	12.5 to 18.6 GHz, –144 dBm
	18.6 to 22 GHz, –140 dBm

Size: 213 mm W x 102 mm H x 297 mm D (8.4 in x 4.0 in x 11.7 in)
Weight: Net, 4 kg (8.8 lb) nominal
Power: 100, 120, 220, or 240 V, ±10%; 47 to 63 Hz

Ordering Information

HP 8449B 1 to 26.5 GHz Preamplifier
Opt 907 Front Handle Kit
Opt 908 Rackmount Kit (half-rack width)

Microwave System Amplifiers

Various Models

- Ultra broadband to 50 GHz
- Up to 1 watt output power
- Compact size

HP Microwave System Amplifiers

Use these amplifiers to increase output power from microwave sources and to increase test system measurement speed with improved dynamic range. Drive a variety of narrowband travelling wave tubes with a single driver solution that is highly reliable and low in cost to maintain year after year. With excellent noise figure relative to its broad bandwidth and high gain, these amplifiers can make significant improvement to system noise figure. By using feedback to an external source ALC input, system designers can level output power at the test port, negating the effects of post sweeper reflections and losses. Place power where you need it with a remotely-locatable dc power supply. The amplifier and the power supply are provided with a 2-m dc bias cable.

Specifications (+20° to +30° C)

HP Model	Frequency (GHz)	Power out Psat (dBm)	Power out P1dBC (dBm)	Gain dB (min)	Noise figure (dB typ.)	Detected output	DC bias volt/amp	RF connectors (Input/Output)
83006A	0.01 to 26.5	+18 typ. 0.01 to 10 +16 typ. 10 to 20 +14 typ. 20 to 26.5	+13, 0.01 to 20 +10, 20 to 26.5	20	13, 0.01 to 0.1 GHz 8, 0.1 to 18 GHz 13, 18 to 26.5 GHz	No	+12 V at 450 mA –12 V at 50 mA	3.5 mm (f)
83017A	0.5 to 26.5	+20 typ. 0.5 to 20 +15 typ. 20 to 26.5	+18, 0.5 to 20 GHz +13, 20 to 26.5	25	8, 0.5 to 18 GHz 13, 18 to 26.5 GHz	Yes	+12 V at 700 mA –12 V at 50 mA	3.5 mm (f)
83018A	2 to 26.5	+24, 2 to 20 GHz +21, 20 to 26.5 GHz	+22, 2 to 20 GHz +17, 20 to 26.5 GHz	27, 2 to 20 GHz 23, 20 to 26.5 GHz	10, 2 to 20 GHz 13, 20 to 26.5 GHz	Yes	+12 V at 2 A –12 V at 50 mA	3.5 mm (f)
83020A	2 to 26.5	+30, 2 to 20 GHz +30, 20 to 26.5 GHz*	+28, 2 to 20 GHz +28, 20 to 26.5 GHz*	30, 2 to 20 GHz 27, 20 to 26.5 GHz	10, 2 to 20 GHz 13, 20 to 26.5 GHz	Yes	+15 V at 3.2 A –15 V at 50 mA	3.5 mm (f)
83050A	2 to 50	+20, 2 to 40 GHz +19, 40 to 50 GHz**	+15, 2 to 40 GHz +13, 40 to 50 GHz	21	6, 2 to 26.5 GHz 10, 26.5 to 50 GHz	No	+12 V at 830 mA –12 V at 50 mA	2.4 mm (f)
83051A	0.045 to 50	+12, .045 to 45 GHz +10, 45 to 50 GHz	+8, .045 to 45 GHz +6, 45 to 50 GHz	23	12, 0.045 to 2 GHz 6, 2 to 26.5 GHz 10, 26.5 to 50 GHz	No	+12 V at 425 mA –12 V at 50 mA	2.4 mm (f)
87405A	0.01 to 3	+26 typ.	+4	22-27 min./max.	6.5, 0.01 to 2 GHz 7.5, 2 to 3 GHz	No	+15 V at 80 mA	N (f)/N (m)
87415A	2 to 8	+26 typ.	+23	25	13	No	+12 V at 900 mA	SMA (f)

* –0.7 dB/GHz (20<f<26.5)
** 19 dBm –0.2 dB/GHz (40<f<50)

Dimensions:
HP 83006A, 83017A, 83050A, 83051A, 87415A: 132 mm L x 103 mm W x 45 mm H (4 in x 1.8 in x 5.2 in)
HP 83018A: 212 mm L x 114 mm W x 76 mm H (4.5 in x 3 in x 8.3 in)
HP 83020A: 275 mm L x 202 mm W x 87 mm H (8 in x 3.4 in x 10.8 in)
HP 87405A: 125 mm L x 28 mm W x 28 mm H (4.9 in x 1.1 in x 1.1 in)

Weight:
HP 83006A, 83017A, 83050A, 83051A, 87415A: .64 kg (1.4 lb);
HP 83018A: 1.8 kg (4 lb); **HP 83020A:** 3.9 kg (8.5 lb);
HP 87405A: .27 kg (0.6 lb)

Bias Cable:
2-m cable with a connector on one end and bare wires on the other, shipped with the amplifiers below
HP 83006A, 83017A, 83018A, 83050A, 83051A, 87415A:
HP p/n 83006-60004
HP 83020A: HP p/n 83020-60004
2-m cables to connect between amplifier and power supplies, shipped with power supplies below
HP 87421A: HP p/n 83006-60005
HP 87422A: HP p/n 87422-60001, 83006-60005

HP power supply	AC Input voltage	DC Output voltage/current	Output power	Size (H,W,D)
HP 87421A	100 to 240 VAC 50/60 Hz	+12 V at 2.0 A, –12 V at 200 mA	25 W max	57 mm, 114 mm, 176 mm 2.3 in, 4.5 in, 6.9 in
HP 87422A	100 to 240 VAC 50/60 Hz	+15 V at 3.3 A, –15 V at 50 mA +12 V at 2.0 A, –12 V at 200 mA	70 W max	86 mm, 202 mm, 276 mm 3.4 in, 8.0 in, 10.9 in

Key Literature

Latest *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E

For more information, visit our web site: **http://www.hp.com/go/MTA**

HP 87130A

HP 11713A Attenuator/Switch Driver

The HP 11713A attenuator/switch driver provides simple GPIB control of up to ten, 24 Vdc solenoid-activated switch or attenuator sections. The HP 11713A supplies 24 Vdc common and ten pairs of current sinking contacts to achieve control of up to ten relays. Each HP 11713A is supplied with two plug-in drive cables to simplify connection to programmable attenuators.

HP 70611A Attenuator/Switch Driver for MMS

The HP 70611A is a one-slot MMS module capable of driving up to 248 electromechanical switches or attenuator switch sections. The HP 70611A is MSIB, SCPI, and GPIB compatible. In addition to being programmable, the HP 70611A features an extremely user-friendly manual interface via any MMS display unit. The highlight of the manual interface is the operator's ability to customize groups of switch control lines and their settings, then identify these switch settings with user-defined alphanumeric labels. In this manner, end users of the HP 70611A can define custom menus with their own identification labels for simplified manual control.

The HP 70611A can store up to 256 user-defined labeled paths. Path definitions can be stored in non-volatile EEROM. Groups of paths can be stored in directories for easy access to similar path commands. The HP 70612A/C and 70613A/C offer compatible capacity with built-in RF switches. (Configurations vary and custom configurations are available.)

HP 87130A Attenuator/Switch Driver

The HP 87130A is a 3.5-inch, full rack width attenuator/switch driver capable of driving up to 248 electromechanical switch or attenuator sections. The HP 87130A is controlled over GPIB via Standard Commands for Programmable Instruments (SCPI) commands. The HP 87130A has been designed for use in both ATE switching systems and computer-controlled bench top applications.

The HP 87130A is electronically identical to the HP 70611A and shares its performance characteristics, with the exception of the manual control method. The HP 87130A has no front panel controls. Manual control of the HP 87130A is realized through its ITG driver and a computer controller. The HP 87130A can drive 31 switch or attenuator sections directly, and up to an additional 217 switches via seven additional HP 84940A driver cards.

HP E1368A, E1369A and E1370A VXI Attenuator/Switch Drivers

HP's VXI family of instrumentation includes modules for microwave switching and attenuation control up to 18.0 GHz. HP E1368A contains three factory-installed SPDT switches such as the HP 8762B which features all-port termination, dc to 18.0 GHz. HP E1369A is identical to the HP E1368A except the switches are not included. This allows user-substitution of HP 8763 or HP 8764 transfer switches. HP E1370A allows the user to customize the internal configuration for HP 8766 series multi-port switches or HP 8494/95/96/97 step attenuators.

HP 84940A Switch Driver and HP 84941A Distribution Card

The HP 84940A is an expansion driver card for the HP 70611/12/13 family of MMS attenuator/switch drivers and the HP 87130A attenuator/switch driver. The HP 84940A has been designed for incorporation into large interfaces located remotely from their controller. A single HP 84940A can control up to 31 switches when located up to 150 feet (45 m) from an HP 70611/12/13 or HP 87130A. The physical interconnection to the switches or attenuators is realized via 31 four-pin output connectors, which permit quick connection and disconnection of the switches or attenuators.

Key Literature

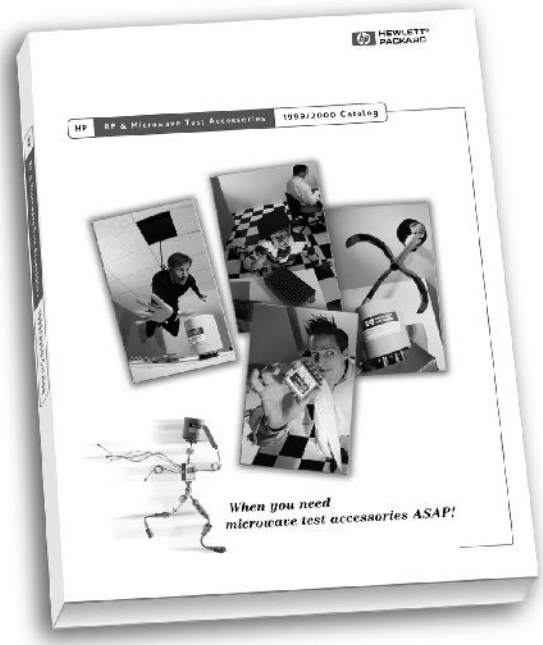
Latest *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E

For more information, visit our web site: **http://www.hp.com/go/MTA**

Ordering Information

HP 11713A Attenuator/Switch Driver
HP 11717A Attenuator/Switch Driver Rack Support Shelf
HP 11761A; HP 8765 to **HP 11713A** Adapter Cable
HP 11764A; HP 84904/6/7 to **HP 11713A** Adapter Cable
HP 11764B; HP 84904/6/7 5-ft Ribbon Cable with 10-pin DIP Connector
HP 44476B Microwave Switch Module for HP 3488A (Holds up to two HP 8762/3/4 Option 011 Switches)
HP 70611A MMS Switch Driver
HP 84940A Attenuator/Switch Driver Expansion Card
HP 84941A Distribution Expansion Card
HP 87130A Attenuator/Switch Driver
HP E1368A 18 GHz Microwave Switch
HP E1369A Microwave Switch Driver
HP E1370A Microwave Switch/Step Attenuator Driver

Indicates QuickShip availability.



RF & Microwave Test Accessories Catalog

The complete catalog of HP's microwave accessories—from adapters to waveguides and everything between, it's all here. Amplifiers, detectors, filters, step and fixed attenuators, switches and switch drivers—the entire HP product line, with all the technical specs.

To receive your free copy in the U.S., call 800-452-4844 and ask for the new *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E, contact your local HP representative, or order on the World Wide Web **http://www.hp.com/go/tmcatalogs.** The entire catalog is also viewable on the web: **http://www.tmo.hp.com/tmo/literature/English/mta99.html**

HP Coaxial Switches

HP coaxial switches feature low SWR, low insertion loss, and excellent isolation. HP offers a broad line of coaxial switches, covering up to 40 GHz, for use in test and measurement applications. All switches use magnetically-latched solenoids and break-before-make RF contacts for test simplicity.

HP 8761 Series

HP 8761A/B is a SPDT switch which operates up to 18 GHz. Each port features six connector options plus 50 Ω termination for design flexibility. These switches offer exceptional repeatability of 0.03 dB over 1 million switching cycles.

HP 8762 Series

HP 8762A/B/C switches operate up to 26.5 GHz. These switches offer exceptional repeatability of 0.03 dB over 1 million switching cycles. They provide exceptional isolation of 90 dB to 18 GHz and all-port switched terminations, so that all ports maintain a 50 Ω match. Internal loads are rated at 1 watt average (100 W peak, 10 μsec pulse width). Control voltage options T15 and T24 are compatible with TTL/5 V CMOS drive circuitry. Another model, HP 8762F is designed for 75 Ω transmission lines, making it valuable for commercial communication applications up to 4 GHz.

HP 8763 Series

HP 8763A/B/C switches operate up to 26.5 GHz. These switches offer exceptional repeatability of 0.03 dB over 1 million switching cycles. They are preferred for drop-out or drop-in applications because of their compact design. These switches are used to automatically insert or remove a test component from a signal path. Because of their excellent isolation, they can also be used as the intersection (crosspoint) switch in full-access matrix switching applications. One port is internally terminated. Options T15 and T24 are available for TTL/5 V CMOS compatibility.

HP 8764 Series

HP 8764A/B/C switches are available in three models up to 26.5 GHz. These switches offer exceptional repeatability of 0.03 dB over 1 million switching cycles. These switches are similar to the HP 8763, but with the internal termination replaced with a fifth port. The fifth port can be utilized for signal path reversal or as a calibration port. Options T15 and T24 offer TTL/5V CMOS compatibility.

HP 8765 Series

HP 8765A/B/C/D/F are available in four models up to 40 GHz, as well as a 75 Ω model to 4 GHz. These SPDT switches offer exceptional repeatability of 0.03 dB over 5 million switching cycles. Unlike the HP 8762 switches, they do not have internal, switched RF loads or dc current interrupts. Coil voltage options cover the complete range from 5 Vdc to 24 Vdc. Since the coils are not interrupted, the coil voltage may be continuous or may be switched off after 15 ms.

The standard HP 8765 comes with ribbon cables and standard printed circuit board 0.025-inch connector for convenient assembly. The ribbon cable also connects with the HP 11761A Cable/Adapter which permits direct connection to the HP 11713A Attenuator/Switch Driver. The HP 8765 can also be driven by the HP 87130A driver, but position monitoring and reporting are not available. Optional solder terminals are available.

Key Literature

Latest *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E

Ordering Information

HP 8761A/B Coaxial Switches
Specify voltage and connectors (including built-in 50 Ω terminations) by alphabetic suffix on the switch model number and the appropriate 3-digit option number. Specify all connectors.
HP 8761A 12 to 15 V Supply Voltage
HP 8761B 24 to 30 V Supply Voltage
Connector Options (Port 1, Port 2, Port C):

Option Code	Connector Type
0	Type-N(f)
1	Type-N(m)
2	APC-7 w/threaded sleeve
3	APC-7 w/coupling nut
4	APC-7 for UT-250 coax
5	SMA(f)
6	SMA(m)
7	50 Ω termination

HP 8762, HP 8763, HP 8764 Coaxial Switches
Specify the frequency and voltage by the alphabetic suffix and option number. The standard model has 24 V supply voltage.
HP 8762A SPDT, DC to 4 GHz
HP 8762B SPDT, DC to 18 GHz
HP 8762C SPDT, DC to 26.5 GHz
HP 8762F SPDT, DC to 4 GHz, 75 Ω
HP 8763A 4-Port, DC to 4 GHz
HP 8763B 4-Port, DC to 18 GHz
HP 8763C 4-Port, DC to 26.5 GHz
HP 8764A 5-Port, DC to 4 GHz
HP 8764B 5-Port, DC to 18 GHz
HP 8764C 5-Port, DC to 26.5 GHz
Opt 011 5 Vdc Supply Voltage
Opt 015 15 Vdc Supply Voltage
Opt T15 TTL/5 V CMOS Compatible Logic with 15 Vdc Supply Voltage
Opt T24 TTL/5 V CMOS Compatible Logic with 24 Vdc Supply Voltage
Opt UK6 Commercial Calibration Test Data with Certificate

HP 8765 Coaxial Switches
A voltage option must be ordered with the switch. Specify frequency, voltage, dc connectors, and ribbon cable extension options by alphabetic suffix and option number.
HP 8765A SPDT, DC to 4 GHz
HP 8765B SPDT, DC to 20 GHz
HP 8765C SPDT, DC to 26.5 GHz
HP 8765D SPDT, DC to 40 GHz
HP 8765F SPDT, DC to 4 GHz, 75 Ω
Opt 005 5 Vdc Supply Voltage
Opt 010 10 Vdc Supply Voltage
Opt 015 15 Vdc Supply Voltage
Opt 024 24 Vdc Supply Voltage
Opt 100 Solder Terminals
Opt 108 8-in Ribbon Cable Extension
Opt 116 16-in Ribbon Cable Extension
Opt 292 2.92 mm (f) Connector[1]
Opt UK6 Commercial Calibration Test Data with Certificate[2] (HP 8765A/B/C/D only)

[1]Option 292 available for 8765D only.
[2]8765D Option 292 and 8765F do not have Option UK6.

Indicates QuickShip availability.

HP 8761–5 Series Specifications

HP Model	Frequency Range (GHz)	SWR 50 Ω Nominal	Insertion Loss	Isolation	Switching Speed	Repeat-ability[2]	Life[3]	RF Connectors	Dimensions W x H x D (mm)	Shipping Weight (g)	
8761A SPDT Unterminated	dc to 18	<1.2 to 12.4 GHz <1.25 to 18 GHz	<0.5 dB to 12.4 GHz <0.8 dB to 18 GHz	>50 dB to 12.4 GHz >45 dB to 18 GHz	35 to 50 mS	0.03 dB	1 x 10^6	See table on page 30.3	38 x 41 x 38	300	
8761B SPDT Unterminated	dc to 18	<1.2 to 12.4 GHz <1.25 to 18 GHz	<0.5 dB to 12.4 GHz <0.8 dB to 18 GHz	>50 dB to 12.4 GHz >45 dB to 18 GHz	35 to 50 mS	0.03 dB	1 x 10^6	See table on page 30.3	38 x 41 x 38	300	
8762A SPDT Terminated	dc to 4	<1.1 to 2 GHz <1.2 to 4 GHz	<0.2 db to 2 GHz <0.25 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10^6	SMA (f)	53 x 14 x 54	220	
8762B SPDT Terminated	dc to 18	<1.10 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<0.2 dB to 2 GHz <0.5 dB to 18 GHz	>90 dB to 18 GHz	<30 mS	0.03 dB	1 x 10^6	SMA (f)	53 x 14 x 54	220	
8762C SPDT Terminated	dc to 26.5	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.4 to 18 GHz <1.8 to 26.5 GHz	<0.25 dB to 2 GHz <0.5 dB to 18 GHz <1.25 dB to 26.5 GHz	>90 dB to 18 GHz >50 dB to 26.5 GHz	<30 mS	0.03 dB	1 x 10^6	3.5 mm (f)	53 x 14 x 54	220	
8762F SPDT, 75 Ω Terminated	dc to 4	<1.15 to 1 GHz <1.3 to 4 GHz	<0.4 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10^6	75 Ω, SMB (m)	53 x 14 x 54	300	
8763A Coaxial Terminated	dc to 4	<1.1 to 2 GHz 1.2 to 4 GHz	<0.2 dB to 2 GHz <0.25 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10^6	SMA (f)	53 x 14 x 54	220	
8763B Coaxial Terminated	dc to 18	<1.10 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<0.2 dB to 2 GHz <0.5 dB to 18 GHz	>90 dB to 18 GHz	<30 mS	0.03 dB	1 x 10^6	SMA (f)	53 x 14 x 54	220	
8763C Coaxial Terminated	dc to 26.5	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.4 to 18 GHz <1.8 to 26.5 GHz	<0.25 dB to 2 GHz <0.5 dB to 18 GHz <1.25 to 26.5 GHz	>90 dB to 18 GHz >50 dB to 26.5 GHz	<30 mS	0.03 dB	1 x 10^6	3.5 mm (f)	53 x 14 x 54	220	
8764A Coaxial Unterminated	dc to 4	<1.1 to 2 GHz <1.2 to 4 GHz	<0.2 dB to 2 GHz <0.25 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10^6	SMA (f)	53 x 14 x 54	220	
8764B Coaxial Unterminated	dc to 18	<1.10 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<0.2 dB to 2 GHz <0.5 dB to 18 GHz	>90 dB to 18 GHz	<30 mS	0.03 dB	1 x 10^6	SMA (f)	53 x 14 x 54	220	
8764C Coaxial Unterminated	dc to 26.5	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.4 to 18 GHz <1.8 to 26.5 GHz	<0.25 dB to 2 GHz <0.5 dB to 18 GHz <1.25 dB to 26.5 GHz	>90 dB to 18 GHz >50 dB to 26.5 GHz	<30 mS	0.03 dB	1 x 10^6	3.5 mm (f)	53 x 14 x 54	220	
8765A SPDT Unterminated	dc to 4	<1.2 to 4 GHz	0.2 +0.025 f (GHz) max <0.2 to 4 GHz[1]	>120 dB to 4 GHz	<15 mS	0.03 dB	5 x 10^6	SMA (f)	33 x 14 x 45	200	
8765B SPDT Unterminated	dc to 20	<1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz	0.2 +0.025 f (GHz) max <0.2 to 4 GHz[1] <0.5 to 20 GHz[1]	>120 dB to 4 GHz >90 dB to 20 GHz	<15 mS	0.03 dB	5 x 10^6	SMA (f)	33 x 14 x 45	200	
8765C SPDT Unterminated	dc to 26.5	<1.25 to 4 GHz <1.45 to 18 GHz <1.7 to 26.5 GHz	0.25 +0.027 f (GHz) max <0.2 to 4 GHz[1] <0.5 to 20 GHz[1] <0.7 to 26.5 GHz[1]	>120 dB to 4 GHz >90 dB to 20 GHz >60 dB to 26.5 GHz	<15 mS	0.03 dB	5 x 10^6	3.5 mm (f)	33 x 14 x 45	200	
8765D SPDT Unterminated	dc to 40	<1.25 to 4 GHz <1.45 to 26.5 GHz <1.7 to 40 GHz	0.2 +0.23 f (GHz) max <0.2 to 4 GHz[1] <0.5 to 20 GHz[1] <0.7 to 26.5 GHz[1] 0.75 + .023 f (GHz) max <1.0 to 40 GHz1	>120 dB to 4 GHz >90 dB to 20 GHz >60 dB to 26.5 GHz >50 dB to 40 GHz	<15 mS	0.03 dB	5 x 10^6	2.4 mm (f) 2.92 mm (f) Option 292	33 x 14 x 45	200	
8765F SPDT, 75 Ω Unterminated	dc to 4	<1.15 to 1 GHz <1.20 to 4 GHz	<0.18 dB to 1 GHz <0.24 dB to 2 GHz <0.40 dB to 4 GHz	>100 dB to 1 GHz >90 dB to 4 GHz	<15 mS	0.03 dB	5 x 10^6	75 Ω, SMB (m	33 x 14 x 45	200	

[1] Typical insertion loss
[2] Measured at 25°C
[3] Cycles per section minimum

For more information, visit our web site: **http://www.hp.com/go/MTA**

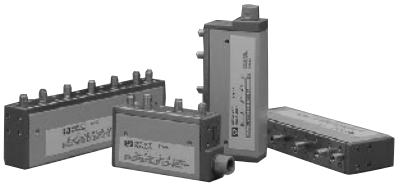
Indicates QuickShip availability.

NEW

HP 87222C/E

HP 87406B

HP 87204B



HP 8766

Transfer Switches–High Performance NEW

The HP 87222C/E 4-port, coaxial transfer switches offer versatility in a number of applications from drop-out to signal reversal. They provide exceptional repeatabilty < .03 dB, a low insertion loss and high isolation. The HP 87222C operates from dc-26.5 GHz and is warranted for 5 million cycles. The HP 87222E operates from dc-50 GHZ. The standard HP 87222C provides a 10-pin connector while Option 100 includes solder terminals. Option 201 provides a mounting bracket.

5

Matrix Switches–High Performance, Terminated

HP 87406/606 Series

The HP 87406B and 87606B 6-port, coaxial matrix switches will provide a valuable tool for 3x3, 2x4, and 1x5 configurations. These high performance matrix switches offer excellent repeatability and life greater than 5 million cycles. The HP 87406B, 87606B operate from dc to 20 GHz with excellent isolation, VSWR < 2.0:1, and with an input power of 1 W avg./50 W peak (10 μs max). The standard HP 87406B/606B provide a 16-pin connector while Option 100 provides solder terminals. Option T24 is available which provides internal circuits that are compatible with external TTL/5 V CMOS digital ICs.

Multiport–High Performance, Terminated

HP 87104/106 and HP 87204/206 Series

HP 87104A/B/C and 87106A/B/C multiport switches are available in 3 models up to 26.5 GHz. These switches offer exceptional repeatability of 0.03 dB over 5 million switching cycles. HP 87104 is a Single-Pole-4-throw (SP4T) and HP 87106 is a SP6T function. Both switches have internal solid-state logic which automatically programs the non-used ports to a matched load when any one port is programmed to "on". This relieves the user from having to provide external logic drive pulses.

HP 87204A/B/C and 87206A/B/C switches are fully equivalent to models HP 87104/06 in their RF switching performance. However, their drive circuits are primarily designed to work with the HP 87130A/11760A switch drivers. These switches do not provide independent position indicators. The standard HP 87204/06 provides a 16-pin connector while Option 100 provides solder terminals.

Multiport–Low Profile, Unterminated

HP 8766/67/68/69K Series

HP 8766/67/68/69K series switches are modified versions of the HP 8494/95/96/97 series step attenuators (dc–26.5 GHz) for applications requiring a single-pole, 3-throw, 4-throw, 5-throw or 6-throw coaxial switch. The switch ports are unterminated. These switches offer exceptional repeatability of 0.03 dB over 5 million switching cycles. The switches are available with several optional cables and connectors to make them compatible with standard 14-pin DIP sockets. Isolation and insertion loss vary with frequency, and depend upon the port selected.

Key Literature

Latest *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E

For more information, visit our web site: **http://www.hp.com/go/MTA**

Ordering Information

HP 87104A SP4T, DC to 4 GHz
HP 87104B SP4T, DC to 20 GHz
HP 87104C SP4T, DC to 26.5 GHz
HP 87106A SP6T, DC to 4 GHz
HP 87106B SP6T, DC to 20 GHz
HP 87106C SP6T, DC to 26.5 GHz
HP 87204A[1] SP4T, DC to 4 GHz
HP 87204B[1] SP4T, DC to 20 GHz
HP 87204C[1] SP4T, DC to 26.5 GHz
HP 87206A[1] SP6T, DC to 4 GHz
HP 87206B[1] SP6T, DC to 20 GHz
HP 87206C[1] SP6T, DC to 26.5 GHz
HP 87222C SP4T, DC to 26.5 GHz NEW
HP 87222E SP4T, DC to 50 GHz NEW
  Opt 201[3] Mounting Bracket
HP 87406B SP6T, DC to 20 GHz
HP 87606B SP6T, DC to 20 GHz
  Opt 100 Solder Terminals
  Opt T24 TTL/5 V CMOS Compatible Logic
  Opt T00[2] Solder Terminals to Replace Ribbon Cable TTL/5V CMOS compatability
  Opt UK6 Commercial Calibration Test Data with Certificate

HP 8766K, HP 8767K, HP 8768K, HP 8769K Coaxial Switches
Specify RF connectors (and frequency), supply voltages, dc connectors by option number. Standard unit is 24 Vdc, 3.5–mm (f) RF connectors (dc to 26.5 GHz), and Viking-type dc connector.

HP 8766K SP3T Multi-Port Switch
HP 8767K SP4T Multi-Port Switch
HP 8768K SP5T Multi-Port Switch
HP 8769K SP6T Multi-Port Switch
  Opt 002 Replace 3.5 mm (f) w/ SMA (m) Connectors
  Opt 008 8-inch Ribbon Cable w/DIP Connector
  Opt 011 5 Vdc Supply Voltages
  Opt 015 15 Vdc Supply Voltages
  Opt 016 16-inch Ribbon Cable w/DIP Connector
  Opt UK6 Commercial Calibration Test Data with Certificate

[1] Provides sensing capability with 87130A and 70611A
[2] HP 87406B only
[3] HP 87222C/E only

Indicates QuickShip availability.

HP 87104/6 Series, 87204/6, 87222C/E, 87406B/606B, 8766/7/8/9 Series Specifications

HP Model	Frequency Range (GHz)	SWR (50 Ω Nominal)	Insertion Loss (db)	Isolation (db)	Switching Time (max)	Repeat-ability[1]	Life (min.)	RF Connectors	Dimensions W x H x D (mm)	Shipping Weight (g)
87104A/204A SP4T	dc to 4	<1.2 to 4 GHz	0.3 + .015 x f (GHz)	>100 to 4 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87104B/204B SP4T	dc to 20	<1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz	0.3 + .015 x f (GHz)	>100 to 12 GHz >70 at 20 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87104C/204C SP4T	dc to 26.5	<1.7 to 20 to 26.5 GHz	0.3 + .015 x f (GHz)	>65 20 to 26.5 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87106A/206A SP6T	dc to 4	<1.2 to 4 GHz	0.3 + .015 x f (GHz)	>100 to 4 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87106B/206B SP6T	dc to 20	<1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz	0.3 + .015 x f (GHz)	>100 to 12 GHz >70 at 20 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87106C/206C SP6T	dc to 26.5	<1.7 to 20 to 26.5 GHz	0.3 + .015 x f (GHz)	>65 20 to 26.5 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87222C NEW	dc to 26.5	<1.1 to 2 GHz <1.15 to 4 GHz <1.25 to 12.4 GHz <1.4 to 20 GHz	0.2 + .025 x f (GHz)	>90 dB at 26.5 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	32 x 69 x 32	100
87222E NEW	dc to 50	<1.3 to 10 GHz <1.4 to 18 GHz <1.5 to 25 GHz <1.7 to 40 GHz <1.9 to 50 GHz	0.26 + .026 x f (GHz)	60 at 50 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	32 x 69 x 32	100
87406B/606B	dc to 20	<1.21 to 4 <1.35 to 10 <1.5 to 15 <1.7 to 18 <1.9 to 20	0.34 + 0.033 x f (GHz)	<100 to 12 GHz <80 to 15 GHz <70 to 20 GHz	15 ms	0.03	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
8766K SP3T	dc to 26.5 or dc to 18 for Option 002	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz	Port 1: 0.2 dB + 0.05 dB/GHz Port 2: 0.2 dB + 0.06 dB/GHz Port 3: 0.2 dB + 0.08 dB/GHz Port 4: 0.25 dB + 0.095 dB/GHz Port 5: 0.25 dB + 0.108 dB/GHz Port 6: 0.25 dB + 0.12 dB/GHz	Consult Technical Data Sheet	20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 82	178
8767K SP4T	dc to 26.5 or dc to 18 for Option 002	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz			20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 105	235
8768K SP5T	dc to 26.5 or dc to 18 for Option 002	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz			20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 133	292
8769K SP6T	dc to 26.5 or dc to 18 for Option 002	<1.3 to 8 GHz <1.55 to 12.4 GHz <1.8 to 18 GHz <2.05 to 26.5 GHz			20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 160	349

[1]Measured at 25° C

For more information, visit our web site: **http://www.hp.com/go/MTA**

HP 84904K
HP 84906K
HP 84907K
HP 84904L
HP 84906L
HP 84907L

HP 84904/6/7K and L

High-Performance Programmable Step Attenuators—dc to 40 GHz

5

HP 84904K/L (0-11, dB steps)
HP 84906K/L (0-90, dB steps)
HP 84907K/L (0-70, dB steps)

The HP 84904/906/907 family of programmable step attenuators offers unmatched attenuation performance to 40 GHz. The K model brings superior accuracy and reliability to 26.5 GHz, while the L model offers unparalleled performance to 40 GHz.

HP step attenuators consist of 3 or 4 cascaded sections of specific attenuation values, e.g., 1, 2, 4, 10, 20 and 40 dB. Both families offer the selection, performance, accuracy and reliability expected from HP attenuators: attenuation ranges of 11, 70, or 90 dB, 1 dB and 10 dB step sizes, 5 million cycles per section, better than 0.03 dB repeatability, connector size options and the choice of male or female connectors. RF connector choices include precision 3.5-mm or 2.92-mm on the 26.5 GHz K model, and precision 2.4-mm or 2.92-mm on the L model. While the 2.92-mm connector format is compatible with both 3.5-mm and SMA connectors, Hewlett-Packard recommends the more rugged 2.4-mm and 3.5-mm connectors.

HP programmable step attenuators feature electromechanical designs which achieve 20 milliseconds switching time, including settling time. The permanent magnet latching allows automatic interruption of the dc drive voltage to cut power consumption and simplify circuit design. They are equipped with 10-pin DIP sockets (m) with interconnect cables available.

Programmable Driver Instruments

Drive options include the HP 11713A and 87130A attenuator/switch drivers, which permit users to easily integrate the attenuator into GPIB compatible automatic test systems, and the HP 70611 MMS attenuator/switch driver. Cabling options include 8- or 16-inch ribbon cables (HP 11764C/D) with a 10-pin DIP socket (f) and a 14-pin DIP plug for easy connection to standard 14-pin DIP IC sockets, a 5-foot Interconnect Cable (HP 11764A) with 10-pin DIP socket (f), and a "Viking" connector for the HP 11713A driver, and a 5-foot Interconnect Cable (HP 11764B) with a 10-pin DIP socket (f) and bare leads for custom applications. Option 100 series replaces one female connector with a male connector to allow end-to-end connection of 1 dB and 10 dB step attenuators.

Key Literature

Latest *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E

For more information, visit our web site: **http://www.hp.com/go/MTA**

Ordering Information

Attenuators
HP 84904K 0 to 11 dB, 1 dB steps, 26.5 GHz
HP 84904L 0 to 11 dB, 1 dB steps, 40 GHz
HP 84906K 0 to 90 dB, 10 dB steps, 26.5 GHz
HP 84906L 0 to 90 dB, 10 dB steps, 40 GHz
HP 84907K 0 to 70 dB, 10 dB steps, 26.5 GHz
HP 84907L 0 to 70 dB, 10 dB steps, 40 GHz
Opt 006 Female 2.92-mm Connectors (L models only)
Opt 011 5 Vdc Supply Voltage
Opt 015 15 Vdc Supply Voltage
Opt 100 Male 2.4-mm Connector (L models only)
Opt 104 Male 3.5-mm Connector (K models only)
Opt 106 Male 2.92-mm Connector (L models only)
Opt UK6 Commercial Calibration Test Data with Certificate

Attenuator Accessories
HP 11764A Interconnect Cable with 10-pin Socket (f) to "Viking" Connector for HP 11713A
HP 11764B Interconnect Cable with 10-pin DIP Socket (f) and Bare Leads
HP 11764C Interconnect Cable with 203-mm (8 in) Ribbon Cable, 10-pin DIP Socket, 14-pin DIP Plug
HP 11764D Interconnect Cable with 406-mm (16 in) Ribbon Cable, 10-pin DIP Socket, 14-pin DIP Plug

HP 84904/6/7K/L Specifications

HP Model	Frequency Range (GHz)	Attenuation Range	Maximum SWR Std (Option 006)	Insertion Loss 0 dB Setting	Repeatability[1]	Life[2]	Shipping Weight
84904K	dc to 26.5	0 to 11 dB	1.3 (1.5) to 12.4 GHz	0.8 dB + 0.04 dB/GHz	0.03 dB	5 x 10^6	291 g
84904L	dc to 40	1 dB steps	1.7 (1.9) to 34 GHz				(10.3 oz)
			1.8 (2.0) to 40 GHz				
84906K	dc to 26.5	0 to 90 dB	1.3 (1.5) to 12.4 GHz	0.8 dB + 0.04 dB/GHz	0.03 dB	5 x 10^6	291 g
		10 dB steps	1.7 (1.9) to 34 GHz				(10.3 oz)
84906L	dc to 40		1.8 (2.0) to 40 GHz				
84907K	dc to 26.5	0 to 70 dB	1.25 (1.4) to 12.4 GH;	0.6 dB + 0.03 dB/GHz	0.03 dB	5 x 10^6	229 g
		10 dB steps	1.5 (1.7) to 34 Gz				(8.1 oz)
84907L	dc to 40		1.7 (1.9) to 40 GHz				

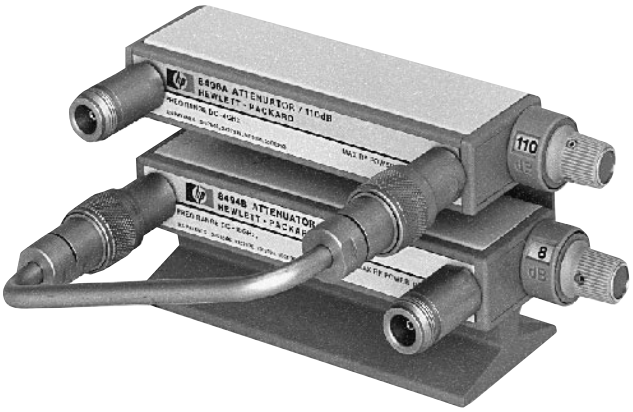
Sensitivity power: dB/watt (temperature dB/° C): 0.001 (0.0001)
Power rating: 1 W ave, 50 W peak, 10 μs max. pulse width
Supply voltage/speed/power: 20 to 30 V / <20 ms / 2.7 W

[1] Measured at 25° C
[2] Cycles per section minimum

Attenuation Accuracy DC to 26.5 GHz	26.5 to 40 GHz
1 dB: 0.4 dB	1 dB: 0.6 dB
2 dB: 0.5 dB	2 dB: 0.6 dB
3 dB: 0.7 dB	3 dB: 0.8 dB
4 dB: 0.7 dB	4 dB: 0.8 dB
5 dB: 0.7 dB	5 dB: 0.8 dB
6 dB: 0.7 dB	6 dB: 0.9 dB
7 dB: 0.8 dB	7 dB: 1.1 dB
8 dB: 0.8 dB	8 dB: 1.1 dB
9 dB: 0.85 dB	9 dB: 1.2 dB
10 dB: 0.9 dB	10 dB: 1.3 dB
11 dB: 1.10 dB	11 dB: 1.5 dB
10 dB: 0.5 dB	10 dB: 0.5 dB
20 dB: 0.6 dB	20 dB: 0.6 dB
30 dB: 0.7 dB	30 dB: 0.7 dB
40 dB: 1.0 dB	40 dB: 1.0 dB
50 dB: 1.2 dB	50 dB: 1.2 dB
60 dB: 1.6 dB	60 dB: 1.6 dB
70 dB: 1.9 dB	70 dB: 1.9 dB
80 dB: 2.7 dB	80 dB: 2.7 dB
90 dB: 2.9 dB	90 dB: 2.9 dB

HP 8495D

HP 8495K



HP 11716A

Programmable and Manual Step Attenuators DC–1000 MHz

Manual

HP 355C (0–12 dB, 1 dB steps)
HP 355D (0–120 dB, 10 dB steps)

Programmable

HP 355E (0–12 dB, 1 dB steps)
HP 355F (0–120 dB, 10 dB steps)

The manual and programmable HP 355 C/D/E/F attenuators offer exceptional attenuation accuracy to 1 GHz; +0.1 dB to 1 kHz, 0.25 dB to 500 MHz, 0.35 to 1 GHz. They feature BNC (f) RF connectors, with optional type-N (Option 001) and TNC (Option 005) also available. To achieve 1 dB steps to 132 dB range, serially connect two attenuators using a standard UG-491A/U BNC (m)-to-BNC (m) adapter. Programmable HP 355 E/F models feature a 7-pin connector (supplied). To protect your transistor driver against transients during the switching cycle, order Option 007 to install a protective diode between each solenoid and driver.

Programmable and Manual Step Attenuators DC–26.5 GHz

HP 8494A/B/G/H (0–11 dB, 1 dB steps)
HP 8495A/B/D/G/H/K (0–70 dB, 10 dB steps)
HP 8496A/B/G/H (0–110 dB, 10 dB steps)
HP 8497K (0–90 dB, 10 dB steps)

The HP 8494/95/96/97 family of step attenuators offer fast, precise signal level control in three frequency ranges, dc to 4 GHz, dc to 18 GHz and dc to 26.5 GHz. They feature exceptional repeatability and reliability in a wide range of frequency, attenuation and connector options.

Attenuation repeatability is specified to be less than 0.03 dB (0.05 dB, 18-26.5 GHz) for 5 million cycles per section. This assures low measurement uncertainty and high user confidence when designed into automatic test systems. Electromechanical step attenuators offer low SWR, low insertion loss and high accuracy required by high-performance test and measurement equipment.

Precision plated leaf-spring contacts remove attenuator sections (miniature tantalum nitride thin-film T-pads on sapphire and alumina substrates) from the signal path. Unique process controls and material selection ensure unmatched life and contact repeatability.

Programmable Models

Miniature drive solenoids in the programmable models keep switching time, including settling, down to less than 20 milliseconds. Once switched, strong permanent magnets hold the solenoids (and attenuation value) in place. Current interrupts automatically disconnect solenoid current, simplifying driver circuit design and minimizing heat dissipation. Programming is done through a 12-pin Viking socket or optional ribbon cables with DIP plugs.

To simplify connecting programmable attenuators to the drive circuit, each unit is supplied with a 5-ft. cable assembly. With an HP 11713A attenuator driver, 87130A attenuator driver, or an HP 70611A driver for MMS-based systems, automatic drive control is easy using the Hewlett-Packard Interface Bus (GPIB) automated system.

HP 11716A/B/C Attenuator Interconnect Kits

Quickly and conveniently connect 1 dB step and 10 dB step attenuators together to achieve greater dynamic range with 1 dB steps. The 11716A/B/C interconnect kits contain a rigid RF cable, mounting bracket, and necessary hardware to connect any pair of HP 8494/95/96/97 attenuators in series (see photo above). Attenuators must be ordered separately.

Key Literature

Latest *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E

For more information, visit our web site: **http://www.hp.com/go/MTA**

Ordering Information

HP 11716A Interconnect Kit (Type-N)
HP 11716B Interconnect Kit (APC-7)
HP 11716C Interconnect Kit (SMA)
HP 11717A Attenuator/Switch Rackmount Support Kit

Indicates QuickShip availability.

HP 355 Series, 8494/5/6/7 Series Specifications

HP Model (Switching Mode)	Frequency Range (GHz)	Attenuation Range (dB)	Maximum SWR	Insertion Loss @ 0 dB	Attenuation Accuracy	Power Rating, Minimum Life	Solenoid Voltage Speed Power	Size, Shipping Weight	Connector Options	Price
355C (Manual) **355E** (Programmable)	dc to 1	0 to 12 1 dB steps	1.2 to 250 MHz 1.3 to 500 MHz 1.5 to 1 GHz	0.11 dB + 1.39 dB/GHz	±0.1 dB @ 1000 Hz ±0.25 dB: dc to 0.5 GHz ±0.35 dB: dc to 1.0 GHz	0.5 W avg. 350 W peak 0.5 million cycles per section	— 15 to 18 V <65 ms 3.0 W	70 mm W x 67 mm H x 152 mm D (2.75 in x 2.6 in x 6 in) 1.4 kg (3 lb)	BNC (f) See Note 1	
355D (Manual) **355F** (Programmable)	dc to 1	0 to 120 10 dB steps	1.2 to 0.25 GHz 1.3 to 0.5 GHz 1.5 to 1 GHz	0.11 dB + 1.39 dB/GHz	±0.3 dB @ 1000 Hz ±1.5 dB to 90 dB, and ±3 dB to 120 dB @ 1 GHz	0.5 W avg. 350 W peak 0.5 million cycles per section	— 15 to 18 V <65 ms 3.0 W	70 mm W x 67 mm H x 152 mm D (2.75 in x 2.6 in x 6 in) 1.4 kg (3 lb)	BNC (f) See Note 1	
8494A (Manual)	dc to 4	0 to 11 1 dB steps	1.5	0.6 dB + 0.09 dB/GHz	±0.2 dB: 1 to 2 dB ±0.3 dB: 3 to 6 dB ±0.4 dB: 7 to 10 dB ±0.5 dB: 11 dB	1 W avg. 100 W peak 10 μs max. 5 million cycles per section	—	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	001 002 003	
8494G (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	See Note 2	
8494B (Manual)	dc to 18	0 to 11 1 dB steps	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	0.6 dB + 0.09 dB/GHz	**dc to 12.4 GHz** ±0.3 dB: 1 to 2 dB ±0.4 dB: 3 to 4 dB ±0.5 dB: 5 to 6 dB ±0.6 dB: 7 to 10 dB ±0.7 dB: 11 dB	1 W avg. 100 W peak 10 μs max. 5 million cycles per section	—	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	001 002 003 See Note 2	
8494H (Programmable)					**dc to 18 GHz** ±0.7 dB: 1 to 5 dB ±0.8 dB: 6 to 9 dB ±0.9 dB: 10 to 11 dB		20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)		
8495A (Manual)	dc to 4	0 to 70 10 dB steps	1.35	0.4 dB + 0.07 dB/GHz	±1.7dB of setting or 0.4 dB whichever is greater	1 W avg. 100 W peak 10 μs max. 5 million cycles per section	—	73 mm W x 43 mm H x 130 mm D (2.9 in x 1.7 in x 5.1 in) 0.9 kg (2 lb)	001 002 003	
8495G (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 141 mm D (3.1 in x 1.7 in x 5.5 in) 0.9 kg (2 lb)	See Note 2	
8495B (Manual)	dc to 18	0 to 70 10 dB steps	1.35 to 8 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	0.4 dB + 0.07 dB/GHz	±3dB: dc to 12.4 GHz ±4dB: dc to 18 GHz	1 W avg. 100 W peak 10 μs max. 5 million cycles per section	—	73 mm W x 43 mm H x 130 mm D (2.9 in x 1.7 in x 5.1 in) 0.9 kg (2 lb)	001 002 003	
8495H (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 141 mm D (3.1 in x 1.7 in x 5.5 in) 0.9 kg (2 lb)	See Note 2	
8495D (Manual)	dc to 26.5	0 to 70 10 dB steps	1.25 to 6 GHz 1.45 to 12.4 GHz 1.6 to 18.0 GHz 1.8 to 26.5 GHz	0.5 dB + 0.13 dB/GHz	±0.3 dB at 6 GHz 10 dB attenuation to ±2.8 dB at 26.5 GHz 90 dB attenuation	1 W avg. 100 W peak 10 μs max. 5 million cycles per section	—	52 mm W x 43 mm H x 159 mm D (2.1 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	004 3.5 mm See Note 2	
8495K (Programmable)							20 to 30 V <20 ms 2.7 W	52 mm W x 43 mm H x 168 mm D (2.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)		
8496A (Manual)	dc to 4	0 to 110 10 dB steps	1.5	0.6 dB + 0.09 dB/GHz	±1.7dB of setting or 0.4 dB whichever is greater	1 W avg. 100 W peak 10 μs max. 5 million cycles per section	—	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	001 002 003	
8496G (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	See Note 2	
8496B (Manual)	dc to 18	0 to 110 10 dB steps	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	0.6 dB + 0.09 dB/GHz	±3dB: dc to 12.4 GHz ±4dB: dc to 18 GHz	1 W avg. 100 W peak 10 μs max. 5 million cycles per section	—	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb)	001 002 003	
8496H (Programmable)							20 to 30 V <20 ms 2.7 W	79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	See Note 2	
8497K (Programmable)	dc to 26.5	0 to 90 10 dB steps	1.25 to 6 GHz 1.45 to 12.4 GHz 1.6 to 18.0 GHz 1.8 to 26.5 GHz	0.4 dB + 0.09 dB/GHz	±0.3 dB at 6 GHz 10 dB attenuation to ±2.8 dB at 26.5 GHz 90 dB attenuation	1 W avg. 100 W peak 10 μs max. 5 million cycles per section	5 V or 24 V	52 mm W x 43 mm H x 143 mm D (2.1 in x 1.7 in x 5.6 in) 0.9 kg (2 lb)	004 3.5 mm See Note 2	

How to Order the HP 8494/5/6/7 Series Attenuators

Each order must include basic model number, suffix letter, and connector option.

Ordering example: HP 8494 **A** Option **001**

4	A	001
4 (1 dB step, 11 dB max)	**A** (Manual, dc to 4 GHz)	**001** (N female)
5 (10 dB step, 70 dB max)	**B** (Manual, dc to 18 GHz)	**002** (SMA female)
6 (10 dB step, 110 dB max)	**D** (Manual, dc to 26.5 GHz)*	**003** (APC-7)
7 (10 dB step, 90 dB max)	**G** (Programmable, dc to 4 GHz)	**004** (3.5 mm female)[1]
	H (Programmable, dc to 18 GHz)	
	K (Programmable, dc to 26.5 GHz)*	

[1] Option 004 is only available on D and K models.

Note 1: 355C/D/E/F connector options (BNC (f) standard):
Option 001 N(f)
Option 005 TNC(f)
Option 007 Transistor protection (355E/F only)

Note 2: 8494/5/6/7 orders must specify connector option. See ordering example.
Option 001 N(f)
Option 002 SMA(f)
Option 003 APC-7
Option 004 3.5 mm (HP 8495D/K, 8497K only)
Option UK6 Commercial Calibration Test Data with Certificate

Indicates QuickShip availability.

HP 8490D


HP 8492A

HP 8493A/B/C Series

HP 8498A High Power Attenuator

The HP 8498A Option 030 is designed to meet the needs of high-power attenuation applications in the RF and microwave frequency range. It is a 25-watt average, 30 dB fixed attenuator with a frequency of dc to 18 GHz. The maximum peak power specification is 500 watts (dc to 5.8 GHz) and 125 watts (5.8 to 18 GHz). Available only in a 30 dB version, the unit offers a 1.3 SWR and ±1 dB accuracy at 18 GHz. Large heat-dissipating fins keep the unit cool even under continuous maximum input power conditions.

HP 8491A/B/C, 8492A, 8493A/B/C Fixed Attenuators

Hewlett-Packard coaxial fixed attenuators provide precise attenuation, flat frequency response, and low SWR over broad frequency ranges. Attenuators are available in nominal attenuations of 3 dB and 6 dB, as well as 10 dB increments from 10 dB to 60 dB. These attenuators are swept-frequency tested to ensure they meet specifications at all frequencies. Calibration points are provided on a nameplate chart attached to each unit (except for the HP 8491C).

HP 8490D 50-GHz Fixed Attenuator

Hewlett-Packard coaxial fixed attenuators have been the standard for accurate flat response and low SWR. The HP 8490D offers exceptional performance to 50 GHz using the 2.4-mm connector. Attenuation values available are 3, 6, 10, 20, 30 and 40 dB. Ideally suited for extending the range of sensitive power meters, or for use as calibration standards, these broadband attenuators are manufactured with the same meticulous care as their lower frequency counterparts.

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HP 8490D, 8491A/B/C, 8492A, 8493A/B/C, 8498A, Specifications

HP Model	Frequency range (GHz)	SWR (max.)	Input Power (max.)		Attenuation Accuracy (+dB) 3 dB Opt 003	6 dB Opt 006	10 dB Opt 010	20 dB Opt 020	30 dB Opt 030	40 dB Opt 040	50 dB Opt 050	60 dB Opt 060	Connectors	
8490D	DC to 50	dc to 26.5 GHz: 1.15 (1.08 Opt 040 only) 26.5 to 40 GHz: 1.25 (1.15 Opt 040 only) 40 to 50 GHz: 1.45 (1.25 Opt 040 only)	2 W avg. 100 W peak	DC to 26.5 26.5 to 50	+0.9 –0.5 +1.8 –0.5	+0.9 –0.6 +1.8 –0.6	+0.9 –0.6 +1.3 –0.6	+1.3 –0.8 +1.7 –0.8	+1.3 –0.8 +1.7 –0.8	+2.5 –1.8 +2.5 –1.8			2.4 mm	
8491A 3 to 30 dB 40 to 60 dB	dc to 12.4	1.2 to 8 GHz 1.3 to 12.4 GHz	2 W avg. 100 W peak		0.3	0.3	0.5	0.5	1.0	1.5	1.5	2	N (m,f)	
8491B 3 to 30 dB 40 to 60 dB	dc to 18	1.2 to 8 GHz 1.3 to 12.4 GHz 1.5 to 18 GHz	2 W avg. 100 W peak		0.3	0.3 to 12.4 GHz 0.4 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	1.5	1.5	2	N (m,f)	
8491C 3 to 30 dB	dc to 18	1.2 to 8 GHz 1.3 to 12.4 GHz 1.5 to 18 GHz	2 W avg. 100 W peak		0.3 to 12.4 GHz 0.4 to 18 GHz	0.4 to 12.4 GHz 0.5 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	—	—	—	N (m,f)	
8492A 3 to 30 dB 40 to 60 dB	dc to 18	1.15 to 8 GHz 1.25 to 12.4 GHz 1.35 to 18 GHz	2 W avg. 100 W peak		0.3	0.3 to 12.4 GHz 0.4 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	1.5	1.5	2	APC-7	
8493A 3 to 20 dB 30 dB	dc to 12.4	1.2 to 8 GHz 1.3 to 12.4 GHz	2 W avg. 100 W peak		0.3	0.3	0.5	0.5	1.0	—	—	—	SMA (m,f)	
8493B 3 to 20 dB 30 dB	dc to 18	1.2 to 8 GHz 1.3 to 12.4 GHz 1.5 to 18 GHz	2 W avg. 100 W peak		+0.3 dB	0.3 to 12.4 GHz 0.4 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	—	—	—	SMA (m,f)	
8493C 3 to 30 dB 40 dB	dc to 26.5	1.1 to 8 GHz 1.15 to 12.4 GHz 1.25 to 26.5 GHz	2 W avg. 100 W peak		0.5 to 18 GHz 1.0 to 26.5 GHz	0.6 0.6	0.3 0.5	0.5 0.6	0.7 1	1.0 1.3	— —	— —	3.5 mm (m,f)	
8498A 30 dB	dc to 18	1.15 to 8 GHz 1.25 to 12.4 GHz 1.35 to 18 GHz	25 W avg. 500 W peak (dc to 5.8 GHz) 125 W peak 500 W/ms max. per pulse (5.8 to 18 GHz)		—	—	—	—	1.0	—	—	—	N (m,f)	

HP Models	Options UK6	
8491A, 8491B, 8492A, 8493A, 8493B, 8493C, 8498A	**Opt UK6**-Commercial Calibration Test Data with Certificate	

HP 11581A, 11582A, 11583A/C Attenuator Sets

A set of four Hewlett-Packard attenuators—3, 6, 10, and 20 dB—are furnished in a handsome walnut accessory case. The HP 11581A set consists of HP 8491A attenuators; the HP 11582A set, HP 8491B attenuators; the HP 11583A set, HP 8492A attenuators; and the HP 11583C set, HP 8493C attenuators. These sets are ideal for calibration labs or where precise knowledge of attenuation and SWR is desired. Also includes commercial calibration certificate with test data.

Key Literature

Latest *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E

Ordering Information

HP 11581A 3, 6, 10, 20 dB HP 8491A Set
HP 11582A 3, 6, 10, 20 dB HP 8491B Set
HP 11583A 3, 6, 10, 20 dB HP 8492A Set
HP 11583C 3, 6, 10, 20 dB HP 8493C Set
Opt 910 Extra Operating and Service Manual

Indicates QuickShip availability.

HP 8474 Series

HP 8471D/E

HP 83036C

Low-Barrier Schottky Diode Detectors

HP 423B, HP 8472B, HP 8473B/C

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These Low-Barrier Schottky Diode (LBSD) detectors have been widely used for many years in a variety of applications including leveling and power sensing. They offer good performance and ruggedness. Matched pairs (Option 001) offer very good detector tracking. A video load option (Option 002) extends the square-law region to at least 0.1 mW (–10 dBm).

Planar-Doped Barrier Detectors

HP 8471D/E

The HP 8471D/E are economy detectors based on the Planar-Doped Barrier (PDB) diodes. The PDB diodes give them superior frequency response, square-law response, and temperature performance. The HP 8471D has a BNC (m) input connector and a frequency range of 100 kHz to 2 GHz, making it ideal for use in RF and low microwave applications. The HP 8471E has a SMA (m) input connector and a SMC (m) output connector. Its frequency range is 10 MHz to 12 GHz. Both models come standard with a negative polarity output; a positive polarity output can be specified as Option 103.

HP 8473D

The HP 8473D detector was the first gallium arsenide PDB diode introduced. It features broadband performance and excellent flatness vs. frequency, along with superior temperature stability. The HP 8473D is available with a 3.5-mm (m) RF connector and a BNC (f) output connector.

High-Performance Planar-Doped Barrier Detectors

HP 8474B/C/D/E

Utilizing a gallium arsenide PDB diode as the detecting element, these detectors offer superior performance when compared to earlier detector designs. They feature extremely flat frequency response over their entire band of operation (typically better than ±1 dB to 50 GHz) and very good frequency response stability versus temperature. For applications where broadband frequency coverage is not required, octave band options are available in specific bands.

The HP 8474 detectors are available with APC-7 (0.01 to 18 GHz), Type N (0.01 to 18 GHz), 3.5 mm (mates with SMA, 0.01 to 33 GHz), 2.92 mm (0.01 to 40 GHz), or 2.4 mm (0.01 to 50 GHz) connectors. These detectors are offered with options for optimal square-law loads (Option 102) and for positive polarity output (Option 103). Because the unit-to-unit frequency response tracking of these devices is typically better than ±0.3 dB, no matched response option is offered.

Broadband Directional Detector

HP 83036C

The HP 83036C is a broadband microwave power sampler that operates in much the same way as a directional coupler and detector combination. It is composed of a resistive bridge and PDB diode that yields a very broadband device with excellent frequency response, superior temperature response and square-law response characteristics. With a 10 MHz to 26.5 GHz frequency range, a single HP 83036C can be used in many applications where two directional couplers and detectors were once required, such as in broadband power monitoring and source leveling.

The maximum SWR is 1.7 above 50 MHz on both the input and output ports. Directivity of 14 dB matches that of most miniature couplers currently available. The maximum insertion loss is 2.2 dB.

The HP 83036C has been used with great success as the sampling element for external leveling of broadband swept frequency sources. The extended frequency range increases the usable band from 100 MHz to 26 GHz, giving the user full use of the broadband source with external leveling. Other uses include the internal leveling element for sources, and forward/reverse power monitoring.

Key Literature

Latest *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E

For more information, visit our web site: **http://www.hp.com/go/MTA**

Planar-Doped Barrier Diode Detectors Specifications

HP Model	Freq. Range (GHz)	Freq. Response (dB)	Max. SWR	Low-level Sensitivity	Max. Input (Peak or Average)	Short-term Max. Input (<1 min.)	Opt. 002/102 Optimum Square-Law Load	Opt. 003/103 Positive Polarity Output	Input/ Output Connector	
8471D	0.0001 to 2	±0.2 to 1 GHz ±0.4 to 2 GHz	1.23 to 1 GHz 1.46 to 2 GHz	>0.5 mV/μW	100 mW	0.7 W	Yes	Yes	BNC (m) BNC (f)	
8471E	0.01 to 12	±0.23 to 4 GHz ±0.6 to 8 GHz ±0.85 to 12 GHz	1.2 to 4 GHz 1.7 to 8 GHz 2.4 to 12 GHz	>0.4 mV/μW	200 mW	0.75 W	No	Yes	SMA (m) SMC (m)	
8473D	0.01 to 33	±0.25 to 12.4 GHz ±0.40 to 26.5 GHz ±1.25 to 33 GHz	1.2 to 14 GHz 1.36 to 26.5 GHz 2.96 to 33 GHz	>0.4 mV/μW	200 mW	1 W	Note 1	Note 1	3.5 mm (m) BNC (f)	
8474B[1]	0.01 to 18	±0.35 to 18 GHz	1.3 to 18 GHz	>0.4 mV/μW	200 mW	.75 W	Note 1	Note 1	Type N (m) BNC (f)	
8474C[1]	0.01 to 33	±0.45 to 26.5 GHz ±0.70 to 33 GHz	1.4 to 26.5 GHz 2.2 to 33 GHz	>0.4 mV/μW	200 mW	.75 W	No	Note 1	3.5 mm (m) SMC (m)	
8474E[1]	0.01 to 50	±0.4 to 26.5 GHz ±0.6 to 40 GHz ±1.0 to 50 GHz	1.2 to 26.5 GHz 1.6 to 40 GHz 2.8 to 50 GHz	>0.4 mV/μW	200 mW	.75 W	No	Note 1	2.4 mm (m) SMC (m)	

[1]Octave band options available (see Data Sheet).

Broadband Directional Detector Specifications

HP Model	Freq. Range (GHz)	Freq. Response (dB)	Max. SWR Input/Output (50 Ω Nom.)	Max. Thru Line Loss (dB)	Low-level Sensitivity	Min. Directivity (dB)	Max. Input (Into 50 Ω Load) w/ 2:1 Source Match	Max. Input (Into Open) w/ 2:1 Source Match	Input/ Output Connector	Price
83036C	0.01 to 26.5	±1.0	1.7	2.2	18 mV/μW	14	32 dBm	21 dBm	3.5 mm (f)	$921

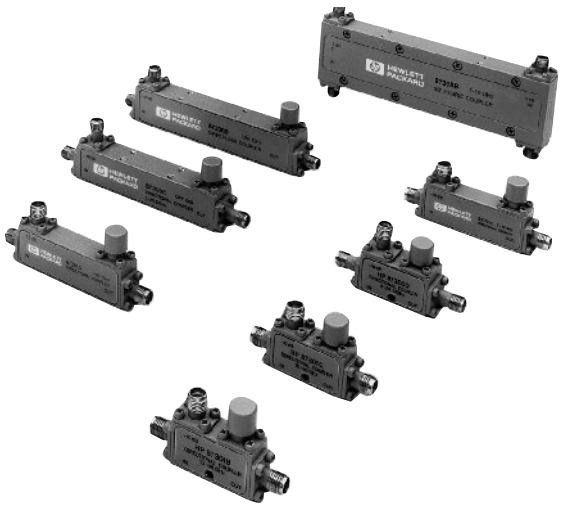
Low-Barrier Schottky Diode Detectors Specifications

HP Model	Freq. Range (GHz)	Freq. Response (dB)	Max. SWR (50 Ω Nom.)	Low-level Sensitivity (mV/μW)	Max. Input (Peak or Average)	Short-term Max. Input (<1 min.)	Matched[2] Response Opt. 001	Optimum Square-law Load[3]	Positive Polarity Output	Input/ Output Connector	
423B	0.01 to 12.4	±0.3 to 12.4 GHz	1.15 to 4 GHz 1.3 to 12.4 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz	Opt. 002	Opt. 003	N (m) BNC (f)	
8470B **8470B Option 012**	0.01 to 18	±0.3 to 12.4 GHz ±0.5 to 15 GHz ±0.6 to 18 GHz	1.15 to 4 GHz 1.3 to 15 GHz 1.4 to 18 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz	Opt. 002	Opt. 003	APC-7 BNC (f) N (m) BNC (f)	
8472B Option 100	0.01 to 18	±0.3 to 12.4 GHz ±0.5 to 15 GHz ±0.6 to 18 GHz	1.15 to 4.5 GHz 1.35 to 7 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz	Opt. 002	Opt. 003	SMA (m) BNC (f) SMA (m) OSSM (f)	
8473B	0.01 to 18	±0.3 to 12.4 GHz ±0.6 to 18 GHz	1.2 to 4 GHz 1.5 to 18 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz	Opt. 002	Opt. 003	3.5 mm (m) BNC (f)	
8473C	0.01 to 26.5	±0.3 to 12.4 GHz ±0.6 to 20 GHz ±1.5 to 26.5 GHz	1.2 to 4 GHz 1.5 to 18 GHz 2.2 to 26.5 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz ±0.5 to 26.5 GHz	Opt. 002	Opt. 003	3.5 mm (m) BNC (f)	

[1]Available as a special option on request. Consult your HP representative.
[2]Must order a quantity of 2 standards and 2 Option 001s for a pair of detectors with matched frequency response.
[3]Defined as ± 0.5 from ideal square law response.

For more information, visit our web site: **http://www.hp.com/go/MTA**

Indicates QuickShip availability.



HP 87300B/C/D, 87301B/C/D, 87310B, 87301E

HP 87300 Series Directional Couplers

This line of compact, broadband directional couplers are ideal for signal monitoring, or when combined with a coaxial detector, for signal leveling. Available in a variety of frequency ranges, they can be matched to specific applications. The HP 8474 series coaxial detectors are recommended if output detection is desired. The HP 87300B is supplied with SMA (f) connectors, the HP 87300C has 3.5-mm (f) connectors, and the HP 87301D has 2.4-mm (f) standard or optional 2.92-mm (f) connectors.

HP 87310B Hybrid Coupler

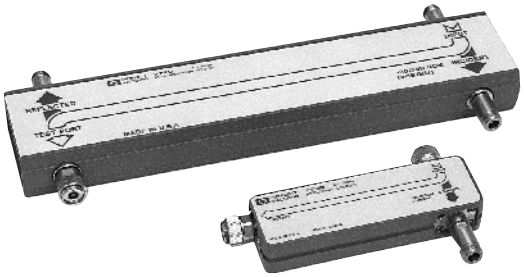
HP 87310B is a 3 dB hybrid coupler, intended for applications requiring a 90 degree phase difference between output ports. In that sense, it is different from typical power dividers and power splitters, which have matched signal phase at their output ports. The HP 87310B features SMA (f) connectors.

HP 87300 Series Specifications

HP Model	Freq. Range (GHz)	Nominal Coupling & (dB) Variation	Directivity (dB)	Max. SWR	Insertion Loss (dB)
87300B	1 to 20	10 ± 0.5	16	1.35	<1.5
87300C	1 to 26.5	10 ± 1	>14 to 12.4 GHz >12 to 26.5 GHz	1.40	<1.2 to 12.4 <1.7 to 26.5
87300C Opt 020	1 to 26.5	20 ± 1	>14	1.4	<1.2
87300D	6 to 26.5	10 ± 0.5	>13	1.4	<1.3
87301B	10 to 46	10 ± 0.7	>10	1.8	<1.9
87301C	10 to 50	10 ± 0.7	>10	1.8	<1.9
87301D	1 to 40	13 ± 1	>14 to 20 >10 to 40	1.5 to 20 1.7 to 40	<1.2 to 20 <1.9 to 40
87310B	1 to 18	3 ± 0.5	—	1.35	<2.0
87301E	2 to 50	10 ± 1	>13 to 26.5 >10 to 50	1.5 to 26.5 1.8 to 50	<2.0

HP 773D Directional Coupler and HP 772D Dual-Directional Coupler

The HP 772D and 773D are high-performance couplers designed for broadband swept measurements in the 2 to 18 GHz range. The HP 773D is ideal for leveling broadband sources when used with an HP 8474B detector. (See also the HP 83036C directional detector.) For reflectometer applications, the HP 772D is the best coupler to use with HP power sensors and power meters (such as the HP 438A dual power meter). Forward and reverse power measurements on transmitters, components or other broadband systems are made simpler using the HP 772D. The broadband design allows the use of a single test setup and calibration for tests spanning the entire 2 to 18 GHz frequency range.



HP 772D and HP 773D

HP 775D to 779D Dual-Directional Couplers

The economical HP 775D-778D couplers cover octave frequency spreads of more than 2:1, each centered on one of the important VHF/UHF bands. With their high directivity and mean coupling accuracy of ±0.5 dB, these are ideal couplers in reflectometer applications. The close tracking of the auxiliary arms makes these couplers particularly useful for reflectometers. Power ratings are 50 W average, 500 W peak.

HP 772-779D, 11691D, 11692D Specifications

HP Model	Freq. Range (GHz)	Nominal Coupling (dB)	Max. Coupling Variation (dB)	Min. Directivity (dB)	SWR Primary Line Max. (50 Ω Nom.)
772D	2 to 18	20	±0.9	2 to 12.4: 30 12.4 to 18: 27	2 to 12.4: 1.3 12.4 to 18: 1.4
773D	2 to 18	20	±0.9	2 to 12.4: 30 12.4 to 18: 27	1.3 1.4
775D[1]	0.45 to 0.94	20	±1	40	1.15
776D[1]	0.94 to 1.9	20	±1	40	1.15
777D	1.9 to 4	20	±0.4	30	1.2
778D	0.1 to 2	20	±1.5	0.1 to 1 GHz: 36[2] 1 to 2 GHz: 32[2]	1.1
779D	1.7 to 12.4	20	±0.75	1.7 to 4 GHz: 30 4 to 12.4 GHz: 26	1.2
11691D	2 to 18	20	±1.0	2 to 8 GHz: 30[3] 8 to 18 GHz: 26[3]	1.3 1.4
11692D	2 to 18	20	±1 incident to test port	2 to 8 GHz: 30[3] 8 to 18 GHz: 26[3]	2 to 12.4 GHz: 1.3 12.4 to 18 GHz: 1.4

[1] Maximum auxiliary arm tracking: 0.3 dB for HP 776D; 0.5 dB for HP 777D
[2] 30 dB, 0.1 to 2 GHz, input port
[3] 24 dB with Type-N connector on the test port (11692D) or on the input port (11691D)

Key Literature

Latest *RF & Microwave Test Accessories Catalog,* p/n 5968-4314E

HP 87302C, 87303C, and 87304C Hybrid Power Dividers

The HP 87302C, 87303C, and 87304C power dividers are compact, hybrid microwave couplers designed for power splitting applications that require minimal insertion loss and high isolation.

The HP 87302C covers the entire 0.5 to 26.5 GHz frequency range with a maximum insertion loss of 1.9 dB. The HP 87303C and 87304C cover the frequency range of 1 to 26.5 GHz and 2 to 26.5 GHz with an even lower insertion loss of 1.6 dB and 1.4 dB, respectively. These hybrid power dividers are excellent for any application requiring low loss power division. They typically exhibit an insertion loss that is 1 to 2 dB lower than an equivalent resistive power divider.

HP Model	Freq. Range (GHz)	Band Segments	Insertion Loss (dB)	Isolation (dB)
HP 87302C	0.5 to 26.5	0.5 to 18 GHz 18 to 26 GHz	1.5 1.9	19 19
HP 87303C	1.0 to 26.5	1.0 to 18 GHz 18 to 26.5 GHz	1.2 1.6	19 21
HP 87304C	2.0 to 26.5	2.0 to 18 GHz 18 to 26.5 GHz	1.1 1.4	19 18

Power Rating: 10 W, CW (2:1 maximum SWR)
Connectors: 3.5 mm (f), SMA compatible

Signal Sources

HP 70340A Module Signal Generator, Brochure
5091-4649E
HP 8370 Series Color Brochure
5963-6614E
(PN ESG-1) Using the HP ESG-D series and the HP 8922 GSM Test Set for GSM Applications
5965-7158E
Generating and Downloading Data to the HP ESG-D series for Digital Modulation
5966-1010E
Controlling TDMA Timeslot Power Levels in the HP ESG-D series
5966-4472E
Generate Digital Modulation with the HP ESG series Internal Dual Arbitrary Waveform Generator
5966-4097E
Customize Digital Modulation with the HP ESG-D series Real-time I/Q Baseband Generator
5966-4096E
Making Bit-error-rate Measurements with the HP ESG-D series
5966-4098E
(PN 8360-1) HP 8340/41 to HP 8360 System Conversion Guide
5952-8089
(PN 8360-2) Obtaining Flat Test Port Power with the HP 8360 User Flatness Correction Feature
5952-8090
(PN 8360-3) Generating Scan Modulation Patterns
5091-0226E
(PN 8360-4) Performing Two-Tone Measurements with the HP 8360
5091-0227E
(PN 8644A-1) Phase Noise Measurements with the HP 8644A and 8655A Signal Generators
5951-6729
(PN 8645-1) Agile Operation of the HP 8645A
5951-6711
(PN 8645-2) A Catalog of HP 8645A Information
5951-6712
(PN 8791-1) Product Note Using Dynamic Data with HP 8791 10 FASS
5953-2343
(PN 8791-2) Programming HP FASS with WGL
5963-0988E
(PN 8791-3) Theory of Operation of the HP FASS
5091-4581E
(PN 8791-4) Secure Communications Testing with HP FASS
5952-0507
(PN 8791-5) Tips on External Clock Operation with HP FASS
5952-1901
(PN 8791-6) Jamming Signal Capability of the HP FASS
5952-1903
(PN 8791-7) Spectral Purity of the HP FASS
5952-1058
(PN 8791-8) Survey of Radar Test Applications Using FASS
5952-2847
(PN 8791-9) User Patterns: Your Key to Signal Customization with HP FASS
5091-0243E
(PN 8350-8) Leveling the HP 8350B Sweep Oscillator with an HP 430 Series Power Meter
5954-1507
(PN 8350-9) Improving Output Flatness
5954-8344
(PN 8648A-2) Servicing and Repairing Pagers using the HP 8648A Option 1EP
5965-1132E
(PN 8780A-1) Introductory Operating Guide to the HP 8780A Vector Signal Generator
5954-6368
(PN 8780A-2) Modulation Solutions RF & Microwave Receivers
5952-1416

Signal Analyzers

Scalar Network Analysis with the HP 8590 Series Spectrum Analyzers, HP 85630A Scalar Transmission/Reflection Measurement Test Set and HP 85714A Scalar Measurement Personality
5091-1338E/EUS
HP 346B Noise Source Technical Data
5953-6452
HP 3587S Demo Video
5964-9460E/PAL
HP 3587S Product Overview
5964-3631E
HP 71000 Series MMS Spectrum Analyzers
5965-2818E
HP 71209A 26.5 GHz Microwave Spectrum Analyzer Product Overview
5091-2581E
HP 71910A Wide Bandwidth Receiver Technical Data
5964-3895E
HP 85719A Noise Figure Measurement Personality and 8590E Option 119 Technical Data
5091-4800E
HP 87405A Preamplifier Technical Data
5091-3661E
HP 89400 Series VSAs Configuration Guide
5964-3630E
HP 89411A 21.4 MHz Downconverter Technical Data
5962-7210E
HP 89450A DMCA Radio Test Application Personality Product Overview
5963-1835E
HP 89451A Radio Test Personality Product Overview
5964-4098E

(PN 8590-2) Time-Gated Spectrum Analysis: New Measurement Fundamentals
5952-3685
(PN 8590EM-1) Electromagnetic Compatibility–Guide to Performing Precompliance Conducted and Radiated Emissions
5964-2151E
(PN 8590E/4Q, 859X) DVB-C Solutions
5965-4991E
(PN) Add Digitized Burst Signal Measurements Capability to HP 8560 E-Series Spectrum Analyzers
5091-5837E
(PN 85719A-1) Maximizing Accuracy in Noise Figure Measurements
5091-4801E
(PN 70000) Series Spectrum Analyzer Programming Code Compatibility to the HP 8566B
5091-2583E
(PN 71910A) Extending Vector Signal Analysis to 26.5 Ghz with 20 MHz Information Bandwidth (71910A, 89400/10A/40A)
5964-3586E
(PN 8902A-2) Accurate Signal Characterization at Millimeter-Wave Frequencies
5953-8436

Self Guide Demo for the VSA Series Transmitter Tester
5968-2808E
CMDA Solutions from HP
5966-3058E
GSM Solutions from HP
5966-1550E
Understanding CDMA Measurements for Base Stations and Their Components
5968-0953E
Understanding GSM Transmitter Measurements for Base Transceiver Stations and Mobile Stations
5968-2302E

RF Microwave Measurement System

RF & Microwave Test Accessories Catalog
5968-4314EN/EUS

Network/Spectrum Analyzers

HP's Family of Combination Analyzers HP 4395A/96B Awareness Brochure
5965-9374E
HP 4395A Network/Spectrum/Impedance Analyzer Technical Specification
5965-9340E
HP 4396B 1.8 GHz Network/Spectrum Analyzer
5965-6311E
Wideband Microwave Spectrum Analysis and Vector Signal Analysis HP 71910A, 71910P, and 89410A, Brochure
5965-7916E

(PN 4395/96-1) How to Measure Noise Accurately Using the HP Combination Analyzers
5966-2292E
(PN 4395-1) ADSL Copper Loop Measurements
5966-2292E

Network Analyzers

HP 87050/75A/B Custom Multiport Test Sets, Product Overview
5964-3830E

(PN 8757-2) V and W Band Millimeter Scalar Measurements Using the HP 8757 Scalar Network Analyzer
5954-8380
(PN 8757-5) Measuring Voltage-Controlled Devices
5954-1537
(PN E5100A/B) Crystal Resonator Measuring Functions of HP E5100A/B Network Analyzer
5965-4972E
(PN 8720-1) Amplifier Measurements with the HP 8720C
5091-1942E
(PN 8720-2) In-Fixture Measurements with the HP 8720C
5091-1943E
(PN 8510-6) On-Wafer Measurements Using Cascade Prober
5954-1579
(PN 8510-7) Measuring Chip Capacitors with the HP 8510C Network Analyzers and Inter-Continental Microwave Test Fixtures
5091-5674E
(PN 8510-8A) Applying TRL Cal to Non-coaxial Measurements
5091-3645E
(PN 8510-13) Measuring Noninsertable Devices
5956-4373E
(PN 8510-14) Using Multiple Test Sets with the HP 8510C
5967-5886E
(PN 8510-15) Lightwave Component Measurements
5952-3524
(PN 8510-16) Test Port Power Flatness
5091-0467E
(PN 8510-18) Testing Amplifiers and Active Devices with the HP 8510 Network Analyzer
5963-2352
(PN 8753-1) Amplifier Measurements Using the HP 8753 Network Analyzer
5956-4361
(PN 8753-2A) Mixer Measurements Using the HP 8753 Network Analyzer
5952-2771
(PN 8753-4) Antenna Measurements Using the HP 8753C Network Analyzer
5952-2776
(PN 8753-5) Mixer Measurement with HP 8753C and HP 8625A Synthesized
5091-1100E
(AN 1291-1) 8 Hints for Making Better Network Analyzer Measurements
5965-8166E
(AN 1287-1) Understanding the Fundamental Principles of Vector Network Analysis
5965-7707E
(AN 1287-2) Exploring the Architectures of Network Analyzers
5965-7708E
(AN 1287-3) Applying Error Correction to Network Analyzer Measurements
5965-7709E
(AN 1287-4) Network Analyzer Measurements: Filter and Amplifier Examples
5965-7710E
(AN 1287-5) Improving Throughput in Network Analyzer Applications
5966-3317E
(AN 1287-6) Using a Network Analyzer to Characterize High-Power Components
5966-3319E

Power Meters

Thermocouple and Diode Power Sensor Family Brochure
5959-8751D
HP 70100A Power Meter Modular Measurement System Catalog
5965-2818E
HP EPM Series Power Meter and E-Series Power Sensors, Brochure
5965-6380E
HP EPM Series Power Meters and E-Series Power Sensor, Technical Data
5965-6382E
HP EPM Series Power Meters and E-Series Power Sensors, Configuration Guide
5965-6381E
HP E-Series E9300 Power Sensors, Product Overview
5968-4960E
Fundamentals of RF and Microwave Power Measurements, Application Note 64-1A
5965-6630E
4 Steps for Better Power Measurements, Application Note 64-4A
5965-8167E

Noise Figure

HP 8970B, HP 8790S/V, 8971C Noise Figure Measurement Products
5091-6049E
(AN 57-1) Fundamentals of RF and Microwave Noise Figure Measurements
5952-8255E
(AN 57-2) Noise Figure Measurement Accuracy
5952-3706
HP 346A/B/C Broadband Noise Sources Technical Data
5953-6452E
HP R/Q347B Solid State Noise Sources
5954-8888
HP 70875A Noise Figure Meter Personality for MMS Spectrum Analyzers Product Overview
5965-5022E
HP 85719A Noise Figure Measurement Personality for 8590E Series Spectrum Analyzer
5091-4800E

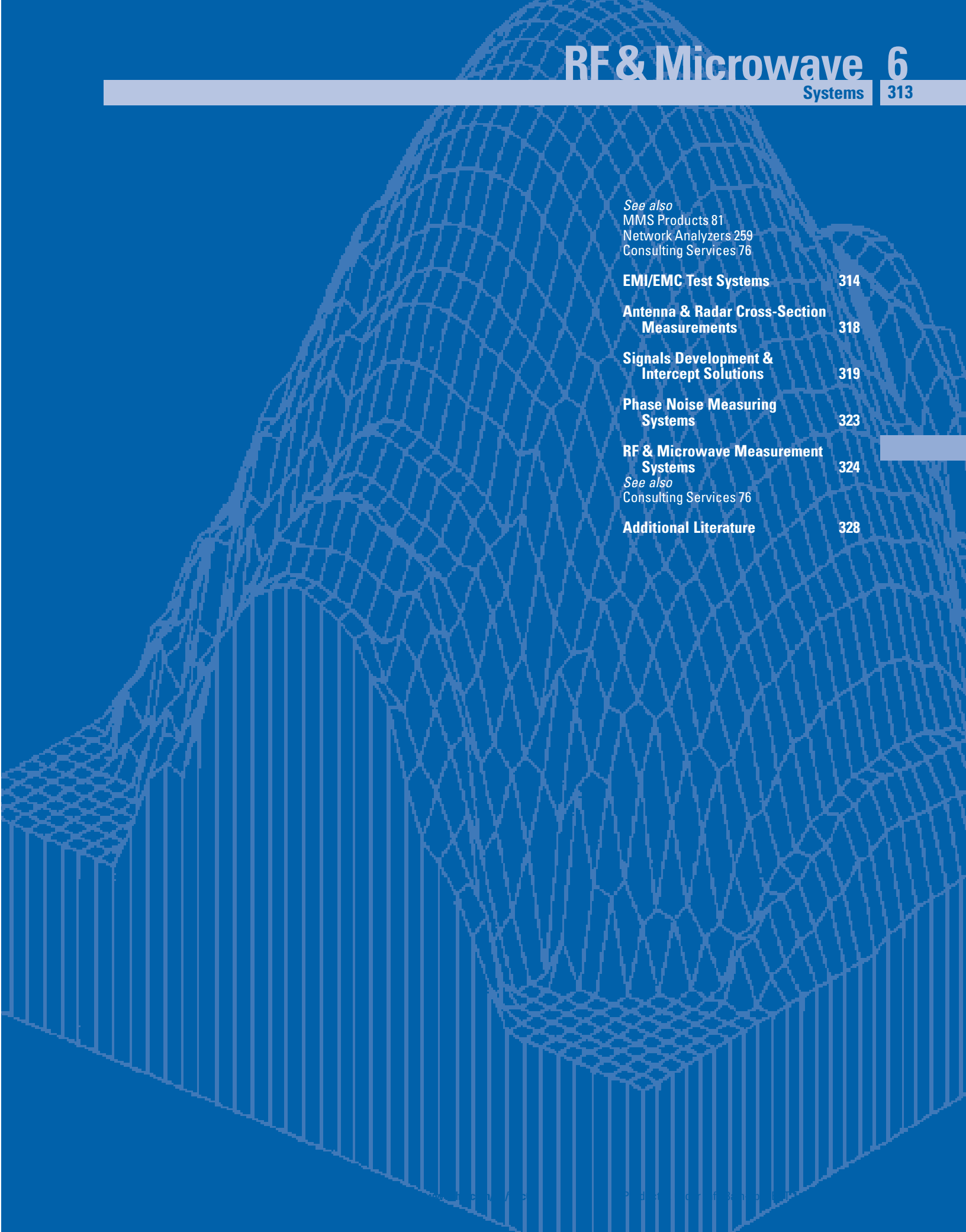
(PN 8970B/S-2) Applications and Operation of the HP 8970B Noise Figure Meter and HP 8970S MW Noise Figure Measurement System
5954-8896
(PN 8970B/S-3) Noise Parameter Measurement Using the HP 8970B Noise Figure Meter and the ATN Model NP4 Noise Parameter Test Set
5952-6639
Success with the HP/ATN Team
5091-3287E
(PN 8970B/S-4) Displaying HP 8970B Noise Figure Meter Measurements on the HP 8757 Scalar Network Analyzer
5959-8742

RF & Microwave Test Accessories

HP Custom Microwave Switch Matrixes
5966-2916E
(PN 8625A) Performing Two-tone Measurements with the HP 8625A
5091-2838E
(PN) ESA-L1500A 1.5 GHz Portable Spectrum Analyzer
5965-6309E

EMI/EMC Testing

Cookbook for EMC Precompliance Measurements
5964-2151E



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EMI/EMC Test Systems **314**

Antenna & Radar Cross-Section Measurements **318**

Signals Development & Intercept Solutions **319**

Phase Noise Measuring Systems **323**

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HP E7400A
HP 84115EM

NEW

6

HP E7400A Series EMC Analyzers

Whether your industry is information technology, automotive, communications, or medical electronics, you need to evaluate the EMI performance of your products during the development phase. With the HP E7400A series EMC analyzers, you can evaluate performance quickly and easily.

Compare your products conducted and radiated emissions performance to the following regulatory agency limits:

EN55011, EN55014, EN55022, FCC Part 15, VCCI, VFG, and GB9254 or generate and save your own limit lines.

The HP E7400A series EMC analyzers have the following functionality and features to speed you through measurements.

- Detectors to perform peak, quasi-peak, and average measurements.
- Complete measurement setups including span and EMI bandwidths.
- Display two limit lines and margins
- Corrections for antennas, cables, and amplifiers
- Measure peak, quasi-peak, and average amplitudes of 2000 signals and store the results into the internal list.
- Use the "Zone" feature to zoom in on a signal while viewing the broad spectrum
- Built-in 3 inch disk drive
- Large crisp color display.
- Built-in preamplifier with 20 dB nominal gain
- Sort, remeasure, mark, and delete signals in the internal list
- Standard GPIB and parallel ports
- Battery pack available
- Edit or customize and store limit lines and correction factors
- Optional built-in tracking generator to 3 GHz

The HP E7400A series EMC analyzers are offered in the following frequency ranges:

HP E7401A: 9 kHz to 1.5 GHz
HP E7402A: 9 kHz to 3.0 GHz
HP E7403A: 9 kHz to 6.7 GHz
HP E7404A: 9 kHz to 13.2 GHz
HP E7405A: 9 kHz to 26.5 GHz

HP 84105EM Design Development System

Identification, isolation, and resolution of problem emissions early in the design process is key to a successful product introduction. With the HP 84105EM design development system, you can easily isolate problems using the close field probes supplied with the system. The calibrated close field probes give very repeatable measurements ensuring that assessments of redesigns will produce meaningful results. The system is based on the new HP E7401A (9 kHz to 1.5 GHz) and includes the HP 11945A close field probe set (9 kHz to 1.0 GHz). An optional preamplifier, HP 11909A is available for additional sensitivity.

HP 84115EM Pre-Production Evaluation System

The HP 84115EM system has everything you need to perform radiated and conducted emissions measurements on your product. The HP 84115EM is based on the new HP E7401A EMC analyzer, which includes quasi-peak detection and EMI bandwidths. The system also includes the following:

HP 11955A biconical antenna, HP 11956A log periodic antenna, HP 11968C tripod, HP 11966L 10 meter cable, HP 11967D line impedance stabilization network, HP 11947A transient limiter and HP 11945A close field probe set.

In addition, the system includes the new HP E7415A EMI measurement software to automate the measurement process.

Key Literature

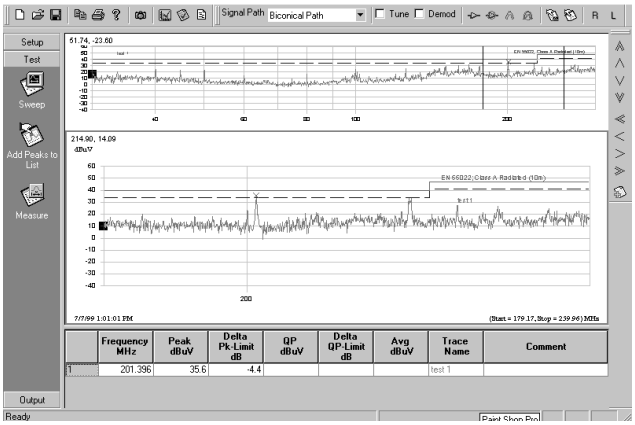
HP E7400A Series EMC Analyzer Brochure, p/n 5968-2516E
ESA/EMC Configuration Guide, p/n 5968-3412E
HP E7400A Series Technical Specifications, p/n 5968-3662E
HP E7400A Ordering Guide
EMC Accessories Catalog, p/n 5966-1188E
EMC Cookbook (APP: Not. 1328), p/n 5968-3661E

Ordering Information

HP 84105EM EMC Design Development System
Opt 909 add HP 11909A preamplifier
HP 84115EM EMC Pre-Production Evaluation System
Opt 909 adds HP 11909A preamplifier
HP E7401A 9 kHz to 1.5 GHz
HP E7402A 9 kHz to 3.0 GHz
HP E7403A 9 kHz to 6.7 GHz
HP E7404A 9 kHz to 13.2 GHz
HP E7405A 9 kHz to 26.5 GHz

- PC and Microsoft® Windows format
- Graphical test setup and execution
- Conducted and radiated capability

Various Models



HP E7415A EMI Measurement Software

Choose the level of automation you need, from simple data capture from your EMC analyzer or receiver to fully automated EMI measurements. With the HP E7415A, you can select the measurement resolution over the span of interest or use the auto-select feature.

Zoom in on an area for a closer look simply by dragging a cursor. Point and click to mark individual signals and add them to a list or use the "Add Peaks to List" function to add all the signals above a limit or margin to a list with one click. Highlight signals in the list to measure peak, quasi-peak and average amplitude or tune and listen.

Generate a report by selecting from a wide range of entries. Your report may include a graph, limit lines, equipment table, transducer factors etc.

The HP E7415A controls the HP E7400A series EMC analyzers with optional asset control modules for the HP 8590EM series EMC analyzer and HP 8546A/42E EMI receivers.

HP 11950X EMC Design Course

"Designing for EMC" is a custom course for engineers who face issues of electromagnetic compatibility. Emphasis is placed on evaluating and solving EMC problems early in the design phase of a product, rather than during final EMC compliance testing. Expert instruction and many demonstrations provide EMC fundamentals, methods of measuring EMC, and principles of incorporating proven EMC design into products.

The course covers the following topics: overview of EMC design, non-conducted coupling, common impedance coupling, radiation from digital circuits, cables, advanced cables, conducted emissions, susceptibility, electrostatic discharge, shielding and diagnostics. The 11-chapter handbook used in the class becomes a permanent reference.

The HP 11950X EMC design course is offered at a fixed fee at the site of your choice. For more information, contact your local HP sales office (listed on page 563).

HP 11940A and 11941A Close-Field Probes and HP 11945A Close-Field Probe Set

These handheld probes are designed to measure magnetic-field radiation from surface currents, slots, cables, and ICs for EMC diagnostic and troubleshooting measurements. Their unique design results in a high level of electric-field rejection. This significantly reduces errors, thus allowing calibrated and repeatable measurements.

The HP 11941A operates from 9 kHz to 30 MHz, the HP 11940A, from 30 MHz to 1 GHz. Five antenna factors appear on each probe for calculating absolute magnetic-field strength (dBµA/m) from the dBµV reading of a spectrum analyzer. Each probe is calibrated and comes with a 2-meter RG-223 coaxial cable, and SMA(f)-to-type-N(m) adapter, and an SMA (f)-to-BNC(m) adapter.

The close field probe set includes both the HP 11940A and 11941A probes for full coverage from 9 kHz to 1 GHz. Option E51 adds the HP 11909A preamplifier, a 36-inch (914-mm) type-N cable, and a carrying bag for storage and protection of the entire set.

HP 119XX Series Antennas

These antennas are individually calibrated and shipped with a calibration certificate showing actual performance data. The series includes the following products:

HP Model		Frequency Range
11955A	Biconical Antenna[1]	30 to 300 MHz
11956A	Log Periodic Antenna[1]	200 MHz to 1 GHz
11966A	Active Loop H-Field Antenna	10 kHz to 30 MHz
11966B	Active Rod E-Field Antenna	100 Hz to 50 MHz
11966C	Biconical Antenna	30 to 300 MHz
11966D	Log Periodic Antenna	200 MHz to 1 GHz
11966E	Double-Ridged Waveguide Horn Antenna	1 to 18 GHz
11966F	Conical Log Spiral Antenna	200 MHz to 1 GHz
11966G	Conical Log Spiral Antenna	1 to 10 GHz
11966H	Dipole Antenna Set	28 MHz to 1 GHz
11966I	Double-Ridged Waveguide Horn Antenna	200 MHz to 2 GHz
11966J	Double-Ridged Waveguide Horn Antenna	18 to 40 GHz
11966K	Magnetic Field Pickup Coil	20 Hz to 50 kHz
11966L	Coax Cable, Type-N	10 m
11966M	Coax Cable, BNC	10 m
11966N	Log Periodic Antenna	200 MHz to 5 GHz
11966P	Broadband Antenna	30 MHz to 1 GHz
11947A	Transient Limiter	9 kHz to 20 MHz

Key Literature

EMC Accessories Catalog, p/n 5966-1188E
EMC Precompliance Measurement Systems and Accessories, p/n 5964-6091E

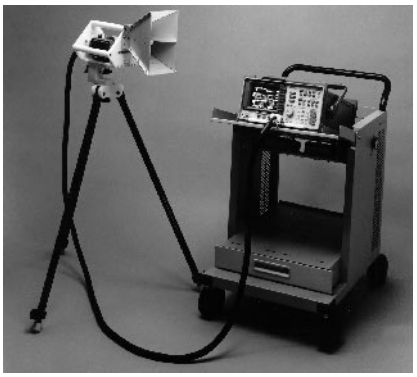
[1] Typical cal factor supplied

EMI/EMC Test Systems

EMI Receivers

HP 84125A
HP 84125B
HP 84125C
HP 85869PC

- Input overload protection
- Low system noise



- Traditional receiver features, including automatic overload detection and auto-ranging
- Three tuning modes, manual, stepped and scanning
- Large, color CRT

HP 8542E 2.9 GHz

HP 84125A/B/C Microwave EMI Measurement Systems

The HP 84125 family of systems are designed to measure electromagnetic emissions from intentional and unintentional radiators from 1 to 18 GHz, 26.5 GHz or 40 GHz. Each system is fully integrated and calibrated for measuring products to rigorous FCC regulations. Equipment manufacturers, EMC test laboratories, and regulatory authorities will find the HP 84125 series microwave test systems a valuable addition to their existing EMI measurement capability.

The cart-mounted equipment is connected to a microwave test set with a 3-m low-loss RF cable assembly maximizing the system sensitivity. The functionality of a HP 8593EM or HP 8564E analyzer and the microwave test set is combined using a system down-loadable program (DLP). The system DLP provides softkeys on the analyzer display allowing easy setup of the measurement parameters.

Note: Tripod not included. It can be ordered separately as HP 11968C.

Specifications

HP 84125A/B/C 1 to 18/1 to 26.5/1 to 40 GHz

Ordering Information

HP 84125A Microwave EMI Measurement System
HP 84125B Microwave EMI Measurement System
HP 84125C Microwave EMI Measurement System

HP 85869PC EMI Measurement Software

The EMI measurement software is a general-purpose program that makes radiated- and conducted-emission measurements automatically up to 22 GHz.

Ordering Information

HP 85869PC EMI Measurement Software
Opt 832 Upgrade Kit from HP 85869A

HP 8546A and HP 8422E EMI Receivers

The HP 8542E and HP 8546A EMI receivers make CISPR-based EMI measurements with unprecedented accuracy, speed, and ease of use. These EMI test receivers can be used to check conformance to standards such as CISPR, EN, FCC, VCCI, and VDE.

Most Requested Features

Both receivers incorporate the features most often requested by EMI test engineers:

- Specifications that meet CISPR Publication 16-1[1] recommendations for making compliance measurements to any civilian EMI measurements standard worldwide
- ±2 dB absolute amplitude accuracy, specified
- Extended frequency coverage to test the newest high-speed ITE equipment
- 3½" disk for test setups and data storage
- Traditional receiver features, including automatic overload detection and auto-ranging
- Three tuning modes: manual, stepped, and scanning
- Large, color CRT

Fully CISPR 16-1 Compliant

GPIB

Report Generation Software is Free

The HP 85878A Report Generator Software is included free with the purchase of an HP 8542E or a HP 8546A. The HP 85878A software can retrieve internal data from the HP 8542E or HP 8546A such as limit lines, stored lists of signals, and external device correction factors (e.g. cables and antennas) and place them into a word processing package.

[1]CISPR Publication 16 is the Comité International Spécial des Perturbations Radioélectriques specification for radio interface measuring apparatus and measurement methods.

Measurement Automation

Both receivers work with new PC-based EMI measurement software—the HP 85876B is a powerful, easy to use automated solution for commercial radiated emission testing.

See the HP E7415A EMI measurements.

Specification Summary

Frequency Range: HP 8542E: 9 kHz to 2.9 GHz; HP 8546A: 9 kHz to 6.5 GHz
Frequency Reference
Aging: <±1 x 10^{-7}/year
Temperature Stability: < ±1 x 10^{-8}
Frequency Readout Accuracy: ± (freq. readout x freq. reference error + 20% of IF bandwidth + 100 Hz) conforms to CISPR 16-1
Displayed Average Noise Level (with CISPR bandwidths, 0 dB attenuation) (characteristic)

	Preamp Off	Preamp On
CISPR Band A (200 Hz BW)		
9 kHz to 150 kHz	3 to – 27 dBμV	– 9 to – 31 dBμV
CISPR Band B (9 kHz BW)		
150 kHz to 30 MHz	– 18 dBμV	– 21 dBμV
CISPR Band C/D (120 kHz BW)		
30 MHz to 1 GHz	– 5 dBμV	–10 dBμV
Noise Figure Characteristic		
9 kHz to 2.9 GHz	14 dB	10 dB
1 GHz to 6 GHz	24 dB	8 dB

Absolute Amplitude Accuracy: 9 kHz to 2.9 GHz: ±2 dB (typical ±1 dB); 2.9 to 6.5 GHz (characteristic): ± 3.0 dB (HP 8546A)
IF Bandwidths
Measurement: 200 Hz, 9 kHz, 120 kHz, 1 MHz
Diagnostic: 30 Hz to 3 MHz (3 dB) in a 1-3-10 sequence
IF Detectors
Measurement: Peak, quasi-peak, average
Overload: RF, IF
Demodulation: AM, FM
Temperature Range: 0° to +55° C, operating; – 40° to +75° C, storage
Size: 457 mm W x 365 mm H x 645 mm D (18 in x 14.38 in x 25.38 in)
Weight: 48.6 kg (108 lb)

Key Literature

HP 8546A EMI Receiver Technical Data, p/n 5091-8314E
HP 8542E EMI Receiver Technical Data, p/n 5963-0081E

Ordering Information

HP 8542E EMI Receiver (9 kHz to 2.9 GHz)
HP 8546A EMI Receiver (9 kHz to 6.5 GHz)

HP 11966P Broadband Antenna with 11968K

HP 11967 Series Current Probes

This series is designed for MIL-STD-461/462 conducted-emission measurements on power and interconnecting leads. Used with 10 µF capacitors, HP p/n 0160-6683.

HP Model	Frequency Range
11967A Current Probe	15 kHz to 50 MHz, dc to 60 Hz powerlines
11967B Current Probe	20 Hz to 2 MHz, dc to 400 Hz powerlines

HP 11967E Line Impedance Stabilization Network

This is a single phase, 25 ampere unit used for commercial conducted emissions measurements and meets the requirements for FCC, CISPR and European Norms. The 11967E LISN is supplied with a NEMA power outlet standard or optional SCHUKO, British, and Australian power outlets.

HP 11967D Line Impedance Stabilization Network

Used for commercial conducted measurements. Maximum current 10 amps. Includes options for NEMA, SCHUKO and British power outlet connectors.

HP 11968 Series Positioning Devices

This series includes manually-operated antenna masts and turntables.

HP Model	Description
11968B	Manually-operated antenna-positioning mast
11968C	Non-metallic antenna tripod; minimizes unwanted reflections in the test environment
11968E	Manually-operated turntable

HP 11729-60014 Low-Noise Preamplifier

This amplifier provides the sensitivity needed for MIL-STD-461C CE-06 receiver/transmitter key-up testing. Frequency range is 10 Hz to 25 MHz.

HP 11909A Preamplifier

Improve receiver, EMC analyzer or spectrum analyzer sensitivity for more accurate radiated emissions measurements. This amplifier has 32 dB gain with a 1.8 dB noise figure. This amplifier is ideal for use with the HP 11940A and 11941A close field probes to detect low level signals from and device-under-test. Frequency range is 9 kHz to 1 GHz.

HP 8449B Microwave Preamplifier

This high-gain, low-noise preamplifier adds sensitivity for MIL-STD radiated measurements. Frequency range is 1 to 26.5 GHz (see page 286).

Ordering Information

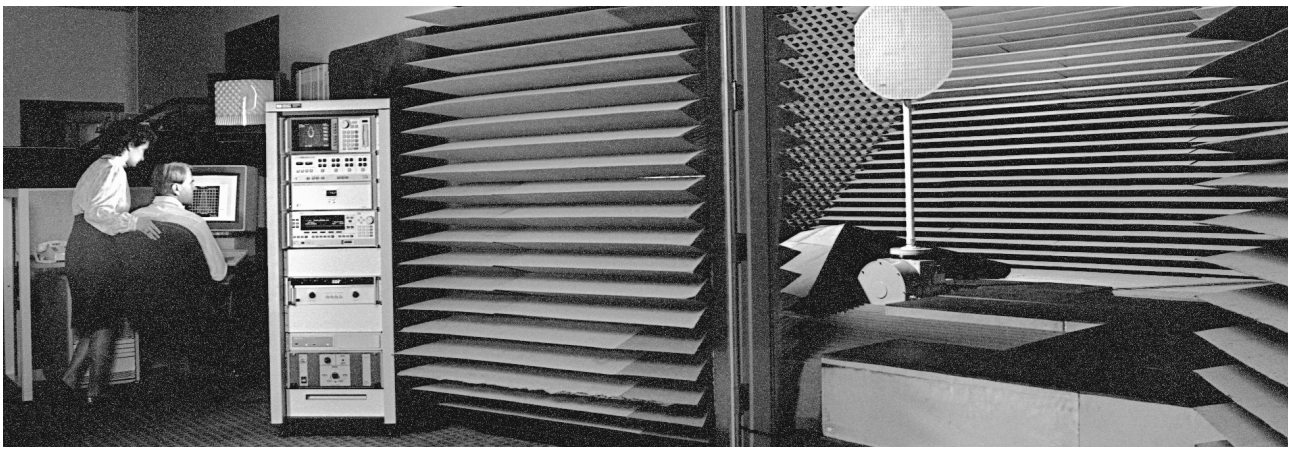
HP 11950X "Designing for EMC" Course (per site)
HP 11940A Close-Field Probe, 30 MHz to 1 GHz
HP 11941A Close-Field Probe, 9 kHz to 30 MHz
HP 11945A Close-Field Probe Set, 9 kHz to 1 GHz
  Opt 001 Rotary Joints
  Opt 003 Delete Cables and Adapters (2 sets)
  Opt E51 Add HP 11909A Preamplifier Carrying Bag, 36-in Type-N Cable
HP 11947A Transient Limiter, 9 kHz to 200 MHz
HP 11955A Biconical Antenna*
HP 11956C Log Periodic Antenna*
HP 11966A Active Loop H-Field Antenna, 10 kHz to 30 MHz
HP 11966B Active Rod E-Field Antenna, 100 to 50 MHz
HP 11966C Biconical Antenna, 30 to 300 MHz
HP 11966D Log Periodic Antenna, 200 MHz to 1 GHz
HP 11966E Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz
HP 11966F Conical Log Spiral Antenna, 200 MHz to 1 GHz
HP 11966G Conical Log Spiral Antenna, 1 to 10 GHz
HP 11966H Dipole Antenna Set, 28 MHz to 1 GHz
HP 11966I Double-Ridged Waveguide Horn Antenna, 200 MHz to 2 GHz
HP 11966J Double-Ridged Waveguide Horn Antenna 18 to 40 GHz
HP 11966K Magnetic Field Pickup Coil, 20 Hz to 50 kHz
HP 11966L Coax Cable, Type-N
HP 11966M Coax Cable, BNC
HP 11966N Log Periodic Antenna, 200 MHz to 5 GHz
HP 11966P Broadband Antenna, 30 MHz to 1 GHz
HP 11967A Current Probe, 15 kHz to 50 MHz
HP 11967B Current Probe, 20 Hz to 2 MHz
HP 111967E 25 amp Line Impedance Stabilization Network
HP 11967D LISN NEMA Connector
  Opt 001 SCHUKO Connecto
  Opt 002 British Connector
HP 11968B Manual Antenna-Positioning Mast
HP 11968C Antenna Tripod
HP 11968K Rugged Tripod
HP 11968E Manual Equipment-Testing Turntable
11729-60014 Low-Noise Preamplifier, 10 Hz to 25 MHz
HP 11909A Preamplifier, 9 kHz to 1 GHz
HP 8449B Microwave Preamplifier, 1 to 26.5 GHz
HP E7415A EMI Software
  Option 001 Report Generation only
  Option 101 Delete HP E7400A ACM Adds HP 8590EM ACM
  Option 102 Delete HP E7400A ACM Adds HP 8546A/42E ACM
HP E7416A EMI Software Upgrades
  Option 101 Adds HP 8590EM ACM
  Option 102 Adds HP 8546A/42E AMC

*Typical antenna factors supplied

Antenna & Radar Cross-Section Measurements

Antenna Characterization and Performance Verification

HP 8530A
HP 85310A
HP 85309A
HP 85320A/B
HP 85330A
HP 85331/32A
HP 85325A
HP 85370A
HP 85395A/B/C

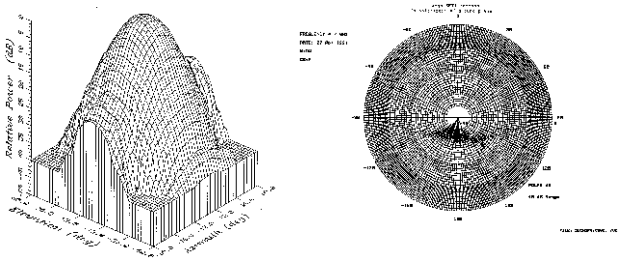


HP's antenna measurement demonstration facility

- Measurement speeds of up to 5000 points/second
- Fast multiple-channel measurements
- Excellent microwave performance and accuracy
- Manual or automated operation
- Built-in graphical display and analysis capability

Products Designed for Productivity

Maintaining a competitive edge requires measurement products with the greatest accuracy, reliability, and productivity available. HP products offer the performance, accuracy, and features you need.



Typical data available from measurement systems

HP 8530A Microwave Receiver

The HP 8530A is a fast and accurate microwave receiver designed for both manual and automated antenna measurement and radar cross-section measurement applications. It features fast data acquisition speeds, excellent sensitivity, wide dynamic range, multiple test channels and fast frequency agility—without compromising measurement accuracy. The receiver provides broad frequency coverage from 45 MHz to 50 GHz, with extensions to 110 GHz.

Easy Upgrades for Existing Antenna Ranges

The HP 8530A microwave receiver can be a replacement receiver for existing antenna or RCS range receivers. With the HP 85370A antenna position encoder, the HP 8530A receiver can be interfaced to virtually any positioning system. Also, any HP 8510 network analyzer can be upgraded to a HP 8530A microwave receiver and still retain network analyzer capability. The HP 85395A/B/C kits provide an on-site upgrade of your existing network analyzer. Whether you upgrade one component or a complete system, HP provides the reliable instrumentation you need, and HP's upgrade paths protect your capital investment in your measurement systems.

Far-field Antenna Measurements

Antenna measurement products must have the flexibility to measure a variety of antennas, and have features and performance to test the most challenging and complex antennas. Far-field antenna measurement applications require good measurement sensitivity, and immunity to spurious signals. HP instrumentation fulfills these demanding requirements on hundreds of far-field antenna ranges worldwide. Systems can be configured to operate from 0.1-110 GHz. A typical far-field antenna measurement system includes an HP 8530A microwave receiver, an HP 85310A distributed frequency downconverter, which consists of an HP 85309A LO/IF signal distribution unit, and HP 85320A/B test and reference mixers. HP 8360 series synthesized sources are used for RF and LO signals.

Near-field Antenna Measurements

HP instrumentation fulfills the demanding requirements imposed by near-field measurement applications. These applications require instrumentation accuracy, stability, rapid data acquisition speeds, fast frequency agility, and multiple channel capability. Either the HP 8700 series of network analyzers, or the HP 8530A microwave receiver with one of two different frequency downconverters; the HP 85310A distributed frequency downconverter, or the HP 8511A/B frequency converter can be used in near-field applications.

Radar Cross-Section Measurements

HP instrumentation is meeting the challenges of RCS measurements by offering broadband frequency capability, excellent sensitivity and accuracy, and a choice of two different frequency downconverters. The HP 8511B provides broadband frequency coverage from 45 MHz to 50 GHz with very fast frequency agility. The HP 85310A frequency downconverter provides excellent sensitivity, and frequency coverage from 0.1 to 110 GHz. Both systems provide excellent measurement accuracy, and multiple channel capabilities.

Antenna Measurement Solutions

HP's channel partner, Nearfield Systems, Inc. (NSI) provides application expertise, system engineering and configurations, integration, installation, performance verification, and training for far-field and near-field solutions. Measurement automation software is available for improving the productivity of data acquisition and analysis. NSI also provides additional complementary products, such as robotic scanners, antenna positioners, and their associated control products. NSI can design and deliver customized systems to meet your unique and/or complex requirements.

Nearfield Systems, Inc.

Contact Nearfield Systems for antenna measurement solutions, measurement automation software, and antenna positioning products.

Nearfield Systems, Inc.
1330 E. 223rd Street, Bldg. 524
Carson, CA 90745 USA
Phone: (310) 518-4277
Fax: (310) 518-4279
E-mail: sales@nearfield.com
Web site: http://www.nearfield.com

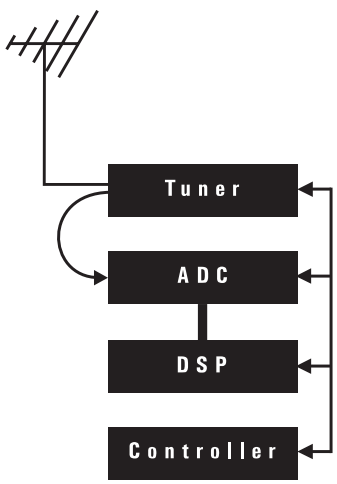
Ordering Information

HP 8530A Microwave receiver
HP 85310A Distributed frequency downconverter
HP 8511A Frequency converter

Additional Information

www.hp.com/go/antenna

Signals development and intercept is the art of finding and analyzing signals that may not want to be found. Hewlett Packard offers a selection of products to help with this task. Each product has distinctive capabilities that make it the preferred system for a particular job.



Wide band receiver block diagram. (Antenna/ Tuner/ADC/DSP)

Use the HP E3238 signals development system for wide-band signal search, classification, and monitoring. This turn-key modular VXI system is noted for sweeping fast with excellent frequency resolution. The tuner has a wide IF bandwidth, at least 4 MHz and is stepped, not continuously swept across the spectrum. The wide IF speeds search by enabling fast tuning and minimizing the number of steps needed to cross a given spectrum segment. The tuner steps so the IF can be digitized. The ADC digitizes the entire IF without degrading the signals and sends the samples to the DSP where a Fast Fourier Transform (FFT) is calculated. The FFT provides selectable frequency resolution and noise floor reduction.

The HP E3238 improves search speed by 10 or 100 times over narrow-band swept search techniques used in other systems. These systems tune a relatively narrow audio bandwidth receiver across the spectrum. Typically such a system can sweep 50 MHz in 2.5 seconds with 7.5 kHz frequency resolution. The HP E3238 can sweep the same spectrum in 50 ms.

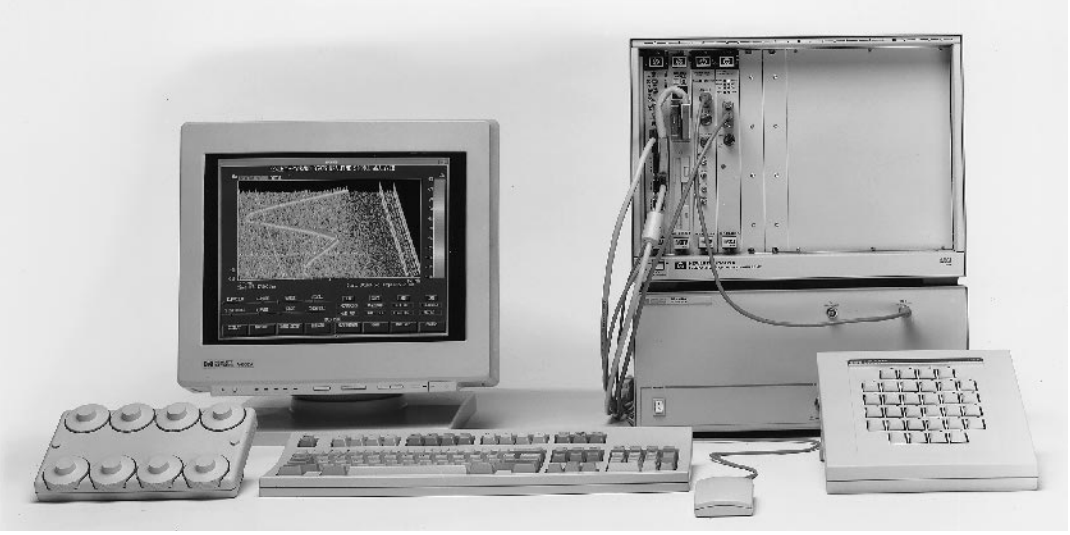
Use the HP 3587 wide-band recording and signal analysis system to evaluate and characterize signal structure. This turn-key modular VXI system is noted for its measurement performance, signal processing tools, fast flexible display types and presentation formats. The HP 3587 uses digital sampling and the FFT to form a spectrum of the signal, in real time or data it records. This technique is useful for measuring signals with a resolution of a few µHz to 100 kHz, and provides frequency, amplitude, and phase information. With its real-time signal analysis capability, and its wide-band recording features, the HP 3587 is able to capture and analyze periodic as well as random and transient signals and events.

Use the HP 6500A VXI Tuner and HP E6501A VXI receiver modules to build your own high performance receiver system. These carefully matched module sets are noted for their superior RF performance and programmability. Combine the E6500A tuner modules with HP VXI ADC and DSP modules (see VXI section in this catalog), and your software, to produce a search receiver system, wide or narrow band, which matches your needs exactly. You can also use the ADC and DSP provided standard with the tuner in the E6501A receiver modules, and your software, to search for and demodulate (AM, FM, PM, SSB, CW) signals.

Real-Time Signal Analysis System

HP 3587

- Measure DC to 3 GHz
- 8 MHz maximum frequency span
- 1 MHz real-time DSP bandwidth
- Frequency, time, and amplitude domain displays
- Spectrogram and waterfall displays
- Compatible with various downconverters



HP 3587

HP 3587 Real-Time Signal Analysis System

The HP 3587 real-time signal analysis system has the measurement power and flexibility you need to capture and analyze real world signals. Its combination of speed, dynamic range, presentation flexibility, signal capture memory, and instrument-like operation will help you analyze non-stationary and low-level signals, even those close to much higher level signals, a higher percentage of the time.

8 MHz Input Bandwidth

Analyze data with up to 8 MHz bandwidth. The HP 3587 uses a 20 MSa/s 23 bit ADC module to digitize signals. This HP A/D is fully alias-protected to assure the Nyquist valid sampling that is key for signal analysis. It also provides up to –110 dBfs of spurious-free dynamic range. A 16 dB noise figure provides excellent sensitivity to complement this dynamic range. Extend the measurement range of the HP 3587 with a selection of HF and VHF/UHF downconverters.

1 MHz Real-Time DSP Bandwidth

The digital signal processing module in the HP 3587 contains 250 MFLOPs of raw computational power. That power gives this signal analyzer 1 MHz of real-time bandwidth. That means you can monitor any 1 MHz span in the DC to 3 GHz range of the HP 3587 continuously, with < 2 kHz frequency resolution and zero revisit time.

Versatile Data Display

Monitor and analyze signals with a choice of frequency-domain, time-domain, and histogram displays. Frequency-domain displays include single-trace spectrums, multi-spectrum waterfalls, spectrograms, and rollograms. Rollograms can update at better than 800 spectrums per second. Time-domain displays include single trace, strip chart, and waterfall. Histograms, probability density function (PDF), and cumulative density functions (CDF) are standard. Other features include digital persistence, digital image enhancement filtering, and a variety of marker functions. Option AGG allows you to create your own markers and modify signal data before it is displayed, as well as modify the user interface.

Signal Capture Memory (Option ATR)

Save important wideband signals using the throughput-to-disk option (Option ATR) and as many as eight E1562 high-speed data disk modules. This capability allows you to save time data at 10 MSa/s (4 MHz bandwidth) to 64 GB of hard disk memory. That's 52 minutes of recording time.

System Advantages

The HP 3587 is a turn-key VXI system. Software is loaded at the factory, so you can take the system out of the box, hook up a few cables, and start making measurements right away.

Specifications

Frequency

Range: DC to 8 MHz
Spans: 0.95 Hz to 8 MHz, octave steps
Resolution: 51 to 12,801 lines
Real-time Bandwidth: 1 MHz (801 lines, 0% overlap, spectrogram mode, rms averaging, 16-bit word width, 1024 x 768 pixel display)

Amplitude

Input Range: +30 dBm to –24 dBm
Accuracy: ± 0.03 dB, f < 100 kHz, 25° C, ± 1 V range, dc coupled alias filter on, digital filters off
Input Impedance: 50 Ω, > 40 dB return loss to 4 MHz
Harmonic Distortion: < –110 dBfs or –80 dBc, whichever is greater

Modes

Averaging Modes: Off, rms, peak, nth
Marker Modes: Single, relative (same trace, separate trace), marker to peak, marker to next peak, right/left, band power, noise power
Memory Modes: Save/recall, record/playback, signal capture
Triggering Modes: Free-run, level, magnitude, external
Printer Output: Print screen/print trace

Key Literature

HP 3587S Signal Analysis System Brochure, p/n 5963-7089E
HP 3587S Technical Specifications, p/n 5963-6607E

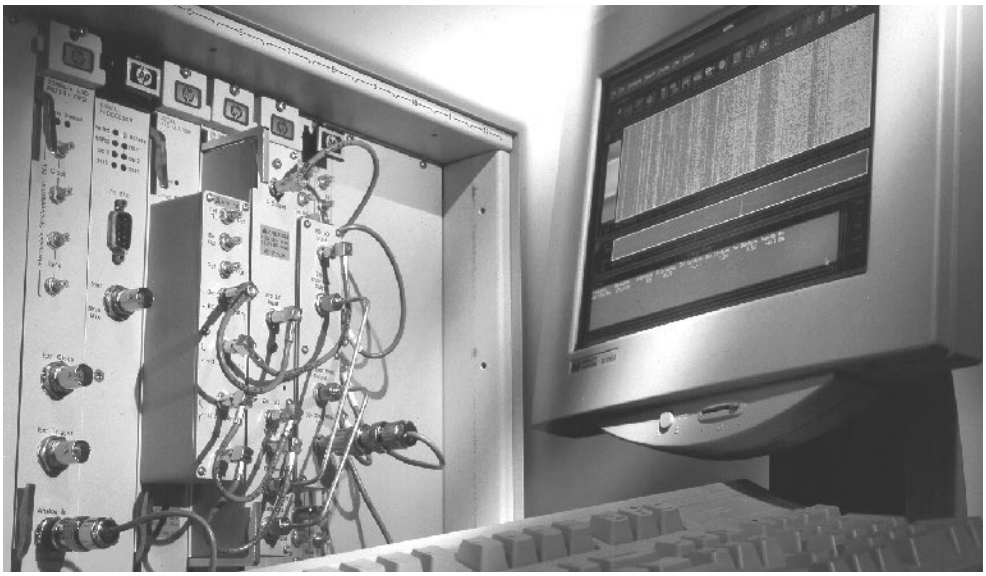
For more information, visit our web site:
http://www.tmo.hp.com/tmo/datasheets/English/HP3587.html

Ordering Information

HP 3587 Real-Time Signal Analysis System
System may include: HP controller, monitor, disk drive, DAT tape, VXI chassis, DSP module, ADC module, HP-UX operating system, HP 35687B measurement/control software. For a complete configuration guide contact your local Hewlett-Packard sales office.
For a pre-bundled system, order 3587B.

*Price will vary with configuration.

- 2.3 GHz/sec scanning rate with 15 kHz resolution
- Manual and automatic signal isolation tools
- Automatic energy detection tools
- Hand-off receiver control
- LAN compatible



HP E3238

HP E3238 Signals Development System

Catching intermittent or clandestine signals in dense signal environments is a challenging task. You'll be equipped to meet that challenge with the HP E3238 signals development system. This fast-scanning, high-selectivity receiver system has the manual and automatic tools you need to detect, classify, and monitor signals of interest.

General and Directed Search

The HP E3238 provides a choice of signal search modes. Choose general search to monitor a large segment of spectrum as part of an environmental scan. Choose directed search to sequentially scan up to 100 individual spectrum segments, skipping the parts of the spectrum that aren't critical to your mission. A full selection of resolution bandwidths and averaging types are available for both modes.

Manual Signal Isolation Tools

The mouse-controlled signal isolation tools in the HP E3238 work directly where your attention is focused, on the signal trace. Zoom in the display by dragging a box around the interesting signal with the mouse; assign a hand-off receiver to a signal by pointing at the signal with the mouse and dragging the signal to the hand-off receiver control box; read the frequency and amplitude of a signal by pointing with the mouse and pressing the left mouse button to activate the marker.

Automatic Energy Detection

Automatically isolate energy of interest based on its frequency, amplitude, bandwidth, duration and more. Select one of the three thresholds to automatically separate signal from noise energy. Automatically gather parameters on all energy above your threshold in the energy history database. Set the alarm function to automatically find signals of interest in the database and take action. Add frequency domain energy filters and parameter extractors, new alarms tasks and more to the HP E3238 with Option AS9 User programming.

User Signal Identification, (Option ASH)

Add narrowband signal processing capability to your HP E3238 with the new User Signal Identification option ASH. This option opens up the HP E3238 in two important ways. It lets you add two sets of "channelizer" hardware to the platform, and it provides the software hooks and libraries needed to tightly integrate your signal identification functionality into the HP E3238 software.

LAN Control

You can operate the HP E3238 via Ethernet LAN, accessing all features, displays, and menus from any X-compatible server anywhere in your network.

System Advantages

The HP E3238 is a turn-key VXI system that comes from the factory configured and ready to run. All the software is loaded on the hard disk before the system is shipped so all you have to do to get started is take the system out of the box and hook up a few cables.

Specifications

Using the HP 89431A – 2 to 2650 MHz downconverter

Frequency
- **Range:** 2 to 2650 MHz
- **Spans:** 1 MHz to 2650 MHz, 1 Hz resolution
- **Resolution:** 7.3 Hz to 120 kHz, octave steps
- **Sweep Speed:** 2.3 GHz/s (using 15 kHz RBW)

Amplitude
- **Input Range:** –50 dBm to +25 dBm (5 dB steps)
- **Sensitivity:** –159 dBm/Hz (–50 dBm range)
- **Noise Figure:** 16 dB
- **Spur Free Dynamic Range:** 70 dB

Key Literature

HP E3238S 2 to 2650 MHz Technical Specifications, p/n 5963-6609E
HP E3238S Scanning Signal Analysis System Brochure, p/n 5963-6610E

For more information, visit our website:
http://www.tmo.hp.com/tmo/datasheets/English/HPE3238S.html

Ordering Information

HP E3238 Signals Development System
Includes: HP controller, monitor, disk drive, DAT tape, DSP module, ADC module, downconverter, RF MUX module, VXI chassis, HP-UX operating system, HP 35688B measurement/control software. For a complete configuration guide contact your local Hewlett-Packard sales office.
For a pre-bundled system, order E3238B.

* Price will vary with configuration.

HP E6500A
HP E6501A
HP E6502A
HP E6503A

HP E6500A VXI Tuner
- 2 MHz[1] to 1000 MHz tuning range (3000 MHz, optional)
- Excellent dynamic range (high TOI, low noise figure)
- Fully input-preselected
- Fast, synthesized tuning with 1 Hz resolution
- Software driver and register-based commands
- Compatible with HP E3238 signals development system

HP E6500A Tuner Configurations:
(left to right) HP E6500A with Option 003 (2 MHz[1] to 3 GHz) in Option 006 six-slot mainframe; HP E6500A standard system consisting of two VXI modules (2 MHz[1] to 1 GHz); HP E6500A Option 003 three-module set (2 MHz[1] to 3 GHz); HP E6500A Option 003 in Option 013 thirteen slot mainframe. (Slot zero controller ordered separately in all systems.)

6

HP E6500A VXI Tuner

Description

The HP E6500A VXI tuner brings high dynamic range, preselection, fast tuning, and the flexibility of a modular architecture to signal monitoring applications in the VHF/UHF frequency ranges. The HP E6500A tuner provides frequency coverage from 2 MHz[1] to 1000 MHz using two C-size VXI modules—the HP E6401A 2 MHz[1] to 1000 MHz downconverter and the HP E6402A local oscillator (LO). For applications requiring frequency coverage beyond 1000 MHz, the HP E6500A Option 003 configuration adds the HP E6403A block downconverter VXI module to extend the frequency range to 3000 MHz.

Applications

The HP E6500A tuner downconverts VHF/UHF signals to an intermediate frequency (IF) of 21.4 MHz or to a baseband output of 2.5 MHz to 9.5 MHz using the HP E6500A Option 001. The high dynamic range and fast tuning make this VXI tuner an excellent front-end for numerous system applications. For example, the standard HP E6500A tuner is combined with the HP E6404A digital IF processor to form the HP E6501A VXI receiver (shown on this page). Another alternative is to use the HP E6500A Option 001 baseband configuration with the HP E1437A or E1430A digitizer in the HP E3238 signals development system.

Many applications such as direction finding (DF) require multichannel tuners, all sharing a common local oscillator (LO). Although the standard HP E6500A is a single channel tuner, HP custom-engineered system options are available to support multiple channels.

Specifications

Frequency Range: 2 MHz[1] to 1000 MHz (3000 MHz with Option 003)
Tuning Resolution: 1 Hz
Noise Figure: 10 dB, typical (20 MHz to 1000 MHz);
14 dB, typical (1000 MHz to 3000 MHz)
Second Order Intermodulation (SOI): +67 dBm, typical
Third Order Intermodulation (TOI): +15 dBm, typical (20 MHz spacing)
Image Rejection: 95 dB
IF Rejection: 90 dB
Phase Noise @ 20 kHz offset: –100 dBc/Hz, characteristic
Internally Generated Spurious: –100 dBm, equivalent input
LO Emissions: –110 dBm (1000 MHz); –100 dBm (3000 MHz)

Key Literature

HP E6500A Product Overview, p/n 5965-5769E
HP E6501A Product Overview, p/n 5966-0165E
HP E6501A Technical Specifications, p/n 5966-3344E
HP E6501A Configuration Guide, p/n 5966-2974E

[1] Although tuning down to 2MHz is allowed, performance is not specified below 20MHz.

HP E6501A VXI Receiver
- 2 MHz[1] to 1000 MHz tuning range (3000 MHz, optional)
- Includes powerful Digital IF Processor VXI module
- Fast, > 2 GHz/sec signal search speed
- Multiple, simultaneous demodulation using digital drop receiver approach
- VXI plug-and play software driver and PC-based virtual front panel demonstration software

HP E6501A Option 003 receiver (2 MHz[1] to 3 GHz) in Option 006 six-slot mainframe. HP E6501A receiver consists of HP E6500A tuner and HP E6404A IF processor VXI module.

HP E6501A VXI Receiver

The HP E6501A VXI receiver combines the high dynamic range, fast tuning, fully preselected performance of the HP E6500A VXI tuner with the powerful digital processing capabilities of the HP E6404A digital IF processor VXI module. By providing high-value receiver subsystem hardware and accompanying software drivers, the HP E6501A enables systems integrators to more quickly and cost-effectively build signal monitoring systems that provide high-speed signal search, demodulation, and direction finding solutions for their customers.

Receiver Applications

Signal monitoring applications require receivers with fast search speed and flexible demodulation capability to detect challenging signals-of-interest. The HP E6501A is a single channel receiver configuration offering excellent RF performance, fast tuning, and DSP-based demodulation. With a software driver that supports a fast step-and-FFT approach for searches, the wide 8 MHz digital snapshot bandwidth provides search speeds faster than 2 GHz/sec with narrow channel bandwidths. Unlike traditional analog receivers which can only demodulate one signal at a time, the HP E6501A includes an optional digital drop receiver (DDR) capability which provides simultaneous demodulation of up to ten signals within an 8 MHz spectral capture range. This benefits the systems integrator by minimizing the system costs and reducing the number of VXI slots required.

Additional receiver configurations are available for applications requiring multiple channels. The HP E6502A dual receiver provides independent search and demodulation since it uses two separate tuners. It can also be configured for multiple channel demodulation requiring a capture range of at least 16 MHz. The HP E6503A dual receiver uses a single shared LO for coherent downconversion and digital I/Q outputs required in direction finding applications. Contact your HP sales representative for custom-engineered solutions supporting more than two channels.

Powerful DSP Capabilities

The HP E6501A VXI receiver includes powerful DSP capabilities to process today's challenging signals. Features and benefits include:
- DSP-based AM, FM, PM, SSB, CW demodulation
- Built-in optional digital drop receivers (DDRs) for simultaneous demodulation of multiple signals within 8 MHz capture bandwidth
- Digital IF filters from 247 Hz to 462 kHz with 1.5:1 shape factors
- Digital I and Q outputs available for post-processing
- Full-rate ADC data available (16 bits @ 28.533MSa/s)

Ordering Information

HP E6500A VXI Tuner
Opt 001 Baseband Output
Opt 003 Increases Frequency Range to 3 GHz
Opt 006 Add HP E1421B six-slot VXI Mainframe
Opt 013 Add HP E1401B thirteen-slot VXI Mainframe
HP E6501A VXI Receiver
Opt 003 Increases Frequency Range to 3 GHz
HP E6502A Dual Channel Receiver (independent LOs)
HP E6503A Dual Channel Receiver (shared LO)

[2] Price on application.

- 50 kHz to 26.5 GHz with expand carrier frequencies to 110 GHz
- Quick and easy integration into your ATE system
- Ability to test a wide range of devices
- Measure AM noise directly

HP E5503A

HP E5503B

HP E5500 Series Phase Noise Measurement Solutions

The new HP E5500 A-series phase noise measurement solutions have been designed to minimize production ATE test times for one-port VCOs, DROs, crystal oscillators, and synthesizers and to maximize the capability for R&D benchtop applications. In addition, with a standard offset range capability from 0.01 Hz to 100 MHz, the HP E5500 B-series provides the capability, flexibility, and versatility to meet changing and demanding needs placed upon the R&D engineer. By building upon 30 years of Hewlett-Packard low phase noise, RF design and measurement experience, the HP E5500 series solutions continue to provide excellent measurement integrity, repeatability, and accuracy.

The E5500 phase noise measurement solutions use the power of a flexible software program to automate phase noise carrier measurements. The E5500 A-series solutions include the HP 70420A phase noise test set, which contains phase detectors and phase-lock loop circuitry, a high speed VXI digitizer with mainframe and high speed VXI-to-PC interface for base-band signal analysis, selected low-noise frequency downconverters, and measurement software. When combined with a PC running Windows NT 4.0, this series provides fast phase noise measurements of carrier frequencies from 50 kHz to 1.6 GHz, 6.0 GHz, 18 GHz, or 26.5 GHz over offset-from-carrier frequencies of 0.01 Hz to 4 MHz. The E5500 B-series includes the HP 70420A phase noise test set, a Pentium PC running Windows NT 4.0, a PC digitizer, and an RF spectrum analyzer, selected low-noise frequency downconverters, and measurement software. This series of solutions provides phase noise measurements of carrier frequencies from 50 kHz to 1.6 GHz, 6.0 GHz, 18 GHz, or 26.5 GHz over offset-from-carrier frequencies from 0.01 Hz to 100 MHz. A variety of signal generators—such as the HP 8662A, 8663A, 8643A, 8644B, 8664A/B, 8665A—can also be added to provide a low-noise reference signal.

Phase Noise Measurement Software

A graphical user interface provides measurement menus allowing the operator to specify the measurement process, including the calibration of the system. Several output formats are available to the user, including plots of the single-sideband phase noise power of the signal, integrated noise power, or the calculated Allan variance. A real-time measurement mode is available to monitor the level of phase noise and discrete spurs as changes are made to the device-under-test. The HP E5500 series phase noise measurement software requires a Pentium PC with 32 MBytes of RAM, a 1 GByte hard drive, and Windows NT 4.0.

Specifications

HP E5500 A-Series
- **HP E5501A:** 50 kHz to 1.6 GHz
- **HP E5502A:** 50 kHz to 6.0 GHz
- **HP E5503A:** 50 kHz to 18.0 GHz
- **HP E5504A:** 50 kHz to 26.5 GHz

HP E5500 B-Series
- **HP E5501B:** 50 kHz to 1.6 GHz
- **HP E5502B:** 50 kHz to 6.0 GHz
- **HP E5503B:** 50 kHz to 18.0 GHz
- **HP E5504B:** 50 kHz to 26.5 GHz

Operating Characteristics

Offset Frequency Range
A Models: 0.01 Hz to 4 MHz
B Models: 0.01 Hz to 100 MHz
System Noise Response[1]**:** –180 dBc/Hz typically (>10 kHz offsets)
System Spurious Response[1]**:** –120 dBc typically
Phase Detector Input Power: (<1.6 GHz carrier frequency)
R input = 0 to +23 dBm
L input = +15 to +23 dBm
Downconverter Input Range: 1 GHz to 6 GHz;
1 GHz to 18 GHz; 1.5 GHz to 26.5 GHz
External Noise Input Port: 0.1 Hz to 100 MHz
Measurement Accuracy: ±2 dB (<1.0 MHz offsets);
±4 dB (<100 MHz offsets)

HP E5500 A-Series Optional Capabilities
Extend offset range to 8, 10, and 100 MHz
Add RF reference source
Add high power input capability (includes μW phase and AM detectors)
Extend carrier frequency to 110 GHz

HP E5500 B-Series Optional Capabilities
Add RF reference source
Add high power input capability (includes μW phase and AM detectors)
Add remote SCPI programming client
Extend carrier frequency to 110 GHz

Ordering Information

HP E5500A Series
HP E5500B Series

See configuration guide for detailed ordering information.

Key Literature

HP E5500 Series Phase Noise Measurement Solutions, Product Overview, p/n 5965-7590E
HP E5500 Series Phase Noise Measurement Solutions Configuration Guide, p/n 5965-7589E

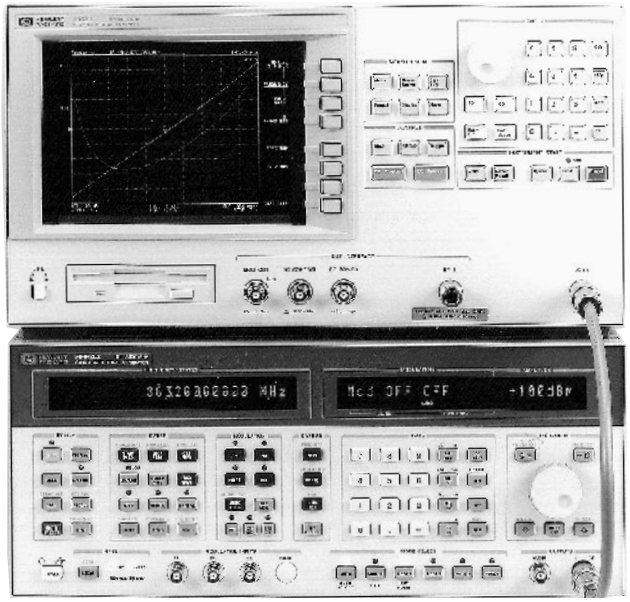
[1]Without reference sources or downconverters

324 VCO/PLL Signal Test System, 10 MHz to 12.6 GHz

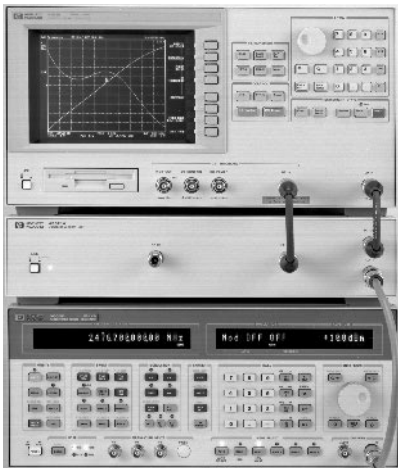
HP 4352S

NEW

- Dedicated VCO and PLL parameters test system
- Excellent solution for LAB and production line
- Simple configuration and multifunctional system
- VCO tuning characteristics evaluation
- Outstanding phase noise measurement capability
- High resolution frequency transient measurement
- Automatic measurement capability and powerful analysis functions



Simple 3GHz Standard System



12.6 GHz System

HP 4352S VCO/PLL Signal Test System

GPIB

The HP 4352S test system can evaluate the characteristics of VCOs and PLLs that are essential to designing local oscillators used in RF wireless communication equipment. This system can provide both powerful analyzing capability for design evaluation in LAB and high speed measurement capability for production line test with 2 operating modes, "Signal Analyzer" and "VCO Tester" mode. The HP 4352S, which consists of the HP 4352B VCO/PLL Signal Analyzer and Hewlett-Packard low-noise signal generator controlled by the HP 4352B, covers up to 3 GHz and can measure the main VCO/PLL evaluation parameters, RF power, frequency, phase noise, spectrum, frequency transient, DC consumption current and FM deviation. In addition, the HP 4352B provides and controls the DC power supply, the low-noise DC control voltage source and the 1 kHz signal source necessary for VCO tuning characterizing.

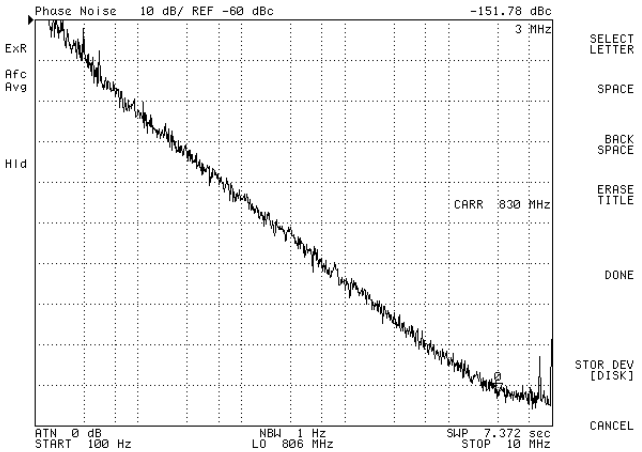
When configured with the HP 43521A downconverter unit, the HP 4352S offers a dedicated and comprehensive VCO/PLL design and production measurement solution for manufacturers that must test at frequencies over 3 GHz. The enhanced HP 4352S is a complete system that offers a frequency range from 10MHz to 12.6GHz and is capable of measuring phase noise, RF power, transients, settling time, and many more parameters required for VCO/PLL evaluations.

This system can make high-speed measurements thanks to the dedicated firmware and "carrier lock multi-mode PLL" technology for phase noise measurement that enables the system lock unto the carrier of the measured signal automatically. In addition, the HP 4352B has excellent phase noise performance such as –157 dBc/Hz at 1 MHz offset typically, so that this test system can make reliable and repeatable phase noise measurement with up to 10 times reduction in measurement time. Actually it can measure 801 measurement points from 100 Hz to 10 MHz offset in 7.4 seconds/sweep. Besides the powerful phase noise measurement capability, the HP 4352S can measure frequency transient with 50 Hz frequency resolution and 12.5 micro seconds time resolution.

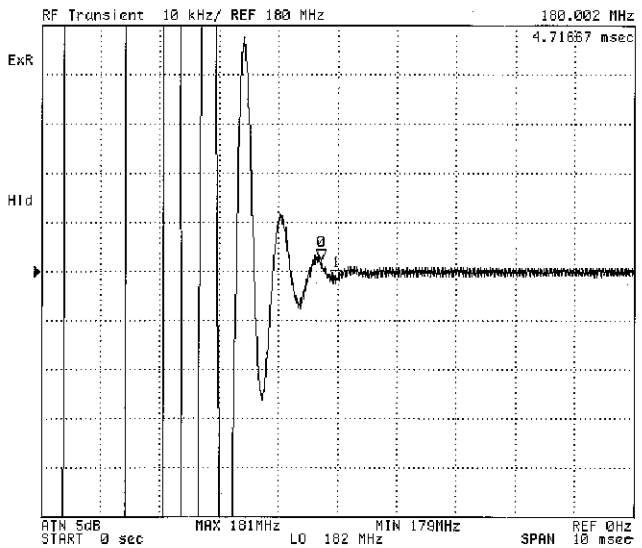
When the HP 71707A Microwave Downconverter is added to the standard system, the phase noise measurement can be performed up to 26.5GHz.

The HP 4352S improves your VCO and PLL evaluation efficiency and testing productivity dramatically.

Measurement Display Examples



VCO phase noise measurement



PLL frequency lock time measurement

Efficient Evaluation in Oscillator Circuit Design

The HP 4352S can measure the following characteristics:

For VCO evaluation

- RF power vs. tuning voltage
- Frequency vs. tuning voltage
- Tuning sensitivity
- Phase noise (Carrier-to-Noise)
- Harmonics
- FM deviation
- DC power consumption current

For PLL evaluation

- RF power
- Phase noise (Carrier-to-Noise)
- Frequency and Frequency transient
- Spurious
- Harmonics

Each parameter can be measured without changing any cable connections. So, you can easily evaluate a VCO/PLL with powerful analysis functions such as marker or limit line.

High Throughput and Easy Test Automation

Thanks to the high-speed phase noise measurement capability, it only takes about 2.5 seconds to measure five VCO parameters (RF power, frequency, phase noise, DC power consumption current and FM deviation) by using "VCO Tester" mode. The HP 4352S has the HP Instrument BASIC programming functions, built-in 3.5 inch disk drive (LIF/DOS format) and a 24-bit I/O. These capabilities allow you to interface to an automatic handler so that you can achieve automatic production-line testing without an external computer.

Specifications Summary

Source Characteristics
DC Power Voltage: 0 to +15.5 V with 1 mV step, 50 mA max.
DC Control Voltage: 0 to +20 V with 100 μV step, 20 mA max.
Option 001: –15 to +35 V
Accuracy: ± (0.1% + 2 mV)
Settling Time: < 20 ms @ 0.1% error (typical)
Noise Density: <1 nV√Hz @ 10 kHz offset
FM Signal: 1 kHz, 0 to 1 Vrms with 1 mV step @ open
Receiver Characteristics
Measurement Frequency Range: 10 MHz to 3 GHz/26 GHz
Input Power Level: –10 to +20 dBm
Input Impedance: 50Ω
SWR: <1.2 (@ < 2 GHz); <1.3
RF Power Measurement
Accuracy @ Peak Voltage Responding
±0.2 dB (@ 1 GHz, –5 dBm, typical); ±1 dB
Resolution: 0.01 dB
Frequency Measurement
Frequency Resolution: 1 kHz
Frequency Transient Measurement
Highest Accuracy: ± 2 kHz
Highest Measurement Resolution: 50 Hz
Maximum Sweep Time: 10 sec.
Minimum Time Resolution: 12.5 μsec.
Phase Noise (Carrier-to-Noise Ratio) Measurement
Offset Frequency Range: 100 Hz to 10 MHz

System Noise Level

Offset	Specification (dBc/Hz)	Typical (dBc/Hz)
100 Hz	–85	–90
1 kHz	–110	–117
10 kHz	–130	–137
100 kHz	–140	–147
1 MHz	–150	–157

Spectrum Measurement
Absolute Level Accuracy: 2 dB (–5 dBm input, @ ATT=0 dB, typical)
Relative Level Accuracy: 0.5 dB (typical)
FM Deviation Measurement
Measurement Range: 0 to 200 kHz (peak)
Accuracy: ±(2% + 0.1% of measurement range) @1 kHz FM rate; ±0.8% (typical)
Residual FM: < 3 Hzrms (@ 300 Hz – 3 kHz BW)
DC Consumption Current Measurement
Measurement Range: 0 to 50 mA
Accuracy: ±(0.2% ± 100 μA)
Storage
3.5-inch FDD: LIF/DOS format, 2DD/2HD
Internal RAM Disk: LIF/DOS format, 512 kB max.
Interfaces
GPIB I/F, 24-bit parallel I/O I/F

General Characteristics

Display: 9-inch color LCD
Operating Temperature: 0 to +40° C
Operating Humidity: 15 to 95% RH
Storage Temperature/Humidity: 0 to +40° C/15 to 95% RH
Power Requirements: 90 to 132 V or 198 to 264 V, 47 to 66 Hz, 300 VA max.
Size: 235 mm H x 425 mm W x 553 mm D
Weight (typical): 21.5 kg

Key Literature

HP 4352S VCO/PLL Signal Test System Product Overview, p/n 5966-0805E
Signal Generator Selection Guide, p/n 5091E-7274E
HP 71707A Microwave Downconverter Technical Data, p/n 5091-4435E

Ordering Information

HP 4352S VCO/PLL Signal Test System
HP 4352B VCO/PLL Signal Analyzer
Opt 001 Expand DC Control Voltage
Opt 1A2 Delete Keyboard
HP 43521A Downconverter Unit
Recommended Signal Generators
HP 8664A Synthesized Signal Generator with Option 004
HP 8665A Synthesized Signal Generator with Option 004
HP 8665B Synthesized Signal Generator with Option 004
HP 8644B Synthesized Signal Generator with Option 002
HP 8657B Synthesized Signal Generator
HP 71707A 26 GHz Microwave Downconverter
HP 70422A 18 GHz Downconverter Module

See Signal Sources section for more details.
When using the other signal generators, please contact the HP Call Center in your region for details.

HP 43521A

NEW

HP 43521A Downconverter Unit

The HP 43521A Downconverter Unit is designed to operate with the HP 4352S VCO/PLL signal test system. When configured with the HP 43521A downconverter unit, the HP 4352S offers a dedicated and comprehensive VCO/PLL design and production measurement solution for manufacturers that must test at frequencies above 3GHz. The enhanced HP 4352S is a complete system that offers a frequency range from 10MHz to 12.6GHz and is capable of measuring phase noise, RF power, transients, settling time, and many more parameters required for VCO/PLL evaluations.

HP 43521A

Specifications

RF-in Port:
- **Connector:** N(f)
- **Frequency:** 10MHz to 12.6GHz

RF Power (Heterodyne Path):
- **Input VSWR:** <1.5
- **Frequency:** 2.4GHz to 12.6GHz
- **Level:**
  - **@ATT=0dB:** –20dBm to 0dBm
  - **@ATT>0dB:** –20dBm to +20dBm
- **Resolution:** 0.01dBm
- **Accuracy:** (@23˚C±10˚C)
  - **@≤15dBm:**
    ±1.5dB @≤4GHz
    ±2.0dB @≤8GHz
    ±2.5dB @≤12.6GHz
  - **@≤20dBm:**
    ±1.5dB @≤4GHz(SPC*)
    ±2.0dB @≤8GHz(SPC*)
    ±2.5dB @≤12.6GHz(SPC*)
  - **@-5dBm:** ±0.8dB @6GHz(Typical)
  - **@-5dBm:** ±1.0dB @12GHz(Typical)

Heterodyne Path Gain: 20dB @6GHz(SPC*)
Direct Path Insertion Loss: 0.5dB @3GHz(SPC*)

LO-in Port:
- **Connector:** N(f)
- **Input Level:** +10dBm Nominal
- **Frequency Range:** 10MHz to 6GHz

LO-out Port:
- **Connector:** N(f)
- **600MHz Output Level:** ≥+8dBm (SPC*)
- **600MHz Accuracy:** 600MHz±50ppm (SPC*)

Power Requirements: 90V to 132V or 198V to 264V, 47 to 63Hz, 100VA max
Size: 425 mm (W) x 101 mm (H) x 553mm (W)
Weight: 8 kg (Typical)

*SPC = Supplemental Performance Characteristics

System Performance with HP 43521A

The system performance is the capacity achieved by the combination of the HP 4352B, the Signal Generator, and the HP 43521A when the HP 43521A is phase-locked to the 40 MHz on the HP 4352B. All data except for RF Power measurement are typical.

The operating frequency depends on the synthesized signal generator as follows.

Signal Generator	HP 4352S Frequency Range
HP 8664A	10MHz to 6.6GHz
HP 8665A	10MHz to 9GHz
HP 8665B	10MHz to 12.6GHz

Direct Path (10MHz to 3GHz)

RF Power: Add ±0.1dB to 4352B spec. (@≤2GHz)
Add ±0.2dB to 4352B spec. (@2GHz<Freq.≤3GHz)
Other Parameters: Same as the 4352B spec.

Heterodyne Path (2.4GHz to 12.6GHz)

Tester Mode
RF Power: Same as 43521A spec.
Frequency
- **Frequency Range:** 2.4GHz to 12.6GHz
- **Resolution:** Same as 4352B spec.
- **Accuracy:** Same as 4352B spec.

FM Deviation
- **Measurement Range:** Same as 4352B spec.
- **Resolution:** Same as 4352B spec.
- **Accuracy:** Same as 4352B spec.

Residual FM: Same as 4352B spec.
Phase Noise: (C/N ratio)
- **Offset Frequency Range:** 100Hz to 10MHz
- **Noise Floor:**
  (when equipped with the HP 8665B** up to 12.6GHz)
  ≤6GHz when equipped with the HP8664A**
  ≤9GHz when equipped with the HP 8665A**

**with Opt 004

Offset Frequency (Hz)					
RF Freq.	100	1k	10k	100k	1M
3GHz	–68	–93	–125	–137	–150
6GHz	–63	–88	–119	–131	–147
9GHz	–57	–84	–114	–125	–143
12GHz	–58	–81	–113	–125	–142

Accuracy: Same as 4352B spec.

Analyzer Mode

RF Power: Same as the 43521A spec.
Frequency: Same as the tester mode spec.
Phase Noise: (C/N ratio) Same as the tester mode spec.
Frequency Transient
- **Frequency Range:** 2MHz, 20MHz, 512MHz
- **Frequency Accuracy:** ±(Measurement Range x 0.1% + Time Base Accuracy of the External Signal Generator)
- **Resolution:** 50Hz, 500Hz, 12.8kHz

Spectrum
- **Absolute Accuracy:** ±3dBm@–10dBm, RF ATT=10dB
- **Relative Accuracy:** Same as the 4352B spec.

Ordering Information

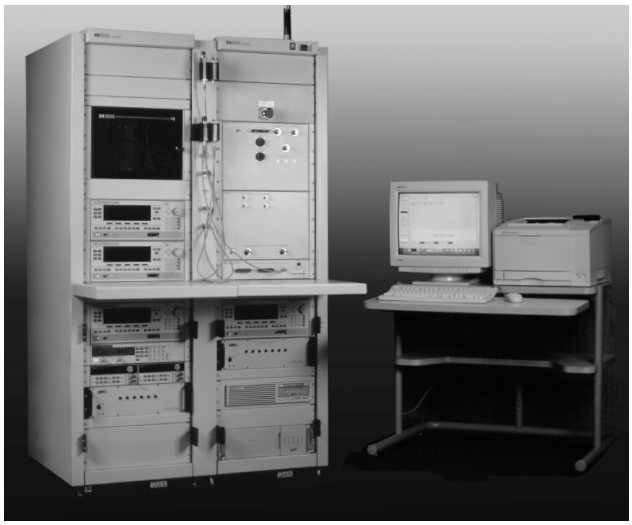
HP 43521A Downconverter Unit
- **Opt 1CM** Rackmount Kit
- **Opt 1CN** Handle Kit
- **Opt 1CP** Rackmount Kit & Handle Kit
- **Opt ABA** English Localization
- **Opt ABJ** Japanese Localization
- **Opt 0B0** Delete Operation Manual
- **Opt 0B1** Add Operation Manual
- **Opt UK6** Commercial Cal.Certificate with Test Data

Recommended Signal Generators when configured with the HP 43521A
HP 8664A Synthesized Signal Generator with Option 004
HP 8665A Synthesized Signal Generator with Option 004
HP 8665B Synthesized Signal Generator with Option 004

HP E6520A

NEW

- 45 GHz solutions for millimeter wave module test
- Device test for LMDS, satellite antenna arrays, digital radio and T/R module manufacturing
- Excellent high frequency repeatability and correlation to benchtop measurements
- Enables fast time to market and low cost of test



HP E6520A

High-Speed Test System for the Manufacturing Floor

High Throughput Test for Microwave and Millimeter Wave Modules

In a manufacturing environment, high-test throughput is key to efficient volume production. Traditional "rack and stack" test systems, which are adequate for R&D characterization, fall short on the production floor where a large volume and/or mix of measurements or devices require full test plan execution within a few seconds. To address this need, HP has continued development of high-speed test platforms aimed at lowering the cost of test and reducing the time to market for device manufacturers.

HP E6520A Millimeter Wave Module Test System

The HP E6520A series mm wave module test systems are designed for complete characterization of microwave and mm wave modules. The flexible architecture incorporates a high speed DSP based receiver with single-touch, multiple-measurement design. These hardware features are combined with user-friendly software to optimize the entire system for fast test plan execution.

Software for Automated Testing

A key part of any high-throughput test system is the software. The software enables the user to quickly create or modify test plans and perform system calibrations. Fast test plan development reduces time to market by greatly limiting the amount of code generation necessary to test complex devices. Measurement path transforms and de-embedding insure the most accurate test results possible, and real time data recording allows viewing of data while the test plan is running. Industry standard data formats are available to insure a swift integration of the test solution to your production floor.

Full Standard Measurement Capability

The HP E6520A mm wave module test system offers broad frequency coverage from 2 GHz to 45 GHz, a variable bandwidth DSP based receiver, two test ports, 1 watt power handling capability, four-2 amp power supplies and two synthesized sources.

Measurements included with standard system:
- S-Parameters, 1 or 2 port
- Power incident to, and out of DUT
- Gain, Gain Compression, Flatness
- Harmonics
- Known Spurs
- Voltage, Current
- Efficiency
- Test Time
- Combinations of the above measurements in the form of math blocks

Optional measurement capabilities:
- Additional test ports, up to a total of six ports (four 2 to 45 GHz ports and two 50 MHz to 3 GHz ports)
- Noise figure
- Mixer/converter measurements
- Two tone IMD
- Digital and analog DUT control

A Modular, Reconfigurable Architecture

The HP E6520A uses industry-standard instrument and computer platforms to protect your investment. This allows quick and easy reconfiguration of stimulus and measurement resources to address different manufacturing test needs. Only HP's high-speed test systems can deliver this kind of flexibility for both your present and future production test requirements.

HP E6520A System Support Services

All HP E6520A test systems include a one-year, on-site worldwide warranty beginning at installation. Warranty services available include:
- Site preparation and installation
- 24 hour per day, 7 days per week phone support
- Next business day on-site response
- Access to regional shared spares
- Software updates (through the warranty period)
- System overview training
- On-line test plan development assistance
- Application phone and e-mail support

Optional support services:

- On-site calibration services
- Hardware maintenance training
- On-site test plan development training
- On-site application consulting
- System Uptime Support Services
- Software Subscription Services

Key Literature

HP E6520A Series MM Wave Module Test Systems Product Overview, p/n 5968-1604E

Ordering Information

Prices vary. For more information, please contact your HP sales representative (listed on page 563).

Communications Signal Path Design Solutions

Communications Design System Brochure
High-Frequency Structure Simulator Rel 5.0 Technical Data Sheet
5967-5846E
HP 85148A Circuit Envelope Simulator Technical Data Sheet
5964-3599E
HP 85154A Impulse Transient Simulator Brochure
5091-4268E
HP E4665A HP Momentum Planar Electromagnetic Simulator Technical Data Sheet
5963-7129E
HP 85180A HP IC-CAP Modeling Suite Release 5.0
5965-7742E
HP 85290A HP APDS Device Suite
5967-5332E
HP E8940A RF Designer
5967-6013E
HP High Frequency Structure Simulator Optimizer
5967-5594E
Picosecond Interconnect Modeling Suite Technical Data Sheet
5964-2310E
Customer Support from HP EEsof Technical Data Sheet
5968-2638E

(PN 85150-1) Using High-Frequency Instruments with MDS
5091-1702E
(PN 85150-2) Simulating Highly Nonlinear Circuits
5091-8568E
(PN 85150-3) Using HP MDS in MMIC Applications
5091-9703E
(PN 85150-5) Using the High-Yield Software Package to Create Robust Designs
5962-9271E
(PN E4600) Creating Measurement-Based RFIC Models
5965-7010E
(PN E4600-9) A Flexible Waveform Generator Using OmniSys and Instrumentation
5965-8120E

EMI/EMC Test Systems

Electromagnetic Compatibility 8590EM-1
5964-2151E

(PN 8566/B) Third Order Intermodulation Distortion Measurements
5954-2701

Signals Development & Intercept Solutions

HP 3587S Signal Analysis, Opt ATR, Product Overview
5964-3631E
HP E3238 Signals Development System Video
5968-3571E/PAL/SECAM
HP E3238 Scanning Signal Analysis System, Opt AS8, Product Overview
5964-3632E
WJ9119 VXI HF Tuner, Technical Specifications
5966-2298E

RF & Microwave Measurement Systems

HP 4352S VCO/PLL Signal Test System, Profile
5966-0805E

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00

Hewlett-Packard is dedicated to providing products, services and solutions to help you meet your business objectives.

Stay ahead of the competition

With so many emerging standards and technologies, and new competitors entering the market every day, the wireless market is undergoing a revolution. Wireless service providers are feeling pressure to reduce costs and meet rising expectations in quality and services. Manufacturers must meet increasing demands to supply high quality products on very short timelines. HP helps you to meet your challenges and stay ahead of the competition by providing the broadest range of innovative design and test products, integrated solutions and services for the wireless industry...today and in the future.

Shorten product development cycle time

R&D engineers need to spend more time creating quality designs and less time verifying them. Tools for design and test must enable that to happen, not hinder it. HP's design tools and test equipment contain the capability and performance needed for today's wireless standards, as well as the flexibility for custom formats and tomorrow's unforeseen needs. When developing 3G products, you will do fewer design iterations by taking advantage of the links between HP's design tools and test equipment.

Reduce time-to-volume and cost-per-unit

Manufacturing test engineers need to ensure that high quality, reliable products are shipped—on time. Tools to optimize your manufacturing test processes for maximum efficiency and flexibility are vital. HP can help you achieve your goal by providing:

- enhanced products that test faster, increasing your throughput
- custom systems that can be designed to test exactly what you need to test, and nothing more
- consulting and engineering resources to help you plan and build the processes that will best meet your production test needs

Speed deployment, decrease costs, ensure high quality-of-service

To be successful, wireless service providers need to expand coverage and add new services while controlling costs and maintaining quality. Hewlett-Packard wireless solutions can help. Our state-of-the-art test products give you the power you need to evolve the network. Plus, with decades of wireless experience from R&D to network installation and maintenance, we provide a breadth of solutions—including training, consulting, financing, and customer care that is unmatched in the industry.

When you invest in a Hewlett-Packard wireless product, you get more than just the product—you get a whole product solution. HP offers the depth and breadth of enhancements, software, services, connectivity, and support to help you to achieve your objectives.

For more information about HP's solutions for the wireless industry come to http://www.hp.com/go/wireless.

Hewlett-Packard Wireless Solutions

Table of Products versus Systems and Measurements

Legend

1 RF source only
2 Supports FLEX, FLEX-TD, and POCSAG
3 HP 8920 does LTR, MPT 1327, and EDACS formats
4 RF source only, analog only
5 Available with TDMA only
6 Applicable to these design areas

Products	Digital Systems																	Analog Systems								
	cdma2000	W-CDMA	CDMA	CDMA (PCS)	CDPD	CT2-CA1	CT3	DCS 1800	DECT	GSM 900	Paging	PCS 1900	PDC	PHS	TDMA (NADC)	TDMA (NADC) PCS	TETRA	AM	AMPS/EAMPS	FM/FM	JTACS	NAMPS	NMT 450/900	NTACS	TACS/ETACS	TRUNKING
3272 Series 3 Process Test System	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
37701B, 37702A T1/Datacom Tester		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
4291B RF Impedance/Material Analyzer	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•
4286A RF LCR Meter	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
4352S VCO/PLL Test System	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•
4396B Network/Spectrum /Impedance Analyzer	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•
53310 Modulation Domain Analyzer					•	•	•	•	•	•	•	•	•	•	•	•	•			•						
5DX X-RAY Inspection System	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
58000 Series Time/Freq Ref Distribution System	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
663XX Mobile Communications dc Sources			•	•				•	•	•		•	•	•	•	•	•	•	•	•	•	•		•	•	
84000 Series RFIC Test System		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
85150B MDS/E4600 Series IV Design System		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
8560 Series Portable Spectrum Analyzers																		•	•							
8590 E-Series Portable Spectrum Analyzers			•	•		•		•	•	•		•	•	•	•	•		•		•						
8648A Opt 1EP Signal Generator											2							•		•						
8648 and **ESG-A** Series Analog Signal Generators																		•		•						
8712ET/ES, 8714ET/ES RF Vector Network Analyzers																										
8752, 53, 8720, 8510 Vector Network Analyzers																										
8643, 44, 47, 56, 57, 62, 63, 64, 65 Signal Generators																		•	•	•	•	•	•	•	•	•
8920A,B RF Communications Test Set															•	•		•	•	•	•	•	•	•	•	3
8921A Cell Site Test Set			•		•										•			•	•	•	•	•		•	•	
8922M,S GSM Mobile Test Set								•		•		•														
8924C CDMA Mobile Station Test Set			•	•															•		•	•		•	•	
8924E CDMA Mobile Station Service Test Set			•	•															•		•	•		•	•	
8935 Series Base Station Test Sets (CDMA or TDMA)			•	•	5			•		•		•			•	•		•	•	•	•	•		•	•	
89400 Series Vector Signal Analyzers	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
8960 Series 10 E5515A Wireless Comm. Test Set								•		•		•														
AcceSS7 Network Monitoring System																										
Advanced Design System	6	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
BV3000 Automated Optical Inspection System	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
E2507B Multiformat Communications Signal Simulator[1]			•	•				•	•			•	•	•												
E4406A VSA-Series Transmitter Tester	•	•	•	•				•		•		•	•		•	•							•			
E6325A, E4594A T1 Test Advisor		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
E6349A, E6323A E1 Test Advisor		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
E6392A GSM Mobile Station Test Set								•		•																
E7480A CDMA Post-Processing Software			•	•				•		•		•			•	•										
E74xx RF Coverage Measurement System			•	•				•		•		•			•	•										
E7580A ProBER 2, 2 Mb/s Handheld Test Set		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
E8285A CDMA Mobile Station Test Set			•																•	•	•	•		•	•	
EPM Series Power Meters (sensor dependent)		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
ESA-E Series Portable Spectrum Analyzers		•	•				•		•		•							•		•						
ESG-D Series Digital Signal Generators	•	•	•	•				•	•	•		•	•	•	•	•	•	•		•						
RF, µW, mmW Components			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•
TS-5500 GSM/CDMA Cellular Phone Funct. Test Platform			•	•				•		•		•														

Legend

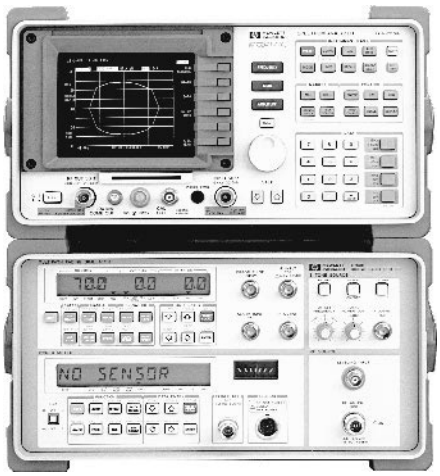
1 RF source only
2 Supports FLEX, FLEX-TD, and POCSAG
3 HP 8920 does LTR, MPT 1327, and EDACS formats
4 RF source only, analog only
5 Available with TDMA only
6 Applicable to these design areas

Products

Products	Measurements																					
	Call Processing	Current Draw	Design & Simulation	Device Trans./Reflec.	Device Complex Imp.	Device Group Delay	Fading Simulation	Functional Test	In-Circuit Test	T1/E1 Circuit Test	Receiver Out-of-Chan.	Receiver In-Channel	Signaling/Protocol	Spectrum Analysis	Spectrum Monitoring	Transmitter Power	Transmitter Frequency	TX Modulation	TX Amplitude	R&D	Manufacturing	Installation
3272 Series 3 Process Test System										•											•	
37701B, 37702A T1/Datacom Tester										•												•
4291B RF Impedance/Material Analyzer					•															•	•	
4286A RF LCR Meter					•															•	•	
4352S VCO/PLL Test System				•		•									•					•	•	
4396B Network/Spectrum /Impedance Analyzer				•	•	•								•		•			•	•	•	
53310 Modulation Domain Analyzer				•		•		•			•	•					•			•	•	•
5DX X-RAY Inspection System																					•	
58000 Series Time/Freq Ref Distribution System				•	•			•			•	•		•		•	•	•		•	•	•
663XX Mobile Communications dc Sources		•						•													•	•
84000 Series RFIC Test System		•		•	•						•	•		•		•		•		•	•	
85150B MDS/E4600 Series IV Design System			•																	•		
8560 Series Portable Spectrum Analyzers			•											•		•	•		•	•		
8590 E-Series Portable Spectrum Analyzers				•											•		•	•	•	•	•	•
8648A Opt 1EP Signal Generator								•												•	•	
8648 and **ESG-A** Series Analog Signal Generators																				•	•	•
8712ET/ES, 8714ET/ES RF Vector Network Analyzers				•	•	•														•	•	•
8752, 53, 8720, 8510 Vector Network Analyzers				•	•	•														•	•	
8643, 44, 47, 56, 57, 62, 63, 64, 65 Signal Generators											4	4								•	•	
8920A,B RF Communications Test Set	•							•			•	•		•		•	•	•	•	•	•	•
8921A Cell Site Test Set								•			•	•		•		•	•	•	•	•	•	•
8922M,S GSM Mobile Test Set	•							•			•	•		•		•	•	•	•	•	•	•
8924C CDMA Mobile Station Test Set	•							•			•	•		•		•	•	•	•	•	•	•
8924E CDMA Mobile Station Service Test Set	•							•			•	•		•		•	•	•	•			•
8935 Series Base Station Test Sets (CDMA or TDMA)								•			•	•		•		•	•	•	•	•	•	•
89400 Series Vector Signal Analyzers														•		•	•	•	•	•	•	
8960 Series 10 E5515A Wireless Comm. Test Set	•							•				•				•	•	•	•		•	
AcceSS7 Network Monitoring System																						
Advanced Design System			•																	•		
BV3000 Automated Optical Inspection System																					•	
E2507B Multiformat Communications Signal Simulator[1]																				•	•	
E4406A VSA-Series Transmitter Tester														•		•	•	•	•	•		
E6325A, E4594A T1 Test Advisor										•												•
E6349A, E6323A E1 Test Advisor										•												•
E6392A GSM Mobile Station Test Set	•	•						•				•			•	•	•		•			•
E7480A CDMA Post-Processing Software	•												•	•	•	•	•					•
E74xx RF Coverage Measurement System	•												•	•	•	•	•					•
E7580A ProBER 2, 2 Mb/s Handheld Test Set										•												•
E8285A CDMA Mobile Station Test Set	•		•				•					•		•		•	•	•	•	•	•	•
EPM Series Power Meters (sensor dependent)																•				•	•	•
ESA-E Series Portable Spectrum Analyzers				•										•		•	•			•	•	•
ESG-D Series Digital Signal Generators											•	•								•	•	•
RF, µW, mmW Components																				•	•	
TS-5500 GSM/CDMA Cellular Phone Funct. Test Platform	•							•			•	•		•		•	•	•	•		•	

HP 11758V
HP 11770A
HP 11757B

- Performs important installation and maintenance measurements
- Easy to use
- Portable and rugged construction
- Group delay and amplitude flatness measurement option



HP 11758V

HP 11758V Digital Radio Test System

The HP 11758V combines several popular HP instruments into one portable system. This combination provides you with an all-in-one portable system that is ideal for the installation and maintenance of microwave radios, and is especially suitable for work in rugged terrain or remote areas.

The HP 11758V can be configured to have all your necessary measurement functions available during radio installation and maintenance. The spectrum analyzer can even control other GPIB instruments to automate measurements for quicker and more reliable results.

Test Functions

Spectrum Analysis: 50 kHz to 22 GHz (26 GHz optional)
Swept Source: 300 kHz to 2.9 GHz (options to 24 GHz)
Group Delay and Amplitude Flatness: 300 kHz to RF source maximum frequency (Option 201)
Multipath Signature Test Set: 40 MHz to 90 MHz (options to190 MHz)
Power Meter: 10 MHz to 18 GHz (options to 26 GHz)
Frequency Counter: 50 kHz to 22 GHz (options to 26 GHz)
Intermodulation Test Signal: 70 and 140 MHz bands available and more

Key Literature

Data Sheet, p/n 5091-4651E

HP 11757B Multipath Fading Simulator/ Signature Test Set

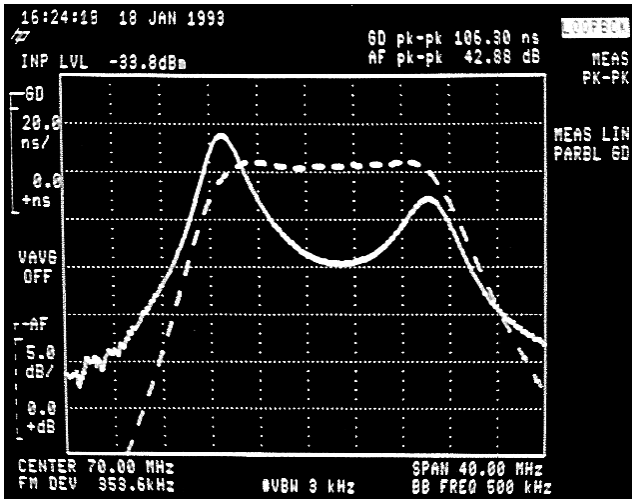
- Automatic multipath signature measurements
- Measures and prints static M-curves, dynamic M- and S-curves, recovery signatures, recovery times, and dispersive fade margin
- High-performance, lightweight, and economical

The HP 11757B characterizes the equalizers in modern digital microwave radios by introducing a precisely-controlled notch in and around the radio's transmission bandwidth. This allows precise measurements of the equalizers' ability to compensate for multipath fading. The HP 11757B records the measurement automatically on a built-in printer.

Key Literature

Data Sheet, p/n 5091-1052EN/EUS
Application Note 355-1, *Tools for Digital Microwave Radio Installation and Maintenance*, p/n 5962-9920E

- An economical way to add high-performance, end-to-end group delay measurements to your spectrum analyzer
- Ideal for digital radio, satellite, and cable testing
- Measures any two-port device between 300 kHz and 2.9 GHz



HP 11770A Link Measurement Personality

Accurately-adjusted group delay and amplitude flatness is critical to the proper performance of virtually every wideband digital or analog communication network. The HP 11770A link measurement personality adds group delay and amplitude flatness measurement capabilities to the HP 11758V, with Option 201, (or to an HP 8593E/94E/95E/96E spectrum analyzer configured with Option 111 group delay and amplitude flatness plus tracking generator). This makes it ideal for testing digital and analog terrestrial radios as well as other broadcast and transmission media like satellite and cable networks.

When this personality is installed in a spectrum analyzer, the HP 11770A is far more portable than any previous solution that makes the same group delay and amplitude flatness measurements, plus it maintains the ease-of-use features you expect from standalone test equipment. This measurement configuration also provides important link analysis functions at a significantly lower cost when compared to using separate pieces of test equipment. DADE and return loss measurements can also be made with the optional switch and bridge.

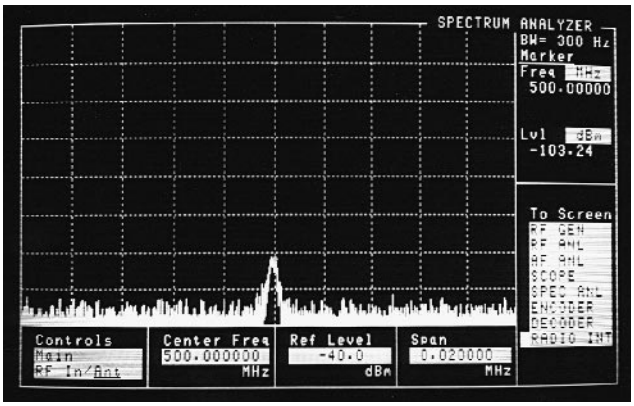
Key Literature

Data Sheet, p/n 5091-4652E

7

HP 8920A
HP 11807A

HP 8920A



HP 8920A Spectrum Analyzer displaying signal at –103.2 dBm (1.54 μV). Sensitive Receiver: 2 μV sensitivity (typically < 1 μV), available through the ANT IN port, allows for off-the-air monitoring of low-level signals. For measuring high-power signals, the HP 8920A can accept 100 W intermittently (for 10 seconds) or 60 W continuous.

HP 8920A RF Communications Test Set

7

The HP 8920A is a full-feature, one-box test set designed to meet service and repair needs in the cellular and land mobile communications market. Combining 22 instruments, the HP 8920A offers full functionality needed in testing cellular phones, land mobile radios, and communications systems up to 1 GHz. Additionally, with the new standard electronic attenuator, the reliability of the HP 8920A has been increased to help guarantee the maximum effective usage of the test set.

Test and Troubleshoot Faster

The HP 8920A decreases test and troubleshooting time by simplifying standard measurement tasks and providing extensive capability in one box. Transmitters and receivers are simply characterized with single-key RX, TX, and duplex tests. Measured results are displayed on a single screen as either digital measurements or analog bar graphs. All settings and measurements are easily accessed and changed using the front-panel knob, and all settings can be saved in nonvolatile save/recall registers or on a SRAM card media for future access.

Spectrum Analyzer with Tracking Generator and Adjacent Channel Power

The HP 8920A's optional synthesized spectrum analyzer measures signals from 10 MHz to 1 GHz with variable spans from 5 kHz to 1 GHz (full span). Display resolution is selectable from 1, 2, or 10 dB per division. The tuneable marker provides automatic readout of frequency and amplitude, or of relative frequency or amplitude from a reference. The tracking generator included with the spectrum analyzer allows for swept characterization of devices with fully settable amplitude and sweep spans (to 1 GHz). The adjacent channel power measurement capability includes both variable bandwidths and variable frequency offsets. Typical performance is –70 dBc.

Signaling Encoder and Decoder

The optional signaling encoder and decoder support all common signaling formats, including tone sequential, digital paging, DTMF, trunking, and cellular signaling. Common standards are list-selectable and easily modified for different user formats. The decoder displays the tone or digital sequence transmitted, and the duration of the tone or tone pair. For digital paging transmitters, the decoder will display the address/code, the message, and the transmission rate.

HP 11807A Radio Test Software

The HP 11807A is an easy-to-use software solution for automatic testing of radio receivers and transmitters. Running on the HP 8920A's built-in IBASIC computer, the HP 11807A offers a complete selection of tests for land mobile radios, cellular phones, and communication systems. Its flexibility and modularity allows the user to select and change test sequences, test parameters, and pass/fail limits without programming expertise. All test results are displayed on the screen and can be documented with hard-copy printouts when an external printer is added.

The HP 11807A system support tests (Option 100) give technicians automated test capability for commonly performed tasks on communications systems. System support tests include cable-fault location, intermodulation-products calculation, frequency scanning, field-strength measurement, and automated save/recall of instrument settings.

International Cellular Phone Testing Solutions

The HP 8920A is capable of testing the world's most common cellular phones by using the HP 11807A radio test software. Three levels of testing are available: manual phone troubleshooting, quick functional checkout, and full parametric testing to system specifications. Cellular formats supported include AMPS, NAMPS, TACS, NTACS, JTACS, NMT 450, and NMT 900. HP 8920A Option 004 is required for cellular phone tests with HP 11807A software.

Trunked Radio Testing

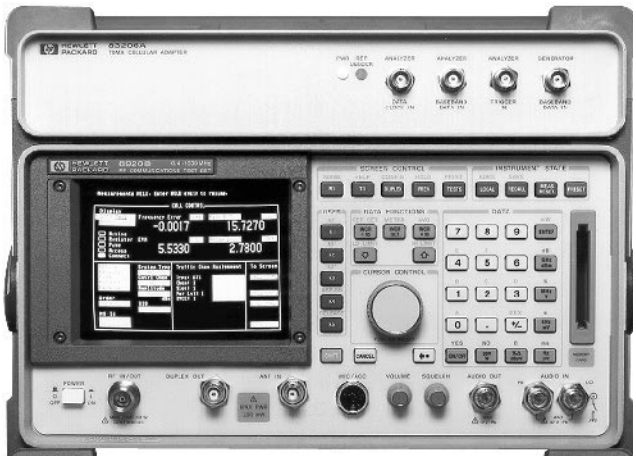
Three HP 11807A software options are available for testing trunked mobile radios. The options support LTR, EDACS, and MPT 1327 trunked radio equipment with a variety of automated tests available to the user.

Through software control, the HP 8920A will test the ability of a radio to establish a link on a trunked system and can retrieve trunking parameters programmed into a mobile radio. The user can choose from manual operations or automated test sequences for full characterization. Detailed printouts of the radio's performance, with failures highlighted, are output when a printer is used with the HP 8920A. (HP 8920A Option 103 is required for printouts.)

HP 8920A Option 004 is required for trunked system tests with HP 11807A software.

Key Literature

HP 8920A Product Overview, p/n 5968-0982E
HP 8920A Price List, p/n 5966-1734EUS
HP 11807A/E Product Overview, p/n 5968-1379E
Service Applications/Brochure, p/n 5952-2795
Manufacturing Application/Brochure, p/n 5952-2796
Cellular Applications/Brochure, p/n 5091-7627E



HP 8920B Option 800

HP 8920B RF Communications Test Set

The HP 8920B is a full-function test set based upon the HP 8920A design but with increased measurement speed, accuracy, and larger user memory (928 kbytes standard). The HP 8920B uses PCMCIA memory cards for data storage and radio test programs. The HP 8920B has the functionality, speed, and accuracy for testing land mobile radios, cellular telephones and other communications systems while improving throughput and quality in manufacturing.

HP 8920B Option 800 – HP 83206A TDMA Cellular Adapter

The HP 83206A TDMA cellular adapter (HP 8920B Option 800) provides a complete π/4 DQPSK signal generator, π/4 DQPSK modulation analyzer, data source, and BER analyzer for TDMA measurements on DAMPS (IS-54) and DCCH (IS-136) phones. The HP 83206A supersedes the HP 83201B TDMA cellular adapter (HP 8920B Option 500) for making measurements on TDMA dual-mode DAMPS phones, adding digital control channel test features to fully characterize DCCH phones. This option replaces the HP 8920D for TDMA mobile test.

HP 8920B Option 801-HP 83236B PCS Interface

Extend DCCH test capabilities for future PCS (1900 MHz) phone test by adding the HP 83236B PCS interface to translate DCCH measurement capability to the International and U.S. PCS bands. Power measurement accuracy and speed are maintained at PCS band frequencies with an internal power meter for measurements on CW and TDMA (π/4 pulsed or continuous) signals. HP 8920B Option 801 is an order convenience option that includes the three units needed for PCS mobiles using IS-136 format. Includes: HP 83206A and HP 83236B host firmware integrates the functions of these three units. Also order Options 001, 004, 006, 051, with Option 800 to do IS-136 TDMA mobile test.

The HP 8920B Increases Throughput

The HP 8920B combines a faster processor, increased user memory, and other new features to gain measurement speed over standard HP-IB instruments and the HP 8920A.

Test Time Execution Comparison

HP 8920B compared to:	Typical test time decrease
Stand alone HP-IB instruments	15%
HP 8920A with internal IBASIC programs	30%
HP 8920A program load from memory cards	90%

HP 8920B Has High Performance and Accuracy as Standard Features

Along with speed enhancements, the HP 8920B has signal generator level accuracy or ±1dB at the duplex port and power measurement accuracy or ±5% for levels from 1 mW to 60 watts at the RF In/Out port. Residual FM is less than 7 Hz rms, CCITT. For audio tests, the variable frequency notch filter from 300 Hz to 10 kHz is standard. The FM deviation accuracy is 3.5% and FM distortion less than 0.5%. HP-IB, RS-232, and Centronics ports are standard.

New Call Processing

Cellular phone testing with the HP 8920B has a whole new look and feel with the new call processing subsystem. New front-panel screens simplify manual testing as well as HP-IB programmability. In call-processing mode, the HP 8920B emulates a cellular base station, allowing you to automatically establish and maintain a cellular link between the test set and cellular phone. Use the front-panel knob to register the phone, originate a call, page the phone, hand-off to other channels, change power and release calls as well as make fast parametric measurements while the phone is on an analog voice or a digital traffic channel.

Easier Programming

The new call-processing subsystem also creates a more user-friendly programming interface for automated cellular phone test. High-level HP-IB commands such as “page” and “register” simplify code generation for phone test.

HP VEE programmers will also benefit with the addition of HP 8920B-HP VEE drivers.

HP 11807E Radio Test Software

The HP 11807E radio test software family offers easy-to-use software programs for automatic testing of radio receivers and transmitters. The HP 11807E software family is the same set of tests as included in the HP 11807A family, but on PCMCIA cards to work with the HP 8920B. A complete selection of tests are available for land mobile radios, cellular telephones, and trunked radio communications systems. The new Option 024 software package is available to test cellular on PCS mobiles using AMPS, NAMPS, DAMPS, and DCCH/PCS formats.

Cellular Telephone and Trunked Radio Testing

The HP 8920B is capable of testing many of the world’s analog cellular and trunked radio systems using the software packages in the HP 11807E family. Cellular systems include: AMPS/EAMPS/NAMPS, TACS/ ETACS, JTACS/NTACS, and NADC-TDMA dual-mode, both DAMPS (IS-54) and DCCH (IS-136). The trunked radio system packages are LTR and EDACS (the trunked packages include FM tests).

Flash ROM Makes Firmware Upgrades Simpler

The HP 8920B firmware is contained in Flash ROM which can be upgraded via a PCMCIA card from the front panel in just minutes. The upgrade card can be reused. This helps maintain better process control on your production line by keeping the latest firmware version current with minimum downtime. One card upgrades the HP 8920B host, but a full digital upgrade requires a card set.

Key Literature

HP 8920B Brochure, p/n 5968-5921E
HP 8920B Technical Specifications, p/n 5968-1376E
HP 8920B Configuration Guide, p/n 5968-5919E
HP 8920B Price List, p/n 5968-5920EUS
HP 11807A/E Product Overview, p/n 5968-1379E

HP 8920A
HP 8920B
HP 8920DT
HP 83201B
HP 83206A
HP 83215A
HP 83215B
HP 83236B
HP 11807A
HP 11807E
HP 11807F

HP 8920DT

HP 8920DT Digital RF Communications System

The HP 8920DT system provides parametric test capability for cellular radios using the Personal Digital Cellular (PDC) and Personal Handy Phone System (PHS) formats. The required instruments used in the system are the HP 8920B, HP 83201B, HP 83215A/B, and the HP 11807F control software. The HP 83215A PDC/PHS interface and HP 83215B PHS-only interface provide accurate frequency conversion to bring the test signals into the range of the HP 8920B. The 83201B TDMA Cellular Adapter adds the specific digital signal processing needed for PDC and PHS. The HP 11807F radio test software controls the system to test PDC and PHS radios according to RCR STD-27E (PDC) and STD-28 (PHS). For additional capability, instruments such as spectrum analyzers and signal generators can be added to the system and will be controlled by the system software.

HP 83206A TDMA Cellular Adapter

The HP 83206A TDMA cellular adapter (HP 8920B Option 800) provides a complete π/4 DQPSK signal generator, π/4 DQPSK modulation analyzer, data source, and BER analyzer for TDMA measurements on DAMPS (IS-54) and DCCH (IS-136) phones. The HP 83206A supersedes the HP 83201B TDMA cellular adapter (HP 8920B Option 500) for making measurements on TDMA dual-mode DAMPS phones, adding digital control channel test features to fully characterize DCCH phones.

Key Literature

HP 8920DT Product Overview, p/n 5963-5519E

Ordering Information

HP 8920A RF Communications Test Set
- **Opt 001** High-Stability Timebase
- **Opt 004** Tone/Digital Signaling
- **Opt 007** Low-Level RF Power Measurement
- **Opt 008** Cellular Mobile RF Power Measuring Range
- **Opt 010** 400 Hz High-Pass Filter
- **Opt 011** CCITT Weighting Filter
- **Opt 012** 4 kHz Bandpass Filter
- **Opt 013** C-Message Weighting Filter
- **Opt 014** 6 kHz Bandpass Filter
- **Opt 016** High power input option: 100 watts
- **Opt 019** Variable Frequency Notch Filter
- **Opt 020** Radio Interface Card
- **Opt 050** Dual-Mode Rear-Panel Connectors
- **Opt 055** Mechanical Attenuator Input Option
- **Opt 102** Spectrum Analyzer with Tracking Generator and ACP
- **Opt 103** HP-IB/RS-232/Parallel dc Current Measurement

HP 11807A Radio Test Software
- **Opt 001** North American FM Tests
- **Opt 002** European PM Tests
- **Opt 003** AM Tests
- **Opt 004** AMPS/EAMPS/NAMPS Cellular Tests
- **Opt 005** TACS/ETACS/NTACS Cellular Tests
- **Opt 006** NMT Cellular Tests
- **Opt 007** JTACS Cellular Tests
- **Opt 010** LTR Trunked Radio Tests
- **Opt 011** EDACS2 Trunked Radio Tests
- **Opt 012** MPT 1327 Trunked Radio Tests
- **Opt 100** System Support Tests

HP 8920B RF Communications Test Set
- **Opt 001** High-Stability Time Base
- **Opt 004** Tone/Digital Signaling
- **Opt 006** 10 W to 50 μW Power Measurement Range
- **Opt 007** Low-Level RF Power Measurements
- **Opt 010** 400 Hz High-Pass Filter
- **Opt 011** CCITT Weighting Filter
- **Opt 012** 4 kHz Bandpass Filter
- **Opt 013** C-Message Weighting Filter
- **Opt 014** 6 kHz Bandpass Filter
- **Opt 016** High Power Input Option: 100 Watts
- **Opt 020** Radio Interface Card
- **Opt 031** Delete Handle and Cover
- **Opt 051** Dual-mode Rear-Panel Connectors
- **Opt 055** Mechanical Attenuator Input Option
- **Opt 102** Spectrum Analyzer with Tracking Generator and ACP
- **Opt 500** HP 83201B Option 003 TDMA Cellular Adapter
- **Opt 800** HP 83206A IS-136 TDMA Cellular Adapter
- **Opt 801** Adds HP 83206A and 83236B for IS-136 Tests
- **Opt 1CM** Rackmount Kit Without Handle
- **Opt AXK** Rackmount Kit with Option 500 or 800
- **Opt 0B0** Delete Manual Set

HP 83206A IS-136 TDMA Cellular Adapter

HP 83236B PCS Interface
- **Opt AX4** Rack Flange Kit Without Handles

HP 11807E PCMCIA Radio Test Software for 8920B
- **Opt 001** North American FM Tests
- **Opt 002** European Phi-M Test
- **Opt 003** AM Tests
- **Opt 004** AMPS/EAMPS/NAMPS Cellular Tests
- **Opt 005** TACS/ETACS Cellular Phone Tests
- **Opt 007** JTACS/NTACS Cellular Phone Tests
- **Opt 008** TDMA Dual-Mode Cellular Phone Tests
- **Opt 009** AMPS/EAMPS/NAMPS/TDMA Dual-Mode Cellular Phone Tests
- **Opt 010** LTR Trunked Radio Tests
- **Opt 011** EDACS Trunked Radio Tests
- **Opt 014** AMPS/NAMPS/DAMPS/DCCH Dual-Mode TDMA Cellular Phones
- **Opt 024** AMPS/NAMPS/DAMPS and DCCH/PCS TMDA Cellular Phones
- **Opt 100** System Support Tests

HP8920DT Digital RF Communication System capability is provided using the following primary instruments plus required options:
HP 8920B RF Communication Test Set
HP 83215A RF Interface
HP 83215B PHS (only) RF Interface
HP 83201B TDMA Cellular Adapter
HP 11807F Radio Test Software with Option 021 or Option 022
Some of the following additional instruments may be necessary to perform some tests:
HP 8595E Spectrum Analyzer
HP 85720C PDC Measurement Personality
HP 85726B PHS Measurement Personality
HP 34401A Digital Multimeter
HP ESG-D300A E4432AR Digital and Analog Signal Generator
HP 8643A Synthesized Signal Generator
HP 6642A or HP 6643A DC Power Supply
HP 83219A Test Format Upgrade

Indicates QuickShip availability.

HP 8921A

HP 8921A Cell Site Test Set

The HP 8921A cell site test set is a highly-portable, integrated solution for the installation and maintenance of AMPS and TACS cell sites and is upgradable to test CDPD, CDMA, and TDMA systems. The HP 8921A incorporates more than twenty powerful instruments into a compact, 38-pound package. The integral IBASIC controller in the HP 8921A runs the HP 11807B cell site test software to fully automate base station test and adjustment procedures. Automation combined with accurate measurements increases technician efficiency to speed installation and maintenance procedures.

HP 8921A Features Summary

- AM/FM signal generator
- AM/FM modulation analyzer
- Duplex offset generator
- RF power meter
- RF frequency counter/frequency error meter
- Audio frequency counter and power meter
- AC/DC voltmeter
- SINAD/SNR/distortion meter
- Two variable frequency AF generators
- Digital oscilloscope
- Built-in IBASIC controller
- Spectrum analyzer with tracking generator
- Adjacent channel power meter
- Signaling encoder and decoder
- High-stability timebase
- DC current meter
- GPIB/RS-232/parallel remote interfaces
- Upgradability to TDMA, CDMA, or CDPD
- Optional cellular base station test software
- Optional Amps cellular phone test software
- Optional radio interface card
- Optional Ericsson PCM reference

Upgrading for New Formats

Beyond testing analog AMPS and TACS base stations, the HP 8921A is ready to grow with your measurement needs for digital cellular systems with upgrades available for:

- TDMA
- CDMA
- CDPD

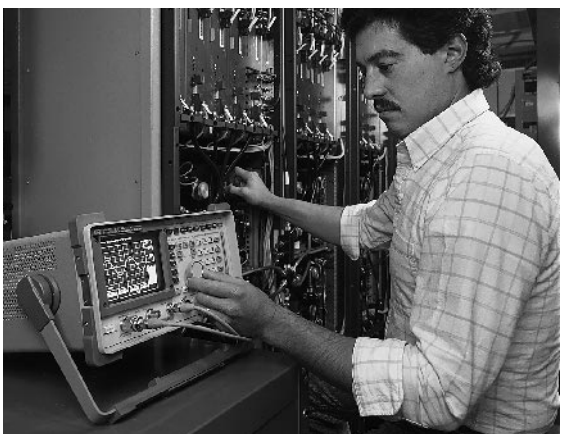
High-Performance Spectrum Analyzer

The spectrum analyzer of the HP 8921A has the wide dynamic range and synthesized frequency accuracy previously found only in expensive stand-alone spectrum analyzers. Wide dynamic range allows the HP 8921A to locate low level signals in the presence of high power transmitters. Synthesized frequency accuracy translates into high confidence that you've located the correct signals.

With frequency spans ranging from 1 GHz to as narrow as 5 kHz, the HP 8921A has the flexibility to look at the entire RF spectrum and then zoom in on the desired signals. The marker function displays the frequency and amplitude of any displayed signal. The marker-to-peak function displays the frequency and amplitude of the largest on-screen signal with a single keystroke.

Built-in Tracking Generator

The HP 8921A spectrum analyzer also includes a built-in tracking generator for tuning base station duplexers. With +13 dBm power output (over range), use the tracking generator as an input stimulus to the duplexer. The calibrated level of the spectrum analyzer ensures accurate adjustment of duplexers. Using the marker function of the spectrum analyzer, the rejection of the duplexer can be measured at any point of the filter response. Antenna return loss can be quickly and accurately measured onsite with the HP 8921A tracking generator. Using the tracking generator to drive the antenna through an external VSWR bridge, the reflected power can be measured on the HP 8921A spectrum analyzer. Other measurements performed with the tracking generator include insertion loss and frequency response of filters, cables, or attenuators. The tracking generator features calibrated output level from –137 to +7 dBm and variable frequency offset for IF to RF conversion measurements. Coupled with 1, 2, and 10 dB per division spectrum analyzer ranges, normalization, and marker capability, the tracking generator makes the HP 8921A ideal for all types of measurements and adjustments.



Automated Base Station Maintenance

For complex base station maintenance, the HP 11807B cell site test software, running on the HP 8921A's internal controller, guides the user through each step of the procedure. Graphical displays show connection diagrams and highlight key adjustment points when required. Technicians spend less time learning and more time testing with the HP 8921A cell site test set.

Another software package, the HP 11807B Option 120, provides AMPS system information. The software uses the HP 8921A to scan for and decode local control channels, display system data, and measure key transmitter characteristics.

Key Literature

HP 8921A Brochure, p/n 5968-5821E
HP 8921A Technical Specifications, p/n 5968-5820E
HP 8921A Configuration Guide, p/n 5968-1288E
HP 8921A Price List, p/n 5968-5468EUS
Also available are videos showing automated testing of cell site equipment:
Optimize Motorola Cell Sites Fast, p/n 5965-2988E
Install and Maintain Ericsson Cell Sites Fast, p/n 5965-2986E
Install and Maintain AT&T Cell Sites Fast, p/n 5965-2987E

HP 8921A Option 600, 602, 603

HP 8921A Option 500, 502, 503

HP 8921A Option 600, 602, 603 CDMA/CDPD Cell Site Test System

GPIB

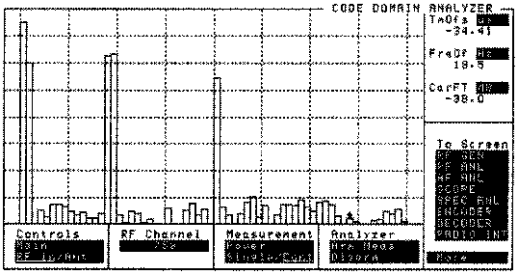
Option 600 (or 603) for the HP 8921A adds the HP 83205A Option 001 (or 003) CDMA cellular adapter to the cell site test set to provide testing of CDMA (IS-95A and IS-97) base station equipment. This system provides signal generation and analysis of QPSK/OQPSK signals. The system measures power in each Walsh-coded signal, code channel timing, and code channel phase relative to the pilot.

The HP 83205A Option 002 (or 003) CDPD test option quickly and accurately tests key RF parameters on both the forward-channel transmitter and the reverse-channel receiver. CDPD software, included with all CDPD hardware, automates transmitter, receiver, and system tests—making it easy to standardize system maintenance with fast and accurate test procedures.

HP 8921A Option 600/603 Features Summary

All HP 8921A standard features, plus:

- Measurements of waveform quality "ρ" (rho), frequency error, time offset, and carrier feedthrough
- Code domain power, timing, and phase analysis
- Average power and CDMA channel power measurements
- CDMA QPSK/OQPSK RF source with data buffer and IS-95 reverse link coding
- Built-in AWGN (Added White Gaussian Noise) source for calibrated E_b/N_o settings
- Includes both 14.4 and 9.6 Kbps vocoder rate sets



HP 83205A CDMA/CDPD Cellular Adapter

For those who already own HP 8921As, the HP 83205A Option 003 CDMA/CDPD cellular adapter can be added to upgrade the unit to perform the CDMA/CDPD tests described above for the HP 8921A. Note: Older HP 8921As may require an upgrade for complete CDMA capabilities.

HP 8921A Option 500, 502, 503 TDMA/CDPD Cell Site Test System

The HP 8921A Option 500 (or 503) adds the HP 83204A to the HP 8921A to provide testing of TDMA (IS-136) base station equipment. This unit adds π/4 DQPSK signal generation and analysis to the powerful analog features of the standard HP 8921A. A custom screen provides control of the TDMA source and provides selection of several measurement modes, making all test results visible in one place.

The HP 83204A CDPD (Option 002 or 003) test option quickly and accurately tests key RF parameters on both the forward-channel transmitter and the reverse-channel receiver. CDPD software, included with all CDPD hardware, automates transmitter, receiver, and system tests—making it easy to standardize system maintenance with fast and accurate test procedures.

HP 8921A Option 500 Features Summary

All HP 8921A standard features, plus:

- Measurements of TDMA modulation accuracy, including phase error, magnitude error, and error vector magnitude (EVM)
- Measurements of I/Q origin offset and frequency error
- Measurements of adjacent and alternate channel power
- TDMA power measurement
- π/4 DQPSK signal generator
- π/4 DQPSK modulation analyzer
- Continuous/pulsed RF power meter
- Bit-error rate meter
- Baseband data source

HP 83204A TDMA/CDPD Cellular Adapter

For those who already own the HP 8921A cell site test set, the HP 83204A Option 003 TDMA/CDPD cellular adapter can be added to upgrade the unit to provide TDMA (IS-136) and CDPD tests on cell site equipment. Once added, all TDMA test features described above are available for manual use as well as under HP 11807B software control.

HP 83202A Interface Kits

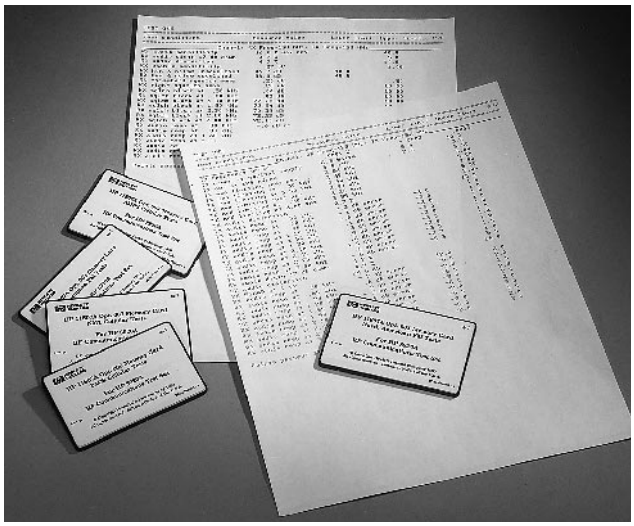
Order the HP 83202A base station connection kit to receive the necessary cables, connectors, and adapters to connect the HP 8921A to a specific type of base station. Available options include connection kits for Motorola, General Electric/Nortel, Ericsson, and Lucent base stations. The 83202A provides everything needed to test base stations with the HP 8921A. Some connection kits also include an interface/switch box to more fully automate the testing process.

HP 83202A Base Station Connection Kits

- Option 032 Ericsson RBS 882/884 Connection Kit
- Option 040 Motorola Connection Kit
- Option 043 Lucent Connection Kit
- Option 044 GE and Nortel Connection Kit

HP 11807B Software for Automated Base Station Maintenance

Developed from manufacturers' recommended maintenance procedures, the HP 11807B cell site test software ensures complete test and adjustment of cell sites. Standardizing system maintenance with the HP 8921A and HP 11807B software increases system integrity. The fast measurement speed of the HP 8921A and HP 11807B software results in less off-line time for each transceiver during maintenance work. Since all cells are uniformly tested using the same test procedure, problems are detected earlier.



Hewlett-Packard has automated testing solutions for the following manufacturers' equipment:

- Motorola HDII, HDII/NAMPS, LD series, TACS, ETACS, UTACS, and EUTACS
- GE standard, extended frequency, and compact RCU series
- Ericsson 882 and 882M analog, microcell, 882D DTRM, and 883, 883M TACS/ETACS, and 884
- Lucent Autoplex Series II analog, LMT microcell, and TDMA/CDMA
- Nortel DRU and P-series
- Hughes GMH 2000 AMPS

In addition to the automated maintenance procedures, the HP 11807B Option 120 provides detailed analysis of AMPS cellular networks. An automated application using the HP 8921A's receiver and decoder, the package displays a wealth of AMPS system data. The system can find local AMPS control channels and display decoded forward control channel data. Other modes decode reverse control channel data, follow calls, and perform measurements on sites or mobiles (see product overview, p/n 5963-6891 EUS).

Total HP Support for Your Cell Site Test Needs

HP offers a variety of options to support cell site testing and keep your solution up to date with the latest technology. The HP 11807B software Option +36H Start-Up Assistance provides one day of on-site training for up to five people. Additional HP consulting/training is also available as needed.

Key Literature

HP 8921A Brochure, p/n 5968-5821E
HP 8921A Technical Specifications, p/n 5968-5820E
HP 8921A Configuration Guide, p/n 5965-1288E
HP 8921A Price List, p/n 5968-5468EUS
Also available are videos showing automated testing of cell site equipment:
Optimize Motorola Cell Sites Fast, p/n 1000-1300
Install and Maintain Ericsson Cell Sites Fast, p/n 1000-1297
Install and Maintain AT&T Cell Sites Fast, p/n 1000-1304

Ordering Information

AMPS/TACS and CDMA/TDMA/CDPD Cell Site Test
HP 8921A Cell Site Test Set
- **Opt 011** CCITT Weighting Filter
- **Opt 020** Radio Interface Adapter
- **Opt 042** Ericsson PCM Reference
- **Opt 500** TDMA Cell Site Test System
- **Opt 502** CDPD MDBS Cell Site Test System
- **Opt 503** TDMA/CDPD MDBS Cell Site Test System
- **Opt 600** CDMA Cell Site Test System
- **Opt 602** CDPD MDBS Cell Site Test System
- **Opt 603** CDMA/CDPD MDBS Cell Site Test System
- **Opt W30** Three-Year Warranty

HP 83204A TDMA Cellular Adapter
- **Opt 001** TDMA Cellular Adapter, upgradeable to CDPD
- **Opt 002** CDPD Cellular Adapter, upgradeable to TDMA
- **Opt 003** TDMA/CDPD Cellular Adapter

HP 83205A CDMA Cellular Adapter
- **Opt 001** CDMA Cellular Adapter, upgradeable to CDPD
- **Opt 002** CDPD Cellular Adapter, upgradeable to CDMA
- **Opt 003** CDMA/CDPD Cellular Adapter

Software for Automated Base Station Maintenance
HP 11807B Cell Site Test Software
- **Opt 023** Lucent CDMA Cellular Test
- **Opt K23** Lucent CDMA Software Upgrade
- **Opt 032** Ericsson RBS 884 Test
- **Opt K32** Ericsson RBS 884 Software Upgrade
- **Opt 040** Motorola AMPS/NAMPS Test
- **Opt K40** Motorola AMPS/NAMPS Software Upgrade
- **Opt 041** General Electric AMPS Test
- **Opt K41** General Electric AMPS Software Upgrade
- **Opt 042** Ericsson AMPS/TDMA Test
- **Opt K42** Ericsson AMPS/TDMA Software Upgrade
- **Opt 043** Lucent AMPS/TDMA Test
- **Opt K43** Lucent AMPS/TDMA Software Upgrade
- **Opt 044** Nortel AMPS/TDMA Test
- **Opt K44** Nortel AMPTS/TDMA Software Upgrade
- **Opt 045** Hughes AMPS Test
- **Opt K45** Hughes AMPS Software Upgrade
- **Opt 050** Motorola TACS/ETACS/UTACS/EUTACS Test
- **Opt K50** Motorola TACS/ETACS/UTACS/EUTACS Software Upgrade
- **Opt 052** Ericsson TACS/ETACS Test
- **Opt K52** Ericsson TACS/ETACS Software Upgrade
- **Opt 120** AMPS Call Analysis, Logging & Monitoring

Base Station Connection Kits
HP 83202A Base Station Connection Kit
- **Opt 032** Ericsson RBS 882/884 Connection Kit
- **Opt 040** Motorola Connection Kit
- **Opt 042** Ericsson RBS 882 Connection Kit
- **Opt 043** Lucent Connection Kit
- **Opt 044** GE and Nortel Connection Kit

- CDMA and TDMA
- New generation of base station test equipment
- Improve technician efficiency and enhance system performance
- Enhanced User Interface
- Rugged, portable design

HP 8935 Series Cellular/PCS Base Station Test Sets

The HP 8935 series is a flexible platform that currently includes two full featured, one-box test sets, for CDMA (E6380A) and for TDMA (E6381A). The 8935 series is designed to meet the needs of installation teams, service providers, and network equipment manufacturers. Building on the success of our previous generations of base station test equipment, this new generation of test gear heavily incorporates feedback from cellular and PCS service providers and network installation teams. For example, the HP 8935 Series utilizes a new, larger, bright electro-luminescent display for easily read data. A new convenient connector section allows unobtrusive, out-of-the-way hook up. A suitcase form factor provides better portability. The HP 8935's new "rugged design" combines a membrane keypad, a gasketed display, stand up operation, filtered airflow and an enclosure to help protect itself from bumps and shocks.

More importantly, the new HP 8935 incorporates a less intimidating, user-friendly interface with Windows® type pull down menus. This new interface, coupled with the HP 8935's faster measurement speed and automated software for vendor specific base stations results in less off-line time and improved system performance. Errors due to test variability are reduced and measurement data can be output to a printer or to the PCMCIA memory card. Additionally, firmware is user upgradeable with a PCMCIA card to Flash PROM. New features and capabilities can be added without returning the unit to a service center. To round out HP's new instrument, the HP 8935 Series includes options for new technician training programs to provide install teams and service providers educational opportunities in AMPS, CDMA, and TDMA technologies and base station test.

HP 8935 Series Key Feature Summary

- Power measurements
  - Average power
  - Channel power
- Site Tests (requires E6554A - RF Tools Hardware Accessory Kit)
  - Return loss (SWR) measurements
  - Cable fault location measurements
  - Insertion loss measurements
- Ruggedized design
- Large, electro-luminescent screen (important for outdoor testing)
- Convenient connector placement
- One-button user interface keys
- Pull-down menus
- Optional automation software
- User upgradeable firmware - PCMCIA to Flash PROM
- AM/FM signal generator
- AM/FM modulation analyzer
- Duplex offset generator
- RF power meter
- RF frequency counter/frequency error meter
- Audio frequency counter and power meter
- Spectrum analyzer with tracking generator (400 kHz-1GHz, 1.7-2 GHz)
- DC current meter
- GPIB/RS-232/parallel remote interfaces
- High-stability time base
- AC/DC voltmeter
- Digital oscilloscope
- Built-in I-BASIC controller
- Decoder for NAMPS

Rugged Design

The mechanical design of the HP 8935 Series addresses the physical requirements of today's base station which may be exposed to environmental elements. Ruggedized attributes include:

- Membrane keypad-resists moisture and dirt, easily cleaned, high reliability
- Gasketed display keeps moisture out
- Stand-up operation-needed for outdoor base stations with no place to set equipment
- Low center of gravity-to minimizes tip-overs when unit is standing
- Filtered air-flow-keeps dirt and dust out of instrument for improved reliability and safety

Portability

The newly enhanced mechanical design provides a "suitcase" form factor that is less bulky and more manageable. Total weight of the unit measures 49 lbs. No additional add-on boxes are required to implement receiver testing.

Key Literature

HP 8935 Series Brochure p/n 5966-4168E
HP 8935 CDMA Technical Specifications p/n 5968-3798E
HP 8935 TDMA Technical Specifications p/n 5966-3732E
HP 8935 Series Configuration Guide p/n 5968-3799E
HP 8935 CDMA Price List p/n 5968-3800EUS
HP 8935 TDMA Price List p/n 5967-3786EUS

E6380A CDMA Cellular/PCS Base Station Test Set

The E6380A is the CDMA member of the HP 8935 Series. This one-box solution characterizes Cellular (850MHz) AMPS/CDMA and PCS (1900 MHz) CDMA base stations. Specific CDMA oriented measurements made by the E6380A include:

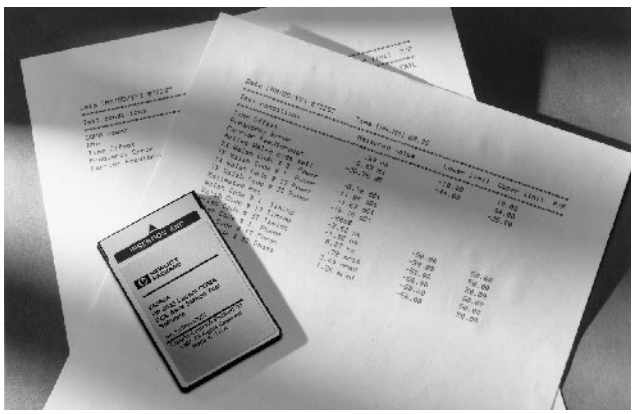
- CDMA Signal quality measurements
  - Rho (ρ)
  - Non-intrusive Rho (ρ)
  - Time offset
  - Frequency error
  - Carrier feedthrough
- Code domain measurements
  - Code domain power (absolute & relative)
  - Code domain timing
  - Code domain phase
- Error vector magnitude, magnitude error, phase error
- PN offset search
- Reverse channel source with data buffer
- AWGN (built-in calibrated E_b/N_o levels)
- Support for CDMA reference clocks and triggers

E6381A TDMA Cellular/PCS Base Station Test Set

The E6381A is the TDMA member of the HP 8935 Series. This one-box solution characterizes Cellular (850 MHz) AMPS/TDMA and PCS (1900 MHz) TDMA base stations. The E6381A test set provides verification of base station performance using its built in TDMA analyzer. An optional rubidium oscillator is available which provides extremely accurate frequency error measurements. Specific TDMA measurements made by the E6381A include:

- Modulation quality
  - Error Vector Magnitude EVM
  - Phase Error
  - Magnitude Error
  - Carrier feedthrough
- Average power
- Frequency Error
- Channel power
- Adjacent channel power
- First and second alternate channel power

In addition, a pi/4 DQPSK TDMA signal generator is also included in the E6381A. This generator makes the E6381A receiver test capable.



HP 8935 Series Software for Automated Base Station Installation and Maintenance

Developed from manufacturer's recommended installation and maintenance procedures, the HP 8935 Series base station specific test software ensures complete base station testing. Software enhancements for vendor specific base station equipment provides structured, automated testing. A simple menu-driven user interface requires less technical expertise to retrieve consistent reported measurements. Less skilled technicians can make measurements with the same confidence as their highly skilled/experienced counterparts. The software is contained on a PCMCIA card.

HP 8935 Series Connection Kits

Order the HP 8935 Series base station connection kit to receive the necessary cables, connectors, and adapters to connect the HP 8935 Series to a specific type of base station. Connection kit hardware is housed in a foam filled case.

Total HP Support for Your Base Station Test Needs

HP offers a variety of options to support base station testing and to keep your solution up-to-date with the latest technology. HP also offers start-up assistance and formal training programs. Additional HP consulting/training is also available as needed.

Ordering Information

E6380A HP 8935 Series CDMA Cellular/PCS Base Station Test Set
- **Opt 1D5** High Stability Frequency Reference
- **Opt OBK** Paper and CD-ROM Manual
- **Opt OBC** Manual on CD-ROM Only
- **Opt W30** Two years additional warranty
- **Opt K03** Two-piece fiberglass transit case
- **Opt K04** Two-piece hinged fiberglass transit case
- **Opt K05** Two-piece hinged lightweight fiberglass case
- **Opt K06** Two-piece hinged lightweight fiberglass case with wheels and telescoping handle
- **Opt UK6** Commercial calibration certificate with test data
- **Opt W30** Two years additional warranty
- **Opt W32** Three year return calibration service
- **Opt W34** Three year return standards compliant calibration service
- **Opt W50** Four years additional warranty
- **Opt W52** Five year return calibration service
- **Opt W54** Five year return standards compliant calibration service
- **RT R58** Firmware upgrade kit

Software for the E6380A CDMA Base Station Test Set:
E6385A Lucent CDMA/AMPS Base Station Test Software
E6387A Nortel CDMA PCS Base Station Test Software
E6550A Samsung CDMA Base Station Test Solution
E6551A LGIC CDMA Base Station Test Solution
E8303A Motorola AMPS/NAMPS Base Station Test Software

Connection kits for the E6380A CDMA Base Station Test Set:
E6554A RF Tools Hardware Accessory Kit
E8300A Lucent base station connection kit
E8300A Option 001 Lucent RF tools hardware accessory kit
E8302A Nortel Base Station Connection Kit
E8302A Option 001 Nortel RF tools hardware accessory kit
E8202A Option 040 Motorola base station connection kit
E6550A Option 001 Samsung RF tools hardware accessory kit
E6551A Option 001 LGIC RF tools hardware accessory kit
E6381A HP 8935 Series TDMA Cellular/PCS Base Station Test Set
- **Opt 003** CDPD Test Module
- **Opt AY5** Rubidium Timebase
- **Opt 0BK** Paper
- **Opt W30** Two Years Additional Warranty

Software for the E6381A TDMA Base Station Test Set:
E8304A Ericsson RBS 882 AMPS/TDMA Base Station Test Software
E6555A Ericsson RBS 884 AMPS/TDMA Base Station Test Software
E6559A Lucent Cellular AMPS/TDMA Base Station Test Software
E6557A Lucent TDMA PCS Base Station Test Software
E6389A Nortel TRU/P-Series AMPS/TDMA Base Station Test Software

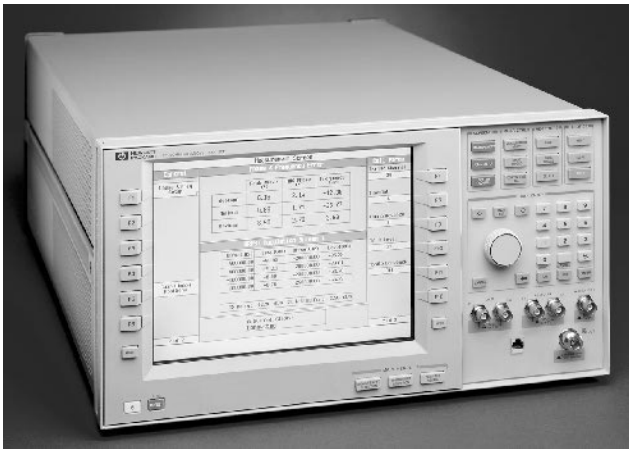
Connection kits for the E6381A TDMA Base Station Test Set
E6556A Ericsson RBS 884 Base Station Connection Kit
E6558A Ericsson RBS 882 and 884 Base Station Connection Kit
E8300A Lucent Base Station Connection Kit
E8302A Nortel Base Station Connection Kit
E6554A RF Tools Hardware Accessory Kit

342 GSM 900, DCS 1800, AND PCS 1900 Mobile Test Set for Manufacturing

HP 8960 Series 10

NEW

- The speed you need in today's competitive mobile manufacturing enviroment
- Measurement accuracy and repeatability you need to insure quality and reduce rework
- An efficient programming language than can reduce the start-up time and the maintenance of code in the future
- A platform product that will support additional cellular formats in the future



HP 8960 Series 10 Wireless Communications Test Set

High-Throughput Test for the Manufacturing Floor NEW

In a manufacturing environment, high throughput is a key to reduce the time and cost of GSM mobile-phone manufacturing test The HP 8960's breakthrough speed and throughput provide an immediate competitive advantage in high-volume production environments.

The HP 8960 Series 10 wireless communications test set is designed to help mobile-phone manufacturers increase their profits and reduce asset expenses. The breakthrough speed of this new test set boosts the throughput of a mobile-phone production-test system by as much as 300%.

The HP 8960 provides immediate competitive advantages for GSM mobile-phone manufacturers, allowing them to increase production volumes, get products to market sooner, and lower the cost of test per phone. These advantages are crucial in today's highly competitive wireless-communications market, which increasingly views mobile phones as commodity items.

The initial release of the HP 8960 test set includes all the functionality needed for automated testing of GSM 900, DCS 1800, and PCS 1900 mobile phones. By means of a flexible hardware and software design, the test set can be upgraded to accept other wireless formats and enhancements that HP will introduce in the future.

Designed for speed, the HP 8960 is a next-generation GSM test set that runs individual tests from ten to thirty times faster than previous instruments. This dramatic improvement in speed means that manufacturers can handle a given production volume with fewer test sets, thereby lowering the cost of test and saving floor space. Manufacturers also have the option to further improve mobile phone quality by running tests that were once considered too time-consuming for a high-volume environment.

To deliver this speed, the test set incorporates hardware that has been optimized with fast processing algorithms and high-speed processor technology. Additionally, the test set is the first to use HP's Reduced Instruction Parallel Processing (RIPP) architecture, which allows measurements to be run concurrently. For example, transmitter and receiver measurements can run at the same time while still maintaining a protocol link.

Easy to program and control in addition to enabling faster measurements, the HP RIPP architecture greatly simplifies writing programs for manufacturing test of GSM mobiles. With fewer lines of code to write and maintain, programmers will find that the HP 8960 is easier and faster to integrate into the manufacturing environment and the code is easier to modify when changes are needed to accommodate product enhancements or new products.

The test set's remote user interface allows the use of high-level tests. Complex measurement processing and error handling that is traditionally performed by an external computer is now executed within the instrument to reduce the bus traffic and increase measurement throughput.

The HP 8960 delivers accurate, repeatable measurements to ensure the quality of GSM mobile phones during final testing. Manufacturers can use measurement results to reliably predict trends and improve measurement processes.

The test set includes the HP E1960A GSM mobile test application, which provides GSM test functionality based on ETSI (European Telecommunication Standards Institute) Phase 2 GSM recommendations.

Transmitter Measurements

- Frequency error
- Output power
- Phase error (peak and rms)
- Power versus time (burst mask comparison)
- Burst timing
- Output RF spectrum due to switching
- Output RF spectrum due to modulation

Receiver Measurements

- Burst-by-burst bit error ratio (fast BER)
- Normal bit error ratio (BER)

Audio Functionality

- Speech echo back to mobile station
- Audio generator encoded on downlink TCH
- Uplink speech level measurement
- Audio generator
- Audio level measurement

GSM Functionality

- Mobile Station Power Output Level Control: Meets GSM phase one and phase two power control levels
- Traffic Channels: TCH/FS—full rate speech
- Broadcast Channel Configuration: BCCH + CCCH + SDCCH/4
- Signaling Protocol Setup: FACCH
- Audio Speech Echo: One-second fixed delay
- Measurement Coordination: Flexible control of burst type, ARFCN, and timeslot

Call Processing Functionality

MS Origination, BS origination, MS release, BS release, Intra-cell channel assignments, Inter-cell handovers

SAACH reporting of servicing cell: RX quality, RX level, TX level, Timing advance

SACCH reporting of first neighbor cell: Channel number, Base station color code (BCC), RX level, Network color code (NCC)

Counters reported: RACH count, Corrupt burst count, Page count, Decode error count, Missing burst count

Last location information reported: Location area code (LAC), Mobile country code (MCC), Mobile network code (MNC)

Mobile-reported information: International mobile subscriber identity (IMSI), International mobile equipment identity (IMEI), Revision level, Power class, Supported band, Called number

Signaling Modes

Full Signaling Call Setup (active cell mode): Protocol used to establish, maintain, change channels and power levels, and terminate the link.

Limited Signaling Call Setup (test mode): Protocol used only to maintain a link established by the mobile station, over-the-air signaling and capability to demodulate and decode uplink RACH (random access channel) bursts is not available.

HP 8960 Series 10 (E5515A with HP E1960A GSM Mobile Test Application) Technical Specifications NEW

RF (Downlink) Generator Specifications

RF generator specifications apply to both RF generators in the HP 8960

RF Frequency

Frequency Range: 810 to 960 MHz, 1.7 to 1.99 GHz
Accuracy and Stability: Same as timebase reference

RF Amplitude

Output Level Range: –110 to –13 dBm
Absolute Output Level Accuracy: <±1.0 dB

GSM Signal Generation

Peak Phase Error: <±4 degrees
rms Phase Error: <1 degree
Frequency Error: <±0.02 ppm plus timebase reference

Spectral Purity

Non-Harmonics:

<-55 dBc for 100 to ≤1500 kHz offsets from carrier
<-68 dBc for >1500 kHz offsets from carrier

Transmitter Measurement Specifications

Phase and Frequency Error Measurement

Minimum Input Level: Signal at test set's RF IN/OUT must have TX output power ≥15 dBm for warranted performance
Frequency Error Measurement Accuracy:
<±12 Hz plus timebase accuracy for normal bursts
<±18 Hz plus timebase accuracy for RACH bursts
RMS Phase Error Measurement Accuracy: <1 degree
Peak Phase Error Measurement Acuracy: <4 degrees

Transmitter Output Power Measurement

Minimum Input Level: ≥20 signal at test set's RF IN/OUT must have TX output power ≥20 dBm for warranted performance

Measurement Accuracy between 20 and 55° C:

Frequency Range	Amplitude Range	Measurement Accuracy
810 to 960 MHz	+4 to +43 dBm	<±0.36 dB
810 to 960 MHz	–20 to +4 dBm	<±0.44 dB
1.7 to 1.99 GHz	–20 to +43 dBm	<±0.48 dB

Output RF Spectrum (ORFS) Due to Modulation Measurement

All specifications for the ORFS due to modulation measurement are valid between 20 and 55° C.
Minimum Input Level: Signal at test set's RF IN/OUT must have TX output power ≥–10 dBm for warranted performance
Measurement Accuracy (referenced to output power in a 30 kHz bandwidth and averaged over 100 measurements):

kHz Offset from Carrier	Power Below Reference (Whichever is Highest)	Measurement Accuracy
±100	–10 dB or –46 dBm	±1.5 dB
±200	–40 dB or –46 dBm	±1.5 dB
±250	–43 dB or –46 dBm	±1.5 dB
±400 to ±1800	–62 dB or –66 dBm	±1.5 dB[1]

[1] Signal power at test set's RF IN/OUT should be ≥ expected power and ≥+16 dBm for specified accuracy. Otherwise, accuracy is <±2.0 dB.

Output RF Spectrum (ORFS) Due to Switching Measurement

All specifications for the ORFS due to switching measurement are valid between 20 and 55 oC.
Minimum Input Level: Signal at test set's RF IN/OUT must have TX output power ≥–10 dBm

Audio Generator Specifications

Frequency

Operating Range: 100 Hz to 5 kHz
Accuracy: Same as timebase reference

Output Level from AUDIO OUTPUT Connector

Ranges: 0 to 1 V peak, 1 to 9 V peak (into ≥600 Ω)
Accuracy: <±1.5% of setting ± measurement resolution
Distortion: <0.1% for 0.2 to 9 V peak into ≥600 Ω

Audio Measurement Specifications

Audio Level Measurement

Measurement Range: 200 Hz to 8 kHz
Measurement Accuracy: ±2% of reading ± measurement resolution

Uplink Speech Level Measurement

Types of Signals Measured: Speech present on uplink TCH pulsed with 50% duty cycle at a 10 Hz rate
Measurement Range: 200 Hz to 3.6 kHz
Measurement Accuracy: Observed inaccuracies are due to mobile phone encoder errors since the algorithm in the HP 8960 contributes no bit errors

General Specifications

Power Requirements: 100 to 240 VAC, 50 to 60Hz
Power Consumption: 500 VA maximum
Operating Temperature and Humidity: 0° to 55° C, ≤95% RH at 40° C
Size: 8.75" H x 16.75" W x 24.63" D (222mm x 426mm x 625mm)
Weight: 66 lbs (30 kg)

Ordering Information

HP E5515A Wireless Communications Test Set
Opt UK6 Commercial Calibration Certificate with data
Opt W30 3-year return service
Opt W50 5-year return service
Opt B8A Performance verification at installation
HP E1960A GSM Mobile Test Application
Opt OBO Delete Manual Set
(CD Rom Documentation only)
Opt OBK Service and Reference Manuals
on Paper + CD ROM)
Must order both E5515A Test set and E1960A Test Application

More Information

Visit the HP 8960 web site: **www.hp.com/hp8960support.**

HP E8285A

NEW

HP E8285A

HP E8285A CDMA Mobile Station Test Set

The HP E8285A CDMA Mobile Station Test Set provides the key set of measurements to manufacture high quality Dual Mode CDMA cellular and PCS mobile telephones in a single box. Acting as a calibrated, high performance CDMA base station, the HP E8285A verifies not only the parametric performance of CDMA phones, but also the functional aspects of phone performance. The HP E8285A is optimized to provide fast high accuracy measurements for efficient manufacturing. The HP E8285A is based on the industry standard HP 8924C. In addition to its CDMA functionality, the HP E8285A includes full AMPS, NAMPS, TACS, NTACS and JTACS analog phone test capability. With the HP E8285A, you save cost by making both analog cellular and CDMA digital cellular/PCS measurements with one instrument.

CDMA Base Station Simulator

The HP E8285A includes a full QPSK signal generator that follows the TIA/EIA-95-A CDMA air interface specifications for base stations. The CDMA signal generator supports an AWGN (Additive White Gaussian Noise) source as well as two CDMA sectors. Sector A supports the following CDMA channels: Pilot, Sync, Paging, Traffic, and OCNS. Sector B offers Pilot, Traffic and OCNS channels. Absolute power is individually settable for the AWGN source, Sector A and Sector B in terms of total power in a 1.23 MHz bandwidth. Using industry standard ASICs, the HP E8285A supports the protocol required to emulate a CDMA base station for mobile station test.

Functional CDMA Mobile Test

The HP E8285A supports mobile or base station terminated call connect and disconnect. To check voice quality the HP E8285A offers a voice echo mode. When active the voice echo mode delays and then retransmits to the mobile phone any audio spoken into it. An operator can quickly verify voice quality by speaking into the phone and then listening to the echoed audio in the mobile handset. The HP E8285A can also send pre-vocoded audio tones of 400 Hz, 1 kHz and an audio sweep to the phone for further audio testing.

CDMA Transmitter Tests

Transmitter tests include fast DSP based average power measurements from +34 dBm to –10 dBm and accurate channel power and access probe power measurements from +30 dBm to –50 dBm. The tuned channel power measurement reports the power in a 1.23 MHz bandwidth. These two power measurement modes allow accurate verification of maximum power, minimum power, open loop power control, and closed loop power control.

The HP E8285A measures transmitted waveform quality by the TIA/EIA-98-A recommended correlated power method “p” (rho). In addition the “p” measurement reports the frequency error, phase error, amplitude error, time offset, and carrier feedthrough of the mobile phone CDMA transmitted signal.

CDMA Receiver Tests

The key performance parameter for CDMA mobile station receivers is Frame Error Rate with and without the presence of AWGN. The built-in high accuracy AWGN generator in the HP E8285A guarantees the FER tests provide the true picture of a CDMA mobile ability to correctly demodulate a signal in the presence of high interfering noise. The HP E8285A fully supports service Options 002 and 009 (RF loopback mode) to test receiver FER performance. The HP E8285A optimizes FER measurement time by employing confidence limit technology. With confidence limits, FER measurements are made in the fastest possible time.

Hand-off Verification

To speed testing, the HP E8285A supports hard hand-offs between RF channels. CDMA to analog hand-offs from both cellular and PCS bands are also supported. With two configurable CDMA sectors, the HP E8285A can verify the ability of a CDMA mobile to support softer hand-offs. Two HP E8285A test sets can be synchronized for more complete idle and soft hand-off testing.

Short Message Service Testing

The HP E8285A supports mobile terminated SMS on both paging and traffic channels. Messages can be sent in both ASCII and HEX formats to support international character sets.

CDMA and AMPS Authentication Testing

The HP E8285A includes authentication tests which support both CDMA (US and Korean) and AMPS. The HP E8285A displays expected mobile phone values and actual values returned. SSD update, A-key entry, RANDC and other authentication procedures are supported.

Analog Capabilities

In addition to powerful CDMA test capabilities, the HP E8285A retains full analog cellular test capability. Based on the HP 8924C CDMA Mobile Station Test Set, the HP E8285A is backwards compatible with most HP 8924C GPIB commands. The HP E8285A includes as standard equipment a high stability timebase, a C-message filter, and a 6 kHz bandpass filter. In addition the HP E8285A supports easy CDMA to analog handoffs from both cellular and PCS channels. It also offers one button analog cellular call processing for AMPS, NAMPS, TACS, NTACS, and JTACS phones. These analog features not only allow the HP E8285A to test dual mode CDMA phones, but also provide an effective suite of measurement tools for radio troubleshooting.

HP 83217A Dual-mode Mobile Station Test Software

Besides its many measurement functions, the HP E8285A includes a programmable IBASIC controller. The HP 83217A Option 004 automates CDMA dual-mode mobile measurements using the HP E8285A. Automated testing improves consistency and reduces operator error resulting in lower operation costs and improved product quality. This software package provides a comprehensive suite of analog and digital tests that can be easily arranged to fit specific testing requirements. Test points, test limits, and test sequences can be stored for future retrieval.

HP E8290A Point of Service Test Software

The new HP E8290A PoST (Point of Service Test) Software makes the HP 8285A an easy to use automated CDMA test solution. The HP E8290A quickly provides accurate phone performance and quality data at the point of sale. This PC-based solution is very easy to use, reduces churn, reduces NTF (No Trouble Found), and improves customer care. Test results can also be stored in databases for further analysis.

HP E8285A Analog Mode Specifications

Signal Generator

Range
100 MHz to 1000 MHz,
1700 MHz to 2000 MHz.

RF IN/OUT Connector
Level Range: –120 dBm to –18 dBm into 50 ohms
Level Accuracy:
±1.0 dB (100 MHz to 1000 MHz), typically ±0.7 dB.
±1.25 dB (1.7 to 2.0 GHz), typically ±1.0 dB.
Reverse Power: 2.5 watts

DUPLEX OUT Connector
Level Range: –120 dBm to –8 dBm into 50 ohms
Level Accuracy: ±1.0 dB

FM Deviation (rates >25 Hz):
100 kHz; 501 to 1000 MHz,
100 kHz; 1700 MHz to 2000 MHz.

Audio Source (both internal sources)
Range: dc to 25 kHz
Accuracy: 0.025% of setting
Range: 0.1 mV to 4 Vrms

RF Analyzer
RF Frequency Measurement
Measurement Range:
100 MHz to 1000 MHz,
1700 MHz to 2000 MHz.

RF Power Measurement

Accuracy: ±7.5% (–10 dBm to +30 dBm)
Measurement Range:–10 dBm to +34 dBm (0.1 mW to 2.5 W)

FM Measurement
Frequency Range
5 MHz to 1000 MHz,
1700 MHz to 2000 MHz.
Deviation Range: 20 Hz to 75 kHz

Spectrum Analyzer (Option 102)
Frequency Range
0.4 MHz to 1000 MHz,
1700 MHz to 2000 MHz
Resolution Bandwidth (coupled): 300 Hz to 300 kHz
Display Range: 80 dB

Audio Analyzer
Frequency Measurement
Measurement Range: 20 Hz to 400 kHz
Accuracy: ±0.02% plus resolution plus reference oscillator accuracy

SINAD Measurement
Fundamental Frequency Range: 300 Hz to 10 kHz ±5%
Input Level Range: 30 mV to 30 Vrms
Accuracy: ±1 dB for frequencies from 300 to 1500 Hz, measured with the 15 kHz LPF (0 to 46 dB SINAD).

Oscilloscope
Frequency Range (–3 dB BW): 2 Hz to 50 kHz
Scale/Division: 10 mV to 10 V

CDMA Signal Generator

CDMA Channels:
Additive White Gaussian Noise
Sector A with Selectable PN Offset:
Pilot Channel at Walsh Code 0
Sync Channel at Walsh Code 32
Paging Channel at Walsh Code 1
Traffic Channel with selectable Walsh Code
OCNS Channel with selectable Walsh Code
Sector B with selectable PN offset:
Pilot Channel at Walsh Code 0
Traffic Channel with Selectable Walsh Code
OCNS Channel with Selectable Walsh Code

Frequency
Frequency Range
501 MHz to 1000 MHz,
1700 MHz to 2000 MHz

Amplitude
Composite Signal Output Level Range:
RF IN/OUT
–120 dBm/1.23 MHz to –20 dBm/
1.23 MHz, useable to -15 dBm.
DUPLEX OUT
–120 dBm/1.23 MHz to –10 dBm/
1.23 MHz, useable to -10 dBm.
Composite Signal Output Level Accuracy
AWGN Off
±1.25 dB 501 MHz to 1000 MHz,
±1.35 dB 1700 MHz to 2000 MHz
Relative CDMA Channel Level Accuracy: <0.2 dB

CDMA Analyzer
CDMA Average Power Measurement
Input Frequency Range
100 MHz to 1000 MHz,
1700 MHz to 2000 MHz.
Measurement Range: –10 dBm to +34 dBm
Accuracy: –10 dBm to +30 dBm
±7.5% ±1 µW (100 MHz to 1000 MHz)
±8% ±1 µW (1.7 GHz to 2.0 GHz) Typically ±5%

CDMA Tuned Channel and Access Probe Power Measurements

Measurement Range
RF IN/OUT: –50 dBm to +30 dBm
ANT IN: –70 dBm to +15 dBm

CDMA Modulation Measurement
Measurement Input Level Range: –20 dBm to +34 dBm
Measurement Accuracy: ±0.003
Frequency Error Measurement Accuracy: ±30 Hz ± timebase accuracy

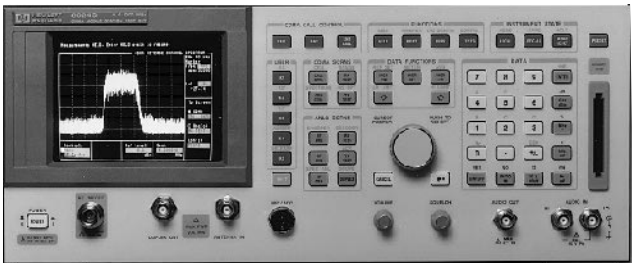
CDMA Frame Error Rate Measurement
FER Measurement Method: Data loopback per Service Option 002 or Service Option 009 supporting Confidence limits as outlined in TIA/EIA-98-B
FER Reported Parameters: Measured FER, Number of Errors, Number of Frames tested, and one of the following: Passed Confidence limit, Failed Confidence limit, or Max. Frames (test indeterminate)

General Specifications

Dimensions (H x W x D): 22.2 cm x 42.5 cm x 59.0 cm
Weight: 22 kg, 48 lbs
Operating Temperature: 0° C to +55° C
Power: 100 V to 240 V, 50/60 Hz, nominally 250 VA.
Calibration Interval: Two years

Ordering Information

E8285A CDMA PCS mobile station test set
Opt 002 Add HP E8290A PoST automated PC software
Opt 011 Add CCITT filter for TACS/ETACS
Opt 102 Add spectrum analyzer with tracking generator
Opt 0B0 Delete manual set.
Opt 0B1 Add one additional manual set.
Opt 0BW Printed service documentation, assembly-level.
Opt AX4 Rack flange kit.
Opt UK6 Commercial calibration certificate with test data.



HP 8924C

HP 8924C CDMA Mobile Station Test Set

The HP 8924C CDMA Mobile Station Test Set provides the key set of measurements to verify the performance of dual-mode CDMA mobile phones operating from 500 to 1000 MHz. With the HP 83236B PCS Interface, the HP 8924C additionally offers CDMA mobile testing from 1700 to 2000 MHz. Acting as a calibrated, high performance CDMA base station, the HP 8924C verifies not only the parametric characteristics of CDMA phones, but also the functional aspects of phone performance

The HP 8924C's full AMPS, NAMPS, EAMPS, TACS, NTACS, ETACS and JTACS test capability saves you space, cost, and training expenses by allowing you to make both analog and CDMA digital measurements with the same instrument.

For complete, call processing verification, the HP 8924C supports both mobile and base station initiated call connect and disconnect. Once a phone call is established, verifying the overall functionality of a CDMA mobile is simple using the HP 8924C's voice echo mode. For testing a variety of protocol formats, the HP 8924C offers six user selectable protocol stacks: IS-95, IS-95A, TSB-74, J-STD-008, ARIB T53, and KOREAN PCS. The HP 8924C also supports a number of service options, including 9600 BPS and 14,400 BPS traffic channel configurations.

High Accuracy CDMA Source for CDMA Receiver Test

Active cell site emulation in the HP 8924C is supplied by Sector A. The Sector A source supports the following CDMA channels: Pilot, Sync, Paging, Traffic, and Orthogonal Channel Noise Source (OCNS). In addition, the HP 8924C has a second sector for testing softer hand-offs. Sector B is a partial sector that has a Pilot channel, a Traffic channel, and an OCNS channel. An Additive White Gaussian Noise (AWGN) Source is also included to provide the interference generated by adjacent cells in a working CDMA network. The HP 8924C measures receiver Frame-Error-Rate (FER) at all four date rates used in the CDMA system: full, half, quarter, and one-eighth. Confidence limit technology is used to reduce receiver test time to an absolute minimum.

CDMA Transmitter Measurements

The HP 8924C provides an average power measurement based on DSP technology. A DSP based channel power measurement enables the HP 8924C to achieve accurate low level CDMA power measurements. Access probe power measurements are also available. The HP 8924C measures transmitted waveform quality by using the IS-98A/J-STD-018 recommended correlated power method, also known as the rho measurement. In addition, the rho measurement reports the frequency error, modulation phase and amplitude error, and the carrier feedthrough.

Handoff Verification

To speed testing, the HP 8924C supports hard hand-offs between RF channels. CDMA to analog hand-offs from both cellular and PCS bands are also supported. With two configurable CDMA sectors, the HP 8924C can verify the ability of a CDMA mobile to support softer hand-offs. Two HP 8924C test sets can be synchronized for complete idle and soft hand-off testing.

Authentication and Short Message Service Support

The HP 8924C provides the necessary features for testing a CDMA mobile station's ability to perform call processing functions with Authentication for Korea and the United States. Also, the HP 8924C supports mobile terminated SMS.

Automated Software

The new HP E8290A PoST (Point of Service Test) Software makes the HP 8924E an automated CDMA test solution. The HP E8290A quickly provides accurate phone performance and quality data at the point of sale. This PC-based solution is very easy to use, reduces churn, reduces NTF (No Trouble Found), and improves customer care.

The HP 83217A CDMA Dual Mode Mobile Station Test Software can also be used to automate CDMA and analog mobile phone measurements. The HP 83217A solution does not require a PC. Rather, automatic tests can be completely set up using the front panel of the HP 8924E. Options are available to meet your test needs for CDMA, AMPS, NAMPS, JTACS, NTACS, U.S PCS and Korean PCS phones.

HP 8924E CDMA Mobile Station Service Test Set

Like the HP 8924C, the HP 8924E CDMA MS Service Test Set acts as calibrated, high performance base station to provide the essential set of measurements required to test the parametric and functional characteristics of cellular, dual-mode CDMA phones.

There are key differences between the HP 8924C and HP 8924E:

- The HP 8924E's spectrum analyzer is optional.
- The HP 8924E has no second sector for softer handoffs.
- Two HP 8924E Test Sets cannot be synchronized for testing soft handoffs.
- The HP 8924E does not have access to certain general purpose analog screens.
- The HP 8924E generally takes twice as long to make the same measurement.
- The HP 8924E only supports the AUTO MS ID.
- The HP 8924E does not support:
  – closed loop power control changes
  – mobile parameter retrieval and setting
- There are rear panel differences between the HP 8924C and the HP 8924E.
- There are technical specification differences between the HP 8924C and the HP 8924E.

Even though it has reduced flexibility and functionality, and slower measurement speed, the HP 8924E CDMA Mobile Station Service Test Set does not sacrifice the quality, thoroughness, repeatability, and accuracy of the HP 8924C. The HP 8924E has a user-friendlier interface optimized for manual operation. It is a lower cost product designed for the CDMA mobile phone service market. The HP 8924E is optimized for the following applications:

- Incoming inspection for service providers
- Failure and repair verification for service organizations

Ordering Information

HP 8924C CDMA Mobile Station Test Set
HP 8924E CDMA Mobile Station Service Test Set
  Opt 001 HP E8290A PoST Software
  Opt 011 ETACS CCITT Filter
  Opt OBW Service Documentation
  Opt OB1 Add Manual Set
  Opt AX4 Rack Flange Kit
  Opt W30 3 Years of Customer Return Repair Service
  Opt W50 3 Years of Customer Return Repair Service
  Opt 102 Add Spectrum Analyzer with tracking generator (standard on HP 8924C)
  Opt 601 Adds PCS Interface
HP 83217A CDMA Dual Mode MS Test Software
  Must order one and only one option per unit HP 83217A
  Opt 001 AMPS/NAMPS/CDMA
  Opt 003 JTACS/CDMA
HP E3290A Point of Service Test Software
HP 83236B PCS Interface
  Opt 004 PCS CDMA/NAMPS/AMPS

Analog Mode Specification Summary

Signal Generator

RF Frequency Range
Standard: 30 MHz to 1000 MHz
With Option 601: 800 MHz to 960 MHz, 1710 MHz to 1990 MHz
Output
RF In/Out Connector
Level Range
Standard: –127 to –10.5 dBm into 50 ohms
With Option 601: –130 to –20 dBm into 50 ohms
Level Accuracy
Standard: ±1.2 dB (Level >= –127 dBm)
With Option 601: ±1.8 dB @ 25° C ±10° C
Reverse Power
Standard: 3 watts continuous
With Option 601: 10 watts continuous
Duplex Out/RF Out Only Connector
Level Range
Standard: –127 to +3.5 dBm into 50 ohms
With Option 601: –130 to –10 dBm into 50 ohms
Level Accuracy
Standard: ±1.0 dB (Level >= –127 dBm)
With Option 601: ±1.8 dB @ 25° C ±10° C
Reverse Power: 200 mW maximum
Maximum FM Deviation (rates > 25 Hz)
Standard: 100 kHz; 501 MHz to 1000 MHz
With Option 601: 100 kHz; 800 to 960 MHz, 1710 to 1990 MHz

RF Analyzer

Frequency Measurement Range
Standard: 30 MHz to 1000 MHz
With Option 601: 800 MHz to 960 MHz, 1710 MHz to 1990 MHz
RF Power Measurement (RF in/out connector only)
Measurement Range
Standard: –10 dBm to +35 dBm (0.1 mW to 3 W)
With Option 601: –13 dBm to +40 dBm (50 μW to 10 W)
Accuracy
Standard: ±5% of reading 1 μW from 15° C to 35° C
With Option 601: ±5% of reading ±2.5 μW from 13° C to 33° C

Spectrum Analyzer

Frequency Range:
Standard: 30 MHz to 1000 MHz
With Option 601: 800 MHz to 960 MHz, 1710 MHz to 1990 MHz
Resolution Bandwidth (coupled to span): 300 Hz to 300 kHz
Display Range: 80 dB

AF Analyzer

Frequency Measurement
Measurement Range: 20 Hz to 400 kHz
Accuracy: ±0.02% + resolution + reference oscillator accuracy
SINAD Measurement
Fundamental Frequency Range: 300 Hz to 10 kHz ±5%
Accuracy: ±1 dB for Fc=300 to 1500 Hz, using the 15 kHz LPF
Residual THD+Noise: –60 dB or 150 μV, whichever is greater

Oscilloscope

Frequency Range (–3 dB BW): 2 Hz to 50 kHz
Scale/Division: 10 mV to 10 V
Time/Division: 10 μs to 100 ms

Remote Programming

HP-IB: Hewlett-Packard's implementation of IEEE Standard 488.2
RS-232: 3-wire RJ-11 connector used for serial data in and out
Centronics Port: Industry standard parallel printer port

Ovenized Reference

Aging Rate: <0.005 ppm pk-pk/day, <±0.1 ppm per year

CDMA Mode Specification Summary

CDMA Call Processing Functionality

Protocol Stack: IS-95, IS-95A, TSB-74, J-STD-008, and ARIB-T53
Service Option Modes: SO 001, SO 002 (9600 bps loopback), SO 003, SO 009 (14400 bps loopback), SO 32768, SO 006, and SO 014
Traffic Channel Data Rates: 9.6 kbps or 14.4 kbps
Call Control: BS call originate, BS call disconnect, MS call originate, MS call disconnect
Hand-off Support: CDMA to CDMA Hard (RF Frequency), CDMA Softer (HP 8924C only), CDMA to Analog (intraband), and CDMA PCS to Analog Cellular
CDMA Soft (requires 2 units) (HP 8924C only)

CDMA Signal Generator

CDMA Channels
Additive White Gaussian Noise
Sector A – includes the following channels: Pilot Channel, Sync Channel, Paging Channel, Traffic Channel, and OCNS Channel
Sector B – includes the following channels: Pilot Channel, Traffic Channel,and OCNS Channel (HP 8924C only)
Frequency Range
Standard: 501 MHz to 1000 MHz, usable from 30 to 248.9 MHz
With Option 601: 800 MHz to 960 MHz, 1710 MHz to 1990 MHz
Composite Signal Output Level Range
Standard:
RF In/Out: –109 dBm/1.23 MHz to –21.5 dBm/1.23 MHz
Duplex Out: –109 dBm/1.23 MHz to –7.5 dBm/1.23 MHz
With Option 601:
RF In/Out: –109 dBm/1.23 MHz to –20.01 dBm/1.23 MHz
RF Out Only: –109 dBm/1.23 MHz to –10.01 dBm/1.23 MHz
Composite Signal Output Level Accuracy (AWGN off)
Standard: ±1.5 dB, typically ±1.0 dB
With Option 601: ±1.8 dB at 25° C ±10° C , typically ±1.0 dB
Relative CDMA Channel Level Accuracy: 0.2 dB

CDMA Analyzer

CDMA Average Power Measurement
Input Frequency Range:
Standard: 30 MHz to 1000 MHz
With Option 601: 800 MHz to 960 MHz, 1710 MHz to 1990 MHz
Measurement Range (RF in/out connector only):
Standard: –10 dBm to +35 dBm (0.1 mW to 3 W)
With Option 601: –13 dBm to +37 dBm (50 μW to 5 W)
Measurement Accuracy
Standard: ±5% of reading ±1 μW from 15° C to 35° C
With Option 601: ±5% of reading ±2.5 μW from 13° C to 33° C
CDMA Channel Power and Access Probe Measurements
Measurement Range: –50 to +30 dBm/1.23 MHz
Calibration: Must be cross calibrated to Average Power Meter
Access Probe Measurement
Triggering: Auto-trigger above –55 dBm
CDMA Modulation Measurement
Input Level Range:
Standard: –20 dBm to +35 dBm, usable to –25 dBm
With Option 601: –25 dBm to +37 dBm, usable to –28 dBm
"ρ" **Measurement Accuracy:** "ρ" ±0.003.
Frequency Error Measurement Accuracy: ± 30 Hz
Other Reported Parameter with "ρ" Measurement: Transmit Time (τ, time offset), Frequency Error, Carrier Feedthrough, Amplitude Error, Phase Error
CDMA Frame Error Rate Measurement
FER Measurement Method: Data loopback using Service Option 002 or 009 supporting Confidence limits per TIA/EIA-98-B
FER Reported Parameters: Measured FER, Number of Errors, Number of Frames tested, Pass or Failed Confidence limit

General Specifications

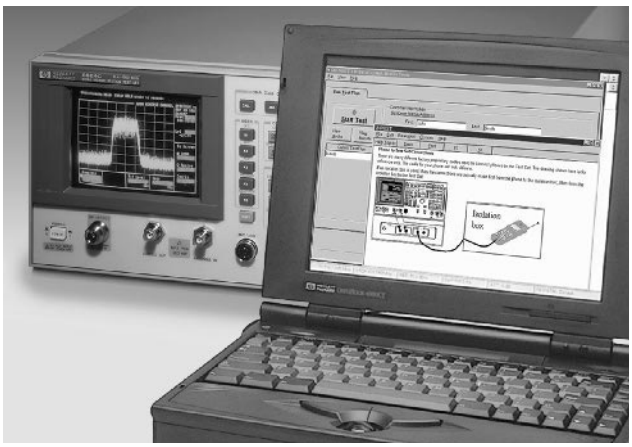
Dimensions (HxWxD)
Standard: 177 H x 426 W x 629 D mm (7 x 16.75 x 24.75 inches)
With Option 601: 254 H x 426 W x 629 D mm (12 x 16.75 x 24.75 inches)
Weight
Standard: 27 kg, 59 lbs
With Option 601: 32.6 kg, 72 lbs
Operating Temperature: 0° C to +55° C
Power
HP 8924C: 100 V to 240 V, 50/60 Hz, nominally 400 VA
HP 83236B: 90 V to 132 V, 198 V to 264 V, 47 to 63 Hz, 100 VA

348 GSM Mobile Station Test Set

HP E6392A

NEW

- A module-level MS tester for a go/no go price
- Versatility, performance, and low cost
- Accurate, reliable troubleshooting
- Flexibility for performing MS service tasks
- Firmware easily upgradable from the web or PCMCIA card
- Easy operation and intuitive interface



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HP E6392A

Lower the cost of repairing GSM mobile phones

To help service technicians cope with the growing number of mobile phones coming into repair shops, the HP E6392A GSM mobile station test set provides module-level repair capability for the price of an entry-level "go/no go" tester.

With the new HP test set, GSM service-provider and mobile-phone-repair organizations can increase the repair capability and effectiveness of their entire service network, extending troubleshooting and repair coverage to local shops while keeping equipment costs in line. They can also reduce the number of "no trouble found" phones that are sent back to the manufacturer.

Versatile Measurement Tools

The HP E6392A offers a combination of just-enough functionality, good performance, and a low price. Comprehensive, automatic GSM measurements speed incoming inspection of mobile phones. With full test capabilities for GSM900, E-GSM, and DCS1800 technicians can check most GSM phones with this single instrument. They can also troubleshoot a problem to the mechanical or module level and make necessary module replacements.

Measurement tools include a direct current (dc) power consumption check, spectrum monitoring capability, and various transmitter and receiver measurements. The test set's built-in functionality includes a dc power supply (standard) and optional spectrum monitor and signal generator. Measurement results are accurate and repeatable. For example, the test set provides a peak power measurement accuracy of ±0.6 dB for transmitter measurements.

Easy to Use and Maintain

Service technicians can learn how to use the GSM test set in about 30 minutes. An intuitive user interface and a PC memory card reader help make the test set easy to set up and operate. Different test conditions can be stored on PC cards for easy uploading into the instrument. Also, HP will supply firmware upgrades for the GSM test set on PC cards.

A variety of optional accessories for the GSM test set includes RF cables, RF and dc power adapters, couplers, GSM test SIMs, and a shielded box for testing in open, spectrally noisy environments.

RF Signal Generator

Frequency Range
935 MHz to 960 MHz (GSM downlink)
925 MHz to 960 MHz (E-GSM downlink)
1805 MHz to 1880 MHz (DCS1800 downlink)
Frequency Resolution: 200 kHz, at channel frequency
Frequency Accuracy: same as reference
Output Level Range: –110 dBm to -50 dBm
Output Level Accuracy: ±1.0 dB
Modulation: 0.3 GMSK
Phase Error: <5° rms typical
Peak Phase Error: <15° peak typical

RF Analyzer

Frequency Range
890 MHz to 915 MHz (GSM uplink)
880 MHz to 915 MHz (E-GSM uplink)
1710 MHz to 1785 MHz (DCS1800 uplink)

Transmitter Carrier Peak Power Measurements

Range: –20 dBm to +39 dBm (0.3 GMSK at burst/continuous or CW)
Accuracy
±1.0 dB (±0.6 dB typical at 25° C ±5° C) at >0 dBm
±2.0 dB (±1.6 dB typical at 25° C ±5° C) at <0 dBm
Resolution: 0.2 dB

Power Ramp Measurement

Range: –11 dBm to +39 dBm (0.3 GMSK at burst)
Accuracy
±0.6 dB typical at 25° C ±5° C at >0 dBm
±1.6 dB typical at 25° C ±5° C at <0 dBm
Resolution: 0.2 dB
Dynamic Range: >40 dB typical

Phase and Frequency Error Measurement

Input Level Range: –11 dBm to +39 dBm
Input Phase Error Range: 0° to 20° (0.3 GMSK at burst)
Phase Error Measurement Accuracy
<1.5° rms at phase error >2.5°
<6.0° peak at phase error >2.5°
Frequency Error Measurement Range: ±9 kHz (0.3 GMSK at burst/continuous or CW)
Frequency Error Measurement Accuracy (average of 10 measurements)
±(10 Hz plus frequency reference accuracy) at GSM/EGSM
±(25 Hz plus frequency reference accuracy) at DCS 1800

DC Power Supply

Range: 3 Vdc to 9 Vdc
Resolution: 0.1 V
Accuracy: 0.1 V at 100 mA load
Maximum Current: 1 A, peak 2 A
Ripple Noise: 100 mV p-p typical
DC Current Measurement
Range: 3 mA to 1000 mA
Accuracy: ±(3 mA +2%)
Frequency Reference
Frequency: 13 MHz
Aging: ±0.1 ppm/year
Temperature Stability: ±0.1 ppm (20° C to 30° C)
Reference Input: 13 MHz, 0 to +10 dBm typical, 50Ω nominal
Reference Output: 13 MHz, >+3 dBm typical, 50Ω nominal
Serial Interface
Interface: EIA RS-232C
Baud Rate: 9600
Connector: D-Sub 9 pin male
Printer Interface
Interface: Centronics
Connector: D-Sub 25 pin female

Memory Card

Type: PCMCIA (U.S.)
Memory Size: SRAM 512 kB

RF Input/Output

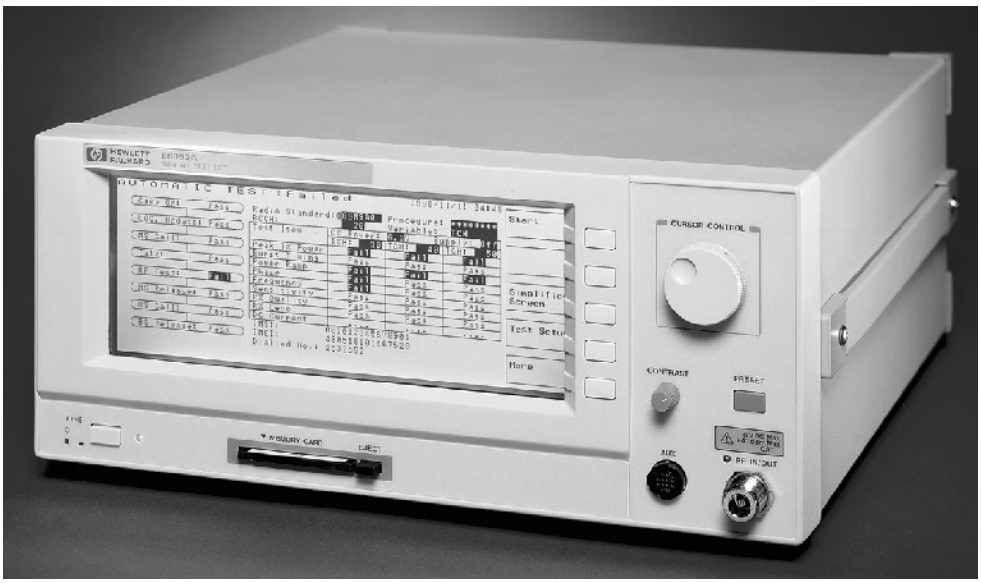
Maximum Safe Reverse Power (peak): +41 dBm (12.6 W; CW; supplemental characteristic)
Impedance: 50Ω (nominal)
SWR: <1.5:1
Connector: N type, female

General Specifications

Size: 350 mm (W) x 150 mm (H) x 350 mm (D)
Weight: 10 kg
Power Voltage: 88 V to 264 V
Power Frequency: 47 Hz to 63 Hz
Power Consumption: <VA
Operating Temperature: 0° C to +40° C
Storage Temperature: –20° C to +60° C

HP E8290A
HP E8291A
HP E8292A

- Verify phone performance
- Reduce number of "no trouble found" phones
- Analyze and store data for trend-analysis and customer-care applications
- Point-and-clock operation for non-technical users
- Comprehensive measurement capabiltiies for test developers



HP E8290A, HP E8291A, HP E8292A

Point-of Service-Test for CDMA, IS-136, AMPS and GSM Phones

To help mobile-phone retailers, wireless service providers, and repair organizations minimize costs; the family of Point-of-Service-Test (PoST) software packages provides quick and easy verification of the performance of CDMA, IS-136, AMPS and GSM dual-mode mobile phones.

With minimal training, sales clerks and other non-technical personnel can initiate and make fast, accurate measurements of phones, finding "no trouble found" phones quickly, thus reducing the number of phones returned to manufacturers. With the easy-to-use, mouse-driven, Windows-based interface, phone problems can be evaluated quickly at a retail store or local service center. With a password protection for software screens, development-mode technical screens can be hidden from non-technical staff, effectively making the PoST software less intimidating.

Yet, in the development mode, technical users can access the capabilities to create customized tests for different phone models. Test plans, as well as test specifications and parameters, can be set up and customized with ease.

Data analysis capability

To help reduce customer churn and improve customer care, PoST software provides detailed, accurate performance data that can be exported in popular PC databases and spreadsheet formats for use in trend analysis. For example, by collecting, merging and analyzing the information from each of your retail store's PoST software databases; it may be possible to identify problems in particular phone models. Reoccurring customer comments may identify problem areas in network operation.

The combination of the HP PoST software and HP's test sets is a practical test solution for the service providers' mobile-quality and repair groups, and verification labs.

The PoST software family utilizes CDMA, TMDA, AMPS and GSM Hewlett-Packard mobile station test sets:

- CDMA/AMPS PoST (E8290A)
  - HP 8924C
  - HP 8924E
  - HP E8285A
- TDMA/AMPS PoST (E8291A)
  - HP 8920B
- GSM/DCS PoST (E8292A)
  - HP E6392A

System Requirements

- An IBM (or compatible) PC with at least:
- 166 MHz Pentium processor
- Microsoft Windows NT 4.0 or Windows 95/98
- 16 MB of RAM
- 20 MB of available hard disk space

Ordering Information

HP E8290A CDMA/AMPS PoST Software
HP E8291A TDMA/AMPS PoST Software
HP E8292A GSM/DCS PoST Software

GSM900, DCS1800, and PCS1900 Test Sets

HP 8922M
HP 8922P

- Complete GSM/DCS/PCS mobile station test sets
- Designed to minimize prodution/service costs
- Built-in toolkit of instruments
- E-GSM and dual-band capability
- Fast and easy to use
- HSCSD Test Solution
- Accurate and repeatable GSM measurements
- Built-in IBASIC controller for easy automation

HP 8922M

HP 8922 GSM Test Sets

The HP 8922 GSM MS Test Set is ideal for use in R&D, high-end service and manufacturing. The easy to use, rich and flexible feature set make it the instrument of choice for bench work. The speed, accuracy and repeatability of the HP 8922 make it ideal for use in incoming inspection and volume manufacturing. The HP 8922 includes a GSM base-station emulator and all the signalling and measurement capability to fully test a mobile without any additional equipment.

GSM Radio Test Solutions

The HP 8922 contains a complete set of instrumentation for testing the RF sections of GSM radios. In addition to the frequency agile 0.3 GMSK RF generator, the RF analyzer has an agile local oscillator, coherent data demodulator, pulse demodulator, FM demodulator, global method analyzer for phase and frequency error, synthesized spectrum analyzer, and pulse power meter. The HP 8922 adds a bit-error-rate tester (BERT) for performing GSM receiver measurements, channel CODEC, and call control protocol to setup a phone call and maintain the link while performing measurements. Echo mode is facilitated by the voice CODEC for functional testing of a mobile, and the electrical man machine interface (EMMI) is implemented for controlling the mobile and supporting the digital audio interface (DAI). Flash memory on the HP 8922 allows easy upgrades.

GSM Data and HSCSD Test Solution

The HP 8922 supports the ability to test GSM single slot data and High Speed Circuit Switched Data (HSCSD) mobiles. For use in R&D, Production and Service, options K09, K17 and K18 can test single slot, 2x1, 2x2, 9.6Kbps and 14.4Kbps mobiles.

Complete Tool Set

Aside from their complete complement of GSM measurements, the HP 8922 contains general-purpose tools useful for module test, troubleshooting, and debugging activities. The tools include a digital oscilloscope, CW RF synthesizer, spectrum analyzer, CW RF frequency counter, CW and peak RF power meter, ac voltmeter, dc voltmeter, 1 kHz distortion/SINAD meter, audio frequency counter, and synthesized audio source. The sum of these capabilities makes the HP 8922 an extraordinarily powerful tool for the design manufacture and repair of GSM radio equipment.

HP 83212D GSM/DCS1800/PCS1900 Mobile Test Software

The HP 83212D is an easy-to-use software solution for automatic testing of GSM900, DCS1800 and PCS1900 mobile stations. Running on the HP 8922's built-in IBASIC controller, the HP 83212D offers a comprehensive set of tests ideal for incoming inspection and repair of GSM phones. Its flexibility and modularity allow you to select and change test sequences, test parameters, and pass/fail limits without programming expertise. Procedures can be simply saved on RAM cards and distributed to colleagues, guaranteeing consistent test methods. All test results are displayed on the screen and can be documented with hardcopy printouts when an external printer is added. Three levels of testing are available with the HP 83212D: manual mobile station troubleshooting, quick functional checkout, and full parametric testing. Automating your measurements provides repeatable results while allowing the user to test more mobile stations in less time. This increase in throughput lowers your testing cost.

HP 83220A/E DCS/PCS Test Sets

The HP 8922M tests GSM mobiles only. Adding an HP 83220A/E expands the capabilities of the HP 8922M to comprehensively test DCS1800 and PCS1900 equipment. The HP 83220E provides a cost-effective solution for mobile testing. The HP 83220A has the frequency range to test both mobiles and base stations. All features of the HP 8922 are retained.

HP 8922P Dual-band Test Sets

Combine the HP 8922M with the HP 83220E and new firmware to form a complete dual-band (GSM 900/DCS 1800) test solution. All the original HP 8922 features are retained but now, with dual-band intra-cell handover capability, the latest GSM mobiles can be tested seamlessly, at all frequencies, through a single RF connector.

HP 8922M Specifications

RF Generator

Frequency Range: 10 MHz to 1000 MHz
Frequency Resolution: 1 Hz
Switching Speed: 577 μs
0.3 GMSK Modulation: External clock and data
Pulse Modulation: Normal and 30 dB
Output Power: –16 to –127 dBm

RF Analyzer

Frequency Range: 10 MHz to 1000 MHz
Frequency Resolution: 1 Hz (100 kHz in hop mode)
Switching Speed: 577 μs
Coherent Data Demodulation: 0.3 GMSK at 270.833 Kb/s, 1 timeslot/frame
Analog Demodulation: FM and pulse
Global Method: rms and peak phase error, frequency error
Amplitude Envelope: Rise, fall, and burst flatness over useful bits
Peak Transmitter Power: +10 dBm to +45 dBm (– 5 dBm to 41 dBm on HP 8922F/H)
Output RF Spectrum Measurements[1]: Due to modulation and switching transients
CW Frequency Counter: 10 MHz to 1000 MHz

Spectrum Analyzer[1]

Frequency Range: 10 MHz to 1000 MHz
Frequency Accuracy and Stability: Same as timebase
Display Range: 80 dB
Other Features: External trigger, marker

Digital Oscilloscope

Frequency Range: 2 Hz to 50 kHz
Sweep Times: 10 μs to 100 ms in 1, 2, 5, 10 steps

Audio Analyzer

Frequency Range: 20 Hz to 400 kHz
AC Voltage Range: 0 to 30 V_{rms}
DC Voltage Range: 100 mV to 42 V
THD + Noise: 1 kHz ± 5 Hz
Sinad: 1 kHz ± 5 Hz

Audio Source

Frequency Range: DC to 25 kHz
Output Level Range: 0.1 mV_{rms} to 4 V_{rms}

Reference Oscillator

External Reference Input Frequency: 13, 10, 5, 2, or 1 MHz
External Reference Output: 10 and 13 MHz

Remote Programming

GPIB: IEEE-488.2
RS-232: 300, 1200, 2400, 4800, 9600, and 19200 baud

Internal Programming

Programming Language: Hewlett-Packard Instrument BASIC
Program Storage: 32 KB to 512 KB external memory cards

General Specifications

Size: 426 mm W x 177 mm H x 574 mm D (16.75 in x 7 in x 23 in)
Weight: 32 kg (70 lb)
Operating Temperature: 0° to + 55° C
Storage Temperature: – 40° to + 75° C
Power: 100, 120, 220, 240 Vac, 48 to 440 Hz, ±10% of line voltage

GSM Functionality

Broadcast Channel Capability: BCCH + CCCH or BCCH + CCCH +SDCCH/4
Control Channels: BCCH + CCCH, BCCH + CCCH + SDCCH/4, SDCCH/8 (non-hopped), SACCH/FACCH
Traffic Channels: TCH (FS/EFS)
Call Control Capabilities: BS originated call (FS/EFS), MS originated call (FS/EFS), MS camp on, BS call disconnect, MS call disconnect
Timing: Auto, manual, uplink-downlink offset measurement
Hopping: Cyclic only, two MA tables with offsets
Digital Audio Interface (DAI): Normal operation and test of acoustic devices and A/D & D/A
Electrical Man Machine Interface: Control via GPIB
Speech Encoding/Decoding: Full rate speech (FS)
Echo Mode: HP 8922M: user selectable delay, 0 to 5 seconds
Bit/Frame Error Rate Measurements: Class Ia, Ib, and II bits. New fast BER measurement has been added.
MS Power Output Level Control: 0 to 19, 30, 31 with RF analyzer auto adjust
Measurement Coordination: Flexible control of burst, ARFCN, and timeslot
SACCH MEAS Results: RXLEV, RXQUAL, timing advance
SMS Cell Broadcast, IMSI attach/detach
HSCSD Test Solution

GSM Reference

External Reference Input Frequencies: 13, 10, 5, 2, 1 MHz, bit clock, or frame clock

HP 83220E Specifications

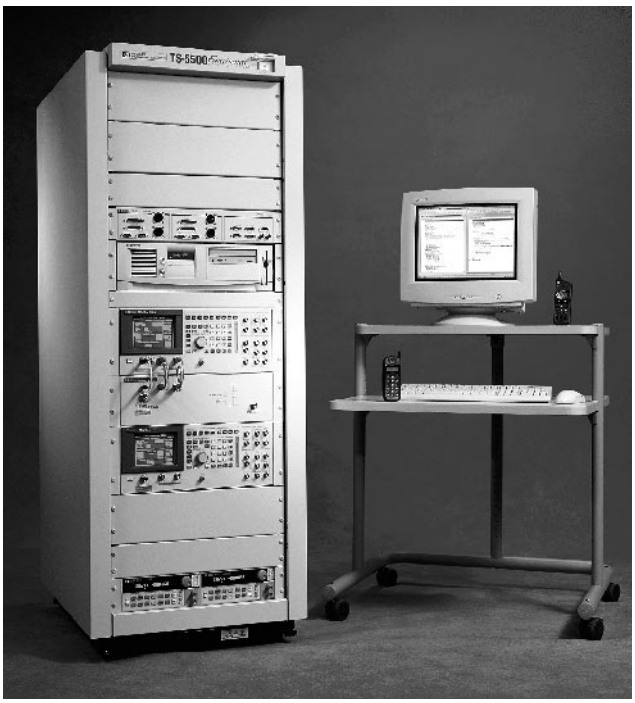
Frequency Range: 1805 to 1990 MHz

Ordering Information

HP 8922M GSM MS Test Set
HP 8922P Dual-band Test Set
HP 83220A DCS/PCS Test Set with aux.ports
HP 83220E DCS/PCS Test Set
Options for HP 8922
- **Opt 001** High-Stability Timebase
- **Opt 006** Spectrum Analyzer
- **Opt 007** 3v/5v Test SIM Card
- **Opt 008** 3v/5v Test Micro SIM Card
- **Opt 012** HP 83212D GMS MS Test Software
- **Opt W30** 3 years Return Repair Service

Options for HP 83220A/E and 8922M
- **Opt 0B1** Provides a total of two sets of Users Guides and Service Manuals (Users Guide only for A/E)
- **Opt AX4** Rackmount Flange Kit
- **Opt 0B3** Adds Service Manual

[1]Requires Option 006, Spectrum Analyzer, on HP 8922M



HP TS-5500 Cellular Phone Functional Test Platform

The HP TS-5500 Platform concept provides a universal test system core of both hardware and software, which can be easily modified to suit various cellular phone manufacturing test stages. Test system developers can customize the use of instruments and test routines to create a specific test stand. The HP TS-5500 Functional Test Platform can decrease test times, decrease floor space, and lower your test equipment costs, while getting your product to market faster.

The HP TS-5500 is a family of test platforms offering choices to meet a variety of test situations. The HP TS-5530 is a simple, cost effective test platform, ideal for manufacturers with semi-automated needs or starting in production. The HP TS-5550 provides more flexibility of measurements and inputs/outputs with the incorporation of VXI.

HP TS-5500 is Measurement-Ready for Cellular Phone Testing Requirements

Testing GSM, CDMA, or TDMA Cellular Phones requires certain instruments for the specific tests and integration of this equipment into the manufacturing line. The HP TS-5500 has the best measurement equipment integrated with the software to do the job.

Turn-on tests of the cellular phone at board-level would include emulating the battery requirements, testing battery charging circuitry, probing points on the board and communicating to the phone. HP's Dynamic Measurement Power Supplies are designed for cellular phone battery emulation and testing.

Calibration tests involve adjusting power levels in the phone circuitry to be able to make a phone call. For these RF measurements, the HP TS-5500 uses one GSM test set (HP 8922M/P or HP 8960), CDMA Test Set (HP 8924C), or TDMA Test Set (HP 8920B) for each phone. Today, the HP's family of RF test sets is a core part of the system to produce quality phones at the best throughput and lowest cost.

Final test verifies a sequence of standard radio tests using the HP RF Test Set as the core measurement instrument. Other final tests include audio tests of the microphone and speakers.

With the high volumes of cellular phone manufacturing, computer-aided-test is of high value. The HP TS-5500 uses a single PC for controlling the instruments, running the tests, and interfacing to automation equipment. A software test executive, radio measurement routines, software utilities, and an operator interface panel are provided.

HP TS-5500 System Lowers Integration Costs

HP integrates the functional test system to lower costs, since HP standardizes the racking, cabling, and mass interconnect. The economies of scale at HP provide a lower cost than one-of-a-kind integration by each test engineering project team. This more complete solution also eliminates steps in test development. Since one HP TS-5500 handles up to four phones with a minimum of one rack of equipment, integration costs are reduced versus building separate racks for each phone.

The HP TS-5500's ExpressConnect is a common, standardized connection point for the test fixtures, as well as system resources and instrumentation. While it is designed for up to four UUTs on the multiple-up testers, the HP ExpressConnect scheme is used on all configurations. All the system's non-RF resources are brought to the HP Express Connect. An optional RF interface with extra RF instruments extends the system for CDMA tests.

HP TS-5500 Software Increases Productivity

The HP TS-5500 software is a complete test development and test execution environment for the entire software development job. The test executive environment is tuned for functional testing of electronic devices in manufacturing. The software runs on a PC with Windows NT for optimum performance and it's pre-installed and ready to use. The HP TS-5500 software provides maximum re-use as a result of its hierarchical environment.

The HP TS-5500 Software Development Environment is for developing tests for cellular phones. It consists of re-useable tests, measurements, and utilities for performing specific functions related to GSM, CDMA, and TDMA phone testing. Templates and examples are provided to serve as a starting point for creating tests. The HP test executive allows you to organize and order tests, reconfigure the test stand, profile the execution speed, and debug tests. The HP-supplied library of tests, measurements, and utilities for GSM, CDMA, and TDMA cellular test are tuned for measurement performance.

The HP TS-5500 Software Test Execution Environment allows an operator to test up to four phones simultaneously and reports test information back to the operator. Using the software utilities, you can easily link the test executive with factory automation, bar code readers, and printers. This operator interface panel is created by the test developer. HP provides a sample operator interface that is easily modified, or you can use Visual Basic to quickly develop a custom operator interface.

Documentation, Training, and Support

Documenting a system can be difficult when test engineering's primary job is to keep production up and running. HP's TS-5500 provides complete documentation of its unique capabilities: cabling, mass interconnect, power distribution, and software. HP also offers training on the system platform to augment its extensive curriculum. Worldwide support on the hardware components and the unique platform features is provided by HP's team. When you deploy a system, all you have to worry about documenting and supporting is your customization of the platform.

Pre-built System Platform Cuts Development Time

From the universal HP TS-5500 Platform, you'll need to complete the system integration by adding the application specific software, fixturing, factory automation, robotics, etc. For example, test developers must add the appropriate phone communications and can customize the operator interface. Test programs and test plans need to be developed for the specific phones undergoing testing.

HP offers a complete range of services to complete the HP TS-5500. HP is experienced at building test systems for cellular phone manufacturers. We've provided project management, software, fixtures, robotics, automation, and vision systems. Additionally, HP has completed many projects that involve creating operator interfaces, final test programs, specific phone communications and custom circuitry .

Ordering Information

HP E8432A TS-5530 Two-up Base System
HP E8454A TS-5550 Four-up Base System
Additional instrumentation and configuration choices must be added with system options.
HP E2181A TS-5500 Family Options

- Multiformat capability
- One-button cdmaOne, GSM, NADC, PDC, W-CDMA, and cdma2000 measurements
- Spectrum and time domain waveform analysis capability

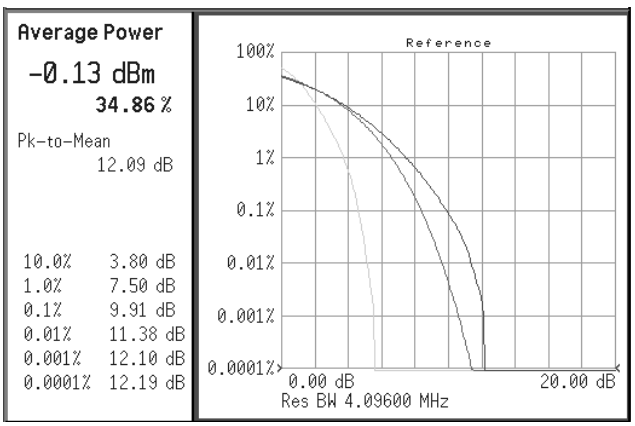
HP E4406A

HP E4406A VSA-Series Transmitter Tester

The HP E4406A VSA-series transmitter tester is a full-featured transmitter tester designed to meet the test needs of wireless equipment manufactures. The VSA provides a wide range of digital modulation analysis capability in an easy-to-use format. The advanced digital demodulation capability makes the VSA an excellent tool for doing R&D on third generation cellular systems. The multiformat capability of the VSA makes it ideal for a flexible production line. Measurements are accessible at the touch of a button and are easily configured with the simple, straight-forward menu structure. The VSA comes standard with the following measurement capability:

- Spectrum (frequency domain) analysis
- Waveform (time domain) analysis
- Channel power
- Adjacent channel power (ACP)
- Occupied bandwidth
- Complementary cumulative distribution function (CCDF)

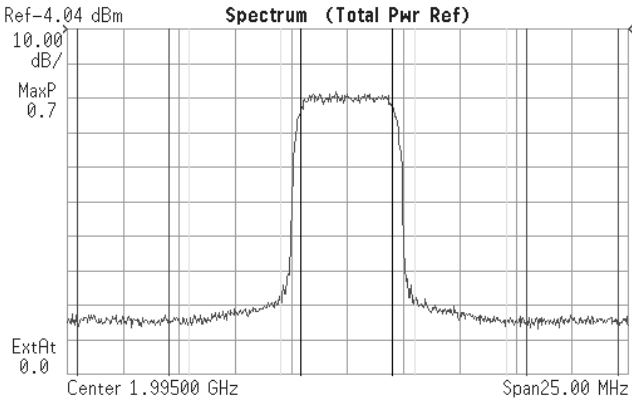
For the latest on our 3G enhancements to the HP E4406A VSA, please visit our web site: **www.hp.com/go/VSA** and click on E4406A VSA.



Complementary cumulative-distribution function curves

cdma2000 Personality

The cdma2000 personality provides key transmitter measurements for analyzing systems based on the IS-2000 Standard. The VSA provides the flexibility to analyze both Spreading Rate 1 (SR1) and Spreading Rate 3 (SR3) systems. The decoding algorithm automatically determines active channels of any code layer. The active channel identification allows engineers to examine and analyze unknown signals with ease. The ability to decode heavily loaded signals means engineers can evaluate and stress test their transmitter.



W-CDMA adjacent channel power ration (ACPR) measurement

cdma2000 Measurements

- Channel power
- Adjacent channel power ratio (ACPR)
- Modulation accuracy
- Code domain analysis
- Symbol EVM
- Power vs. symbol

W-CDMA Personality

The W-CDMA personality provides key transmitter measurements for analyzing W-CDMA systems based on the 3GPP standard. The system automatically determines active channels of any code layer. It can display the code domain power information in a composite multi-rate view. The robust decoding algorithm can decode heavily loaded signals which means engineers can evaluate and stress test their transmitter.

W-CDMA Measurements

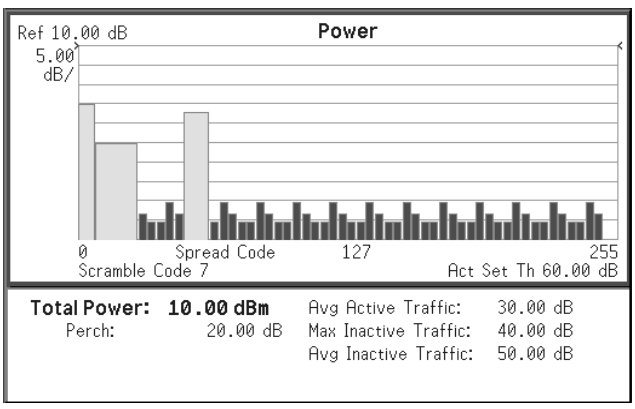
- Channel power
- ACPR
- Modulation accuracy
- Code domain analysis
- Symbol EVM
- Power vs. symbol

cdmaOne Personality

Built on Hewlett-Packard's pioneering efforts in CDMA measurement techniques, the VSA lets you quickly and efficiently make cdmaOne measurements. The transmitter tester performs tests to the requirements of industry standards, such as IS-95, IS-97, IS-98, and ANSI J-STD-008 specifications.

cdmaOne Measurements

- Channel power
- Modulation accuracy (Rho)
- Code domain power
- ACPR
- Close-in spurious



Code domain power measurement

GSM Personality

The HP E4406A VSA's GSM measurement personality lets you quickly and efficiently perform GSM measurements. The VSA provides capability to completely characterize GSM900, DCS1800 and PCS1900 transmitters for GSM requirements.

GSM Measurements

- Mean TX carrier power
- Power vs. time
- Output RF spectrum (due to modulation and transients)
- Phase and frequency error
- Transmit spurious
- Receive spurious

NADC/PDC Personality

The NADC/PDC personality provides transmitter measurements for both the North American Digital Cellular (NADC) time-division multiple access radio system and the Personal Digital Cellular (PDC) time-division multiple access radio system at both cellular and PCS frequencies.

NADC measurements

- ACP
- Modulation quality

PDC Measurements

- ACP
- Modulation quality
- Occupied bandwidth

E4406A VSA Key Features

- Multiformat capability
- User upgradeable firmware
- GPIB, LAN, and parallel interfaces standard
- High stability timebase standard
- SCPI instrument command language
- Large high-resolution color LCD display
- One-button measurements
- Softkey/hardkey user interface
- Flexible card cage instrument architecture
- Built-in 3.5-inch disk drive
- Plug & play drivers

VSA—A whole product solution

To provide you with a whole product solution and protect your investment in the HP E4406A VSA Series transmitter tester, HP provides:

- Standard three-year global warranty with optional extension to 5 years
- Customer education available on the product and popular wireless communications technologies
- Worldwide Call Center and Service Center support network
- PC-based performance verification and adjustment software available with optional response center support and update service
- GPIB, parallel and LAN interfaces for connectivity with computers and printers
- VXI plug&play instrument drivers

Tools available at **www.hp.com/go/vsa**

Physical Specifications

Weight: 19 kg (42 lb) net
Dimensions: 177 mm H x 426 mm W x 432 mm D
(7.0 in H x 16.8 in W x 17 in D)

Key Literature

HP E4406A VSA Series Transmitter Tester Brochure, p/n 5966-4762E
HP E4406A VSA Series Transmitter Tester Technical Specifications, p/n 5968-3030E

Ordering Information

HP E4406A VSA Series Transmitter Tester
Opt BAC cdmaOne measurement personality
Opt BAH GSM measurement personality
Opt BAF W-CDMA measurement personality
Opt B78 cdma2000 measurement personality
Opt BAE NADC, PDC measurement personality

HP E4402B
HP E4404B
HP E4405B
HP E4407B

- One button-cdmaOne and GSM measurements
- Rugged and portable for field use
- Spectrum & time domain waveform analysis capability

Transmitter Testing Measurement Personalities

Transmitter test measurement personalities customize the HP ESA-E series spectrum analyzers, by adding one-button test capability for industry standard tests. The versatile HP ESA-E series cardcage architecture and floppy disk drive makes it easy to add application specific measurement hardware and software. The rugged, portable ESA-E series spectrum analyzers with optional measurement personalities and battery pack are ideal for onsite testing of transmitters in the most demanding environments.

HP E4402B

HP ESA-E Series with CDMA Measurement Personality

NEW

Simplify your measurements of cellular, PCS and other spread spectrum transmitters based on cdmaOne standards. The HP ESA-E series measurement personality provides both frequency- and time-domain measurements plus digital demodulation for rho and code domain measurements. The functionality also includes spurious measurements in- and out-of band.

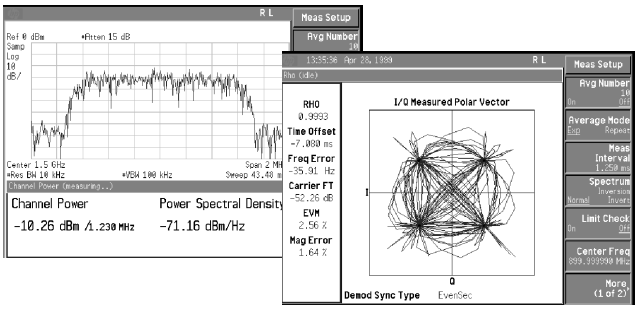
Measurements

- Average channel power
- Receive channel power
- Modulation accuracy (rho)
- Code domain power
- Spurious emissions in- and out -of -band
- Occupied bandwidth
- Harmonics
- Monitor channel/band

Recommended Configuration

HP E4402B, E4404B, E4405B, and **E4407B** portable spectrum analyzer with the following options:

Opt BAC cdmaOne measurement personality
Opt B74 RF and digital communications hardware



HP ESA-E Series with GSM Measurement Personality

NEW

Making complex GSM measurements is easy using the HP ESA-E series spectrum analyzer with the GSM measurement personality. One-button tests verify the performance of GSM transmitters for P-GSM, E-GSM, R-GSM, DCS1800 and PCS1900 systems.

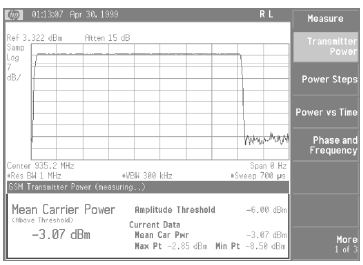
Measurements

- Burst power
- Phase and frequency error
- ORFS due to modulation and transients
- Power vs. time
- Spurious emissions in- and out- of -band
- Distance to fault (requires optional tracking generator)

Recommended Configuration

HP E4402B, E4404B, E4405B, and **E4407B** portable spectrum analyzer with the following options:

Opt BAH GSM measurement personality
Opt B74 RF and digital communications hardware
Opt 1DN Tracking generator (for distance to fault)

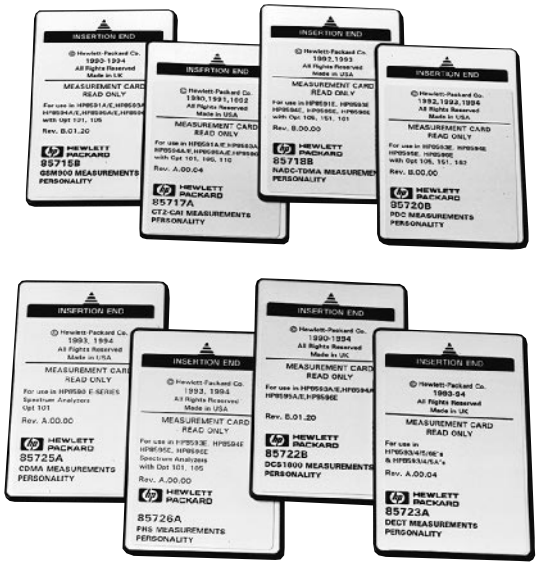


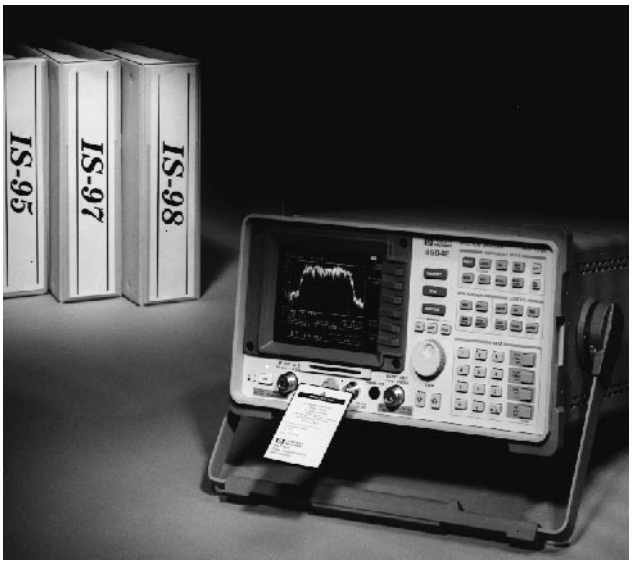
7

Measurement Personalities for HP 8590 Series Spectrum Analyzers

Overview

- One-button measurements customized for your application
- Easy to use
- Solutions available for: CDMA, GSM, DCS1800, PCS1900, DECT, CT2-CAI, NADC-TDMA, PDC, PHS





Measurement Personalities for Customized Transmitter Testing

Measurement personalities are software programs provided on ROM-based memory cards that customize your HP 8590 series spectrum analyzer to perform complex transmitter tests simply and quickly with the push of a button from easy-to-follow screen menus. They automatically set the analyzer controls and perform calculations required to test to the industry standard for the communications format.

Quick, Easy, One-Button Measurements

Using a measurement personality with an HP 8590 series spectrum analyzer reduces complex transmitter systems or component measurements to single-button operations. Easy-to-use softkey menus are labeled with familiar format-specific measurement names.

Power, Frequency, Timing, and Modulation Accuracy

With a properly-configured spectrum analyzer, most personalities allow you to perform power-, frequency-, timing-, and modulation-accuracy measurements of your signal. Measuring modulation quality for some of the formats requires a digital demodulator option in the spectrum analyzer: for example, error vector magnitude (EVM) for $\pi/4$ DQPSK signals of NADC-TDMA, PDC and PHS, and global phase and frequency error for 0.3 GMSK signals of GSM900, DCS1800 and PCS1900. There are other demodulator option cards for the spectrum analyzer for the 0.5 GFSK signals of CT2-CAI and DECT.

Product Development and Production Troubleshooting

Evaluate your design and thoroughly troubleshoot failures. Measurements can be run continuously, allowing real-time equipment adjustments and troubleshooting. Waveform and graphical results add key visual information to numerical results. Pass/fail messages draw attention quickly to system problems. Test limits can be modified from the front panel, external keyboard, or computer so that you can set your own test goals.

High-Speed Production Testing

Reduce costs with increased test throughput. Since all of the customized measurements are programmable, each is executed with a single command. We've written the code for you.

Reliable Accuracy

Most of our solutions offer an improved amplitude accuracy option on the spectrum analyzer, so you can measure your transmitters with near-power-meter accuracy.

Features to Make Your Measurements Easier

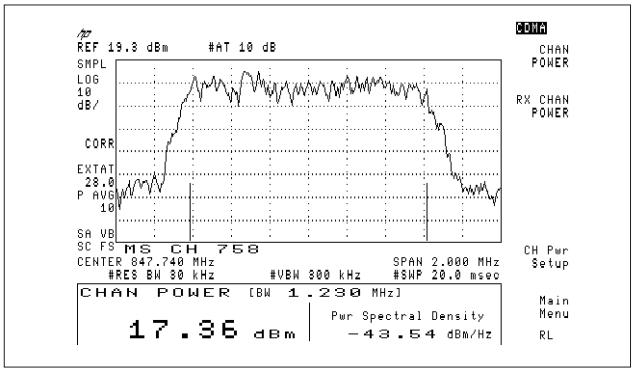
The measurement personalities contain one or more added features to make your measurements even easier such as automatic tuning by channel number, frequency-band monitoring, and combiner tuning. The newest addition to HP's portfolio of measurement personalities for transmitter testing, the HP 85725C for CDMA has an on-screen help feature to guide you through your measurements.

Accessories

For many of the measurements on burst signals, a TTL transition is required to synchronize the measurement system with the transmitter-under-test. The synchronization signal must occur once per frame. If an external signal is unavailable, the HP 85902A burst-carrier trigger may be used. Many other accessories are available from HP to help you make your measurements.

Ordering Information

Refer to the next few pages in the catalog for more details about each of the measurement personalities. See pages 231 to 235 for detailed information about the HP 8590 series spectrum analyzers, all available analyzer options and measurement personalities for other applications.



HP 85725C CDMA Measurement Personality

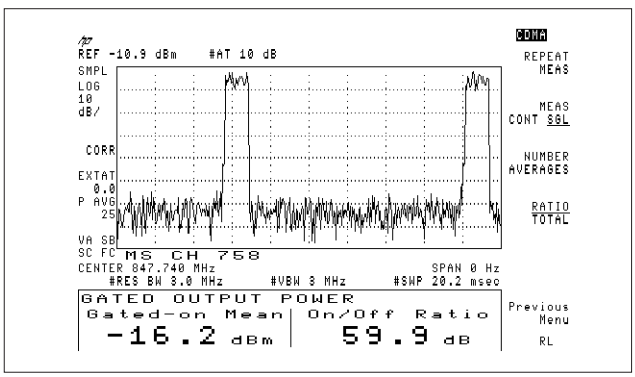
Simplify your measurements of cellular, PCS and other spread spectrum transmitters based on EIA/TIA IS-95, -97, -98 and J-STD-008 standards with the HP 85725C. Both frequency- and time-domain measurements are provided. The C version of this personality adds the adjacent channel power ratio (ACPR) measurement. The HP 85725C is designed with a great amount of flexibility, including on-screen help messages, so measurements can easily be configured to meet your special needs.

Measurements

Frequency Domain
- RF channel power
- Receive RF channel power
- Spurious emissions
- Standby output power (mobile)
- Spectral regrowth
- Occupied bandwidth
- Adjacent channel power ratio (ACPR)

Time Domain
- Gated output power
- Gated output power time response
- Time response of open loop power control

General Frequency- and Time-Domain Measurements
- Channel spectrum
- Monitor channel
- Monitor band
- Time-domain analysis
- Amplitude probability density
- Mean and peak-to-mean power



Built-In Flexibility for PCS and Other Wireless Applications

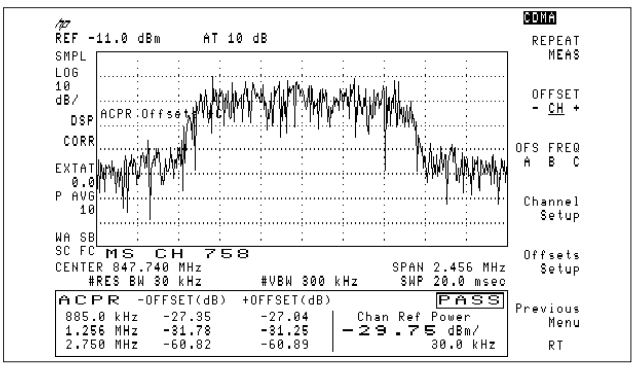
If you are involved with designs at other frequencies, for other services and even using technologies other than IS-95 or J-STD-008, you will appreciate the greater flexibility we have designed into the CDMA personality. You can configure the personality to make the measurements you need to make.

Flexibility Features

- Define your own tuning scheme based on the frequency allocation of your system. The configuration for channel-number tuning has an IS-95A, J-STD-008, ARIB STD-T53, Korean PCS setup and a custom setup.
- Change the pass/fail limit lines from the default settings to meet your requirements. For example, you may want to add test line uncertainty, additional margin or alternative limits.
- Measure your signal channel power in a channel bandwidth other than the IS-95A and J-STD-008 (for example: AMPS, or FCC Part 15). You can easily define the signal measurement bandwidth and viewing span.

Adjacent Channel Power Ratio (ACPR) Measurement

Easily test Adjacent Channel Power on CDMA components with the new one-button measurement.The flexibility allows the user to make measurements according to the two different Qualcomm definitions, or a faster HP-defined method. Integration bandwidths, resolution bandwidths, and frequency offsets can easily be changed in the ACPR setup menu to fit any application.



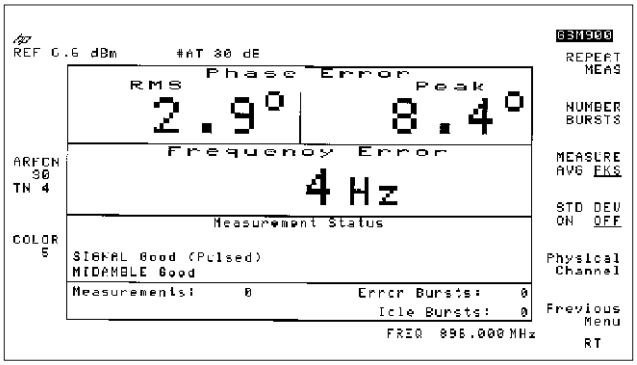
Recommended Configuration

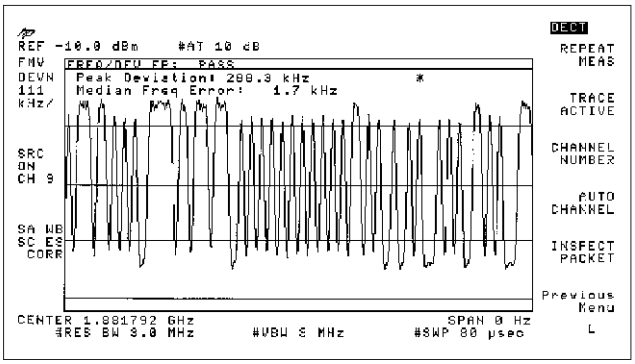
HP 85725C CDMA Measurements Personality
and
HP 8591E, HP 8594E, HP 8595E, HP 8596E, or HP 8593E Portable Spectrum Analyzer with the following options:
With DSP (Opt 151) for high speed measurements
- **Opt 004** Precision Frequency Reference
- **Opt 053** Improved Amplitude Accuracy for CDMA Cellular Bands
- **Opt 151** Digital Signal Processor
- **Opt 160** PDC/PHS/NADC/CDMA Firmware for Option 151

Without DSP
- **Opt 004** Precision Frequency Reference
- **Opt 053** Improved Amplitude Accuracy for CDMA Cellular Bands
- **Opt 101** Fast Time-Domain Sweeps

Key Literature

Portable CDMA Spectrum Analyzer, p/n 5963-9969E





HP 85715B GSM900, HP 85722B DCS1800 and HP 85727A GSM Multi-Band Transmitter Measurement Personalities

The HP 85715B, HP 85722B and HP 85727A provide all the GSM900 and DCS1800 transmitter measurements specified in the GSM 11.10 (mobile) and GSM 11.21 (base station) recommendations. GSM Phase II specification limits are used and the extended GSM (E-GSM) frequency bands are supported. GSM-based PCS measurements only at 1900 MHz may be made using the HP 85722B special Option H19.

For next generation GSM systems inter-working between GSM900, DCS1800, and PCS1900, the HP 85727A measurement personality assures that your new multi-band systems conform to worldwide GSM standards.

Measurements

- Phase and frequency error
- Demodulated data bit display
- Mean transmitted carrier power
- Power versus time
- Output RF spectrum
- Spurious emissions
- Intermodulation attenuation
- Combiner tuning

Recommended Configuration

HP 85715B GSM900 Transmitter Measurements Personality
or
HP 85722B DCS1800 Transmitter Measurements Personality
or
HP 85722B H19 PCS1900 Transmitter Measurements Personality
or
HP 85727A GSM Multi-band Measurements Personality
and
HP 8594E, HP 8595E, HP 8596E, or HP 8593E Portable Spectrum Analyzer with the following options:

With Phase and Frequency Error Measurement

Opt 004 Precision Frequency Reference
Opt 105 Time-Gated Spectrum Analysis
Opt 151 Fast ADC and Digital Demodulator
Opt 163 GSM/DCS Firmware for Option 151

Or as an ordering convenience, the spectrum analyzer may be ordered with Opt BD1 which contains the HP 85727A GSM Multi-band measurement personality and the options listed above.

Without Phase and Frequency Error Measurement

Opt 004 Precision Frequency Reference
Opt 101 Fast Time-Domain Sweeps
Opt 105 Time-Gated Spectrum Analysis

Related Spectrum Analyzer Options

Opt J62 Enhanced Power Measurement Accuracy in the GSM900 Band (880 to 960 MHz)
Opt J63 Enhanced Power Measurement Accuracy in the DCS1800 Band (1710 to 1880 MHz)
Opt J66 Enhanced Power Measurement Accuracy in the PCS1900 Band (1850 to 1990 MHz)

Key Literature

Portable GSM/DCS Transmitter Measurement Systems, Product Overview, p/n 5966-3803E
GSM900 and DCS1800 Transmitter Testing, White Paper, p/n 5962-9942E

HP 85723A DECT Measurement Personality

The HP 85723A adds the key DECT measurements to the HP 8590 E-series spectrum analyzers. Option 012 on the spectrum analyzer adds a built-in DECT source which can be used as a stimulus for module testing or sensitivity measurements. The DECT demodulator Option 112 on the analyzer gives the capability to demodulate and analyze GFSK data in the DECT burst.

Measurements

- Carrier power
- Power versus time
- Center frequency
- Frequency deviation
- Adjacent channel power
- Spurious emissions
- Intermodulation attenuation

Recommended Configuration

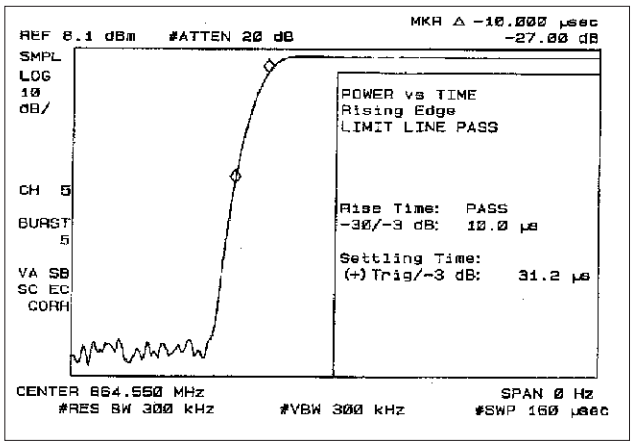
HP 85723A DECT Measurements Personality and
HP 8594E, HP 8595E, HP 8596E, or HP 8593E Portable Spectrum Analyzer with the following options:

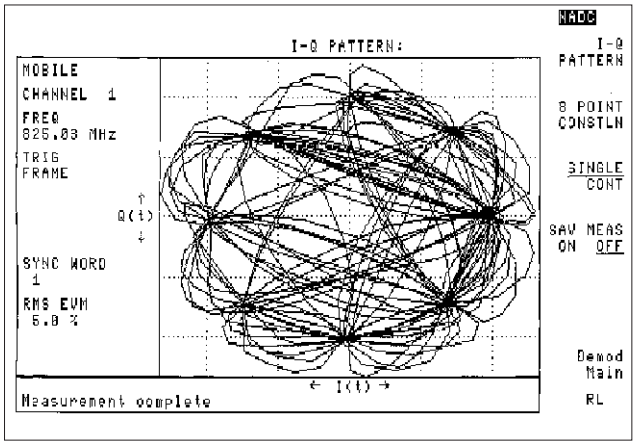
Opt 004 Precision Frequency Reference
Opt 012 DECT Source
Opt 101 Fast Time-Domain Sweeps
Opt 105 Time-Gated Spectrum Analysis
Opt 112 DECT Demodulator Card

Or as an ordering convenience, the spectrum analyzer may be ordered with Option E67 which contains the options listed above.

Key Literature

HP 8590 E-Series DECT Measurement Solutions Technical Data, p/n 5091-7761E





HP 85717A CT2-CAI Measurement Personality

The HP 85717A simplifies I-ETS 300-131 and MPT 1375 RF transmitter testing of second-generation cordless telephones with common air interface (CT2-CAI). All of the required transmitter tests are provided by the personality for both cordless fixed parts (bases) and cordless portable parts (handsets). Added flexibility allows you to define your own custom channel tuning plan and band edge frequencies, as well as set up spurious emissions parameters for your particular needs.

Measurements

- Mean carrier power
- Carrier-off power
- Adjacent channel power
- Out-of-band power
- Spurious emissions
- Intermodulation attenuation
- Frequency error and deviation

Recommended Configuration

HP 85717A Measurements Personality
and
HP 8591E, HP 8594E, HP 8595E, HP 8596E, or HP 8593E Portable Spectrum Analyzer with the following options:

Opt 004 Precision Frequency Reference
Opt 101 Fast Time-Domain Sweeps
Opt 105 Time-Gated Spectrum Analysis

For Frequency Error and Frequency Deviation Measurements also order:

Opt 110 CT2 Demodulator Card
or
HP 53310A Modulation Domain Analyzer (requires Option 041 GPIB interface on the spectrum analyzer)

For Improved Amplitude Accuracy in the CT2-CAI Band Order:

Opt 010 Built-In Tracking Generator
HP 437B Power Meter
HP 8481A or 8482A Power Sensor
HP 8491A/B Opt 006 6 dB Fixed Attenuator

Key Literature

HP 85717A CT2-CAI Measurements Personality, p/n 5091-2986E

Ordering Information

More information about the HP 8590 E-series spectrum analyzers and all analyzer options, including ordering information, can be found on pages 231 to 235.

HP 85718B NADC-TDMA Measurement Personality

Based on the complete set of transmitter measurements required by EIA/TIA IS-54-B, -55-A, and -56-A standards, the HP 85718B provides tests for North American Dual-mode Cellular (NADC) time-division multiple-access radio systems. NADC-based PCS measurements at 1900 MHz (IS-136 standard) can also be made with the HP 85718B. The push of a button allows you to select between IS-54 800 MHz, IS-136 800 MHz, and IS-136 1900 MHz tuning plans.

Measurements

- Carrier power and carrier-off power
- Channel power
- Occupied bandwidth
- Adjacent and alternate channel power leakage
- Attack and release time
- Intermodulation spurious
- Power steps

Modulation Accuracy Measurements

- RMS error vector magnitude (EVM) and peak EVM
- RMS magnitude error and phase error
- Carrier frequency error
- Amplitude droop
- I-Q origin offset

Recommended Configuration

HP 85718B Measurements Personality
and
HP 8594E, HP 8595E, HP 8596E, or HP 8593E Portable Spectrum Analyzer with the following options:

With Modulation Accuracy Measurements

Opt 004 Precision Frequency Reference
Opt 050 Improved Accuracy for NADC Cellular and PCS Bands
Opt 105 Time-Gated Spectrum Analysis (mobiles only)
Opt 151 Fast ADC and Digital Demodulator
Opt 160 PDC/PHS/NADC/CDMA Firmware for Option 151

Without Modulation Accuracy Measurements

Omit **Opt 151 and 160**
Add **Opt 101** Fast Time-Domain Sweeps (mobiles only)

Note: In a configuration without modulation accuracy measurements, the HP 8591E is also supported.

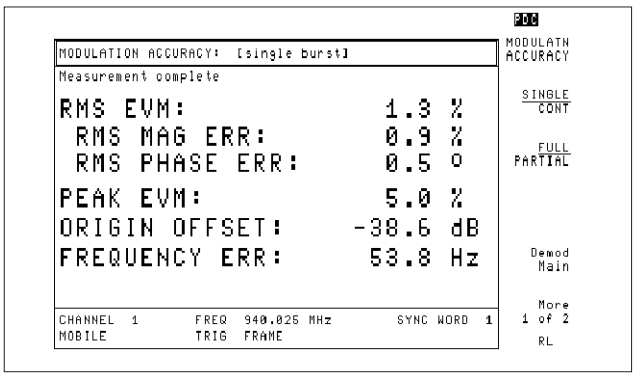
Key Literature

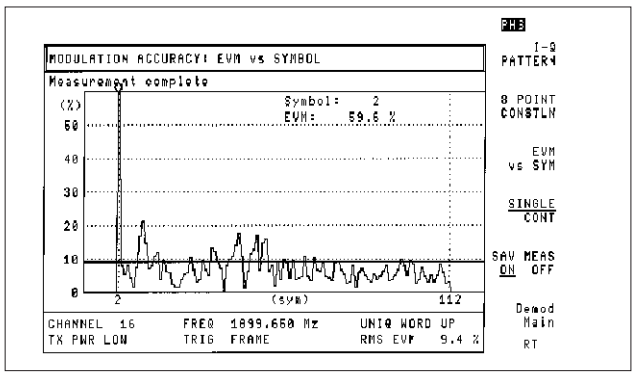
Portable NADC-TDMA Transmitter Tester, p/n 5962-6217E

Ordering Information

More information about the HP 8590 E-series spectrum analyzers and all analyzer options, including ordering information, can be found on pages 231 to 235.

HP 85720C
HP 85726B





HP 85720C PDC Measurement Personality

The HP 85720C provides transmitter measurements for Personal Digital Cellular (PDC) time-division multiple-access radio systems. This personality provides tests that are customized based on the RCR STD-27C standard for both high and low PDC frequency bands. Also the HP 85720C test times have been reduced by up to 30 percent as compared to the HP 85720B.

7

Measurements

- Antenna power
- Carrier-off leakage power
- Channel power
- Occupied bandwidth
- Adjacent channel power leakage
- Burst ramp-up and ramp-down power vs. time
- Transmitter intermodulation
- Spurious emissions
- Power step

Modulation Accuracy Measurements

- RMS error vector magnitude (EVM) and peak EVM
- RMS magnitude error and phase error
- I-Q origin offset
- Carrier frequency error

Recommended Configuration

HP 85720C PDC Measurements Personality
and
HP 8594E, HP 8595E, HP 8596E, or HP 8593E Portable Spectrum Analyzer with the following options:
With Modulation Accuracy Measurements
Opt 004 Precision Frequency Reference
Opt 051 Improved Accuracy for PDC Bands
Opt 105 Time-Gated Spectrum Analysis (mobiles only)
Opt 151 DSP, Fast ADC, and Digital Demodulator
Opt 160 PDC/PHS/NADC/CDMA Firmware for Option 151
Without Modulation Accuracy Measurements
Omit **Opts 151 and 160**
Add **Opt 101** Fast Time-Domain Sweeps (mobiles only)
Note: In a configuration without modulation accuracy measurements, the HP 8591E is also supported.

Key Literature

Portable PDC Transmitter Tester, p/n 5963-9971E

HP 85726B PHS Measurement Personality

The HP 85726B measurement personality provides transmitter tests for Personal Handy Phone System (PHS) radios based on the RCR STD-28 standard. Most tests are also based on the methods of measurement called out by the MKK. In addition to modulation accuracy measurements, this personality has reduced test times by up to 50 percent as compared to the HP 85726A.

Measurements

- Antenna power
- Adjacent channel power
- Burst ramp-up and ramp-down power vs. time
- Carrier-off time leakage power
- Spurious emission
- Occupied bandwidth

Modulation Accuracy Measurements

- RMS error vector magnitude (EVM) and peak EVM
- EVM vs. symbol
- RMS magnitude and phase error
- I-Q origin offset
- Carrier frequency error

Recommended Configuration

HP 85726B PHS Measurements Personality
and
HP 8594E, HP 8595E, HP 8596E, or HP 8593E Portable Spectrum Analyzer with the following options:
With Modulation Accuracy Measurements
Opt 004 Precision Frequency Reference
Opt 052 Improved Amplitude Accuracy for PHS Band
Opt 105 Time-Gated Spectrum Analysis
Opt 151 DSP, Fast ADC, and Digital Demodulator
Opt 160 PDC/PHS/NADC/DCMA Firmware for Option 151
Without Modulation Accuracy Measurements
Omit **Opts 151 and 160**
Add **Opt 101** Fast Time-Domain Sweeps

Key Literature

Portable PHS Transmitter Tester, p/n 5964-0110E

- Accurate, automated ACP measurements on TDMA and TDD signals
- Measure according to NADC-TDMA, PDC, PHS, and other standards
- Measurement accelerators speed up ACP testing
- Carrier on/off power
- Total channel power, percent occupied bandwidth
- Burst-timing measurements

HP 8561EC

Accurate and Easy-to-Use Power Measurements Using the HP 8560 EC-Series Spectrum Analyzers

Many wireless communications systems today employ burst-carrier techniques such as time-division multiple access (TDMA) and time-division duplex (TDD) to maximize system capacity. The HP 8560 EC-series spectrum analyzers offer power measurements for both continuous and burst signals that are accurate, and easy to make. Measurement capability includes adjacent channel power (ACP), carrier power, channel power, and occupied bandwidth. These analyzers provide the greatest measurement flexibility and RF performance, making them powerful tools for R&D designers working with current wireless standards, or on systems with standards still under development.

The HP 8562EC Spectrum Analyzer

The HP 8562EC Spectrum Analyzer was designed specifically for digital comms. Its frequency coverage of 13.2 GHz means that now you can use the same analyzer for harmonic and spurious testing both in- and out-of-band. The increased dynamic range and third-order intercept (TOI) capability allows wireless communications engineers to test high-performance components in burst operation systems. See pages 230 to 236 for details.

Measurement Utility Increases Speed and Repeatability

The HP 85672A Spurious Response Measurements Utility makes measurements fast and easy with the touch of a button. Works on all HP 8560 EC-Series spectrum analyzers. See page 245 for details.

Adjacent Channel Power

The ability to measure ACP on today's wireless telephones, pagers, and other transmitters is critical in R&D, manufacturing and in the field. The HP 8560 EC-series spectrum analyzers provide ACP measurements for a variety of wireless communication systems, including support for NADC-TDMA, PDC, and PHS digital formats. Many of the implementation difficulties of the established standards have been addressed, providing fast, accurate, and easy-to-use ACP measurements. Use an HP 8560 EC-Series spectrum analyzer with the HP 8563EC Option E35 APCR test set to meet the needs of the emerging W-CDMA specifications.

In addition to the standard analog method for making ACP measurements (used for FM mobile telephones and continuous digital formats), the analyzers support four other methods used for burst-carrier measurements of TDMA and TDD signals:

- Peak (for PDC and PHS)
- Two-bandwidth (for PDC)
- Time-gated (for NADC-TDMA)
- Burst-power (an HP proprietary method)

The burst-power method overcomes many of the problems of the other standards, and is suitable for all formats. These methods can easily be adapted to measure other transmitters besides those used for cellular or cordless telephones. Configuration parameters that can be set by the user include channel spacing and bandwidth, number of alternate channels, burst period and width, and values for root-raised-cosine frequency weighting. Measurement results can be displayed in both graphic and tabular formats for ease of data interpretation and documentation. Measurement accelerators are available that give ACP results in just a few seconds, allowing real-time transmitter adjustments.

METHOD: ANALOG PEAK 2BW BURSTPWR **GATE**			METHODS
ACCELERATOR:	**NORMAL**	FASTEST	ACCELERAT
(ERROR:	0dB	<2dB)	
CHANNEL SPACING:	30.00kHZ		SPACING/
CHANNEL BANDWIDTH:	33.00kHZ		BANDWIDTH
ALTERNATE CHANNELS:	2		
BURST PERIOD:	20.0ms		BURST/
BURST WIDTH:	6.53ms		WEIGHTING
FREQ WEIGHTING:	**ROOT-RAISED-COS**	OFF	ACPSTATE
WEIGHTING T :	41.0 us		DFL CURR
WEIGHTING :	.350		
MEASUREMENT STATE:	**DEFAULT**	CURRENT	PREV MENU

Setup menu for adjacent channel power measurements

Carrier Power

The carrier power feature provides the user with a quick means of measuring the average "on" and "off" power of the burst carrier. This measurement is performed in the time domain, using zero span.

Channel Power

The channel-power feature quickly provides the user with information on total power within a specified channel bandwidth, as well as power density within the channel. This feature greatly simplifies this common measurement, as the spectrum analyzer automatically performs the necessary integration across the desired frequency band.

Occupied Bandwidth

Occupied bandwidth is a way of determining the spectral spread of a signal. It is defined as the bandwidth which contains the specified percent of the total transmitted power. The user may specify the percentage to be anywhere from 0.1 to 99.99 percent.

Burst Timing

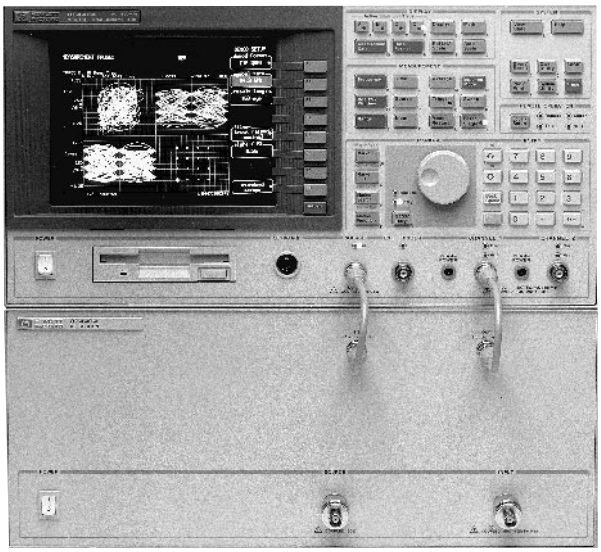
Complete timing measurements can be made on the burst-carrier signal using digitized, fast time-domain (zero span) sweeps. Using sweep times as fast as 50 µs, edge times, burst width, and time between bursts can easily be measured.

More Information

More information about the HP 8560 EC-series spectrum analyzers, including ordering information, can be found on pages 236 to 239.

HP 89441B
HP 89410B
HP 89441V
HP 89411A
HP 89450A
HP 89451A

- Unequalled digital modulation troubleshooting tools
- Advanced time- and frequency-domain analysis
- EDGE, WCDMA, and many others (optional) NEW
- Statistical power measurements, including CCDF NEW
- Direct burst-carrier settling analysis
- Adaptive equalization removes linear distortion (optional)



HP 89441A

HP 89441A DC to 2.65 GHz Vector Signal Analyzer

GPIB

A Signal Analyzer for Communications Designers

Designers of communications systems can now spend their time verifying and improving their designs rather than creating specialized testing tools for each component, new signal, or modulation type. Using vector-signal analysis and advanced DSP techniques, signals that formerly required much time and effort to measure can be viewed with ease.

The HP 89441A offers many types of measurements for characterizing performance or locating problems throughout the block diagrams of transmitters and receivers—from baseband to RF stages. Analyze burst, transient, or modulated signals with simultaneous views of time, frequency, phase, and amplitude. Using this flexibility, measurements such as LO stability, phase noise, and transient characteristics are direct, easy, and reduce the overall amount of required test equipment.

Adaptive Equalization

Adaptive equalization works with digital demodulation to remove linear errors, such as frequency response and reflections, from transmitted signals. This allows measurements in some impaired channels and can be used to isolate linear vs. non-linear error mechanisms. For more information, see page 251.

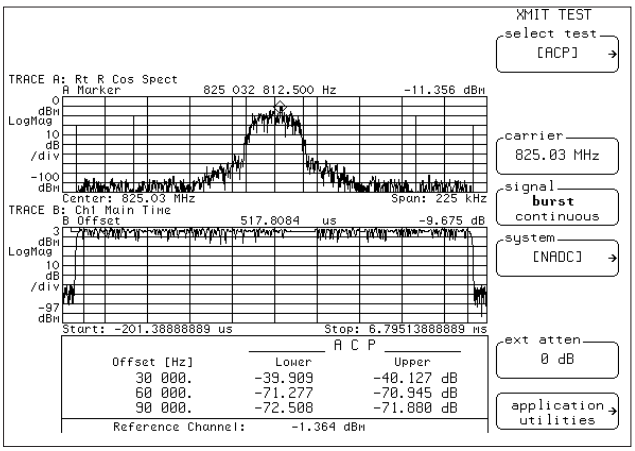
Flexible Vector-Modulation Analysis

Measurements of RF or IF signals are simplified since no external filters, coherent carriers or symbol-timing signals are required. Baseband I and Q signals can also be analyzed simultaneously with the optional second 10 MHz input channel. Modulation including BPSK, QPSK, Offset QPSK, DQPSK, π/4DQPSK, 8PSK, 16-256QAM, VSB, MSK, and 2- to 4-level FSK are supported. Various filter types with adjustable parameters and user-defined filters, in addition to burst length, symbol rate, and carrier frequency can all be selected by the user. To simplify measurements, the parameters for systems such as CDMA, GSM, NADC, PDC, PHS, DECT, and CDPD can be set with a single button.

Measurement results can be displayed in various formats and tables. Constellation, vector, and eye diagrams provide familiar tools for analyzing vector-modulated signals. Detected data tables display the received binary bits and show results of modulation quality including amplitude droop and quadrature error. The vector-modulation analysis option also offers error measurements by generating an ideal reference signal to compare to the received signal. Results include error vector magnitude, phase error, and magnitude error.

Radio Test Personality

The HP 89451A personality adds "one-button" measurements to quickly set up and test NADC, PDC, PHS, and user-defined systems. Occupied bandwidth, adjacent channel power, modulation accuracy, and frequency tolerance are included in the suite of measurements that can be made on burst or continuous signals. Accuracy required for R&D applications, ease-of-use, and measurement speed are all provided as well as the flexibility to change any of the demodulation parameters or access any of the HP 89441A measurement modes to troubleshoot difficult system problems.



Specialized display from the HP 89451A Radio Test Personality

Support New Generation Modulation Formats

The new option B7A adds EDGE demodulation and measurements to Option AYA at RF, IF and baseband. Composite frames containing EDGE and GSM burst can be analyzed together or separately in the frequency domain (spectrum) or time domain (burst envelope). IF triggering, flexible averaging, gated sweep and band power markers provide all the measurements needed to characterize a signal, system or component.

New option B79 allows CDP measurements and more on W-CDMA systems including the ARIB 1.0-1.2 and the experimental system in Japan. View the code power for all code layers and symbol rates on a single composite display. The HP 89441A measures 4 Mchips/second, while using the HP 89410A with other downconverters allows measurements on 8-16 Mchips/second systems. You can isolate a single code channel for modulation analysis, view the power versus time in a selected code channel, as well as use standard HP 89400 digital modulation troubleshooting tools.

CAE Simulator Link for Connected Design

Testing "concurrently designed" systems typically requires waiting for an entire system to be physically prototyped and its subsystems assembled. The HP 89441A analyzer in conjunction with HP Advanced Design System reduce overall system development time by emulating signals that the hardware will actually generate—but, before the hardware exists. The built-in arbitrary source can provide this emulated signal as stimulus to subsequent sections of the system that have been completed. Also, real-world measurement results can be used in system simulations prior to prototyping. Compatible data formats in Advanced Design System and the HP 89441A links theory to reality, lowering system development time barriers.

Solutions for Microwave Frequency Coverage

The HP 89441A is a complete solution for characterizing systems up to 2.65 GHz. To extend the vector-signal analysis capabilities to higher frequencies, the HP 89410A, 89411A, plus an external spectrum analyzer provide microwave coverage.

See page 250 for more detailed descriptions, specifications, and complete vector-signal analyzer ordering information.

For more information, visit our web site: **http://www.hp.com/go/89400**

HP E4430B
HP E4431B
HP E4432B
HP E4433B
HP E4434B
HP E4435B
HP E4436B
HP E4437B

- Built-in digital modulation formats for W-CDMA, cdma2000, EDGE, CDMA, DECT, GSM, NADC, PDC, PHS and TETRA
- <1% rms EVM for NADC, PDC, PHS, TETRA
- 0.75° rms global phase error for GSM
- First alternate channel power for NADC of –80 dBc (typical)
- Rho of 0.996 (typical) for CDMA signals

HP ESG-D Series E4433B

Meet Complex Digital Requirements Using the HP ESG-D and HP ESG-DP Series of Digital Signal Generators

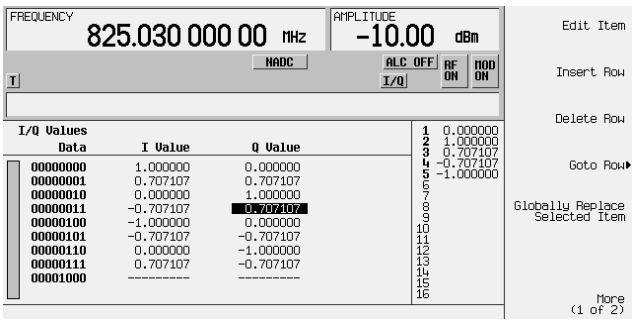
GPIB

The HP ESG-D and HP ESG-DP series of digital RF signal generators are ideal for testing in a variety of wireless communication applications. Digital receivers or their components can efficiently be tested with the digital modulation capabilities of an ESG-D and HP ESG-DP series with options. These options provide standard TDMA signals such as DECT, EDGE, GSM, NADC, PDC, PHS, TETRA and the flexibility to create variations of these standards or proprietary modulations. Test W-CDMA, cdma2000 and CDMA base station and mobile components by generating single or multiple Walsh coded channels. All these digital modulations are easily configured with the use of the table editor feature.

Custom Modulation

The ESG-D and ESG-DP series has two optional implementations of baseband generators to meet any digital modulated signal requirements.

Option UN8, real-time I/Q baseband generator, provides internal symbol generation via a custom ASIC. Choose from MSK, PSK, QAM and FSK modulation signals, Gaussian, root Nyquist, Nyquist filters, data types and symbol rates to build proprietary or unique digitally modulated signals. Achieve maximum flexibility by defining the required modulation in an I/Q table and required filtering with FIR coefficients.

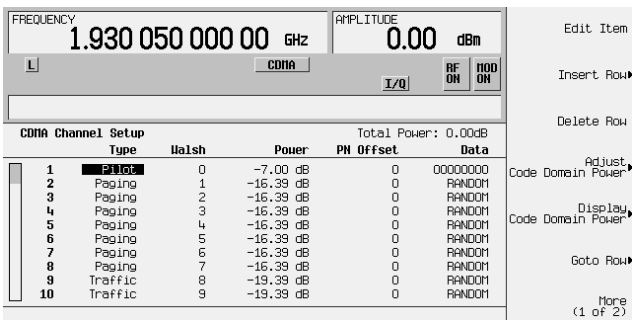


I/Q Table Editor

Option UND is an internal dual arbitrary waveform generator. Any mathematically generated digitally modulated signal can be replayed. The dual arb has high signal fidelity (14 bit DACs) and deep memory (1 Msample/channel non-volatileRAM) for replaying complex waveforms.

CDMA and W-CDMA Personalities

Several CDMA, cdma2000 and W-CDMA personalities extend the power of the optional baseband generators. These options generate single or multiple coded channels to test mobile and base-station components and receivers.



CDMA Table Editor

TDMA Standards

DECT, GSM, EDGE, PDC, PHS, NADC, TETRA standards are included with Option UN8. These standards include easy to configure frames and timeslots. Each timeslot within a frame can be configured independently to simulate different types of traffic, control or synchronization channels (or bursts). Modify the digitally modulated signals by changing filter factor, data or data rate to fully characterize components and systems.

High Spectral Purity

The ESG-D and ESG-DP series signal generators are an excellent choice for adjacent channel selectivity measurements of digital receivers. By providing low SSB phase noise at wide offsets, you can measure out-of-channel characteristics of digital receivers with high spectral purity performance. Spectral purity is maintained even when the modulators are on.

More Information

More information about the HP ESG (analog) and HP ESG-D (digital and analog) series signal generators, including ordering information, can be found on pages 190 and 196, or visit our web site:
http://www.hp.com/go/esg

Audio Analyzer, 20 Hz to 100 kHz; Distortion Analyzer, 20 Hz to 100 kHz

HP 8903B
HP 8903E

- Measures distortion, SINAD, signal-to-noise
- Measures true-rms ac volts, dc volts, frequency
- Low-distortion programmable source
- rms, average, and quasi-peak detection

HP 8903B

- Measures distortion, SINAD
- Measures true-rms ac volts, dc volts, frequency
- rms, average, and quasi-peak detection

HP 8903E

HP 8903B Audio Analyzer and HP 8903E Distortion Analyzer

GPIB

The HP 8903B audio analyzer and HP 8903E distortion analyzer provide unparalleled versatility and performance for audio measurements from 20 Hz to 100 kHz. The HP 8903B combines the functionality of a low-distortion audio source, high-performance distortion analyzer, frequency counter, ac voltmeter, dc voltmeter, and SINAD meter into one compact package. With microprocessor control of source and analyzer, the HP 8903B can perform stimulus-response measurements, such as signal-to-noise ratio and swept distortion, automatically, with no additional equipment. The HP 8903E distortion analyzer is the analyzer portion of the HP 8903B audio analyzer. (The HP 8903E has no source.)

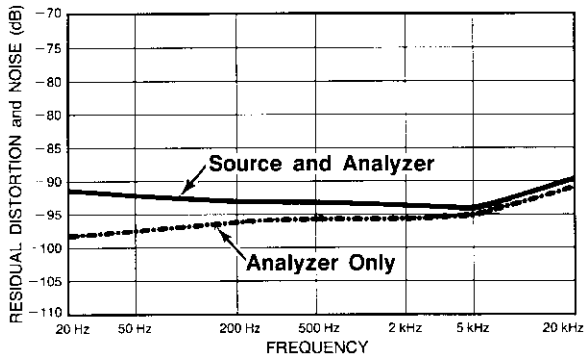
For ease of use, most measurements on the HP 8903B and HP 8903E are made with only one or two keystrokes. Both instruments automatically tune and autorange for maximum accuracy and resolution. For quick identification of input signals, the analyzer counts and displays the input frequency in all ac measurement modes.

Low-Frequency Applications

The HP 8903B/E have many features that make difficult audio measurements easy. These include flexible data display formats, a selectable balanced or unbalanced input, plug-in filters, and automatic notch filter tuning. With the ratio key, you can establish a reference in % or dB and directly make frequency-response and 3 dB bandwidth measurements without computation. A fully balanced analyzer input allows testing of the bridged power amplifiers found in many radios and car stereos, as well as professional balanced audio equipment.

With 2 internal plug-in filter slots and 6 optional filters to choose from, we simplify your audio measurements by providing the filter networks required by international standards. (See the next page for a complete list of filters.) The HP 8903B and HP 8903E both use true-rms detection (for all signals with crest factor 3) for accurate measurement of complex waveforms and noise. Average and quasi-peak detectors are also available. (Quasi-peak is selectable only via GPIB on the HP 8903E.) Accurate distortion measurements typically can be made down to less than –90 dB (0.003%) from 20 Hz to 20 kHz.

For receiver testing, both instruments have a tunable SINAD notch filter. On the HP 8903B, the filter is automatically tuned to the source frequency. With the HP 8903E, a front-panel key allows the operator to lock the notch filter at any given input frequency.



Typical residual THD + noise for source and analyzer combined (source voltage set to 1.5 V, 80 kHz BW). Dashed line represents typical residual THD + noise for the analyzer only.

HP 8903B and HP 8903E Specifications

System Specifications (HP 8903B only, source and analyzer combined)

Distortion
Residual Distortion and Noise (the higher of):
80 kHz BW: –80 dB (0.01%) or 17 μV, 20 Hz to 20 kHz
500 kHz BW: –70 dB (0.032%) or 50 μV, 20 Hz to 50 kHz; –65 dB (0.056%) or 50 μV, 50 kHz to 100 kHz
Signal-to-Noise
Frequency Range: 50 Hz to 100 kHz
Display Range: 0 to 99.99 dB
Accuracy: ±1 dB
Input Voltage Range: 50 mV to 300 V
Residual Noise (the higher of): –85 dB or 17 µV, 80 kHz BW; –70 dB or 50 μV, 500 kHz BW

Source Specifications (HP 8903B only)

Frequency
Range: 20 Hz to 100 kHz
Resolution: 0.3%
Accuracy: 0.3% of setting

Output Level
Range: 0.6 mV to 6 V open circuit
Resolution: 0.3% or better
Accuracy (open circuit): 2% of setting 60 mV to 6 V, 20 Hz to 50 kHz; 3% of setting 6 mV to 6 V, 20 Hz to 100 kHz; 5% of setting 0.6 to 6 mV, 20 Hz to 100 kHz
Flatness (1 kHz reference): ±0.7% (±0.06 dB), 20 Hz to 20 kHz; ±2.5% (±0.22 dB), 20 Hz to 100 kHz
Distortion and Noise (the higher of):
80 kHz BW: –80 dB (0.01%) or 15 μV, 20 Hz to 20 kHz
500 kHz BW: –70 dB (0.032%) or 38 μV, 20 Hz to 50 kHz; –65 dB (0.056%) or 38 μV, 50 to 100 kHz
Impedance: 600 Ω ±1% or 50 Ω ±2%, front-panel selectable (GPIB programmable)
Sweep Mode: Log sweep with up to 500 points per decade or 255 points total between entered start and stop frequencies

HP 8903B
HP 8903E

Analyzer Specifications (Both HP 8903B and HP 8903E)

Distortion
Fundamental Frequency Range: 20 Hz to 100 kHz
Display Range: 0.001% to 100% (–99.99 to 0 dB)
Accuracy: ±1 dB, 20 Hz to 20 kHz; ±2 dB, 20 Hz to 100 kHz
Input Voltage Range: 50 mV to 300V
Residual Distortion and Noise (the higher of):
80 kHz BW: –80 dB (0.01%) or 15 μV, 20 Hz to 20 kHz
500 kHz BW: –70 dB (0.032%) or 45 μV, 20 Hz to 50 kHz; –65 dB (0.056%) or 45 μV, 50 kHz to 100 kHz
Supplemental Characteristics
3 dB Measurement Bandwidth: 10 Hz to 500 kHz
Detection: True-rms or rms-calibrated average

SINAD
Fundamental Frequency Range: 20 Hz to 100 kHz
Display Range: 0 to 99.99 dB
Residual Distortion and Noise: Same as listed under Distortion
Accuracy: ±1 dB, 20 Hz to 20 kHz; ±2 dB, 20 to 100 kHz
Input Voltage Range: 50 mV to 300 V
Supplemental Characteristics
Detection: True rms or rms-calibrated average
Tuning: HP 8903B: Notch filter is tuned to the internal source frequency. HP 8903E: Notch filter is tuned to the counted input frequency. Notch filter hold function available on front panel.

AC Level
Full Range Display: 300 V, 30 V, 3 V, 0.3 V, 30 mV, 3 mV, 0.3 mV
Overrange: 33%, except on 300 V range
Accuracy: ±2%, 50 mV to 300 V, 20 Hz to 20 kHz; ±4%, 0.3 to 50 mV, 20 Hz to 100 kHz; ±4%, 50 mV to 300 V, 20 to 100 kHz
Supplemental Characteristics
AC Converter: True-rms responding for signals with crest factor up to 3, rms-calibrated average detection and quasi-peak
3 dB Measurement Bandwidth: >500 kHz

DC Level
Full Range Display: 300 V, 48 V, 16 V, 4 V
Overrange: 33%, except on 300 V range
Accuracy: ±1.0% of reading, 600 mV to 300 V; ±6 mV, V_{in} 600 mV

Frequency Measurement
Measurement Range: 20 Hz to 150 kHz (20 Hz to 100 kHz in distortion and SINAD modes)
Resolution: 5 digits (0.01 Hz for input frequencies <100 Hz)
Accuracy: ±(0.004% + 1 digit)
Sensitivity: 50 mV in distortion and SINAD modes, 5.0 mV in ac level and signal-to-noise (HP 8903B only) modes

Standard Audio Filters
30 kHz Low-Pass Filter
3 dB Cutoff Frequency: 30 kHz ±2 kHz
Rolloff: Third-order Butterworth; 18 dB/octave or 60 dB/decade
80 kHz Low-Pass Filter
3 dB Cutoff Frequency: 80 kHz ±4 kHz
Rolloff: Third-order Butterworth; 18 dB/octave or 60 dB/decade
Internal Plug-In Filter Options
Both the HP 8903B and HP 8903E have two internal plug-in filter slots, each of which will accept one of 6 optional filters. The standard HP 8903B/E come with 30 kHz and 80 kHz low-pass filters, but with no plug-in filters. The appropriate filter options must be ordered for the analyzers to have any of the filters listed below. Each filter option has two option numbers: the 010 series for the left filter slot and the 050 series for the right filter slot. Each filter option ordered (maximum of two) adds additional cost to the instrument.

Filters	Option Numbers Filter Position Left slot	Right slot
400 Hz High-Pass	010	050
CCITT Weighting Filter	011	051
CCIR Weighting Filter	012	052
C-MESSAGE Weighting Filter	013	053
CCIR/ARM Weighting Filter	014	054
"A" Weighting Filter	015	055

Analyzer Input
Input Type: Balanced (full differential)
Input Impedance: 100 kΩ ±1% shunted by <300 pF, each side to ground. (In dc-level mode the input resistance is 101 kΩ ±1%.)
Max. Input (maximum peak input voltage, any combination of ac/dc):
HP 8903B: 425 V peak, applied differentially or between either input to ground
HP 8903E: 42 V peak, low side to ground
425 V peak, differentially or high side to ground
CMRR: >60 dB, 20 Hz to 1 kHz, Vin <2 V; >45 dB, 20 Hz to 1 kHz; >30 dB, 20 Hz to 20 kHz

General
Temperature: Operating, 0° to 55° C; storage, –55° to 75° C
Power: 100, 120, 220, or 240 V (+5, –10%); 48 to 66 Hz; 100 or 120 V (+5, –10%); 48 to 440 Hz; 100 VA maximum
Size: 425 mm W x 146 mm H x 462 mm D (16.8 in x 5.75 in x 18.2 in)
Weight: HP 8903B: Net, 12.3 kg (27 lb); shipping, 16.4 kg (36 lb); HP 8903E: Net, 11.8 kg (26 lb); shipping, 15.9 kg (35 lb)

Key Literature

HP 8903B Technical Specifications, p/n 5953-8243

Ordering Information

Analyzer Mainframes
HP 8903B Audio Analyzer[1]
Opt 001 Input/Output Connectors on Rear Panel Only
Opt 910 Two sets of Operation/Calibration (08903-90079) and Service Manuals (08903-90062)
Opt 915 Service Manual (08903-90062)
Opt W30 Extended Repair Service
Opt W32 Calibration Service
HP 8903E Distortion Analyzer[1]
Opt 001 Input/Output Connectors on Rear Panel Only
Opt 910 Additional Operation and Calibration Manual (08903-90053) and Two Service Manuals (08903-90065)
Opt 915 Add Service Manual (08903-90065)
Opt W30 Extended Repair Service
Opt W32 Calibration Service
Options for both HP 8903B and HP 8903E
Opt 010 or 050 400 Hz High-Pass Filter
Opt 011 or 051 CCITT Weighting Filter
Opt 012 or 052 CCIR Weighting Filter
Opt 013 or 053 C-Message Weighting Filter
Opt 014 or 054 CCIR/ARM Weighting Filter
Opt 015 or 055 "A" Weighting Filter
Opt 907 Front Handle Kit (5061-9689)
Opt 908 Rack Flange Kit (5061-9677)
Opt 909 Rack Flange Kit (5061-9683) with Front Handles

[1]GPIB cables not included.

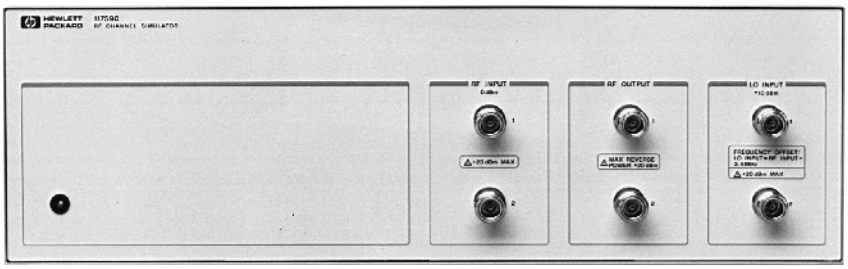
Indicates QuickShip availability.

7

RF Channel Simulator, 40 to 2700 MHz

HP 11759C

- Simulates realistic signal propagation for CDMA, NADC (TDMA or E-TDMA), GSM, PDC, DCS1800, PHS, and more
- Rayleigh, Rice, or Log-normal fading
- RF bandwidth >6.0 MHz
- Doppler to 425 Hz
- Delay intervals to 186 µ in 1 ns steps
- PC controlled



HP 11759C

HP 11759C RF Channel Simulator

The HP 11759C RF channel simulator has all the features and performance characteristics that make it ideally suited for testing digital cellular radios under RF multipath conditions. Whether the radio is designed for operation with the CDMA (Option H30), GSM, NADC, DCS1800 or PDC cellular systems, it is easy to simulate the fast and slow fading, time dispersion and Dopplers experienced in the mobile radio environment. The HP 11759C is also suitable for testing many other analog and digital wireless communications systems with RF bandwidths to 6.0 MHz under multipath fading conditions.

The HP 11759C consists of the applications software and the RF processing hardware. To complete the RF multipath simulation system, two user-supplied components are necessary—a PC acting as a user-interface and a synthesized LO used to determine the RF operating frequency and to supply a 10 MHz clock signal.

Two Multipath Channels Provide Test Flexibility

The HP 11759C contains two independent 40 MHz to 2700 MHz RF channels of three paths each. Each path can be Doppler-shifted or Rayleigh or Log-normal faded, delayed and attenuated relative to the others. In addition, under Rayleigh fading conditions, the correlation factor for path pairs in the two channels is adjustable from 0 to 1.

For test applications requiring more paths per channel (e.g., GSM or DCS1800), the HP 11759C Option 001 configures the HP 11759C as one channel of six paths. By pairing two HP 11759C Option 001 units and controlling them from a single PC, the full 12-ray testing requirements of the GSM and DCS1800 systems can easily be accomplished. And, to make it even easier, the 12- and 6-ray propagation models are pre-stored in memory for easy recall and setup.

With an external power divider and/or power combiner, and two separate channels available, it is easy to configure the HP 11759C(s) for single-channel 6 (or 12) path tests, co-channel interferer tests, adjacent and alternate channel tests, and space and/or frequency diversity tests. This flexibility is particularly important during the radio R&D phase and also important for manufacturing test and type acceptance testing.

Easy to Use Manually or Remotely

Simple-to-use onscreen menus guide the user through the task of creating complex RF multipath signals for testing a mobile or base station radio. These same menus are accessed remotely by installing a GPIB interface card in the PC.

HP 11759C Partial Specifications

See Technical Data Sheet for complete specifications.

RF Channel Specifications

Independent RF Channels: 2 of 3 paths each
(1 of 6 paths with Option 001)
RF Input/Output Frequency Range: 40 to 2700 MHz
RF Bandwidth (1 dB): >6.0 MHz typically
Path Insertion Loss: Typically 24 dB ±3 dB
LO Input Frequency Range: RF input frequency less 6 MHz

Channel Simulation Specifications

Number of Independent Paths per Channel: 3 (6, Option 001)
Independent Rayleigh (Classical) fading, Delay, Doppler and level available on each path
Path Attenuation Range: 0 to 50 dB, in 0.1 dB steps
Path Delay Interval Range: 0 to 186 µs, in 1.0 ns steps
(Delays to 1.48 ms are available by special order)
Simulated Vehicle Speed Range (at 900 MHz): 0 to ±509 km/h
Simulated Doppler Range: 0 to ±425 Hz
Rayleigh (Classical) Amplitude Distribution: Available on all paths for vehicle speeds from 1 to 509 km/h (at 900 MHz)

Repetition Interval: >27 seconds
Deviation from Rayleigh CDF (typical):
<±1.0 dB from +10 to –20 dB relative to the mean power
<±3.0 dB from –20 to –30 dB relative to the mean power

Level Crossing Rate Accuracy (+10 to –30 dB of the mean power level):
Typically deviates from theoretical <±5% of the simulated Doppler
Remote Control: Available through optional GPIB interface card installed in user supplied PC controller

General

Operating Temperature Range: 0° to 55° C
Specifications Warranted: +15° to +35° C
Power: 90 to 132/190 to 264 V; 48 to 66 Hz; 325 VA maximum
Size: 425 mm W x 146 mm H x 620 mm D (16.8 in x 5.7 in x 24.4 in)
Weight: Net, 13.6 kg (30 lb); shipping, 19 kg (42 lb)

Ordering Information

HP 11759C RF Channel Simulator
Opt 001 One Channel of 6 Paths
Opt 002 Rear-Panel-Only RF Connectors
Opt 003 One Channel of 6 Paths with Rear-Panel-Only RF Connectors

- Wireless network optimization
- Site selection and evaluation
- Network performance characterization
- Troubleshooting
- Speed network turn-up
- Optimize network performance
- Maximize productivity
- Minimize drive test cost

HP E7473A
HP E7474A
HP E7475A
HP E7480A

NEW

HP E7473A with otpions 020 and 330.

Integrated RF and Call Performance Coverage

A critical measure of the quality of a wireless network is the performance of the air interface. Drive testing is critical to maintaining top network performance. In order to understand how well service is being delivered to subscribers you must characterize the performance of your network as a function of location.

The primary underlying factor that defines air interface performance is RF coverage. How well are the RF signals being propagated? Are there coverage holes? Is there intrasystem interference: CDMA pilot pollution, GSM co-channel interference, etc.? Is there external interference from signals outside of the network?

The measures of performance that a subscriber experiences are call-based parameters: dropped calls, blocked calls, poor voice quality, and failed terminations. Both call-based and RF parameters must be measured as a function of location in order to both characterize the performance and to understand the underlying cause of performance problems.

The HP E74xx family of air interface measurement tools provides a comprehensive, scaleable set of drive testing capabilities for wireless networks. All of the systems are based on the same easy-to-use graphical user interface. The software foundation automates the data collection process. The user has complete control over which measurements are logged – any or all. Sophisticated alarm capabilities notify the user of specific conditions.

CDMA Drive Test Solutions

The HP E7473A CDMA Drive Test System provides comprehensive characterization of the RF environment and call-based performance for CDMA networks in the PCS and cellular bands. Integration of RF coverage and service quality measurements delivers a complete solution for CDMA drive testing. The E7473A system combines Windows 95/98/NT software with CDMA mobile phone(s) and/or HP digital RF receiver(s). Software options provide phone-based, receiver-based or combined phone and receiver-based functionality. Receiver options are available for the cellular and PCS bands.

The receiver-based software interfaces with an HP digital RF receiver, or multiple receivers, to make RF measurements as a function of location. They measure the power (Ec, Io, and Ec/Io) of any or all pilot channel signals in IS-95 and J-STD-008 CDMA networks. All measurements are made independently from network parameter settings providing a completely objective view of the pilot signal environment. These systems also provide CW and channel power measurements for site evaluation/selection testing as well as spectrum display capability for diagnosis of RF problems.

The phone-based software interfaces with a CDMA mobile phone or multiple phones. Easy-to-use controls of phone functionality allow the user to characterize network performance parameters such as Frame Erasure Rate (FER), dropped call rate, and blocked call rate. The system displays rake receiver finger activity and pilot measurement information. Messaging information is displayed in a clear tree-oriented format, and the user has control over which sets of messages are displayed: paging, access, etc.

The combined phone and receiver-based software integrates phone and receiver functionality to deliver complete drive test capability. RF and call-based measurements are controlled from an integrated user interface. As the phone delivers critical performance indicators: dropped calls, blocked calls, etc., the receiver provides a complete characterization of the RF coverage. The phone indicates what the problem is (e.g., dropped call), and the receiver shows you why it occurred (e.g., neighbor list error). In other words, the phone provides the "What" and the receiver provides the "Why".

GSM 900/DCS 1800/GMS 1900 Systems

The HP E7475A GSM drive test system is a scalable integrated air interface measurement system, used to obtain comprehensive RF measurement and call performance data verus location. Depending on the selected hardware options it can make measurements on E-GSM900, DCS1800, GSM1900 or Dual-band GSM/DCS networks. Receiver based, phone based or combined measurement capabilities are selected via stackable software licenses that reside on a supplied software protection key.

HP E7473A
HP E7474A
HP E7475A
HP E7480A

The HP E7475A combines specially designed measurement receivers and test mobile phones with Windows95 (also Windows98 or Windows NT compatible) software. Extensive event alarm capabilities make it easy to identify potential problem areas and improves operator efficiency. An 'Export Wizard' enables ease of data transfer to post processing software applications.

With the receiver-based measurement software the HP E7475A can measure the power of all the channels in E-GSM (or DCS1800 or GSM1900) networks and can decode broadcast channel BSICs. Adjacent channel power and carrier to interference ratio measurements identify potential interference problems. The receivers can also make CW and channel power measurements for cell-site evaluation and selection testing. A spectrum-analyzer display eases general interference management and diagnosis of RF problems.

With the phone-based measurement software the HP E7475A can control up to four test mobile phones to characterize network performance parameters such as RxQual, RxLev and Frame Erasure Rate (FER). Call performance statistics such as number of drops and number of handovers can be enumerated. Layer III protocol-messaging information can be recorded and decoded in a clear tree-oriented format.

The receiver and phone-based measurements can reside simultaneously allowing synergy between the measurement devices. For example, the receiver can be set to track and measure parameters on the phone reported serving cell as it hands off during a drive. The phone delivers critical performance indicators; dropped calls, blocked calls, and the receiver provides a complete characterization of the RF coverage. Providing both call based and RF based measurements allows users to characterize the performance of their networks and understand the underlying causes of performance problems. The phone provides the "what" and the receiver provides the "why".

TDMA Drive Test Solutions

The HP E7474A TDMA Drive Test System provides comprehensive RF and call-based performance measurements for IS-136, IS-54 and AMPS wireless networks. The system integrates Windows95, 98, NT software with HP digital RF receivers and/or TDMA mobile phones. Receivers are available for the cellular and PCS frequency bands. The receiver makes the following TDMA measurements: channel analyzer-power of any user specified set of channels or all channels, adjacent channel interference–power of the upper and lower adjacent channels with respect to the serving channel. The receiver also makes spectrum measurements for interference detection and band clearing applications, and it makes CW and channel power measurements for site evaluation applications.

The E7474A software provides automated control of up to four TDMA handsets. Critical network performance parameters extracted from the handset(s): Bit Error Rate (BER), dropped calls, access failures, receive power, transmit power, etc. Decoded messaging information (Layer III) is displayed in a clear tree-oriented format, and the user has control over which messages are decoded (RACH, FDTC, RDTC, etc.).

Integrated CDMA, TDMA and GSM Testing

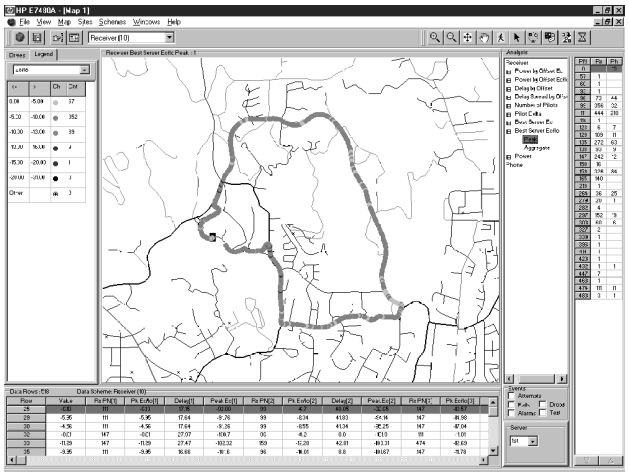
The HP E74xx family of drive test solutions can integrate CDMA, TDMA and GSM drive testing capability in one tool controlled from a single user interface. This provides a powerful solution for competitive analysis applications as well as providing a common platform for providers who need to manage networks using each technology.

Multiple Receiver Capability

The HP E7473A, E7474A and E7475A each includes one HP receiver as part of the system. Each of these systems can integrate up to four receivers controlled from a single interface. To add an additional receiver to a system simply order that receiver. The cables necessary for interconnection of the receivers are included.

Post Processing Software

The HP E7480A (CDMA) software package enable graphical views of integrated HP E74xx receiver and phone collection tool data. The graphical view and the easy to use graphical user interface (GUI) enable the user to utilize the full value of HP E74xx collection tool data, helping to solve problems faster.



Fast, flexible and easy-to-use post processing.

Selected Key Specifications

CDMA/TDMA Receivers

Frequency Range (PCS Band): 1850 to 1910 MHz; 1930 to 1990 MHz
Frequency Range (Cellular Band): 824 to 849 MHz; 869 to 894 MHz
Frequency Range (Japan Cellular Band): 832 to 870 MHz; 887 to 925 MHz
Frequency Range (Korea PCS Band): 1710 to 1785 MHz; 1805 to 1880 MHz
Frequency Accuracy: ± 1 ppm
w/GPS Time Synchronisation: ± 0.05 ppm characteristic
IF Bandwidth:1.25 MHz; 30 kHz characteristic
Amplitude Accuracy (1.25 MHz IFBW): ± 1 dB, ± 0.5 dB typical (20° to 30°C); ±2 dB (0° to 55°C)
Amplitude Accuracy (30 kHz IFBW): ± 1.5 dB (20° to 30°C); ± 2.5 dB (0° to 55°C)
Noise Figure: 8 dB typical

HP Digital Receivers for GSM Drive Test

The following digital receiver options are available for the HP E7475A system:
Opt 300, Opt 310 (includes internal GPS) **E-GSM900 Receiver Specifications:**
Frequency Range:
880 to 915 MHz
925 to 960 MHz
Opt 320, Opt 330 (includes internal GPS) **DCS1800 Receiver Specifications:**
Frequency Range
1710 to 1785 MHz
1805 to 1880 MHz

Key Literature

HP E7473A Technical Specification, p/n 5968-5555E
HP E7473A Configuration Guide, p/n 5968-5553E
HP E7474A Technical Specification, p/n 5968-5556E
HP E7474A Configuration Guide, p/n 5968-5861E
HP E7475A Color Brochure, p/n 5968-5562E
HP E7475A Configuration Guide, p/n 5968-5563E
HP E7475A Technical Specification, p/n 5968-5564E
HP E7480A Product Overview, p/n 5968-1549E

Ordering Information

HP E7473A CDMA Drive Test System
HP E7474A TDMA Drive Test System
HP E7475A GSM Drive Test System
HP E7485A GSM Post Processing Software

For more information, visit the Drive Test Solutions web site:
http://www.hp.com/go/drive_test

- 100 kHz to 1.0 GHz
- POCSAG, FLEX, and FLEX-TD
- Pager testing you can depend on

HP 8648A with Option 1EP

Easy, Economical, One-Box Pager Testing Using the HP 8648A Option 1EP

GPIB

The HP 8648A Option 1EP provides a complete, economical, one-box pager test solution. It includes the digital pager encoder that supports the popular worldwide standard, POCSAG (Post Office Code Standardization Advisory Group), and the newer paging standards, FLEX and FLEX-TD (RCR-43, for Japan).

Offering Key FLEX Specifications

The specifications of the HP 8648A Option 1EP are ideal for the stringent FLEX and FLEX-TD test requirements. It offers 60 Hz frequency shift keying (FSK) deviation accuracy within specific pager service bands. This is the most important FLEX specification. Also, it typically offers 40 Hz carrier frequency accuracy (relative to CW in dcFM).

Faster, Easier Testing

Now test time is reduced and simplified with the HP 8648A's semi-automated features:

- Customize your result with user-defined messages of up to 40 characters
- Reduce test time with 5 built-in test messages
- Increase test reliability with 70 internal storage registers capable of storing the entire protocol configuration

Performance Summary

Frequency: 100 kHz to 1 GHz
Frequency Accuracy with Option 1E5: Typically 0.15 x 10^{-6} x carrier frequency in Hz, or typically 0.092 x 10^{-6} x carrier frequency in Hz within 90 days of calibration
Output Level: +10 dBm to –136 dBm
Output Level Accuracy: 1 dB (> –127 dBm)
Carrier Frequency Accuracy: (relative to CW in dcFM) 100 Hz (typically 40 Hz), deviation < 10 kHz (within one hour after dcFM calibration)

Pager Signaling

Supported Pager Protocols: POCSAG, FLEX and FLEX-TD

POCSAG

Speed: 512, 1200, and 2400 bps
Message Format: Tone only, Numeric, Alphanumeric

FLEX/FLEX-TD

Speed: 2 Level FSK: 1600 and 3200 bps; 4 Level FSK: 3200 and 6400 bps
Message Format: Tone only, Numeric (standard and special), Alphanumeric, HEX/binary
Address Type: Short, long (messaging accessible from front panel or GPIB)
Message Types: Five fixed (built-in), one user-defined message
Length: 40 characters maximum
Repetition Modes: Single, burst, continuous (messaging accessible only over GPIB)
FLEX/FLEX-TD: 128 frames
POCSAG: 128 batches
Data Rate Accuracy: 5 ppm

Key Literature

HP 8648A Pager Test Option, p/n 5964-6686 E

Ordering Information

HP 8648A Synthesized Signal Generator
Opt 1EP Pager Signalling
Opt 1E5 High-Stability Timebase (FLEX, FLEX-TD only)
FLEX Code Word Generation Software
download from the web

Digital Microwave Radio Test Equipment

(PN 3708A-5) Testing Satellite Systems with the HP 3708A
5954-9555

Mobile/Cellular Radio Test Sets

(PN 892X) Techniques for Programming the HP 892X Family of Instruments
5965-6120E
(PN 83236A/B) Writing Control Software for the HP 83236A/B
5965-5626E
(PN 8920-1) Using the IBASIC Programming Environment on the HP 8920 Test Set Family
5963-0046E
(PN 83204A/5A) CDPD Conceptual Overview
5965-6326E
(PN 83204A/5A/21A) CDPD MDBS Cell Site Test Software Troubleshooting
5965-7060E
(PN 8921-1) HP 8921A Cell Site Test Set
5962-9475E
(PN 8320NX/8921A) Step by Step Testing Procedure for PCSI CDPD MDBS Radios
5965-7345E
(PN 8921-2) HP 8921A Cell Site Test Set TACS Base Station Testing
5962-0157

Cellular/PCS Transmitter & Receiver Test Equipment

(PN 89400-1) Frequency and Time-Selective Power Measurements with the HP 89400 Series Vector Signal Analyzers
5091-7194E
(PN 89400-2) Measuring Phase Noise with the HP 89400 Series Vector Signal Analyzers
5091-7193E
(PN 89400-3) CDMA Measurements with the HP 89400 Series Vector Signal Analyzers
5091-7196E
(PN 89400-4) Characterization of Digital Communications Channels with the HP 89400Series Vector Signal Analyzers
5091-7195E
(PN 89400-5) Measuring Transmitter Transients with the HP 89400 Series Vector Signal Analyzers
5962-9493E
(PN 89400-6) Translated Frequency Measurements with the HP 89440A
5091-7412E
(PN 89400-7) The Dynamic Range Benefits of Large-Scale Dithered Analog-to-Digital Conversion in the HP 89400 Series VSAs
5091-7668E
(PN 89400-8) Using Vector Modulation Analysis in the Integration, Troubleshooting, and Design of Digital RF Communication Systems
5091-8687E
(PN 89400-9) Downconverted Measurements Using the HP 89410A and HP 89441A
5091-8691E
(PN 89400-10) Time-Capture Capabilities of the HP 89400 Series Vector Signal Analyzers
5091-8686E
(PN 89400-11) Phase Noise Performance of the HP 89400 Series Vector Signal Analyzers
5963-0039E
(PN 89400-12) Understanding Time and Frequency Domain Interactions in the HP 89400 Series Vector Signal Analyzers
5962-9217E
(PN 89400-14) Using Error Vector Magnitude Measurements to Analyze and Troubleshoot Vector-Modulated Signals
5965-2898E

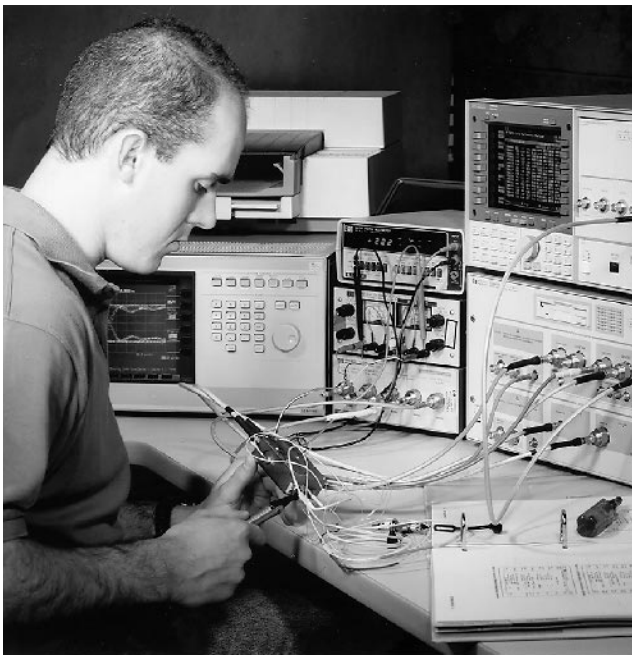
Cellular/PCS Spectrum Monitoring & RF Measurement Systems

HP E4916A Crystal Impedance Meter
5967-6115E

Pager Test Equipment

(PN 8648A-1) Pager Testing Using the HP 8648A with Internal Pager Encoder Option 1EP
5965-1131E
(PN 8648A-2) Servicing and Repairing Pagers Using the HP 8648A Option 1EP
5965-1132

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00



HP71612A

Portable protocol analyzer isolates operational problems on data communications networks.

Test Solutions for Communications Networks

With the most comprehensive technology resources available anywhere, Hewlett-Packard can provide complete and integrated solutions to meet your test needs at every phase of the network life cycle. HP offers telecommunication and data communication test equipment to help you design state of the art, high quality communication products. We also offer the tools you need to test, monitor, troubleshoot and eliminate operational problems on your network, no matter what its size or type.

From handheld testers to network monitoring systems, HP equipment is easy to use and rugged enough to stand up to years of use in the field, factory, or lab. Backed by HP's unparalleled worldwide support, this total capability enables you to increase your network's quality of service and uptime—and to enjoy a low overall cost of ownership.

You can maximize the value of your investment in HP solutions through comprehensive education and training courses that give your workforce the skills necessary to solve the problems they encounter accurately and quickly. Both traditional classroom and customized on-site training is available in a wide variety of areas. Example topics include:

- Developing IP Networks in an ATM environment
- Design of SONET Networks
- Frame Relay technology and troubleshooting techniques
- Migrating to fast and switched ethernet

For a complete list of courses and times please see the HP web site: **www.hp.com/go/tmeducation**

Protocol Analyzers

Protocol Analyzers are instruments that monitor the traffic on a network to determine that it conforms to the specific set of rules, helps to identify specific error conditions and manage network performance and quality. HP provides a broad set of solutions specifically designed for R&D engineers, Network Managers and Field Service Technicians. A full range of technologies is supported, including: Ethernet, fast Ethernet, gigabit Ethernet, token-ring, FDDI, ISDN, frame relay, X.25 and ATM. HP also supports the industries broadest coverage of network types with solutions for low speed dial-up connection all the way to OC12 core transmission circuits.

HP Internet Advisors-LAN/WAN/ATM

The HP Internet advisor gives you the capabilities you need to identify and solve problems correctly the first time you connect, anywhere in the internetwork. To maximize network uptime, the HP Internet Advisor helps you isolate network problems before they occur. With the capability to base line network behavior, the Internet Advisor provides critical information for intelligently optimizing, reconfiguring, fine-tuning and expanding data communications networks.

Signaling Test Sets

THE HP 37900E signaling test set is a rugged, portable PC-based instrument, providing monitor and emulation of SS7, ISDN, X.25 and V.5 protocols. It can handle up to 40 duplex protocol streams carried on one to 24 links. The HP 37900E is targeted at the telecommunications protocol test market, particularly SS7-based protocols in both wireless and fixed/wireline networks. The test set can be used for emulating protocols as well as monitoring live traffic and deriving measurement statistics.

The HP 37907A Signaling Advisor (new in this catalog) is designed for signaling engineers and technicians who maintain, install and develop multilink, multiprotocol wireline or wireless signaling networks. This practical, intuitive-to-use test tool enables technicians to deal with routine signaling problems easily, and frees engineers to focus on major or complex signaling issues.

Transmission Impairment Measuring Sets (TIMS)

It is necessary to make analog measurements on a network in order to analyze its ability to transmit signals on the Physical Layer. The HP 4934A (TIMS) measures frequency response, noise and cross talk, with the results displayed indicating the health, or acceptability, of the network.

The deployment of DSL technologies such as HDSL and ADSL requires a new generation of wideband TIMS. New in this catalog are the N1625A (ANSI) and N1626A (ITU) xDSL TIMS modules. These modules plug into the N1610A HP Service Advisor tablet, new in this catalog. The Service Advisor provides a three tier Asymmetric Digital Subscriber Line (ADSL) HP test solution to support local-loop service deployment, and addresses testing required for high speed ADSL services for consumers and businesses over existing copper lines.

The HP 37718A and 37719A communications performance analyzers offer a multi-rate test solution for both network operators and network equipment manufacturers.

Hewlett-Packard provides a wide range of portable testers to help you monitor and maintain your digital and analog networks.

Digital Transmission Testers

The fundamental measure of performance, or quality, in digital systems is the probability of any transmitted bit being received in error. This is the purpose of digital pattern generators and error detectors, often referred to as "Bit Error Rate Testers" or BERTs. HP offers the highest performance family of these instruments for synchronous (SONET/SDH) and plesiochronous (PDH) networks.

PDH

HP manufactures a full line of products for use in the installation, maintenance, and troubleshooting of telecommunications networks worldwide. These include handheld test sets and portable analyzers. Configurations address your needs for network use and speed, including ATM.

The HP E7580A ProBER (new in this catalog) is a powerful handheld solution for testing 2Mb/s and 64 kb/s digital circuits. It offers extensive BER test functions plus a unique range of signal quality measurements (pulse mask, jitter, level and frequency). For other PDH test solutions see the HP 71603B Gigabit Error Performance Analyzer, the HP 4594A T1 Test Advisor and the HP E8595A HDSL Installer Assistant.

SONET/SDH

HP's SONET and SDH analyzers perform accurate, reliable tests on network equipment and transmission services. Low-cost and portable units troubleshoot SONET equipment at rates up to 155 Mb/s or, optionally, to 622 Mb/s. Modular, VXI-based instrumentation can be easily integrated into R&D, production-line, or ATE systems that tests in both SONET and SDH transmission standards, up to 2.488 Gb/s.

The HP 37718A and 37719A Communications Performance Analyzers (new in this catalog) offer a multi-rate test solution for both network operators and network equipment manufacturers. The HP 37717C Communications Performance Analyzer offers an upgradeable one box solution for installation, field maintenance, commissioning and manufacturing, which is rugged and portable and allows full functioning testing of SDH, PDH and ATM equipment, including jitter generation and measurement. The HP E4480A (CERJAC 156 MTS) is a complete DS3 test set that offers a wide range of optional features including DS0, DS1, FT1, E1 and SONET, ATM and T-carrier in-service or out-of-service testing, for both electrical and optical networks.

Network Monitoring Systems

HP offers distributed systems that monitor network performance and report results at a central location. This creates the ability to achieve accurate fault diagnosis and location quickly, improve network and service reliability and decrease overall maintenance costs. HP offers monitoring systems for network technologies such as:

- Common Channel Signaling (AcceSS7)
- Interoffice Fiber Trunks
- Enterprise datacomm networks for LAN, WAN and ATM
- ISP services management
- Network Timing and synchronization

For more information on these options, contact the HP Call Center in your region.

Communications Products Covered in Other Sections of this Catalog

HP offers a comprehensive line of network test, measurement and timing products to satisfy your needs in all types of networks, and all phases of their life cycle. Please also see the following for more information:

- Cellular Testers (See pages 334-366)
- Microwave Radio Testers (See page 333)
- Lightwave Transmission Testers (See page 461)
- Network Synchronization Units (See pages 502-505)

For the latest product information, please visit the HP communications test web site**: www.hp.com/go/comms**

Software-based Expanded Network Security Solutions

Security software solutions from Hewlett-Packard offer a complete line of computer and network security products that can reduce, and even eliminate, the very real threat posed by those who would steal or vandalize computer-based intellectual property. This integrated family of products can be host-based or network-based, operates with Windows NT, and can be installed in mobile, resident, or distributed environments. The security suite of software solutions, scheduled to be rolled out over the period from August, 1999 through the year 2000, provide the capabilities to:

Find and repair the vast majority of security holes in your computer system or network, as a key component of vulnerability analysis. With its automated repair capability, SFProtect software also saves you time and money

Simulate attacks to expose security vulnerabilities from a hacker's perspective by using known attack methods to attempt to penetrate operating systems, firewalls, routers, and other security hardware/software.

Identify attacks, either as they occur, or afterward in order to uncover evidence of recent successful or failed attacks. These intrusion detection tools can be used as preventive measures or in investigative processes.

Manage an entire system's security, implement and update security policy from a single location.

Anyone concerned with computer or network security can get just the right solution by using the HP's test and measurement security software family of products. To download a demo of HP's latest security product visit: **http://www.hp.com/go/netsecurity3.**

HP J2300D
HP J3446D
HP J2899A
HP J1950A

HP J2300D

HP Internet Advisor

Complete Solution under One Handle

The HP Internet Advisor is designed to be a strategic tool for today's network managers, engineers, and field service personnel for the deployment, troubleshooting, and optimization of today's mission-critical networks. The HP Internet Advisor gives you the capabilities you need to identify and solve problems correctly the first time you connect, anywhere in the network. With the capability to baseline network behavior, the HP Internet Advisor provides critical information for optimizing, reconfiguring, fine-tuning and expanding diverse and increasingly complex networks. The HP Internet Advisor's modular design enables the user to start with any combination of LAN, WAN, or ATM test capability, with the option to add further functionality as the network evolves.

This Pentium-based analyzer with Windows architecture offers even new users the ability to get results fast.

Three mainframe configurations are available for different measurement requirements. The HP J2300D Offers WAN and ATM analysis while the HP J3446D offers Ethernet and Fast Ethernet (10/100) analysis. The following undercradles and modules are available:

LAN	WAN	ATM
10/100 Ethernet	TI/EI	TI/EI
Gigabit Ethernet	ISDN	DS3/E3
Token Ring	HSSI	OC-3c/STM-1
FDDI	DS3/E3 (frame and cell-based	155 Mbps UTP
	DDS 4-wire	OC-12c/STM-4c

Solve Network Problems the First Time

- Expert analysis and network health reporting
- Vitals which anticipate and solve problems
- Commentators point you to the source of the problem
- LAN over WAN analysis
- LAN over ATM analysis
- Customizable statistical analysis
- Extensive on-line Help

HP Internet Advisor LAN

Simplifies Troubleshooting with Expert Analysis

The HP Internet Advisor LAN offers extensive measurement capabilities on Ethernet, Fast Ethernet, Gigabit Ethernet, Token Ring and FDDI networks. The analyzer has seven-layer protocol decodes, comprehensive statistical measurements, active stimulus/response tests and traffic generation. In addition the Expert Analyzer provides continuous feedback on key network issues such as router misconfigurations, connection resets and many other problems. The drill down capability of the Expert Analyzer enables the user to focus on the data to find the source of the problem. On-line help enables the user to quickly understand the problem and offers suggestions for solutions or optimizations.

HP Internet Advisor WAN

Eliminates Poor Network Performance

To install, maintain, or troubleshoot a wide area network, you need to test many things: physical errors, equipment interoperability, and network inter-connectivity. The HP Internet Advisor WAN offers integrated WAN and LAN over WAN protocol analysis capabilities, along with bit error rate testing, stimulus and response measurements, and statistical analysis capability to help you solve your networking problems.

HP Internet Advisor ATM

Optimize Performance with real-time QoS Testing and Policing

No matter where you are in the process of bringing up your ATM network, the HP Internet Advisor ATM gives you the tools to identify and resolve network problems quickly the first time. To install or troubleshoot an ATM link, you need to test for many things: Physical congestion, equipment interoperability, ATM cell congestion, and even LAN traffic problems. The HP Internet Advisor ATM offers integrated ATM, WAN, and LAN protocol analysis capabilities you require to get a good look at the physical layer, the data link layer, and the upper layer protocols.

HP Internet Reporter

Understand Efficient Network Behavior

The HP Internet Reporter automatically generates presentation-quality tables, charts and reports on statistics collected on almost any network. Useful for a wide variety of baselining and benchmarking task, the HP Internet Reporter will help you evaluate network operation, isolate traffic-related problems, evaluate the impact of hardware or software changes and plan for future growth.

- Build historical trends to anticipate problems and bottlenecks before they occur
- Benchmark applications and network devices
- Cost-justify network equipment upgrades
- AutoReport feature makes report generation as easy as selecting a data file, choosing a report type, and pressing the GO! Button; AutoReport does the rest
- HP Internet Reporter's tables are stored in a Microsoft Excel format

Commentators

Ease Application Bottlenecks

HP Internet Advisor LAN Oracle Commentator software gives you the expert analysis capabilities you need to successfully manage Oracle distributed relational databases running in a client/server environment on Ethernet, Fast Ethernet, Token Ring and FDDI networks. With the Oracle Commentator, you can view summary information of significant network events and then drill down to get an easy-to-understand description of events, including an explanation of probable causes and suggestions for correcting the problem.

For more information visit our web site: **www.hp.com/go/internetadvisor** and **www.hp.com/go/lananalyzer**

HP LAN Analyzer NEW

Scaleable, Affordable Analysis and Troubleshooting

The HP LAN Analyzer product family provides software and hardware tools to manage and maintain 10/100/1000 Ethernet LANs and 4/16 Token Ring networks. It provides a complete range of solutions, from HPs first software analyzer that runs on your notebook with a standard NIC card; to complete, distributed analysis systems for 100% wire-speed capture of full-duplex, 100Mbps switched traffic.

Visit our web site: **www.hp.com/go/lananalyzer7** and download a free complete trial edition of the new HP LAN Analyzer today.

Key Literature

HP Internet Advisor WAN, Product Overview, p/n 5967-5566E
HP Internet Advisor ATM, Product Overview, p/n 5968-1437E
HP Internet Advisor LAN, Product Overview, p/n 5966-0828E
HP LAN Analyzer, P/N 5968-5538E

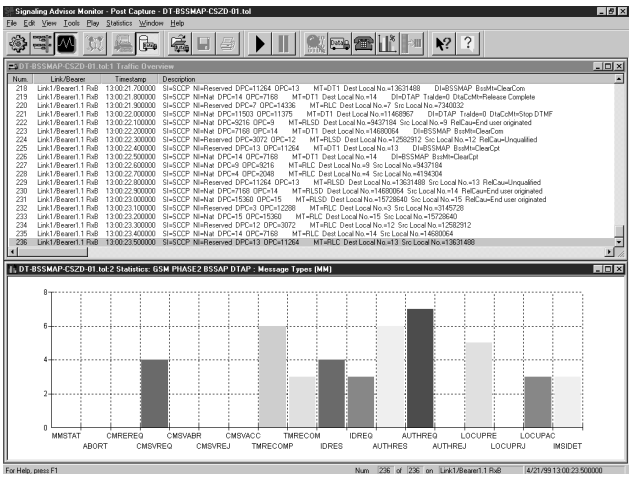
Ordering Information

HP J2300D Internet Advisor WAN
HP J3446D Internet Advisor LAN - Fast Ethernet
HP J2899A +UAF Internet Advisor SW Subscription
HP J1950A LAN Analyzer Software

- Intuitive GUI simplifies monitor- and emulate-testing
- Auto-configure hardware and software
- Up to 16 links and 32 duplex timeslots monitor and emulate

HP 37907A
HP J4211A
HP J4212A
HP J4213A

HP 37907A



Graphics-based user interface lets you analyze problems and status of signaling simultaneously.

HP 37907A Signaling Advisor

HP 37907A Signaling Advisor Mainframe

The HP 37907A test mainframe is designed for engineers who maintain, install or develop multi-protocol signaling networks. Used in conjunction with the HP J421xA series of signaling application software products and the HP E757xA series of signaling line interface modules (LIMs), the HP Signaling Advisor makes measurements and results analysis easy for signaling engineers, enabling them to check performance and troubleshoot signaling systems easily and accurately.

The HP Signaling Advisor is rugged and portable, weighing less than 10 kg, and provides powerful, modular, scalable test capability (up to 16 links).

HP J421xA Monitor Applications

Monitoring application software for the HP Signaling Advisor enables customers to monitor signaling interactions across link sets or complete network elements easily, without having to reconfigure artificially for tests. Users can perform measurements on up to 32 duplex time slots from eight duplex signaling links (expandable to 16), working at sub and fractional rates, or full rate T1/E1.

The HP Signaling Advisor's time-saving features and user-friendly operation are designed to enable service engineers to improve service quality and availability, allowing them to predict problems early and resolve faults quickly and effectively. Its intuitive graphical user interface helps users configure even the most complex triggers, filters or traces for tests across multiple signaling protocols and standards.

Test analysis is also simplified with automatic sequence- and protocol-deviation detection, decoding of signaling to text and graphical statistics. Understanding complex signaling interactions and messages, even those involving multiple protocols, becomes simple.

Three monitor application software packages (for use with the HP Signaling Advisor Mainframe) provide signaling capture, decode, call trace and statistical analysis:

HP J4211A SS7 Monitor Application

- For ITU-T, ETSI, ANSI/Bellcore and national variant SS7 protocol stacks.

HP J4212A GSM Monior Application

- For GSM MAP, BSSMAP, DTAP, ABIS, TRAU and GPRS. Also provides ITU-T, ETSI, ANSI/Bellcore and national variant SS7 protocol stacks.

HP J4213A cellular/PCS Monitor Application

- For IS-41 and IS-634. Also provides ITU-T, ETSI, ANSI/Bellcore and national variant SS7 protocol stacks.

Key Literature

HP J4211A Brochure, p/n 5968-6239E
HP J4211A Specifications, p/n 5968-6243E
HP J4212A Brochure, p/n 5968-6240E
HP J4212A Specifications, p/n 5968-6244E
HP J4213A Brochure, p/n 5968-6242E
HP J4213A Specifications, p/n 5968-6246E

Ordering Information

HP 37907A Signaling Advisor Mainframe.
HP J4211A SS7 Monitor Software .
HP J4212A GSM Monitor Software .
HP J4211A Cellular/PCS Monitor Software.
HP E7571A E1 Balanced LIM .
HP E7572A E1 Unbalanced LIM .
HP E7573A T1 LIM.
HP E7574A V.35/RS-232-C/RS-449 LIM .
HP E7575A DS0-A LIM.
HP E7577A Link Expansion Undercradle .

2 Mb/s Handheld Tester and Telecom/Datacom Analyzers

HP ProBER 2
HP 37722A
HP 37732A

- Combined transmitter and receiver
- 2 Mb/s, n x 64 kb/s and 64 kb/s co-directional testing
- Easy-to-use application driven interface
- Signal quality measurements (pulse mask, level, frequency and O.172 jitter)
- Local language support
- Over 8 hours battery life

HP ProBER 2

HP ProBER 2, 2 Mb/s Handheld Test Set

The HP ProBER 2 handheld test set provides a powerful handheld solution for testing 2 Mb/s and 64 kb/s digital circuits. It offers extensive BER test functions plus a unique range of signal quality measurements (pulse mask, jitter, level and frequency). This unmatched capability, combined with the intuitive operation of HP ProBER 2, simplifies installation and maintenance testing for faster problem resolution.

Measurement Summary

- Extensive error and alarm generation and measurement
- G.703 Pulse mask measurements
- Jitter measurements to ITU-T O.172
- Frequency and level measurements
- Histogram analysis
- ITU-T recommendations G.821, G.826 and M.2100 performance analysis
- Propagation delay measurement
- VF tone generation and measurement
- Timeslot activity monitor
- Line rate offset
- Frame data control and monitoring
- Channel associated signaling and spare (Sa) bit control
- Synchronization status messages
- Built-in talk/listen
- Thru-mode test capability

Key Literature

Brochure, p/n 5967-5869E
Specifications, p/n 5968-3793E

Ordering Information

HP E7580A ProBER 2, 2 Mb/s Handheld Test Set
Option 001 Advanced Signal Quality Measurements
Option 002 64 kb/s Co-directional Interface
Option 020 Carrying Case
Option 210 M.2100 Analysis.
Option AB2 Chinese Localisation

- Combined telecom and datacom testing in one analyzer
- Eight interfaces in one analyzer
- Powerful results storage without using printer

HP 37732A

HP 37722A and HP 37732A Telecom/Datacom Analyzers

HP 37722A Telecom Analyzer

The HP 37722A telecom analyzer offers installation and maintenance (in- and out-of-service), bit error and signal measurements on digital circuits in a portable, rugged package. It provides framed pattern generation and measurements at 704 kb/s, 8 Mb/s, 2 Mb/s and ±64 kb/s. To help increase productivity and network uptime the HP 37722A includes event storage in text and graphical form, timeslot access, sub-64 kb/s testing, slips and wander, and tone generation and measurement. The HP 37722A is upgradedable to a HP 37732A by ordering HP 15901A Option 001.

Specifications

Measurements: Bit errors, code errors, frame errors, CRC errors, REBEs (E bits), slips, round trip delay
Error Analysis: G.821 standard, user-defined and Annex D, M.2100
Timeslot Access: External drop/insert of 64 kb/s timeslot to VF ports or n x 64 kb/s (n = 1 to 6) to X.21 datacom port
RS-232 Remote Control and Printer Interface

HP 37732A Telecom/Datacom Analyzer

The HP 37732A offers all the functionality of the HP 37722A but adds datacom testing on V.24, V.35, V.11/X.21-leased interface rates up to 2 Mb/s. It also provides a full range of BER/BLER measurements, control-circuits timing analysis with transition diagrams on screen, a built-in V.24 breakout box and an internal synthesizer. Test set-ups are fast and results are presented in easy-to-read and easy-to-record ways that make it easy to pinpoint the cause of a problem.

Specifications

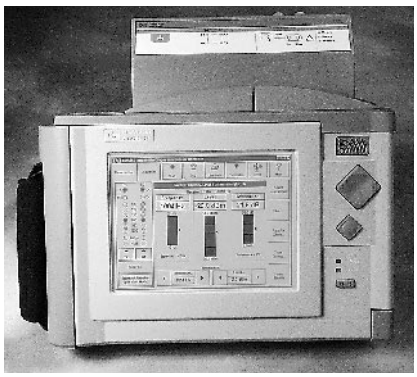
Telecom testing and remote control as HP 37722A
Data Rates: 50 b/s to 2.048 Mb/s (synchronous: built-in synthesizer); 50 b/s to 19.2 kb/s (asynchronous)
Test Patterns: 63-bit, 511-bit, 2047-bit, 215-1, 220-1, all 1s, all 0s, 8 to 1024-bit user-definable word, FOX word
Measurements: Errors, BER, block, block errors, BLER, error seconds, % EFS, Tx and Rx frequency, alarm seconds, clock slips, alarms, G.821 analysis. V.11/V.35 activity indicators on data, clock, and control circuits
Control-circuit Timing: Measures times between selectable start/stop events; timing range 100ms, 1s, 10s
Transition Diagrams: For RTS, CTS, DTR, DSR, DCD

Ordering Information

HP 37722A Telecom Analyzer
HP 37732A Telecom/Datacom Analyzer
HP 15901A Opt 001 Datacom Module
For all other options and pricing, please contact the HP Call Center in your region.

HP N1610A
HP N1610U

NEW



Service Advisor with DSL TIMS Module

Service Advisor Portable Test Tablet

Maximum Test Flexibility

The Service Advisor Portable Test Tablet is HP's newest modular test platform providing maximum test flexibility for Telco, residential access and line qualification applications. The modular test design enables users to rapidly switch test applications. The Windows CE operating system and large touch screen make the Service Advisor easy to operate. The Service Advisor's modular architecture provides a cost-effective solution for expanding capabilities to meet new technologies and testing requirements.

- Interchangeable test modules
- Windows CE operating system
- Touch Sensitive Color VGA Screen with large 7.2" display
- Remote control capabilities with the Service Advisor Companion software and SCPI command line interface
- Rechargeable NiMH smart battery
- I/O ports include serial, parallel and PS/2 ports; internal speaker, headphone and microphone jacks
- Supports Modem, LAN, and Flash-ROM PC cards
- Rugged, water-resistant and lightweight

Ordering Information

N1610A Service Advisor Tablet
  Opt 500 Remote Services
N1610U N1610A Upgrade Option
  Opt 500 Remote Services Field Upgrade
N1611A Additional NiMH Battery
N1612A AC Adapter
N1613A External Battery Charger
N1614A 12 Vdc Vehicle Power Adapter
N1615A Soft Carry Case for Service Advisor
N1616A Hard Carry Case for Service Advisor
N1617A Service Advisor Connectivity Kit
N1618A 56K/V.90 Modem PC-card
N1620A 10BaseT Ethernet LAN PC-Card
N1621A 10MB Compact Flash and PCMCIA Adapter

Service Advisor Plug-In Modules

For maximum flexibility, the Service Advisor accepts plug-in modules that enable the user to rapidly switch interfaces or test applications. The Service Advisor accepts up to two single width modules or one dual width module. The Service Advisor has a growing suite of test capabilities and offers the following test modules:

DSL TIMS Test Modules

Provides comprehensive subscriber loop testing to 2 MHz.

- Line qualification test sequences for DSL installations including ADSL, HDSL, SDSL, IDSL
- Line qualification test sequences for analog services including VF-POTS and Modem
- 36 Individual tests
- ANSI and ITU-T Versions
- Complies with IEEE-743, T1.413
- User defined test sequences
- Standard custom line qualifications

Time Domain Reflectometer (TDR) Test Module

Provides TDR line qualification testing for all metallic cable including twisted pair, coaxial and LAN.

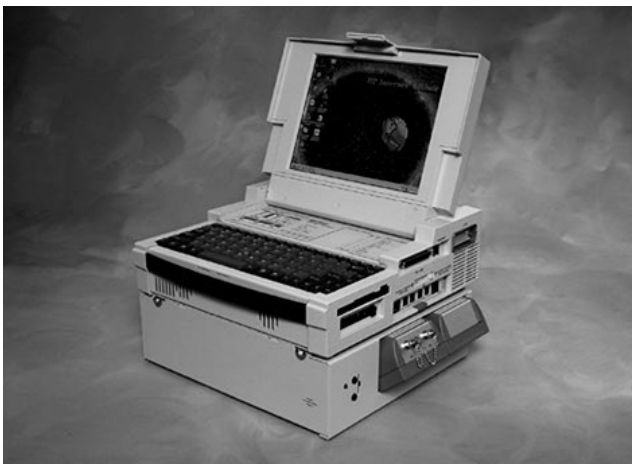
- Balanced (coaxial) and unbalanced cable interfaces
- TDR, crosstalk and return loss measurements
- Auto-fault location
- Wave-form storage and comparison
- 10 feet to over 20,000 feet range

ATM Cell Processor Test Module

When paired with a line interface module provides complete SONET, SDH, and PDH ATM testing.

- ATM testing up to 155Mbps
- Quality of Service (QoS) testing
- VPI/VCI scan
- AALO and AAL 1 Cross Cell Bert
- ATM cell capture
- HEC error testing
- OAM support
- LEDs for quick and easy error, alarm and status reporting
- Error, alarm and status file logging
- Inter-operates with SONET/SDH interface Module

HP N1625A
HP N1626A
HP N1627A
HP N1640A
HP N1640A
HP N1645A
HP N1660A
HP N1700A
HP E8550A
HP E8560A
HP E8571A



N1700A, N1640A, N1645A, J2300C

SONET/SDH Interface Module

Provides SONET and ATM testing at OC3c/1 or SDH and ATM testing at STM-1/0o for 1310 intermediate reach single mode laser interface.

- 155Mbps (OC-3c/STM-1o) and 51Mbps (OC-1/STM-0o) optical interfaces
- 1310nm Intermediate Reach (IR) Single Mode (sm) or Multi-Mode (mm) optical options
- FC/PC, ST and SC connectors
- Clear Channel BERT
- LEDs for quick and easy error, alarm and status reporting
- Pointer, APS and overhead control monitoring
- Inter-operates with ATM cell processor module

Dual DS1/0 Test Module

The N1660A Dual DS1/0 Test Module for the Service Advisor family provides:

- 2xRx and 2xTx
- T1 and Nx56kbps and Nx64kbps BERT
- Unframed, ESF, SF and SLC-96 testing
- T1/DDS Testing
- Monitors and inserts errors, alarms, loop codes and tones
- Audio, input and output
- Signaling and pulse mask measurement options

Service Advisor Undercradle for the Internet Advisor

The N1700A Service Advisor Undercradle operates with the J2300C Internet Adviser to provide telecom service providers with a comprehensive solution that covers physical layer through application layer testing. The N1700A Service Advisor Undercradle enables users to easily share Service Advisor modules between the J2300C and the N1610A Service Advisor.

- Hot-swap plug-in modules without having to power down the Internet Advisor
- Accepts Service Advisor plug-in modules
- Windows 95/98 user interface
- Headphone and microphone jacks
- Internal Speaker

Ordering Information

N1625A North American (ANSI) TIMS Test Module
  Opt 010 Advanced POTS Signaling
N1626A 2 MHz ITU TIMS Test Module
N1627A TDR Test Module
N1640A ATM Cell Processor Test Module
N1645A SONET/SDH Interface Module
  Opt 100 1310nm IR Single Mode FC/PC connect
  Opt 101 1310nm IR Single Mode ST connectors
  Opt 102 1310nm IR Single Mode SC connectors
  Opt 103 1310nm IR Single Mode D4 connectors
  Opt 111 1310nm SR Multi Mode ST connectors
  Opt 112 1310nm SR Multi Mode SC connectors
N1660A Dual DS1/0 Test Module
  Opt 010 Signaling
  Opt 020 Pulse Mask Measurement
  Opt. 030 DS1 Jitter and Wander Measurement
N1700A Service Advisor Undercradle for the Internet Advisor

DSL Service Installer Base Unit and Test Module

DSL Service Installer

The DSL Service Installer offers a choice of turnkey DSL modules that combine Golden Modem, TIMS, Load Coil detection, and integrated POTS functions for quick turn-ups and troubleshooting to meet the growing demand for ADSL services.

The DSL Service Installer enables technicians to complete the installation or troubleshooting of DSL circuits in one visit. The DSL Service Installer's modular platform provides ADSL measurements for CAP (E8550A) or DMT (E8570A) technologies and is expandable to meet future technology requirements. This self-contained unit performs go/no go tests between the central office and customer premise, and tests the local loop to validate line performance at the expected rate. Test features include:

- Load Coil Detection
- DC Current and Voltage measurements
- Resistance Measurements between tip, ring and ground
- POTS Tones generate and measure frequency and loss
- High Frequency Tones generate and measure frequency and loss of DSL services
- Locator Tones for identifying twisted pair cables

Specifications

E8551A ADSL CAP Module: Chipset Globespan CAP 16
E8571A ADSL DMT Module: Chipset Alcatel 1000
Load Coil Detector: Frequency Sweep/up to four detected
DC Measurements
  DC Voltage 0 VDC to ±250 VDC Accuracy 2%
  DC Current 0 mA to ±125 mA Accuracy 2%
Resistance: Tip to Ring; Tip to Ground; Ring to Ground, Range < 1K ohms, < 10K ohms, >10K ohms
VF Transceiver
  Transmit 404 Hz, 1004 Hz, 2804 Hz
  Measure Loss and Freq. 50 Hz to 15 kHz; Loss in dB 0 to –40 dB ±1.5dB; Frequency .02%
DSL Transceiver
  Transmit 196, 392 kHz, 772 kHz, 1.1 MHz, 1.5 MHz at 5 V P-P
  Measure Loss and Freq. 150 kHz to 196 kHz
  Loss in dB. 0 to –50dB ±2 dB Freq. .02% 196 kHz to 1.5 MHz
  Loss in dB. 0 to –40dB ± 1.5dB Freq. .02%
Test Connection: RJ-45 to 3 alligator clips and RJ-45 to RJ-11
Power: 12 VDC
Battery: 5 to 10 hours, depending on usage

Ordering Information

HP E8550A CAP DSL Service Installer Kit
(Includes E8551A, E8560A, cables)
HP E8551A CAP ADSL Test Module
(Requires base unit E8560A)
HP E8560A DSL Service Installer Base Unit
(Requires Test Module)
HP E8570A DMT DSL Service Installer Kit
(includes E8571A, E8560A, cables)
HP E8571A DMT ADSL Test Module
(Requires base unit E8560A)

HP N1725A
HP N1726A
HP N1727A
HP N1728A
HP N1735A

auroraPlus

auroraDuet

auroraTempo

aurora Plus

The auroraPlus is a reliable, easy-to-use handheld Basic Rate ISDN tester for the office or field technician who needs a rapid and reliable, yet simple and foolproof, installation tool. Key features include:

- Hand-held—"Butt" style design
- Combined ISDN and Analog capability
- Rugged, water resistant, shock and dust resistant case
- Fully integrated test interfaces—Single connector
- Field upgrade via Serial port and Flash EPROM

Ordering Information (Americas ONLY)

N1727A US auroraPlus (must order w/option)
Opt 001 ISDN BRI S&U
Opt 031 ISDN BRI S&U w/POTS
N1728A ITU auroraPlus (must order w/options)
Opt 001 ISDN BRI S&U
Opt 031 ISDN BRI S&U w/POTS

aurora Duet

The auroraDuet has been designed to provide all round capability to ISDN technicians and engineers as an installation, troubleshooting and maintenance, integration, and product development tool. Available as a Basic Rate or combined Basic and Primary Rate ISDN tester, the auroraDuet is easy to operate, displays meaningful and understandable results and is functionally complete. Key features include:

- Combined BRI/PRI/T1 tester
- Simulation of both CO and CPE
- D-Channel monitor and decode
- Automatic test suites for quick line status
- Operates in concert with auroraExpert for protocol diagnostics
- PC-based Remote Control

Ordering Information (Americas ONLY)

N1725A US auroraDuet (must order w/option)
Opt 001 BRI S&U
Opt 011 BRI/PRI S/U/2xT1
Opt 111 BRI/PRI S/U/2xT1/sw
N1726A ITU auroraDuet (must order w/option)
Opt 001 BRI S&U
Opt 021 BRI/PRI S/U/2xE1
Opt 121 BRI/PRI S/U/2xE1/sw
N1731A auroraExpert for Windows s/w for auroraDuet
N1732A Remote control s/w
N1733A Modem adapter assembly

aurora Tempo

The auroraTempo is essential for installing, configuring and maintaining Frame Relay services running over V-series interfaces, T1 circuits, and DDS lines. It provides a full suite of physical layer and Frame Relay protocol tests that allow you to speedily verify the service, or examine more complicated issues with real-time analysis, statistical analysis, and detailed simulation for both Switched Virtual Circuits (SVCs) and Permanent Virtual Circuits (PVCs)

The auroraTempo meets the needs of Frame Relay technicians with a portable, powerful cost-effective solution. Key features include:

- Simulation and monitoring at all interfaces (UNI/NNI)
- Emulation of Switch & CPE
- Supports SVC and PVC simultaneously
- Variety of Frame Relay protocol tests to verify the behavior of the service & the equipment
- Easy to use user interface
- Simultaneous dual-port operation
- Multi-interface support

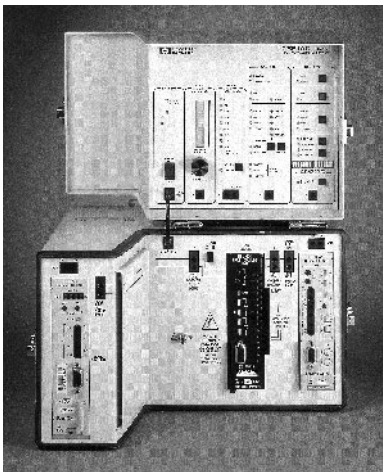
Ordering Information (Americas ONLY)

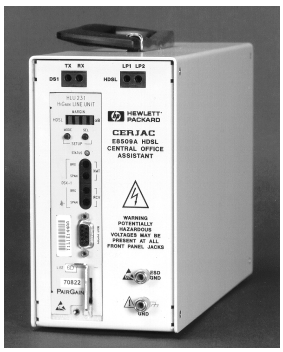
N1735A auroraTempo (must order w/option)

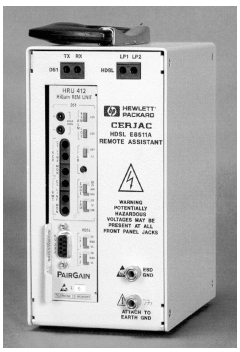
US Options
Opt 001 2x V/X, PVC software
Opt 003 1x V/X, PVC software
Opt 010 2x T1, PVC software
Opt 011 V/X & T1, PVC software
Opt 012 1x T1, PVC software
Opt 111 V/X & T1, PVC &SVC s/w

ITU Options
Opt 002 2x V/X, PVC software (ITU)
Opt 020 2x E1, PVC software
Opt 021 V/X & E1, PVC software
Opt 121 V/X & E1, PVC &SVC s/w

HP E8505A
HP E8509A
HP E8510A
HP E8511A







HP E8505A

HDSL Installer's Assistant

The HDSL Installer's Assistant offers a wide range of capabilities for HDSL circuit installation and maintenance including:

- HDSL plug-in card powering and verification
- Load coil detection
- Cable loss measurement
- T1 BERT

The HDSL Installer's Assistant is a field-portable, rugged unit which accepts Central Office, Doubler, and remote unit HDSL plug-in cards. The plug-in cards are powered from the built in AC power supply, or they may be line powered. The unit can verify proper operation of the HDSL cards with each other. Easily accessible front panel break jacks allow connection to the circuit. If the circuit does not come up properly with the plug-ins, the technician can access the cable pairs at any point in the span to sectionalize the problem to an individual part of the cable span.

After the pre-turn-up tests are completed and the HDSL plug-ins are installed, the technician can use the built-in T1 BERT tester for final turn up and trouble shooting. Using a pair of HDSL Installer's Assistants, it's a simple matter to generate an end-to-end HDSL signal on the cable span.

Ordering Information

E8505A HDSL Installer's Assistant
E8506A Cable Kit for E8505A
E8507A Softside Carrying Case for E8505A

New HDSL Modules Support Specialized Needs

The HDSL Assistant family offers a wide range of capabilities for HDSL circuit installation and maintenance including:

- HDSL plug-in card powering and verification
- Transmitting and receiving HDSL signals over a circuit
- Temporary jumpering of a doubler into a circuit

The HDSL Assistants are a trio of field-portable, rugged units, which accept central office, doubler, and remote unit HDSL plug-in cards. The plug-in cards are powered from the built-in AC power supply; or they may be line powered. Used together, the units can verify a wide range of HDSL installation and maintenance problems. In addition, all can be used in conjunction with the E8505A HDSL Installer's Assistant.

After the pre-turnup tests are completed, and the HDSL plug-ins are installed, the technician can use a DS1 BERT tester for final turn up and trouble shooting via the front panel DS1 transmit and receive jacks. Using a set of HDSL Assistants, it's a simple matter to generate an end-to-end HDSL signal on the cable span.

An excellent complement to the E8505A HDSL Installer's Assistant, this trio of plug-in verification tools replaces cumbersome, jury-rigged equipment shelves currently in use and help technicians to install, test, and sectionalize HDSL circuits.

Separate cable kits and soft side carrying cases are available for each unit .

HDSL Central Office

Assistant (E8509A)

This unit accepts standard HDSL central office plug-in cards. It can be connected to the distribution frame at the serving office, providing a powered HDSL signal toward the customer. It includes a built in AC power supply.

HDSL Doubler/Remote

Assistant (E8510A)

This unit accepts standard doubler, mini-doubler, and remote HDSL plug-in cards. It can be connected to the circuit at either a midspan point or at a remote end pedestal for maintenance applications. A doubler or remote line unit can be switched in to verify performance level. Because the plug-in cards are powered by the HDSL line, no further field power is required.

The HDSL Remote Assistant

(E8511A)

This unit can be easily patched in at any point in the circuit to verify HDSL transmission from the central office to the patch in point. Because the plug-in cards are powered by the HDSL line, no further field power is required.

Ordering Information

HDSL Modules
E8509A HDSL Central Office Assistant
E8510A HDSL Doubler/Remote Assistant
E8511A HDSL Remote Assistant

HDSL Module Accessories

Cable Kits
E8513A Cable kit for the CO Assistant (E8509A) & HDSL Remote Assistant (E8511A)
E8514A Cable kit for the Doubler/Remote Assistant (E8510A)

Carry Cases
E8512A Padded carry case for the CO Assistant (E8509A)
E8515A Padded carry case for the Doubler/Remote Assistant (E8510A)
E8516A Padded carry case for the Remote Assistant (E8511A)

Shelf Adapters for Line Units
E8508A Mini-Doubler Adapter for the E8505A and E8509A
E8517A HLU-319 Shelf Adapter for the E8505A and E8509A
E8518A HLU-388 Shelf Adapter for the E8505A and E8509A
E8519A Shelf Adapter set for the E8505A and E8509A (includes E8508A, E8517A, and E8518A)

HP E4594A
HP E6325A
HP E6323A
HP E6349A

- Windows graphical user interface
- T1 or E1 testing
- Full and fractional testing
- Full drop-and-insert voice frequency testing
- Datacom testing

E1 Test Advisor Family

The 2 Mb/s test products are designed to work with the T1 products. Together, they provide flexible, modular solutions for expanding business needs. Like the T1 test products, the 2 Mb/s products are extremely easy to use, even for the occasional user, with intuitive Windows-based interfaces, context-sensitive help functions and on-line manuals.

The 2 Mb/s Test Advisor product family includes a range of product options so users can select the configuration that best fits their needs. Versions include a “brick” for use with a PC and an “undercradle” for use with the Internet Advisor (J230XX).

All HP 2 Mb/s test solutions include G.821 Error Analysis as well as M2100, M2110, and M2120 Error Analysis. The products are dual-port testers that enable technicians to simultaneously control two full-duplex drop-and-insert transmitters and receivers. All include a built-in log that captures up to 3300 separate, user-selected error events.

Applications

The 2 Mb/s Test Advisor’s main screen provides vital at-a-glance information for quick circuit “check-ups,” including alarms, alarm history and results summary. Other tab displays provide information on level and frequency of the 2 Mb/s signal, comprehensive BERT results, and allow drop-and-insert of tones and data. Optional data modules allow BER testing at V.35, RS-232, RS-449 and EIA-530A interfaces.

HP E6323A Test Advisor Undercradle for the Internet Advisor (J230XX)

Provides E1 testing for J230xx LAN or WAN Internet Advisor. Can be used with J3754C for complete stand-alone E1 testing.

HP E6349A E1 Test Advisor Brick

An existing notebook PC can be used with the E6349A configuration of the E1 Test Advisor. It is ideal for “drop-box” applications at customer sites that require long-term monitoring via modem or LAN.

HP E6351A Dual 600-ohm Audio Access Plug-in

Provides dual 600-ohm DSØ access for audio delay and echo cancellor applications

T1 Test Advisor Family

All versions of the T1 Test Advisor provide users with capabilities for simultaneous control of two full-duplex drop-and-insert transmitters and receivers. The product’s intuitive Windows graphical user interface, combined with context-sensitive help and on-line manuals, makes the T1 Test Advisor extremely easy to use, even for occasional users. Optional plug-in modules provide support for datacom testing capability while also providing an easy method of extension. Upgradeability is accomplished either by a disk containing new software and firmware, or over a dial-up telephone line. Results and set-ups can be stored to disk for later analysis. SLC96 testing includes TR-TSY-000008 SLC modes and makes full use of graphics to ensure easy hook-up and testing. The T1 Test Advisor supports full and fractional T1 testing and comes standard with two transmitters and two receivers. T1-based DDS capability is included. Versions include a "brick" for use with a PC or an "undercradle” for use with the Internet Advisor (J230xx).

Applications

The T1 Test Advisor’s main screen provides vital at-a-glance information for quick circuit “check-ups,” including alarms, alarm history and results summary. Other tab displays provide information on level and frequency of the T1 signal, comprehensive BERT results, and allow drop-and-insert of tones and data. Optional data modules allow BER testing at DDS/DSØ V.35, RS-232, RS-449 and EIA-530A.

HP E4594A T1 Test Advisor Undercradle for the Internet Advisor (J230XX)

Provides T1 testing for J230xx LAN or WAN Internet Advisors. Can be used with J3754C for complete stand-alone T1 testing.

HP E6325A T1 Test Advisor Brick

An existing notebook PC can be used with the E6325A configuration of the T1 Test Advisor. It’s ideal for “drop-box” applications at customer sites that require long-term monitoring via modem or LAN.

E8529A DDS plug-in module for T1 Test Advisors.

Test DS0 DDS circuits from bi-polar, logic near and logic far access points using bit/byte or composite clocks.

J3754C HP pcAdvisor

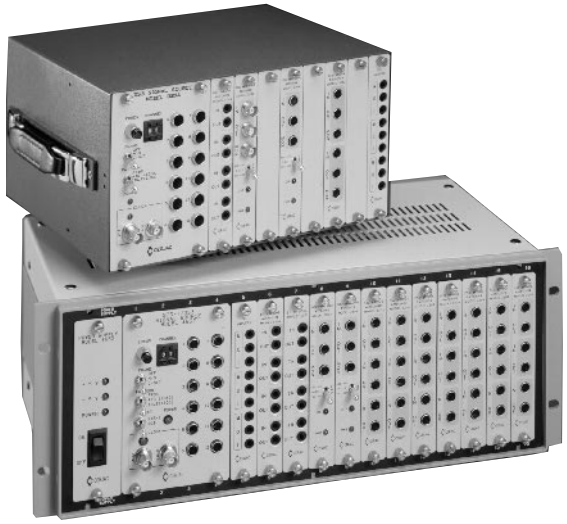
Pentium-based mainframe to be combined with E4594A or E6323A for complete stand-alone T1 or E1 testing package.

Ordering Information

E4594A T1 Test Advisor Undercradle
E6325A T1 Test Advisor Brick
E6323A E1 Test Advisor Undercradle
E6349A E1 Test Advisor Brick
E4592A Voice Frequency Plug-in Module
E4593A RS-232 Plug-in Module
E4597A V.35 Plug-in Module
E4598A RS-499 Plug-in Module
E4599A RS-530 Plug-in Module
E8529A DDS Plug-in Module
E8530A LAN Interface
E8532A External Modem
E6351A Dual 600-ohm Audio Access Plug-in
J3754C HP PC Advisor for E4594A or E6323A
E6326A Custom Softside Carrying Case for E6325A, E6349A
E6359A Soft Carrying Case for E4594A, E6349A
E6328A NI-CAD Rechargeable Battery for E6325A, E6349A

HP E448XA
HP E449XA

- R&D, manufacturing test or network "keep-alive" application platform



HP E448XA, E449XA

Communications Products

This family of modular communications products is designed to provide telephone companies and network providers with a cost-effective way to maintain service while installing new T-Carrier and SONET-based network equipment. It consists of a compact, standardized, multi-purpose equipment shelf and plug-in product modules, which are each packaged separately. Communications modules, which are shipped ready-to-use, include:

- DS1 Bridge Amplifier
- E1 Bridge Amplifier
- DS3 Bridge Amplifier
- STS-1 Bridge Amplifier
- DS3 Bridge Repeater
- DS3 Signal Source
- STS-1/DS3 Signal Source

Applications and Features

These communications products can be used to support applications including:

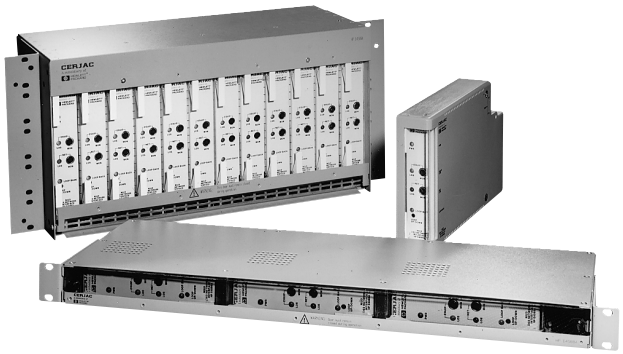
- Standard cut-over, reconfiguration and emergency restoral
- Re-routing of service around construction sites
- Extension of cross-connect distance
- Generation of "keep-alive" signals for spare fiber and radio routes

Intuitive controls and output connectors are conveniently located on each module's front panel, so the communications product family requires a minimum of operator training and is easy to use. And because any combination of plug-in modules can be mixed within a single shelf, users can configure a general-purpose portable tool, or support specific applications, as required.

Ordering Information

E4488A
Opt 001 12-slot, 33 cm (13 in) rackmount
Opt 002 12-slot portable
Opt 003 16-slot 48 cm (19 in) or 58 cm (23 in) rackmount
E4489A STS-1/DS3 signal source for use in E4488A
Opt 001 Add single channel error burst
Opt 002 Add Stratum-3 on-board STS-1 clock
E4490A DS3 bridge amplifier
E4491A DS3 bridge amplifier with monitor
E4492A DS3 bridge repeater
E4493A DS3 signal source
Opt 001 Add single channel error burst
E4494A DS1 bridge amplifier
E4495A DS1 bridge amplifier with monitor

- Remote testing and maintenance device for DS3 services
- Quickly isolates network or customer equipment problems
- Cuts costs by reducing the need to dispatch technicians



NIU 1-slot, 3-slot, 12-slot

DS3 Network Interface Unit

The DS3 Network Interface Unit (NIU) serves as a demarcation point between the network and customer premises equipment (CPE). The NIU features loopback capabilities that can be used for remote test and maintenance, verification at customer service turn-up, and quick isolation of network or customer equipment problems.

Applications

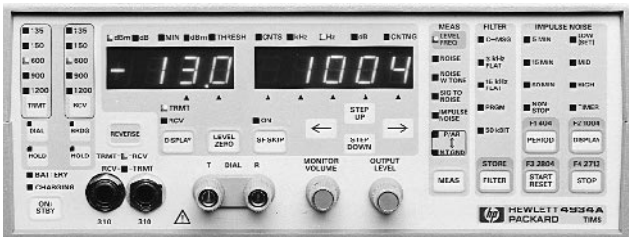
- Resides at the demarcation point between the customer premises and carrier network.
- Provides the ability to run a BERT between the Central Office and the NIU residing on the customer premises to isolate network/customer equipment problems.

Measurement Summary

Responds to ANSI T1.404, Network-to-Customer Installation "reserved for network use" loopback Far-End Alarm and Control (FEAC) codewords. Monitor ports available for on-site monitoring of network and customer equipment signals.

Ordering Information

HP E4586B DS3 NIU Interface Card Plug-in
HP E4587A 1-slot NIU Housing
Opt 001 248 Vdc Power Supply (115 Vac)
HP E4588A 3-slot NIU Housing for 23-inch Rack
HP E4589A 12-slot NIU Housing for 19-inch or 23-inch Rack



HP 4934A

HP 4934A TIMS

The HP 4934A transmission impairment measuring set (TIMS) increases installation and maintenance productivity for telephone companies and service providers through its ease of use, portability, and ruggedness. Measurements include:

- Level/frequency up to 110 kHz (200 kHz option)
- Noise and noise-to-ground
- Noise-with-tone and signal-to-noise ratio
- Three-level impulse noise
- P/AR
- RS-232 remote control (not available with J01/J02)

The HP 4934A TIMS Option J01 and J02 are versions of the instrument with measurements for installation and maintenance of voice frequency or wideband leased lines to CCITT specifications. Option J01 is for countries with 820 Hz holding tone and Option J02 is for countries with 1020 Hz holding tone. Measurements are to CCITT specifications:

- Level/frequency to 110 kHz
- Circuit noise
- Noise-with-tone and signal-to-noise ratio

(Optional battery with typical 6 hours of operation.)

Ordering Information

HP 4934A 110 kHz TIMS
Opt 001 Internal Battery and Charger
Opt 021 200kHz Wideband (ANSI VER only)
Opt J01 CCITT (820 Hz tone)
Opt J02 CCITT (1070 Hz tone)

HP 37701B or HP 37702A

HP 37701B and HP 37702A T1/Datacom Tester

The HP 37701B T1/datacom tester offers complete T1 and fractional T1 bit-error and signal measurements. It also generates tones in a channel and allows VF signals in any timeslot to be monitored. Test results are presented using easy-to-read bar charts allowing quick analysis of the circuit trouble. Tests can be performed using auto-configure or user-prestored setups for fast and easy testing. Optional pulse shape and clock slip analysis allow quick, graphic interpretation of distortion and timing problems. DTE/DCE interface and measurements can be added for datacom testing.

The HP 37702A digital data tester has all the functions of the HP 37701B plus DDS capabilities in one unit. It performs the full range of DDS testing from simple in-service tests to complete installation and acceptance tests. Built-in T1 channel access allows access to a signal in any timeslot.

Measurement Summary

T1: Auto code, frame, and pattern detection, error monitoring, BER testing, alarm, and event generation, ESF decode and encode, DS1 signal level and frequency, fractional T1 n x 56 or n x 64 kb/s contiguous or non-contiguous
DDS: (DS0A, DS0B) BER testing, error correction, error monitoring, loop back operation and MJU control

Ordering Information

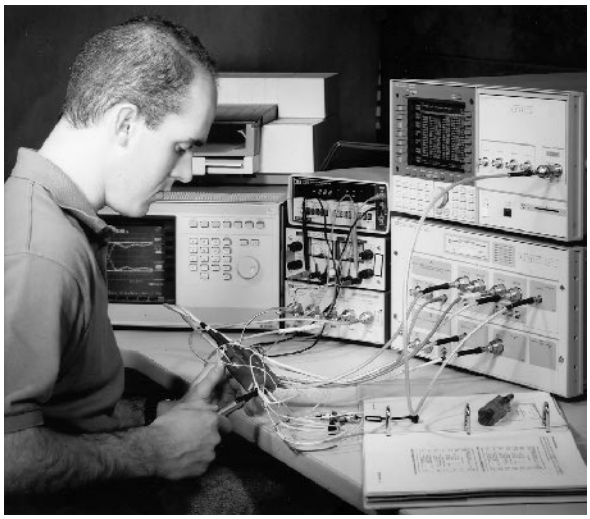
HP 37701B T1/Datacom Tester
HP 37702A T1/DDS Tester
Opt 001 Pulse Shape
Opt 002 Data Comm
Opt 004 DS0B Testing (HP 37702 only)

Digital Transmission Testers

Gigabit Error Performance Analyzers and Pattern Generators

HP 71603B
HP 71604B
HP 71612B Series
HP 71501C
HP E4543A
HP E4544A

- User-programmable patterns with screen-based editor
- Hitless switching between two programmed patterns
- Trigger anywhere in pattern
- Automatic setting of clock/data phase and data decision threshold
- Advanced eye-diagram analysis
- Full jitter analysis capabilities
- Fast transition times, low jitter
- Burst-mode capability for fiber-loop testing (HP 71612B)
- 4 sub-rate outputs for WDM testing (HP 71612B)
- Location of specific errored bits (HP 71612B)



HP 71612B

HP 71603B 3 Gb/s Error Performance Analyzer

Comprises Pattern Generator, Synthesized Clock Source and Error Detector

The HP 71603B covers the range 100 Mb/s to 3 Gb/s and features automatic clock/data alignment for rapid setup of the error detector. The HP 71603B makes measurements on waveforms badly distorted by noise, jitter, inter-symbol interference through the high-resolution setting of decision threshold, and phase adjustment.

HP 71604B 3 Gb/s Pattern Generator

Comprises Pattern Generator and Synthesized Clock Source

The HP 71604B covers the range 100 Mb/s to 3 Gb/s and features pseudo-random test patterns up to 2^{31}–1 bits long. Users can program and run variable length test patterns from 1 bit to 4 Mb long on MS-DOS-compatible disks.

Applications

Component test
GaAs and high-speed silicon; electrical and optical components

Module/system test
SONET and SDH; broadband video and ATM; submarine cable; high-speed datacom, LAN and computer peripheral communication

Specifications (typical)

Bit Rate: 100 Mb/s to 3 Gb/s (optional 50 Mb/s to 3 Gb/s)
Rise Time: (20% to 80%): < 90 ps
Patterns: 2^7–1 to 2^{31}–1, user patterns to 4 Mb
Data and Data Outputs: 0.25 V to 2 V p-p amplitude; +1 V to –3.75 V range
Data Input Sensitivity: < 50 mV @ 2.5 Gb/s
Decision Threshold Voltage: +1 V to –3 V, resolution 1 mV
Clock/Data Delay: ± 1 ns; resolution 1 ps
Measurements: Error count, ratio, errored-intervals, G.821 analysis, eye width and height

Ordering Information

HP 71603B Error Performance Analyzer.
HP 71604B Pattern Generator.
Individual modules can be ordered separately.

Lightwave Interfaces
The HP 83446 A/B lightwave receivers can be used together with the HP 83430A lightwave digital source and the HP 71603B/4B to form a complete high-performance optical parametric stimulus/response test system for SDH/SONET and WDM.
HP 83446A Lightwave Clock/Data Receiver 2.48832 Gb/s .
(includes FC/PC connector interface)

HP 71612B Series 12 Gb/s Testers

The HP 71612B series of 12 Gb/s products includes an error performance analyzer, pattern generator, and error detector, with similar functionality to the 3 Gb/s series. User pattern length has been increased to 8 Mb, and this series offers Error Location Analysis. The HP 71612B Option UHF error performance analyzer and Option UHG pattern generator have four sub-rate pattern outputs at one quarter of the output rate.

Applications

The increased speed and pattern size allow the simulation of SONET and SDH frames at the STM-64/STS-192 transmission rate and margin testing up to 12 Gb/s. The burst mode feature allows fiber-optic loop tests, while Error Location Analysis allows the identification of pattern dependent errors for user defined patterns.

Specifications (typical)

Bit Rate: 1 to 12 Gb/s (optional 100 Mb/s to 12 Gb/s)
Patterns: Same as the HP 71603B with user patterns extended to 8 Mb
Transition Times: (10% to 90%) <30 ps
Jitter: <15 ps p-p @ 10 Gb/s
Data and Data Outputs: 0.5 V to 2 V p-p amplitude; +1.5 V to –3.0 V range
Data Input Sensitivity: <50 mV @10 Gb/s (typical)
Decision Threshold Voltage: +1 V to –3 V: resolution 1 mV
Clock/Data Delay: ±1 ns up to 500 MHz; 1 clock period 500 MHz to 12 GHz
Measurements: Same as HP 71603B with the addition of optional Error Location Analysis

Add Jitter Analysis Capability to the HP 71603B or 71612B

Full jitter analysis capability can be achieved with either the HP 71603B or 71612B with the addition of the HP 71501C. Measurements include jitter transfer, jitter tolerance and jitter generation over the full data rate range of the error performance analyzer.

HP E4543A Q-Factor and Eye-Contour Software

This PC-based software automates measurements made by the HP 71612B/71603B, providing rapid analysis of eye-diagrams in optical line systems. The HP E4543A software controls the acquisition of measurement data and interprets and displays the eye contour and Q-factor which can be used to estimate very low BER.

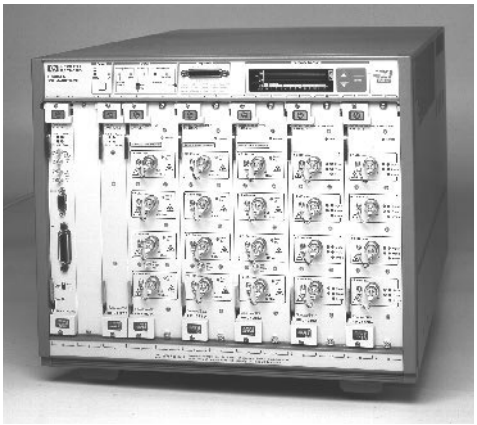
HP E4544A SONET/SDH Functional Test Software

This PC-based software allows the user to construct SONET/SDH frames up to OC-192/STM-64 and load them into the pattern memory of the HP 71612B/71603B. Frames can be edited to inject specific parity errors and alarm conditions.

Ordering Information

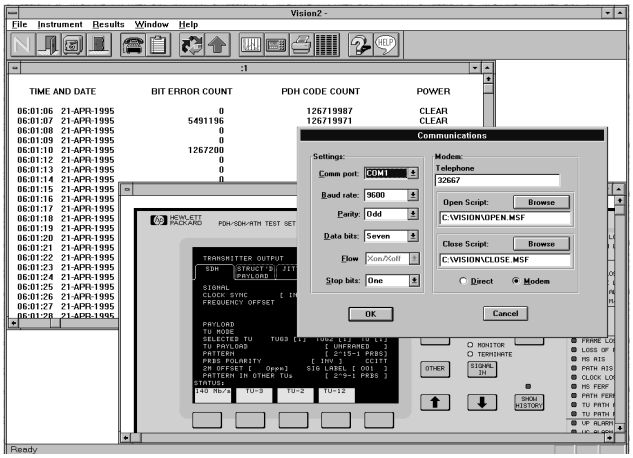
HP 71612B Opt UHF Error Performance Analyzer .
HP 71612B Opt UHG Pattern Generator .
HP 71612B Opt UHH Error Detector .
HP E4543A Analysis Software .
HP E4544A Functional Test Software.

- Modular and scalable DWDM test solution
- Open and flexible system architecture
- High channel count in a small footprint
- Low cost of test-per-channel



HP SpectralBER

- Low-cost distributed network analysis software
- Controls the HP OmniBER and HP 37XXX range of portable test sets
- Creates a multisite remote monitoring and results retrieval system



HP E4540A

HP SpectralBER 2.5 Gb/s Test Solution

HP SpectralBER offers a flexible and cost-effective approach to testing DWDM, OXC and OADM systems. Being both modular and expandable, it can be tailored to match any production stategy—whether low-volume, high mix or high-volume production. In addition, as optical network elements evolve and channel counts increase, this test solution can be scaled to meet production demand quickly and cost-effectively.

Using the open VXI architecture as its platform, HP SpectralBER provides high test port density in a small footprint. This allows DWDM systems with high channel counts to be tested simultaneously for faster throughput while avoiding congestion on the production floor. In addition, HP SpectralBER's open-system approach enables the integration of other test and measurement modules within the same test stand for faster and easier test development.

Aimed at satisfying the line-final, system-integration and quality-assurance requirements of DWDM, OXC and OADM manufacturers, HP SpectralBER provides functional test capability for optical add/drop multiplexers, optical translators, transponders and multi-channel systems. Additional capabilities include BER performance, concatenated payloads to simulate live traffic, and path trace to identify individual channels for continuity tests. SONET/SDH overhead performance monitoring and analysis is also provided, together with error injection and alarm monitoring.

Control of the HP SpectralBER is via an interactive virtual panel, or instrument driver, or directly via SCPI commands. The system also supports both short- and long-reach optics covering every wavelength on the ITU-T grid.

Key Features

HP SpectralBER's quality-of-service and DWDM features include:

- 1310 nm, 1550 nm or ITU-T wavelengths
- Bit; B1, B2 and J0 byte monitoring and analysis
- Long- or short-reach optics for transmitter and receiver
- BER system performance
- Error injection and detection
- Alarm detection
- Manual gating

Key Literature

Brochure, p/n 5968-4022E
Specifications, p/n 5968-5444E
Configuration Guide, p/n 5968-5448E

Ordering Information

HP SpectralBER 2.5 Gb/s DWDM test solution.
For all other options and pricing, please contact the HP Call Center in your region.

HP E4540A Distributed Network Analyzer Software

The HP E4540A allows the creation of a low-cost distributed network analysis system to reliably gather information about network performance from remote test sets. It avoids the large commitment of time and resources needed to implement a dedicated network management system—an important benefit with network technologies changing so rapidly. The HP E4540A distributed network analyzer software controls HP's range of HP OmniBER and HP 377XXX test sets, and allows the creation of an extensive measurement and data analysis system. With this PC software it is possible to control one instrument (at a local or remote site) or a number of instruments in a multi-site system.

With network technologies evolving rapidly, it is difficult to keep up to date with ever-changing test procedures. The HP E4540A interactive diagnostics allow the maximum use of scarce test engineering expertise. The expert at the central control site, using virtual instrument displays, can interactively work with technicians at the remote site. Test sequences simplify complex testing of new technologies. Key HP E4540A features include:

- No software expertise required to use the HP E4540A
- Robust automatic results retrieval for monitoring network performance
- Transfer of results into MS Windows applications for analysis, or to produce graphs and reports
- Simplified installation and maintenance testing using stored test sequences and configurations
- Real-time update of keystrokes at remote site and central site

The HP E4540A analyzer software is Windows-based, operating on a PC or laptop, and connects to the remote site via Hayes compatible modems, or using the LAN remote control port available on the test set.

Ordering Information

HP E4540A Distributed Network Analyzer
Opt 0A9 10 User License
Opt UAT Unlimited User License
Opt USS Distributed network analyzer firmware

Note: Opt USS required in HP 377XXX test set (not required for HP OmniBER 718 and HP OmniBER 719)

HP OmniBER 718
HP OmniBER 719

NEW

- Multi-rate testing to OC-48/STM-16, including jitter
- Supports concatenated payloads to OC-48c/STM-16c
- Comprehensive measurement capability includes protection switching tests, mixed payload generation and analysis, and pointer processing
- HP Smart Test offers fast access to key measurement tasks
- Works with HP E4540A distributed network analysis software

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HP OmniBER 718 Communications Performance Analyzer

The HP OmniBER 718 offers SDH or dual SONET/SDH testing to STM-16/OC-48 including STM-16c/OC-48c payloads. Rugged and portable, this single-unit solution is ideal for installation, maintenance and manufacturing of SDH and SONET networks and network elements. It provides full PDH/T-carrier capability and SDH/SONET capability. Plus, it has a large, multi-window color display, optional graphics printer, and integral 3.5 inch disk drive for results storage/retrieval and firmware upgrades.

SDH/SONET

The HP OmniBER 718 provides a single set of multi-rate optical interfaces covering SONET/SDH BER and jitter testing at 52 Mb/s, 155 Mb/s, 622 Mb/s and 2.5 Gb/s. In addition, it provides full ITU-T G.707/GR.253 mapping support including concatenated payloads at STM-1/OC-3c, STM-4c/OC-12c and STM-16c/OC-48c. Optical 1310 nm and 1550 nm interfaces are supported as well as electrical interfaces at 52 Mb/s and 155 Mb/s. Key measurements supported are SONET/SDH error/alarm generation, APS times, mixed payloads generation/detection, pointer sequence generation, overhead sequence generation and detection. The instrument supports full mux/demux from 2.5 Gb/s to n x 64 or n x 56 kb/s. The user interface provides error and alarm stored measurement graphics, pointer graphs, in-service alarm/BIP scan and out-of-service tributary scan.

HP Smart Test capability provides fast access to key measurement tasks. HP Smart Setup provides an easy-to-use graphical means of detecting unknown payload structures and aids the user to quickly setup the instrument. This mode also provides fast detection of payload test patterns.

Full thru-mode capability at all synchronous rates (optical and electrical) is provided with internal TU-n/VTn drop/insert for SDH/SONET ring testing.

PDH/T-carrier

PDH interfaces are supported at ITU-T rates of 2, 8, 34 and 140 Mb/s plus T-carrier rates of DS1 and DS3. Full mux/demux is available, as is PDH/DSn error/alarm generation and detection.

Jitter and Wander

Jitter generation/measurement to ITU-T O.171/O.172 is available from 2.5 Gb/s through 622/155/52 Mb/s to PDH rates from 140 Mb/s to 2 Mb/s/DS1. Automatic jitter tolerance and automatic narrowband jitter transfer testing is available to ITU-T G.958 for SDH network elements, GR-253 for SONET, and ITU-T G.823 for PDH network elements. Full jitter and wander generation to ITU-T G.825 is available, plus transient pointer jitter measurements to ITU-T G.783/GR.253 and SDH/SONET line rate jitter to ITU-T G.958/GR.253 with RMS and peak-to-peak jitter measurements. Wander generation plus wander measurements at all rates are supported.

HP OmniBER 719 Communications Performance Analyzer

The HP OmniBER 719 offers SONET testing to OC-48 including OC-48c payloads. Rugged and portable, this single-unit solution is ideal for installation, maintenance and manufacturing of SONET networks and network elements. It provides full T-carrier capability and SONET capability. Plus it has a large color display, optional graphics printer, and integral 3.5 inch disk drive for results storage/retrieval and firmware upgrades.

SONET

The OmniBER 719 provides a single set of multi-rate optical interfaces covering SONET BER and jitter testing at 52 Mb/s, 155 Mb/s, 622 Mb/s and 2.5 Gb/s (OC-1 through to OC-48). In addition, it provides full GR.253 mapping support including concatenated payloads at OC-3c, OC-12c and OC-48c. Optical 1310 nm and 1550 nm interfaces are supported as well as electrical interfaces at 52 Mb/s and 155 Mb/s. Key measurements supported are SONET error/alarm generation, APS times, mixed payload detection, pointer sequence generation, overhead sequence generation and detection. The instrument supports full mux/demux from 2.5 Gb/s to n x 64 or n x 56 kb/s. The user interface provides error and alarm stored measurement graphics, pointer graphs, in-service alarm/BIP scan and out-of-service tributary scan.

HP Smart Test capability provides fast access to key measurement tasks. HP Smart Setup provides an easy to use graphical means of detecting unknown payload structures and aids the user to set up the instrument quickly. This mode also provides fast detection of payload test patterns.

For SONET ring testing, thru-mode capability is supported at all synchronous rates (optical and electrical). In thru-mode, DSn payload signals can be added and dropped from the live signal.

T-carrier

T-carrier interfaces are supported at rates of DS1, DS3, E1 and E3. Full mux/demux is available, as is DSn error/alarm generation and detection.

Jitter and Wander

Jitter generation/measurement is available from 2.5 Gb/s through 622/155/52 Mb/s to T-carrier rates from DS3/E3 to DS1/E1. Automatic jitter tolerance and automatic narrowband jitter transfer testing is available to GR.253 for SONET network elements. Transient pointer jitter measurements and SONET line rate jitter to GR.253 with RMS and peak-to-peak jitter measurements are supported, as are wander measurements at all rates.

Ordering Information

HP OmniBER 718 Communications Performance Analyzer
HP 37718A For rates 2.5 Gb/s and below
  Opt 001 SDH test.
  Opt 002 SDH/SONET test.
HP 37718B For rates 622 Mb/s and below
  Opt 001 SDH test.
  Opt 002 SDH/SONET test.
HP 37718C For rates 155 Mb/s and below
  Opt 001 SDH test.
  Opt 002 SDH/SONET test.
HP OmniBER 719 Communications Performance Analyzer
HP 37719A For all rates.

HP E4480A
HP E4487A

- Field-portable test sets for SONET, ATM and T-carrier testing
- Flexible configuration for evolving network testing needs
- Available with OC-12c/OC-3c and ATM testing capabilities

CERJAC 156MTS

CERJAC 156MTS and Series 31XE SONET, ATM and T-carrier Maintenance Test Sets

GPIB

The field-portable HP E4480A CERJAC 156MTS combines SONET, ATM and T-carrier testing for installation, qualification, and maintenance testing from OC-12 to DS0. The instrument provides a wide array of options to support evolving network measurement needs. "Auto" and "Troublescan" capabilities quickly synchronize with complex network configurations to report errors on a high-contrast display. A full suite of BER test patterns with alarm, error, and pointer monitoring and generation capability is included for T-carrier, clear-channel and ATM payloads.

The HP E4487A CERJAC Series 31XE provides identical capability for testing from STS-1 electrical to DS0.

SONET Applications

- SONET testing at OC-12/3/1 optical interfaces (156MTS only)
- SONET testing at STS-1/B3ZS interface
- Transmission and multiplexer testing
- Alarm stimulus/response testing
- Transport overhead and path trace programming and display
- STS-1 jitter measurements
- Error injection and analysis

ATM Applications

- STS-12c/3c ATM payload testing (156MTS only)
- DS3/HEC, DS3/PLCP, E1, DS1 ATM payload testing
- Foreground and background channel testing
- Cell loss, cell delay and inter-arrival cell delay measurements
- AAL0 and AAL1 BERT testing
- Automatic VP/VC scan and cell capture with filtering

T-carrier Applications

- Full DS3/DS1/FT1/E1/FE1/DS0 transmission testing
- DS1/DS0 testing via M13 or VT1.5 async and byte sync
- E1/TS testing and E1-in-DS3
- DS3, DS1 and E1 jitter measurements
- DS3 pulse mask measurements
- DS1 in-band and out-of-band loop-up and loop-down testing

Measurement Summary

Common to both products unless otherwise stated.

Optical Interfaces (156MTS only): OC-12, OC-3, OC-1. 1310 nm and 1550 nm; intermediate and long reach lasers; interchangeable connectors available. Receive optical power and frequency measurements.

Electrical Interfaces: STSX1/B3ZS, DSX3/B3ZS, E1/AMI/HDB3, DSX1/AMI/B8ZS. Receive peak electrical level and frequency measurements.

Frame Formats and Mappings

SONET (156MTS only): STS-12, STS-12c, STS-3, STS-3c.
SONET: STS-1, DS3 and VT1.5 async or byte sync structured.
ATM: AAL0 and AAL1.
DS3: M13, C-bit and unframed, DS1 and E1 structured.
DS1/FT1: D4, ESF, SLC, MBLT and unframed.
E1/FE1: TS0, TS0/16, TS0/CRC, TS0/16/CRC and unframed.

Timing References: Internal Stratum 3, DS1 BITS, loop timing and external.

Drop and insert interfaces: STS-1, DS3, E1, DS1, DCC, V/F.

Payloads (156MTS only): STS-12c, STS-12c/ATM, STS-3c, STS-3c/ATM.
Payloads: DS3, DS3/ATM-HEC, DS3/ATM-PLCP, DS3/DS1/DS0, DS3/E1/TS and VT1.5/DS1/DS0.

Internally Generated Patterns: PRBS23, PRBS20, PRBS15, PRBS11, PRBS9, PRBS6, QRSS, all 1's, all 0's, 3 in 24, 0/1, 55 octet and programmable user patterns.

Jitter Measurements: STS-1 to GR.253, DS3/DS1 to GR.499, E1 to ITU-T G.823, measurement range 0.1-12UI peak-peak, resolution 0.1UI, accuracy +/-5% +/-0.05UI, programmable hits threshold.

Alarm Testing

SONET: LOS, LOF, LOCLK, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, AIS-V, LOP-V, RDI-V.
ATM: LOS Cell sync, SCNR, LOPAT, VP AIS and RDI, VC AIS and RDI.
DS3: LOS, FFM, OOF, LOP, AIS, CV.
DS1: LOS, OOF, LOP, AIS, Yellow, COFA, Ones density, CDI (Idle).

Error Add and Monitor

SONET: BPV, Frame, B1, B2, B3, REI-L, REI-P, Data, VT1.5 BIP and REI-V.
ATM: HCS, Data, PLCP.
DS3: BPV, Frame, Data, C1, C2, C3, X-bit, FEBE.
DS1: BPV, Frame, CRC, Data.

Overhead Testing

Section: AI, A2, C1, E1, FI and D1-D3.
Line: K1, K2, D4-12, Z1, Z2, E2.
Path: B3, C2, G1, F2, Z3-Z5.
VT: V4, V5.

APS Message Testing: Message displayed in text form to Bellcore GR.253.

Path and VT Path Trace: Generates and monitors user programmable 64 byte sequence.

STS and VT Pointer Monitoring: Increment, decrement and new pointer.
Remote Control: RS-232 and HP-IB SCPI controllable, RS-232 remote front panel, field downloadable software upgrades via RS-232.

Ordering Information

For full option details, please refer to Brochure 5966-2243E
HP E4480A CERJAC 156MTS SONET tester.
- **Opt UQG** OC-3/1 testing with 1310nm IR optics.
- **Opt UQK** OC-12/3/1 testing with 1310nm IR optics.
- **Opt 201** Base jitter measurement.
- **Opt 206** 1550nm IR rear-panel laser.
- **Opt H15** STS-1 jitter filter.
- **Opt UQP** DS3 jitter filter.

HP E4487A CERJAC Series 31XE tester.
- **Opt UQP** DS3 jitter measurement.

The following options are common to both products:
- **Opt URZ** Advanced ATM testing.
- **Opt URR** DS3 test with drop/insert from STS-1.
- **Opt 202** DS3 pulse mask measurements.
- **Opt UQZ** Second DS3 transmitter and receiver.
- **Opt URS** DS1/DS0 test with drop/insert from DS3.
- **Opt UQA** VT1.5 mapping.
- **Opt USO** Fractional T1 testing.
- **Opt UQQ** DS1 jitter filter.
- **Opt URQ** E1/TS test with E1 drop/insert from DS3.
- **Opt UQR** E1 jitter filter .
- **Opt UHR** HP-IB and RS-232 SCPI interface.

HP E6322A DS3 pulse mask graphic software.
HP E6347A Remote front panel software.
HP E6348A Remote event logging software

HP E4200B
HP E4210B

NEW

HP E4200B/E4210B Broadband Series Test System

HP Broadband Series Test System

When time-to-market really counts, the best engineers turn to the industry-standard HP Broadband Series Test System (BSTS).

The internet is creating a new world in which the huge volume of data traffic is rapidly overtaking voice. The force of change is driving a global "FastPacket" revolution – the rapid development of high-speed, packet-based technologies and totally new network architectures. Circuit-switched networks are being supplanted by terabit carrier-class IP routers, multi-layer hardware-based packet and cell switches, and faster access based on ADSL, cable, Passive Optical Networks and 3rd-generation wireless technologies.

The BSTS has always been on the leading edge of ATM technology for developers of ATM switches and network services. BSTS has the largest worldwide installed base and is renowned for its reliable, accurate measurements and its support of industry standards. Now, with a new wave of innovative solutions for LAN, WAN, POS, and IP testing, the industry-standard BSTS is helping equipment developers and service providers lead the FastPacket revolution and accelerate the time to market of their broadband network products and services.

It offers:

- The most comprehensive standards-based Traffic Management test solution
- The widest range of signalling capabilities
- The fastest identification and diagnosis of signalling problems
- The best characterization of multi-layer switch-router performance
- The first choice 3rd-generation wireless test solution

ATM Traffic Management Test Solution

BSTS offers the most comprehensive standards-based test solution for ATM Forum Traffic Management compliance. The E1607A/E1609A ATM Stream Processors use the industry-standard O.191 test cell and a multi-stream GCRA-compliant scheduler for real-time traffic contract verification, guaranteeing accurate, industry-accepted test results.

The E6287A ABR Emulator, E4219A ATM Network Impairment Emulator, and the E6270A OAM Protocol Tester provide powerful, hardware-based solutions that make the BSTS the only analyzer that can adequately measure the dynamic behavior of ATM's real-time protocols.

Physical interfaces at rates up to 2.4 Gb/s are available and can be used with any of these modules. LIFs perform extensive transmission and ATM layer test functions.

ATM Signalling Test Solution

The E4209B Cell Protocol Processor (CPP) and the E1600A Multiport UNI Signalling Performance test solution form the foundation of the BSTS signalling test solution. With software applications and test suites for UNI, PNNI, NNI, ILMI, and VB5 protocols, including MTP-3b emulation, complete ILMI emulation and SSCOP control, BSTS has the most comprehensive signalling protocol coverage available for the functional, performance and conformance testing of ATM signalling. Users can regression-test all protocols over all line interfaces up to 2.4 Gb/s.

A comprehensive range of BSTS conformance and interoperability test suites, such as the E7838A Point-to-point PNNI signalling suite, allows network equipment manufacturers and service providers to ensure their products meet the requirements set out in protocol specifications. Test suites are ATM Forum-compliant, which means that the test methods have been developed by those who write the standards. A range of TTCN automation tools lets you rapidly develop or customize your own tests in an industry-standard high-level language. Software applications use HP-developed signalling protocol stacks, offering independent protocol verification—many analyzers use the same 3rd-party stacks as ATM switches!

BSTS offers the fastest identification and diagnosis of protocol implementation errors and performance bottlenecks. With the ability to generate signalling call loads and rapidly correlate measurements across multiple ports, the multiport UNI test solution offers realistic SVC performance benchmarking for today's distributed signalling switch architectures. Because it can monitor physical, ATM, and AAL-5 errors and SVC call failure reasons in real-time, the BSTS can rapidly detect and identify the cause of performance bottlenecks—which reduces the time-to-market for your broadband equipment or network services.

Switch-Router Test Solution

With the evolution of wire-speed switch-routers from enterprise networks to core carrier data networks, Packet-over-SONET/SDH (POS) is now an accepted layer 2 protocol for high-speed IP public data network connectivity. However, switch developers and service providers are concerned about the reliability and performance of these carrier-class routers under real-world conditions. With products such as the E4202A 2.4 Gb/s ATM/POS Analyzer Bundle, the BSTS offers the world's first POS test solution at 155 Mb/s, 622 Mb/s and 2.4 Gb/s line rates with real-time scrambling and PPP emulation for active connection to the router under test.

Next-generation multiservice switches have evolved from traditional IP routers and ATM switches into a hybrid architecture that harnesses the benefits of ATM's cell-based fabric, coupled with IP's ubiquitous deployment from the enterprise to the core. The E6283 Packet Performance Application and the E1607/E1609A ATM Stream Processors provide real-time, standards-compliant cell and packet performance measurement to industry-accepted standards such as ATM Forum O.191 and IETF RFC-1944/2544. To accurately validate packet forwarding and characterize the performance of routers with multi-layer packet forwarding, the dual-port E6282A Ethernet Frame Processor is a complete test solution that offers 8 streams of real-time layer 2 to layer 7 filtering and QoS/CoS measurement.

The BSTS offers the common line interfaces for ATM, POS, Frame Relay, Ethernet and HSSI in one platform, enabling IP and interworking testing in the industry-standard broadband test system.

3rd Generation Wireless Test Solution

The need for ubiquitous, high-speed internet and intranet access and the shortage of available radio channels are driving the development of spectrum-efficient 3rd-generation wireless network architectures with data rates of up to 2 Mb/s. ATM is the key technology used to multiplex voice, data, and signalling between the fixed network elements.

BSTS is the first-choice 3rd-generation wireless test solution that couples innovative 3G protocol applications with comprehensive multi-layer ATM testing, enabling engineers to bring their 3G network elements and systems and mobile services to market faster and with greater confidence. The E4224A W-CDMA Test Software provides dedicated higher-layer protocol analysis for systems based on the 3GPP W-CDMA specification.

For 3GPP (W-CDMA), 3GPP2 (CDMA-2000), and other 3G specifications, encodes and decodes for ATM Adaptation Layer protocols such as ITU-T I.366.1 SSTED/SSSAR, AAL-2, and AAL-5 are available for the BSTS using the E4212B AAL Test Software. The E4219A Network Impairment Emulator, E1607A/E1609A ATM Stream Processor and other BSTS products offer a comprehensive ATM-layer test solution for 3G wireless test applications.

Modular Architecture

A flexible architecture allows you to start with a basic, cost-effective configuration and expand your test capability as your test needs change. The BSTS is modular, UNIX-based test platform with all the UNIX advantages of power, TCP/IP networking via an Ethernet port, X-Windows remote operation, and multi-user shared access.

The BSTS is available in two system platforms. The HP E4210B Form-13 mainframe is a rack-mountable chassis with 11 open slots for modules. The HP E4200B Form-7 transportable base, with 5 open slots and a built-in monitor and keyboard, is ideal for field trials. HP BSTS modules and software applications are the same for both platforms.

HP E4200B
HP E4210B
HP E5200A

ATM Traffic Management
E5115A BSTS ATM Traffic Management Test Solution
E1609A 0-622 Mb/s ATM Stream Processor
E1607A 0-155 Mb/s ATM Stream Processor
E4202A/S 2.4 Gb/s ATM/IP Analyzer Bundles
E4219A ATM Network Impairment Emulator
E6270A OAM Protocol Tester for the BSTS
E6287A ABR Emulator
E4209B 0-155 Mb/s Cell Protocol Processor (CPP)
E4212A AAL Test Software
E4212B AAL Test Software with AAL-2
E4223A Policing and traffic characterization SW
E7820A ATMF UNI 3.0 ATM Layer CTS for Int. Sys.
E7821A ATMF UNI 3.0 Interop. TS for Int. Sys.
E7822A ATMF UNI 3.0 ATM Layer CTS for End Sys.
E7830A ATMF UNI 3.1 ATM Layer CTS for Int. Sys.
E7831A ATMF UNI 3.1 Interop. TS for Int. Sys.
E7832A ATMF UNI 3.1 ATM Layer CTS for End Sys.

ATM Signaling
E5116A BSTS ATM Signaling Test Solution
E1600A Multiport Test Module
E1601A Quad OC-3c/STM-1 Multimode Port Adapter
E1602A Quad OC-3c/STM-1 Singlemode Port Adapter
E4209B 0-155 Mb/s Cell Protocol Processor (CPP)
E4212A AAL Test Software
E4214B UNI Signaling Test Software
E4217B NNI Signaling Test Software
E5145A VB5 Signaling Test Software
E6273B ILMI Emulation Test Software
E6280A PNNI Test Software
E7823A ATMF UNI 3.0 Signal. CTS for Net. Side
E7833A ATMF UNI 3.1 Core Signal. CTS Net. Side
E7833C ATMF UNI 3.1 Complete Signal. CTS Net. Side
E7834A ATMF UNI 3.1 Core Signal. CTS Net. Side
E7842A ATMF UNI 3.x ILMI Addr.Reg.TS User Side
E7843A ATMF UNI 3.x ILMI Addr.Reg. TS Net.Side
E7844A ATMF UNI 4.0 Core Signal. CTS Net. Side
E7845A ATMF UNI 4.0 Core Signal. CTS User Side
E7838A Point-to-point PNNI Signaling CTS
E7839A PNNI Routing CTS for single Peer Groups

Switch-Router Testing
E5118A BSTS Switch-Router Test Solution
E4200/10B #050 622 Mb/s POS Bundle
E4200/10B #055 155 Mb/s POS Bundle
E4202A 2.4 Gb/s ATM/POS Bundle (1310 nm)
E4202S 2.4 Gb/s ATM/POS Bundle (1550 nm)
E16158 2.4 Gb/s ATM/POS Generator/Analyzer
E4211A SMDS Test Software
E4213A SMDS DXI Test Software
E4213B SMDS DXI Software with FRP Support
E4215B LAN Protocols Test Software
E4216A Frame Relay Test Software
E6272B LAN Emulation Test Software
E6275A FUNI Test Software
E6278A Frame Relay SVC Protocol Viewer
E6279A Frame Relay over HSSI Test Software
E6282A 10/100 Mb/s Ethernet Frame Processor
E6283A Packet Performance Application
E7293B ATMF LANE 1.0 Compl. Service Testing ETS
E7840A Bellcore FR/ATM Interworking Test Suite
E4204A HSSI Line interface
E4206A T1/E1 Frame Processor
E4207A V interface Frame Processor

3rd Generation Wireless
E5117A BSTS 3G Wireless Test Solution
E4224A W-CDMA Test Software
E4212B AAL Test Software with AAL-2
E4219A ATM Network Impairment Emulator
E4209B 0-155 Mb/s Cell Protocol Processor (CPP)
E1607A/E1609A ATM Stream Processors

Other Line Interfaces
E1610A 34 Mb/s Line Interface for BSTS
E1612A 155 Mb/s Electrical Line Interface
E1613A 6.3 Mb/s J2 Electrical line interface
E1614A 6.3 Mb/s J2 Optical Line Interface
E1616A 1.5/45 Mb/s DS1/DS3 Line Interface
E1617A 52 Mb/s Optical Line Interface
E1618A 622Mbps Optical Line Interface
E1619B 25.6 Mb/s ATM Line Interface
E1696A 155 Mb/s ATM Optical load generator
E1697A 155 Mb/s Optical line interface
E4201A 2 Mb/s E1 Line Interface
E4204A HSSI Line interface
E4205A 155 Mb/s UTP-5 Line Interface
E4206A T1/E1 Frame Processor
E4207A V interface Frame Processor

Automation Tools
E5576A Test Manager Integration Kit - 1 User
E7310A TTCN Productivity Tools - 1 user license
E7313A HP-ITEX TTCN Editor - 1 user license
E7329A Test Manager API
E7328A TM API Run-Time Code for add. Testers

MPEG over ATM
E4226B MPEG-2 Protocol Viewer Test Software
E6271A MPEGscope ATM test application

For More Information

For up-to-date product information, visit our web site:
http://www.hp.com/go/bsts

Contact your local HP representative and request BSTS Catalog (p/n 5966-0035E) or BSTS Brochure (p/n 5968-3035E)

HP E5200A

HP E5200A Broadband Service Analyzer

Hewlett-Packard's portable, dual-port E5200A Broadband Service Analyzer enables leading communications companies to deploy and maintain the latest broadband equipment and services simply and accurately. The service analyzer puts you in control immediately by providing service-focused measurements, not just test technology. The testing approach used by the service analyzer represents a fundamental change in measurement methodology from transport and protocol testing to one that gives a service-related view of network problems.

Applications

The HP E5200A Broadband Service Analyzer is a powerful and flexible measuring instrument designed to:
- minimize troubleshooting time
- help meet service delivery requirements
- characterize end-to-end Quality of Service
- enable rapid turn-up of both PVC and SVC ATM networks

Key Literature

Broadband Service Analysis–Coping with the Network Management Test Challenge, p/n 5965-1377E
HP E5200A Broadband Service Analyzer Brochure, p/n 5965-1378E
HP E5200A Broadband Service Analyzer Technical Data, p/n 5966-0714E

Communications Performance Analyzer

- ATM testing and LAN connectivity measurements
- Physical layer testing with jitter generation and analysis
- In-service and out-of-service testing supported for installation and maintenance or manufacturing test applications
- ANSI, ETSI and ATM Forum standards supported
- Full remote management with HP E4540 Distributed Network Analyzer software
- Portable and rugged; lid-based graphical printer available
- Designed to be soft-upgradeable, making it future proof
- Modular and configurable to suit your ATM test needs

HP OmniBER 717 Communications Performance Analyzer

The HP OmniBER 717 provides solutions for broadband testing from the physical layer up to service layers. The modular nature of this flexible instrument allows it to be configured to match a wide range of applications including installation and maintenance and manufacturing test applications. It can operate at all the most common ANSI and ETSI wide-area transmission rates.

In-Service ATM Analysis

Use the Channel View feature to find and identify up to 1023 active virtual channels on an ATM link, including even single cell events. Observe real-time cell rate/count simultaneously on all found channels. Post analysis of each active channel is performed automatically to identify the AAL or OAM cell type in use; ATM layer alarms are also displayed. Perform detailed analysis at the ATM or higher layers. Monitor real-time in-service cell delay variation graphically using 1-point CDV measurements and count non-conforming cells to I.356. Analyse I.610 performance management OAM cells to obtain cell loss and misinsertion results from live traffic. Analyse AAL errors to gain a useful indication of problems at the ATM layer.

Out-of-Service ATM Analysis

Generate and analyse O.191 Test Cells to obtain measurements for 2-point CDV, cell loss, cell misinsertion and cell errors, according to I.356. Generate up to ten virtual channels, each with a user-definable profile of constant, Poisson or bursty traffic. In addition to Test Cells, generate and analyze single cell or cross-cell (segmented) pseudo-random binary sequences. Inject single or double header errors or payload impairments and generate and identify ATM layer alarms using the F4 and F5 OAM flows.

Physical Layer Features, including Jitter

Analyze physical layer errors, perform G.826 analysis and generate physical layer impairments, generate and identify physical layer alarms. Measure the received clock rate and optical power, and offset the analyzer's internally-generated clock rate. Generate and analyze physical layer jitter which, together with the frequency offset capability, make this analyzer an important tool for checking the jitter tolerance of ATM interfaces.

Ethernet Connectivity

Check LAN over WAN connectivity on Ethernet networks. Use "pings" and Ping History to check the end-to-end service.

Specifications

Physical Layer (general)
- **Interfaces:** DS1 (1.5Mb/s), DS3 (45Mb/s, direct and PLCP mapped ATM), E1 (2Mb/s), E3 (34Mb/s), E4 (139Mb/s), OC-3c (155Mb/s), STM-1e / STM-1o (155Mb/s)

Physical Layer Generation
- **Alarm Generation:** LOS, LOF, AIS, RAI/RDI
- **Error Add:** DS1: FAS, BPV/code, CRC-6; DS3: FAS, MFAS, BPV/code, parity (P bits), CP (parity), FEBE, EXZ; DS3 PLCP: B1, FEBE, C1, frame; E1: FAS, BPV/code, CRC-4, REBE; E3: BPV/code, BIP
- **DS3 FEAC:** DS3 Loopback control

Physical Layer Analysis
- **Alarm Indication:** LOS, LOF, AIS, RDI/RAI, Loss of DS3 PLCP Frame, Loss of CRC multiframe, DS3 FEAC

ATM Generation
- **Cell Headers:** UNI and NNI, all fields programmable
- **Traffic Generation:** 1 foreground and 9 background virtual channels, each independently settable in bandwidth and distribution (constant, Poisson, bursty (adjustable rate during burst); foreground payload: Test Cell (O.191), PRBS-15, PRBS-23, S-PRBS-9, user-programmed repeating byte
- **Error Add:** Single and double header error; payload bit error
- **Alarm Generation:** VP-RDI, VP-AIS, VC-RDI, VC-AIS

ATM Analysis
- **Channel View Capture:** All VPs (or range) or VCs up to 1023
- **Channel View Display:** Cells/s, cell counts, % bandwidth (numerically and histographically), AAL type or OAM cell type, ATM alarm
- **Payload Analysis:** Test Cell (O.191) related results (to I.356): cell loss count/ratio, cell misinsertion count/rate, cell error count/ratio, mean transfer delay, 2-point cell delay variation; PRBS (as above) bit errors
- **Rate History:** Up to 1000 samples showing histographically the minimum, mean and maximum cell rate within each sample period (1 second to 1 hour)
- **AAL Analysis:** AAL-1: lost cells, corrected and uncorrected SNP errors, count of SAR-PDUs; AAL-3/4: SAR-PDU CRC-10 errors, lost cells, segment type errors, count of received CPCS-PDUs, count of received and aborted SAR-PDUs; AAL-5: CPCS-PDU CRC-32 errors, length errors, length over-run errors, received and aborted CPCS-PDUs
- **PM-OAM Analysis:** Cell loss/misinsertion, BEDC errors
- **In-service Analysis:** 1-point cell delay variation (to I.356)
- **Alarm Indication:** VP-RDI, VP-AIS, VC-RDI, VC-AIS

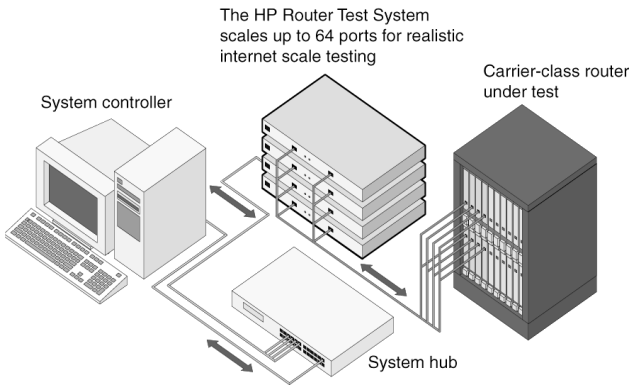
LAN Connectivity
- **LAN type:** 10 Mb/s Ethernet
- **Interface:** UTP (RJ45) and AUI
- **Network Protocol:** IP
- **LAN Generation:** Single packet manually initiated, continuous ping rate up to 10 per second, end-to-end packet load, variable packet load level from 1 to 550 packets per second, file transfer simulation (bulk transfer-approx. length 1M byte)
- **LAN Measurement:** Ping response time, ping packet return count, ping packet loss count, Ping History — graphically displays results over time, verification of file transfer.

Ordering Information

HP OmniBER 717 Communications Performance Analyzer*

* Price depends heavily on option mix.

- Test system for carrier class gigabit/terabit routers
- Full bandwidth IP packet generation and real time analysis
- Multiport, scalable architecture
- Dual port OC-12c or single or dual port OC-48c Packet over SONET/SDH modules
- Internet Scale BGP-4 routing protocol emulation



The router test system is a multiport, scalable solution for testing the performance of gigabit and terabit routers.

The Router Test System

The router test system is designed specifically for testing carrier class gigabit and terabit routers.

The router test system simulates realistic Internet traffic through integrated multi-flow traffic generation and routing protocol emulation. On the receive side, Nexstream performs real-time IP Quality of Service performance measurements on multiple traffic flows over many ports.

The router test system scales to up to 64 ports of OC-12c or OC-48c Packet over SONET/SDH (POS) interfaces. By generating and analyzing multiple streams of IP traffic in real time, the ability of a router to deliver varying service levels is stressed—to the limit.

Applications

The router test system:

- Stresses the IP packet switching mechanisms within a router by generating IP packets at wire speed (up to 6.1 million packets per second) from any port in the test system through to any other port, at wire speed.
- Measures IP destination address lookup, switching speeds and reliability by measuring the throughput, frame loss and latency of IP packets switched through a router.
- Measures the ability of a router to deliver QoS guarantees according to traffic type by simulating many different types of traffic per port.

High Speed Packet over SONET/SDH Interfaces

Packet forwarding performance is the hallmark of the backbone router. OC-12c and OC-48c POS interfaces deliver, at wire speed, the volume of packets needed to stress the switching and traffic prioritization features of the backbone router.

Multi-Stream Traffic Generation

Each port generates multiple streams of traffic at line rate, with each stream molded according to a distinct traffic profile. Each is characteristic of a stream of voice, a stream of web traffic, a video stream or any other type of traffic. A combination of these streams presents a realistic simulation of traffic to the router.

Real-Time Performance Analysis

Latency, throughput and IP packet sequence statistics are gathered concurrently in real time on multiple streams. Routing performance and QoS delivery can be correlated in order to determine the impact between streams.

Routing Protocol Emulation

The router test system emulates the Border Gateway Protocol version 4 (BGP-4) on every port. The BGP-4 emulation rapidly sets up a broad range of network addresses to closely simulate the diverse nature of network address assignments in the Internet.

Specifications Summary

NEW

System: The router test system consists of up to 32 test modules, connected via a Fast Ethernet hub to the system controller, a Hewlett-Packard Kayak PC. All traffic generation, stream analysis and protocol emulations are performed by the test modules. The graphical user interface running on the system controller allows the user to quickly and easily configure and control the modules, and to display real-time statistics and results.

Packet Over SONET/SDH Interfaces: Choose from a dual-port OC-12c POS module or a single or dual port OC-48c POS module. All modules provide a Packet over SONET/SDH interface according to RFC 1619. IP packets are encapsulated using PPP in HDLC like framing according to RFC 1662. The HDLC frame can be scrambled using a 1 + X43 scrambler.

Traffic generation: Up to 15 different traffic classes can be defined. Each traffic class is characterized by a traffic profile (burst or constant distribution), packet length and packet contents. Up to 256 different streams per port can be defined. Each stream assumes one of the traffic profiles plus a set of source/destination IP address pairs (up to 65,536 address pairs per port) and a source/destination TCP port identifier. This allows the user to define a realistic mix of traffic—combine streams characteristic of voice, ftp, http and real-time applications to simulate the types of services a router must manage.

Traffic meshes: Several types of traffic meshes can be defined. Meshes can be defined wherein all traffic streams are directed from a single port to one other port, from one port to many ports, or as a bidirectional fully meshed configuration wherein traffic streams from every port are directed to every other port. A bidirectional fully meshed configuration is characteristic of real network traffic, and can effectively reveal the performance of a router.

Stream Analysis and Statistics: All received packets are analyzed in real-time in order to determine the latency, frame loss and throughput on up to 15 separate streams per port, simultaneously. For example the impact on voice stream latency can be observed as the bandwidth consumed by an http or ftp stream increases, in real time. All timing measurements are accurate to 10 ns.

Routing Emulation: A router within the core of the Internet must maintain routing tables ranging in size of up to 100,000 or more routes. In order to quickly teach the router about these routes, each port within The router test system emulates the role of an Autonomous System. Each port exchanges routing information with the router via the Border Gateway Protocol version 4 (BGP-4). The system can automatically assign routes, or the user can manually configure the routes.

Programmable: An Application Programming Interface (API) is provided via the Tool Command Language (Tcl). Custom test scenarios, such as the creation of unique traffic patterns to emulate realistic Internet profiles, can be easily created. Custom scripts can also provide automatic configuration and test execution. The system controller can be networked, and scripts can run on any Microsoft Windows/NT or UNIX based workstation connected to the network.

Key Literature

The Router Test System—Gigabit through Terabit Router Performance Testing, p/n 5968-1046E
E7902A The Router Test System P12/2 Dual Port OC-12c Packet over SONET/SDH Test Module Technical Data, p/n 5968-5963E
E7901A/E7903A The Router Test System P48 OC-48c Packet over SONET/SDH Test Modules, p/n 5968-5970E
E7850A The Router Test System IP Performance Test Application Technical Data, p/n 5968-5967E
E7851A The Router Test System BGP-4 Emulation Application Technical Data, p/n 5968-5966E

Ordering Information

E7901A The Router Test System P48/2 (Dual-Port OC-48c POS Test Module)
E7902A The Router Test System P12/2 (Dual-Port OC-12c POS Test Module)
E7903A The Router Test System P48/1 (Single Port OC-48c POS Test Module)
E7890A The Router Test System System Controller
E7850A The Router Test System IP Performance Test Application
E7851A The Router Test System BGP-4 Emulation Application

For More Information

New modules and software applications for the Internet Performance Test System are introduced frequently. For the latest products news, information and specifications, visit our web site: **www.hp.com/go/RouterTest**

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Protect Your Networks

Installers and operators of fiber optic communications networks are faced with the continuing challenge of managing and maintaining their systems with near-perfect uptime and quality while employing the most cost-effective procedures and equipment available. Through the technology and value leadership of our products and services, Hewlett-Packard can serve as your working partner in this endeavor. We offer a full range of scalable solutions for fault isolation, characterization, and reporting—on site, at the bench, or remotely across an entire network.

The HP E6000B mini-Optical Time Domain Reflectometer (mini-OTDR) equips the on-site installer or maintenance technician with a complete, highly portable optical fiber test set. This small, lightweight, modular instrument combines high resolution and long-distance, high speed and high dynamic range with one-button operation and an award-winning user interface that extends your technicians' efficiency and effectiveness. Several additional modules and sub-modules can enhance their abilities without the penalty of added weight.

At the next level of test and measurement capability, the HP 8147 Optical Time Domain Reflectometer (OTDR) combines automatic measurement and analysis ability with preprogrammable procedures that speed up operation. Functionality spans on-site problem-solving, bench-top characterization and remote controlling, while modular architecture allows you to expand its capabilities in keeping with both your needs and your budget.

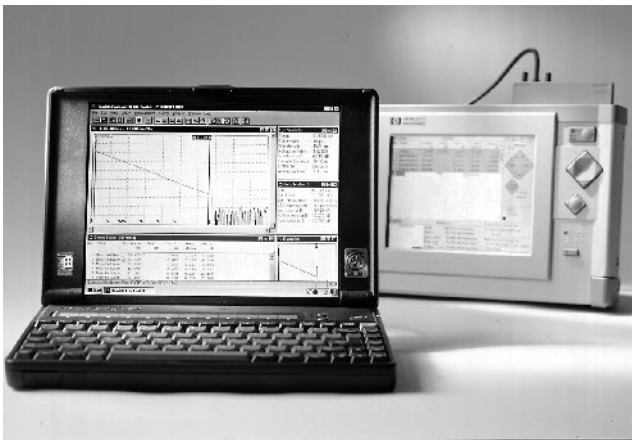
The HP E6053A, HP E6058A and the HP E6060A rack OTDRs are the newest arrivals in the Hewlett-Packard OTDR family. Primarily suited for use in fiber test systems, the rack OTDRs feature the high durability of the HP E6000B mini-OTDR and easy integration into manufacturing, monitoring or test systems.

To manage and maintain your entire fiber optic network at maximum uptime and quality with minimum cost, implement AccessFiber. Based on a detailed and comprehensive fiber network model, AccessFiber delivers all the information required for effective and efficient network planning, as well as installation and maintenance processes. Interfaces for standard tools, such as workflow and workforce management systems and GIS (geographic information systems) are provided. The availability of such interfaces means that you can protect your investment and revenues while you add significant value to the quality of service received by your customers.

- Low cost
- Easy integration into manufacturing, monitoring or test systems
- Software tools included for seamless use with existing systems
- Remote control via PC
- Automatically commission and monitor fiber links

- Software toolkit post-processes and analyzes Bellcore GR-196 files

HP E6053A
HP E6058A
HP E6060A
HP E6090A



HP E6053A, HP E6058A, HP E6060A Rack Optical Time Domain Reflectometer

Hewlett-Packard's new series of rack OTDRs cost about one-third of the price of the large OTDRs used in most rack systems. They feature the high durability you would expect from an instrument based on the design of the HP E6000B mini-OTDR and are ideal for use in the fiber test procedures normally conducted by cable- or network-equipment manufacturers and telecommunications companies.

These rack OTDRs can be built into a system and controlled remotely with a PC for non-stop use. A range of included software tools is available for integration into existing environments. When used in conjunction with an optical switch and a PC, the HP rack OTDR can be used for commissioning and monitoring a fiber optic link automatically. The HP rack OTDR can also be used with a keyboard and VGA monitor as a standalone mini-OTDR.

Specifications

Rack OTDR	Wavelength	Fiber Type	Dynamic Range	Attenuation Deadzone
HP E6053A	1310/1550 ± 25 nm	Single-mode	35/34 dB	20/25 m
HP E6058A	1310/1550 ± 25 nm	Single-mode	40/39 dB	20/25 m
HP E6060A	1625 ± 20 nm	Single-mode	37 dB	28 m

Key Literature

Fiber Optic Test Solutions for Network Installation and Maintenance, Color Brochure, p/n 5965-1256E
HP E6053A, HP E6058A, HP E6060A Rack Optical Time Domain Reflectometer, Technical Specifications, p/n 5966-3115E

For more information, visit our web site:
http://www.hp.com/go/lightwave

Ordering Information

HP E6053A 1310/1550 nm single-mode module
Opt 002 HP connector interface for straight connectors
Opt 006 RS485 serial interface
Opt UK6 Commercial calibration certificate
HP E6058A 1310/1550 nm single-mode module
Opt 002 HP connector interface for straight connectors
Opt 006 RS485 serial interface
Opt UK6 Commercial calibration certificate
HP E6060A 1625 nm single-mode module
Opt 002 HP connector interface for straight connectors
Opt 006 RS485 serial interface
Opt UK6 Commercial calibration certificate
HP 81000AI/FI/GI/HI/KI/SI/VI/WI Connector Interfaces

HP E6090A OTDR Toolkit

The HP E6090A OTDR Toolkit is ideal for post-processing, analyzing and batch processing Bellcore GR-196 based OTDR files. Systems employing the HP E6090A software can transfer data serially to a PC running Windows 3.1, Windows 95 or Windows NT. The data can then be analyzed easily and saved for use in a spreadsheet or database. All HP OTDR and mini-OTDR test instruments can be remote-controlled from a PC running the HP E6090A software.

Other HP E6090A OTDR Toolkit features include:

- Analysis of splices, connectors and attenuations
- Comparison of up to four traces simultaneously
- Trace Manager, to enable high-speed multiple trace transfer between the OTDR and PC
- "Print Multiple Traces" capability to facilitate fast paper documentation
- "Process Multiple Traces" capability to allow templating of traces after measurement
- Two-way averaging for accurate loss calculations
- Subtract traces for easy trace comparison
- Comprehensive context-sensitive on-line help
- ASCII export for further spreadsheet processing
- "Copy to Clipboard" capability to enable quick and easy report generation

The OTDR Trace Viewer, the viewing companion based on the HP E6090A which displays Bellcore GR-196 trace data, can be downloaded free from our web site: **http://www.hp.com/go/lightwave** (search "HP OTDR Trace Viewer")

Key Literature

OTDR Toolkit HP E6090A Photocard, p/n 5966-4760E

For more information, visit our web site:
http://www.hp.com/go/lightwave

Ordering information

HP E6090A OTDR Toolkit

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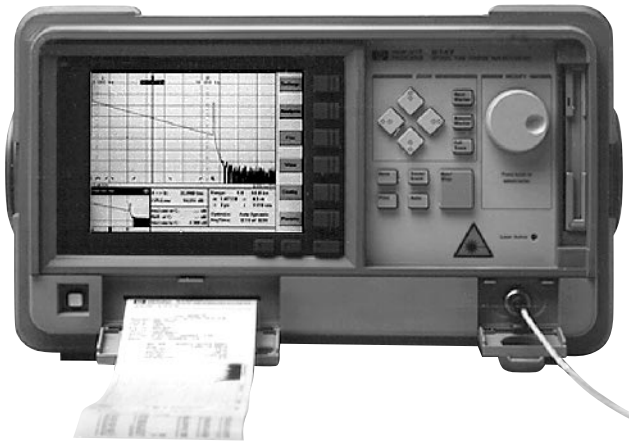
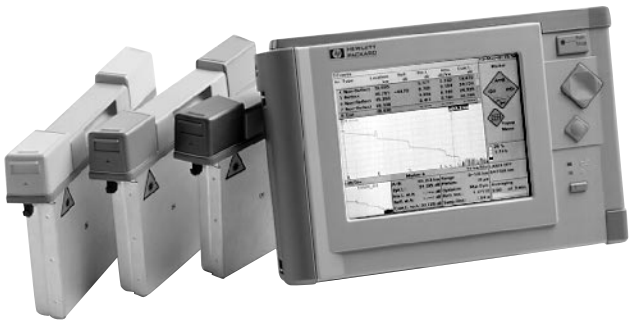
Optical Time Domain Reflectometer

HP 8147
HP E6000A

- High resolution and dynamic range in each module
- Pre-programmable procedures
- Full on-line analysis and remote operation
- Exceptionally flexible
- Fast and accurate fault characterization
- One button automatic measurement and analysis
- Small, rugged and lightweight
- Excellent resolution
- Ultra high dynamic range



HP 8147



HP E6000B and modules

HP 8147 Optical Time Domain Reflectometer

The HP 8147 is a high performance optical time domain reflectometer for installation, commissioning and bench applications. It is designed for fast and accurate measurement and analysis of a fiber link, all at the touch of a single button.

"Easy Mode" lets you pre-program complete procedures, so that with a couple of keystrokes, you get standardized measurements. That way, regardless of the operator's experience level, you get accurate and repeatable results every time.

Extended in-depth analysis including two-way measurements, delta measurements and comparison of up to four traces, is now available online. A return loss graph allows you to see the reflectance of individual events at a glance, as well as the total return loss of the link.

The HP 8147 remote ability provides the centralized operation, collection and analysis of results from remotely-stationed OTDRs. As a result, you can maximize the use of scarce test expertise throughout your network.

At only 9 kg (20 lbs), the HP 8147 can be carried easily into those awkward places.

A variety of performance classes can now be selected to ensure you have just the right performance for your application. Many standard interfaces and options are available to ensure that the OTDR can be configured to your exact needs.

Specifications

HP 8147 OTDR	Wavelength	Fiber Type	Dynamic Range (typ)	Attenuation Deadzone (typ)
HP E4311A	1310 ± 15 nm	Single-mode	30 dB	10 m
HP E4312A	1550 ± 15 nm	Single-mode	30 dB	12 m
HP E4313A	1310/1550 ± 15 nm	Single-mode	30/30 dB	10/12 m
HP E4314A	1310 ± 15 nm	Single-mode	35 dB	10 m
HP E4315A	1550 ± 15 nm	Single-mode	34 dB	12 m
HP E4316A	1310/1550 ± 15 nm	Single-mode	35/34 dB	10/12 m
HP E4317A	1310 ± 15 nm	Single-mode	40 dB	10 m
HP E4318A	1550 ± 15 nm	Single-mode	39 dB	12 m
HP E4319A	1310/1550 ± 15 nm	Single-mode	40/39 dB	10/12 m
HP E4321A	1625 ± 15 nm	Single-mode	42 dB	14 m
HP E4324A	1310/1550 ± 15 nm	Single-mode	45/43 dB	10/12 m

Key Literature

HP 8147 Optical Time Domain Reflectometer, Technical Specifications
p/n 5964-1986E
HP 8147 Optical Time Domain Reflectometer, Configuration Guide
p/n 5964-1987E

Ordering Information

At least one user-exchangeable connector interface (HP 81000xI) is required for the module.

HP E4310A Optical time domain reflectometer mainframe
- **Opt 001** DC input: 11–30 V
- **Opt 002** Thermal printer
- **Opt 003** Color screen, VGA-LCD
- **Opt 004** HP-IB interface
- **Opt 005** LAN interface
- **Opt AB2** Chinese user interface

HP E4311A 1310 nm single-mode module (30 dB)
HP E4312A 1550 nm single-mode module (30 dB)
HP E4313A 1310/1550 nm single-mode module (30 dB)
HP E4314A 1310 nm single-mode module (35 dB)
HP E4315A 1550 nm single-mode module (34 dB)
HP E4316A 1310/1550 nm single-mode module(35/34 dB)
HP E4317A 1310 nm single-mode module (40 dB)
HP E4318A 1550 nm single-mode module (39 dB)
HP E4319A 1310/1550 nm single-mode module (40/39 dB)
HP E4321A 1625 nm single-mode module (40 dB)
HP E4324A 1310/1550 nm single-mode module (45/43 dB)
HP E6090A ODTR Toolkit Software

HP E6000B Mini-Optical Time Domain Reflectometer

The HP E6000B mini-OTDR maximizes your network uptime by locating and characterizing faults quickly and accurately. The unrivalled combination of 16,000 data points and a minimum sample spacing of 8 cm allows the powerful analysis algorithm to determine the exact location and characteristic of an event. Add to this the 20 m attenuation deadzone, and you really can measure and resolve closely-spaced events along the whole fiber link.

Its one button operation, combined with its intuitive user interface, makes it easy even for those with minimal training to quickly make advanced, reliable OTDR measurements.

Its high dynamic range of up to 45 dB not only gives you the possibility to look at long stretches of fiber, but also helps you increase the speed at which you can accurately determine a certain event.

The HP E6000B, however, goes beyond a mini-OTDR. Its fiber break locator mode looks exclusively for breaks, and these are then displayed quickly. The real-time mode gives you instant feedback on parameter changes you make, so that the optimal setup can be found quickly.

Specifications

HP E6000B Mini-OTDR	Wavelength	Fiber Type	Dynamic Range	Attenuation Deadzone
HP E6001A	1310 ± 25 nm	Single-mode	28 dB	10 m
HP E6002A	1310 ± 25 nm	Single-mode	35 dB	10 m
HP E6003A	1310/1550 ± 25 nm	Single-mode	35/34 dB	10/12 m
HP E6003B	1310/1550 ± 25 nm	Single-mode	40/38 dB	10/12 m
HP E6004A	1310/1550 ± 25 nm	Single-mode	28/28 dB	10/12 m
HP E6008B	1310/1550 ± 25 nm	Single-mode	45/43 dB	10/12 m
HP E6010A	1625 ± 20 nm	Single-mode	40 dB	14 m
HP E6012A	1550/1625 ± 25/10 nm	Single-mode	43/40 dB	12/14 m
HP E6005A	850/1300 ± 30 nm	Multimode	26/34 dB	10/10 m
HP E6009A	850/1300 ± 30 nm	Multimode	18/23 dB	10/10 m

Additional Modules

The HP E6000B mini-OTDR is not just a high performance OTDR for single-mode fiber networks. Additional modules and sub-modules enhance its capabilities, without adding any significant weight. The modules simply plug into the existing instrument, making the mini-OTDR the right tool for versatile, optical fiber test measurements.

Multimode Modules

These modules are designed to test all popular multimode fibers at both 850 nm and 1300 nm wavelengths. With an event deadzone of less than three meters, the HP E6005A multimode module offers a dynamic range of up to 34 dB.

Ultra High Performance 1625 nm Modules

The HP E6010B, HP E6012A, HP E4321A and HP E6060A OTDR modules enable testing of Optical Supervisory Channel capability of WDM links and fast and accurate fiber testing at 1625 nm. Out of band testing also allows users to perform a fiber test while transmitting data at 1310 nm or 1550 nm.

Optical Power Meter Sub-Module

This high performance, miniature and extremely light (130 g) sub-module provides a measurement range of +10 dBm to –70 dBm with 5% accuracy, 0.01 dB resolution and automatic zeroing. The power meter can be used to perform end-to-end loss testing, characterize optical passive components and test transmitter power levels.

A simple user interface and a hold data function make this power meter easy-to-use. A reference power level can be stored at each wavelength for loss measurements when the source is not available. It can even detect various modulation frequencies used to identify the wavelength being sent by the source. Now it's possible to perform end-to-end loss testing without communicating with the other end of your link.

The power meter has high return loss and low polarization-dependent loss. This ensures accurate measurements, especially for high coherent laser sources, such as in Dense Wavelength Division Multiplexing (D-WDM) and CATV applications. It is fast, providing more than three updates each second. Its non-contact ferrule enhances reliability and facilitates cleaning in the field.

Visual Fault Finder Sub-Module

This visible light source helps you to identify bends, breaks and stress points along individual fibers at the patch panel. The bright red light allows you to locate these faults within the deadzone of an OTDR, and at distances of up to 5 km. The Visual Fault Finder can be used to identify fibers within a cable and also to check the quality of your patchcords and connections. The 1 Hz modulation causes the light to flash, making it easier to identify fibers and locate faults.

Optical Fiber Test Set–Everything in Your Hands

The mini-OTDR from Hewlett-Packard provides much more than just the fastest OTDR measurements; all the HP OTDR modules also act as powerful stabilized continuous wave (CW) light sources, and with the Optical Power Meter Sub-Module in place, you're able to perform loss and power measurements. Within half a minute, you can switch from locating a break with the Visual Fault Finder to checking the multimode LAN.

All the OTDR modules use HP connector interfaces, which are easy to clean, interchangeable and provide flexibility.

At less than 2.8 kg (6.2 lbs), the HP E6000B, with its rugged design, is ideal to be carried even into those inaccessible places. Containing the most advanced smart battery technology, you never need be caught without power. The battery delivers exact information on the charge status—with an accurate on-screen "fuel gauge". A full recharge takes less than 3 hours.

There's no need to switch instruments, for multimode or single-mode measurements; with the HP mini-OTDR, you have a complete optical fiber test set in one instrument.

Key Literature

Fiber Optic Test Solutions for Network Installation and Maintenance, Color Brochure, p/n 5965-1256E
HP E6000B Mini-Optical Time Domain Reflectometr, Technical Specifications, p/n 5965-1298E

For more information, visit our web site:
http://www.hp.com/go/lightwave

Ordering Information

At least one user-exchangeable connector interface (HP 81000xI) is required for the module.

HP E6000B Mini-OTDR Mainframe
- **Opt 002** Hardcase
- **Opt 003** Color Display
- **Opt 004** Software Upgrade Kit
- **Opt 005** 20 MB Flashdisk Card
- **Opt 006** B/W Display
- **Opt 007** Mini keyboard
- **Opt AB1** Korean user interface
- **Opt AB0** Traditional Chinese user interface
- **Opt AB2** Simplified Chinese user interface
- **Opt AB8** Turkish user interface
- **Opt AB9** Portuguese user interface
- **Opt ABD** German user interface
- **Opt ABE** Spanish user interface
- **Opt ABF** French user interface
- **Opt ABJ** Japanese user interface
- **Opt ACB** Russian-Cyrillic user interface
- **Opt AKB** Czech user interface

HP E6001A 1310 nm single-mode module (30 dB)
- **Opt UK6** Calibration Report

HP E6002A 1310 nm single-mode module (35 dB)
- **Opt UK6** Calibration Report

HP E6003A 1310/1550 nm single-mode module (35/34 dB)
- **Opt UK6** Calibration Report
- **Opt 022** Angled Connector

HP E6003B 1310/1550 nm single-mode module (40/38 dB)
- **Opt UK6** Calibration Report
- **Opt 022** Angled Connector

HP E6004A 1310/1550 nm single-mode module (30/30 dB)
- **Opt UK6** Calibration Report
- **Opt 022** Angled Connector

HP E6005A 850/1300 nm multimode module (high performance) (26/34 dB)
- **Opt UK6** Calibration Report

HP E6006A Optical Power Meter Sub-Module
- **Opt UK6** Calibration Report

HP E6007A Visual Fault Finder Sub-Module

HP E6008B 1310/1550 nm ultra high performance single-mode module (45/43 dB)
- **Opt UK6** Calibration Report
- **Opt 022** Angled Connector

HP E6009A 850/1300 nm multimode module (economy) (18/23 dB)
- **Opt UK6** Calibration Report

HP E6010A 1625 nm ultra high performance single- mode module (40 dB)

HP E6012A 1550/1625 nm ultra high performance single- mode (43/40 dB)
- **Opt UK6** Calibration Report
- **Opt 022** Angled Connector

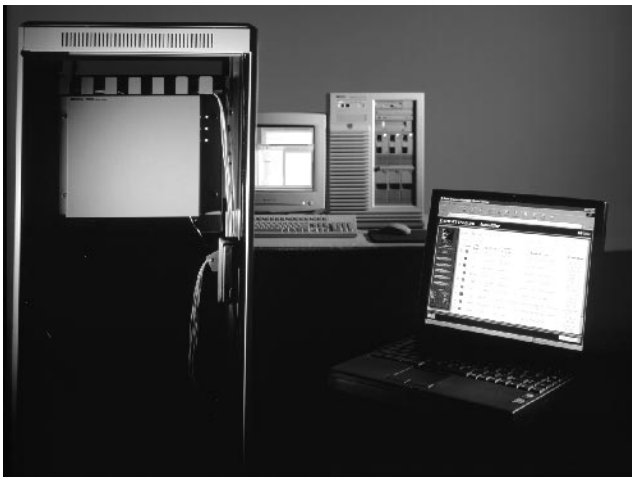
HP E6090A OTDR Toolkit Software

HP 81000AI/FI/GI/HI/KI/SI/VI/WI Connector Interfaces

HP E597xA Handheld Fiber Optic Test Equipment
Please refer to Product Overview 5963-6656E.

AccessFiber

- Integrated Fault Management workflow
- GPS Coordinates-based Fiber Network Documentation
- Standards-compliant (SNMP and TMN)
- Both dark and active fiber monitoring and testing.
- Easy access to centralized information from anywhere



AccessFiber Network Management

AccessFiber is a modular, distributed system that manages the planning, installation and maintenance of a fiber optic network through a single application using the network central database information. GPS coordinates are used to accurately model the fiber optic network and locate the outside plant equipment (OSP). Using the location information plus the comprehensive fiber optic network model, the system always presents the appropriate information about the network to the end user, whether the information is for planning, installation, maintenance or emergency purposes.

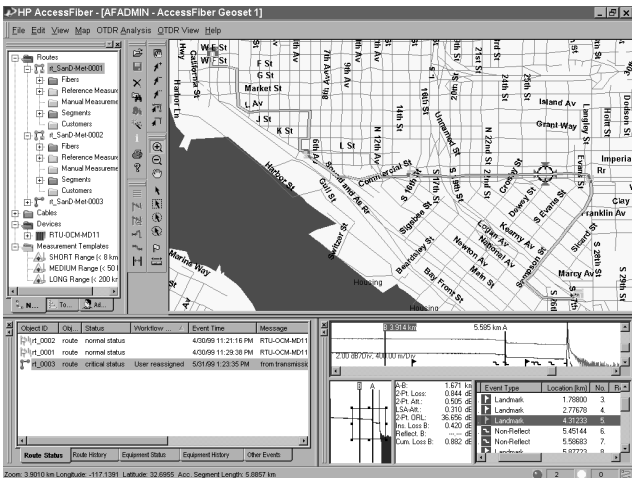
The system consists of processor, measurement and communication hardware, as well as operating and application software. The system can be tailored to suit all requirements and is designed to follow the growth of your network. Configuration options range from a single site standalone system up to a multiple remote site system.

Effective alarm handling is granted by an intuitive graphical user interface that provides design and modeling of the alarm workflow exactly according to the end users needs. As an alternative, standard interfaces to tools that might already be in place, are provided, thus the investment made is protected.

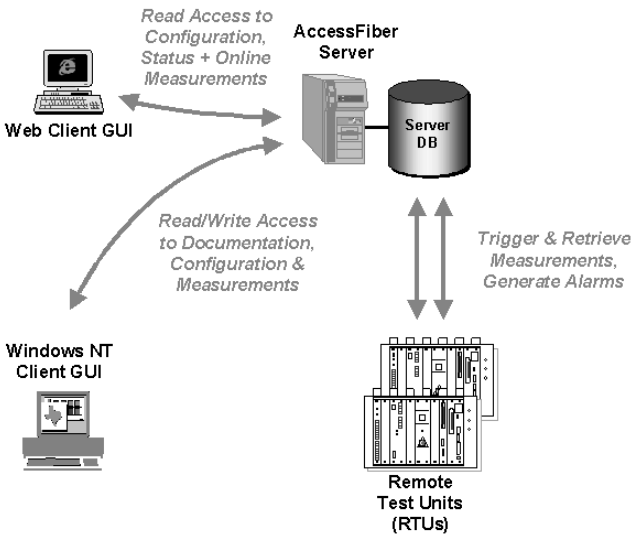
The system uses remote test units (RTUs) to perform and analyze OTDR measurements of optical fibers. An RTU consists of a cardcage that fits a central office rack and can be accessed via various networking options. OTDR modules are available for 1310 nm, 1550 nm and 1625 nm wavelengths with a choice of a 34 dB to 42 dB dynamic range, so the most appropriate price/performance option for a particular application can be selected. Switch modules from 1 x 4 to 1 x 96 can be integrated into the same cardcage. The OTDR modules support both dark and active fiber testing.

The signatures taken by the OTDR are compared with stored reference measurements to determine if any changes can be detected. This ongoing process of measurement and comparison produces a comprehensive view of the status of the optical fiber network. Significant changes or failures, as well as the exact geographic location of the problems are reported to the central manager. User-definable alarm thresholds ensure that any gradual deterioration of fiber performance is reported before a breakdown of service occurs. The system handles the alarm management workflow.

AccessFiber improves network quality as it checks fiber links automatically on a regular basis and supports the fiber network documentation process by providing access to all fiber-related information via one centralized repository. The system also takes advantage of open communication protocols and can be fully integrated into an SNMP Network Management, as well as a standardized Telecommunications Management Network (TMN) environment. AccessFiber is an element manager for the network element fiber and meets the requirements of standard ITU-T M.3010, based on the OSI model.



System Components and Interconnections



Specifications

Server:
AccessFiber Manager Software
Oracle 8.0 RDBMS (operates under HP-UX 10,2 or Microsoft Windows NT 4.0)

Client:
AccessFiber Client Software
6IS/6PS viewer from MapInfo (Map X) (supports Microsoft Windows NT 4.0)

World Wide Web Server:
AccessFiber WWW Server Software including 8 licenses

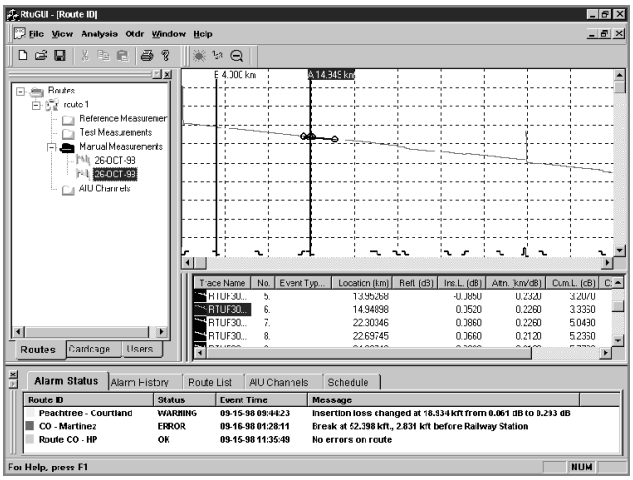
Key Literature

HP AccessFiber—Fiber Network Management System Configuration Guide, p/n 5968-5342E
HP AccessFiber—Fiber Network Management System Release 3.0 Technical Specifications, 5968-0067E
HP AccessFiber—The Complete Fiber Network Management Brochure, p/n 5968-1543E

Ordering Information

Please contact the HP Call Center in your region for ordering information and prices.

- Fiber network monitoring
- Remote fiber testing
- Standards-compliant (SNMP)
- Both dark and active fiber monitoring and testing.
- Easy integration into existing management platforms



Remote Fiber Test & Monitoring

The remote fiber test units (RTUs) perform and analyze OTDR measurements of optical fibers. An RTU consists of a cardcage that fits a central office rack and can be accessed via various networking options. OTDR modules are available for 1310 nm, 1550 nm and 1625 nm wavelengths with a choice of a 34 dB to 42 dB dynamic range, so the most appropriate price/performance option for a particular application can be selected. Switch modules from 1 x 4 to 1 x 96 can be integrated into the same cardcage. The OTDR modules support both dark and active fiber testing.

The signatures taken by the OTDR are compared with stored reference measurements to determine if any changes can be detected.

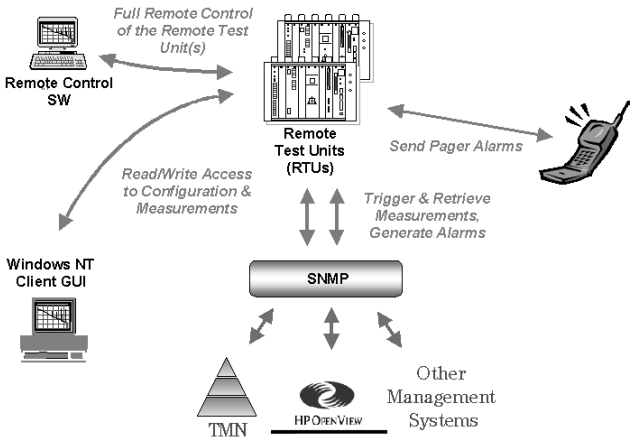
This ongoing process of measurement and comparison produces a comprehensive view of the status of the optical fiber network. Significant changes or failures, as well as the exact location of the problems are reported to the alarm user specified. An optional interface to a standard paging software package is also available. User-definable alarm thresholds ensure that any gradual deterioration of fiber performance is reported before a breakdown of service occurs.

The RTU not only features a local Graphical User Interface (GUI) for full operation, it also supports multiple users in a Client/Server configuration as well as remote access through dial-up lines.

The Remote Fiber Test unit improves network quality as it checks fiber links automatically on a regular basis as well as manual tests of remote fibers at any time. The system also takes advantage of open communication protocols and can be fully integrated into an SNMP Network Management environment.

The Remote Fiber Test unit is fully compliant with AccessFiber, the multi-purpose Fiber Network Management and Documentation System and can easily be upgraded to an AccessFiber RTU, if needed.

System Components and Interconnections



Specifications

Central wavelengths: 1310 nm, 1550 nm, 1625nm
Attenuation deadzone: 20 m to 30 m
Dynamic range: 28 dB to 42 dB
OTDR modules
1310 nm/1550 nm 35/34 dB and 45/43 dB
1550 nm 34 dB and 43 dB
1550 nm/1625 nm 43/42 dB
1625nm 42 dB
Switch modules: 4, 8, 16, 24, 32, 48, 72, 96 channels
Insertion loss: Typically 1 dB
Return loss: 40 dB
Cardcage: 9 slots
Controller: Pentium 166 or better
Power supply: –36 V to –60 V DC
Dimensions:
418 mm H x 426 mm W x 218 mm D
(16.5 in H x 16.8 in W x 8.6 in D)

Key Literature

HP AcessFiber—Fiber Network Management System Release 3.0 Technical Specifications, p/n 5968-0067.

Ordering Information

Please contact the HP Call Center in your region for ordering information and prices.

HP Telegra Fax Test Systems

HP Telegra M and HP Telegra D

HP J3947A
HP J3948A
HP J3935A

HP Telegra Fax Test Systems

NEW

The world-wide standard for automated testing of fax systems, servers and networks carrying fax traffic, HP Telegra Fax Test System is a fax analysis and call generation test used to test Internet fax services, VoIP gateways, fax servers, fax machines, fax modem devices, and traditional and IP based fax networks. The system can monitor, record, and analyze calls between fax devices or it can be programmed to act as a sending or receiving fax device with specific performance characteristics. It performs end-to-end network quality and connectivity testing. HP-Telegra Fax Test Systems can be controlled remotely via modem, Internet, or LAN connections, providing access to the same functionality that is available when controlling locally.

Why Fax testing?

Introduce new products and network services sooner

HP Telegra test systems help you get products and services to market earlier with higher confidence. Find more problems faster by automating initial and regression testing. Locate subtle problems early in development or deployment when they are much less expensive to fix.

Identify network problems before your customer does

Increase customer satisfaction by constantly monitoring or actively measuring your network quality and reliability at various points to identify problems before your customer does. Analyze failed calls and quickly identify the cause of the problem through easy to use graphical interfaces that provide all the information you need on one screen

HP-Telegra is a must, if you are:

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- Designing fax machines, fax modem devices, fax cards, fax servers or systems
- Testing fax systems in QA or production test
- Providing customer support on fax products, systems, or networks
- Developing Internet fax servers or systems
- Developing cellular and satellite networks
- Maintaining international network operations
- Testing remote networks or servers
- Supporting fax transmission on local, wide area, Internet, cellular, satellite or mobile networks
- Testing line quality from the central office or customer premises

The HP Telegra Test Platforms

- HP Telegra M– performs bulk call generation and V.17 and V.34 fax analysis on up to 192 ports, and can be used to stress networks, gateways and servers to measure limits of performance.
- HP Telegra D– This single or dual port portable V.17 and V.34 fax analyzer is used to monitor and analyze calls between fax devices and simulate fax machines with worst case performance.

HP Telegra M

HP Telegra M is a multi-port rack mountable fax load and analysis system used to test multi-port fax networks, active and passive network devices, fax servers, and Internet fax systems, all through analog and T1/E1 interfaces. The system is designed for test labs, as well as network and service operational testing, and is controlled by client PCs via direct connection, or remotely via Internet, LAN, or modem connections. HP Telegra M is the first product specifically designed to test, analyze and evaluate multi-port fax systems and networks, and networks carrying fax traffic.

HP Telegra D

HP Telegra D is a notebook-sized fax analysis and call generation test system, offered either as a single or dual port solution. HP Telegra D equipped with two ports can also be programmed to perform end-to-end network quality and connectivity testing. The unit can easily be carried into the field for testing at a customer site using a laptop PC, or it can be dropped off at any location for remote testing via modem or Internet connections. Connecting via a 10baseT cable, HP Telegra D can also be used in test labs controlled directly through any PC or LAN.
Both the HP Telegra M and HP Telegra D operate the HP Telegra Fax Application described next on single or multiple ports.

HP Telegra Fax Application

- Generation and analysis of traffic to test compliance with all ITU-T Group III standards: V.34, V.17, V.33, V.29, V.27, and V.21 modulation, T.30 and V.8 handshaking and T.4 and T.6 image encoding.
- Origination, reception, or passive monitoring of fax calls.
- Comprehensive test script libraries and network test suites for interoperability testing, test automation, and regression testing.
- Editing tools to design your own scripts for special tests.
- Statistical analysis of all calls to provide a quick review of the overall result as well as detailed analysis of selected individual calls.
- Explanation of highlighted errors in plain English with suggestions for design improvements.
- Easy to read graphical display of send- and receive-message sequences and timing. Message details can be reviewed by clicking any message.
- Presentation of fax device capabilities and call configurations in easy to read table format.
- Display of captured or transmitted fax images including compression codes.
- HP Telegra systems can be distributed to remote sites or laboratories and remotely controlled over any LAN, WAN, the Internet, or via a modem connections. Multiple users can access individual ports in the same system, and can use the complete set of test capabilities.
- Field testing from a laptop PC.

For more information visit our web site: **www.hp.com/go/internetadvisor**

Key Literature

HP Telegra M, Product Overview, p/n 5968-5652E
HP Telegra D, Product Overview, p/n 5968-5651E

Ordering Information

HP J3947A Telegra M V17AP–4 port analog fax analyzer
HP J3948A Telegra M V17AF–48 port analog fax analyzer
HP J3935A Telegra D V17A–single port fax analyzer

HP J1845A
HP J1846A

NEW

- Automated telephony application test and emulation
- Test existing and next-generation networks and network elements
- Intuitive GUI and user-friendly test creation environment (TCE)
- Completely verify end-to-end service in mixed networks, from customersí point-of-view
- Wide variety of signaling and network types supported
- Advanced intelligent network (AIN) based design

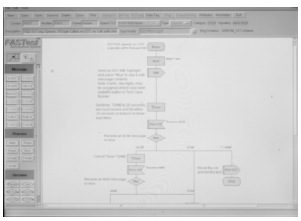
HP J1845A FASTest-PC

HP FASTest Automation System NEW

The HP FASTest family of products provides automated verification and emulation of telephony services and applications. Using an Advanced Intelligent Network (AIN) based test creation and execution environment, FASTest allows the development of automated, reusable application test cases and scenarios.

HP FASTest supports simultaneous testing on Signaling System Number 7 (SS7) links, Integrated Services Digital Network (ISDN) trunks, and Per-Trunk Signaling (PTS) circuits. FASTest is ideal for verification and emulation on Class 3, 4, and 5, Gateway switching systems, Mobile Switching systems (MSC), and SSPs, as well as wireless Home Location Registers (HLRs), Visitor Location Registers (VLRs), AIN Service Control Points (SCPs), and Local Number Portability (LNP) SCPs.

HP FASTest works at the application level on a network or element. For a telephony application or service, FASTest can be used for service verification, regression testing, and billing verification. This end-to-end testing can be implemented in the lab or in the field to test existing and next-generation network elements and networks.



Test Logic Program Editor provides drag and drop test creation.

Test Reporter lets you view test results in tabular or graphic format.

Platform Configurations

The product family is available in three configurations:
- FASTest-PC: a single-user pc-based standalone portable unit
- FASTest Automation System: a multi-user Unix-based platform
- FASTest-NET: a multi-user distributed system for network-level testing

Specifications Summary

Supported Signaling: SS7 (SCCP, TCAP, ISUP, TUP), ISDN (PRI, BRI), PTS (inband, MF, DTMF), Lineside (CLASS, Caller ID), E1 R2 signaling
Emulated Network Modes: SCP (service control point), STP (signal transfer point), SSP (service switching point), HLR (home location register), MSC (mobile switching center), VLR (visitor location register)
Billing Verification: AMA (wireline and wireless), CDR, custom

Examples of Service/Feature Emulation

- AIN (0.1 and 0.2)
- Wireless (IS41, GSM, PCS)
- Debit/credit card
- VPN (virtual private network)
- IVR (interactive voice response)
- Freephone (800) and Premium (900)
- LIDB (line information database)

Key Literature

FASTest Product Family Overview, p/n 5968-4455E
FASTest-PC brochure, p/n 5968-4457E
FASTest Automation System brochure, p/n 5968-4454E
FASTest-NET brochure, p/n 5968-4458E
FASTest Automation System Profile, p/n 5968-4456E

Selected Ordering Information

J1845A HP FASTest-PC basic configuration
- **Opt 001** HP FASTest-PC with SS7 (ANSI) and T1 interface
- **Opt 002** HP FASTest-PC with SS7 (ITU) and E1 interface
- **Opt 003** HP FASTest-PC with SS7 (ITU), E1 interface, and Data Manager module
- **Opt 004** HP FASTest-PC with SS7 (ANSI), T1 interface, and ANSI SCCP/TCAP signaling module
- **Opt 005** HP FASTest-PC with SS7 (ANSI), T1 interface, Per Trunk signaling, T1 analyzer, and external device driver

J1846A HP FASTest Automation System (Unix)
- **Opt 001** HP FASTest with SS7 (ANSI) and ISDN (ANSI)
- **Opt 002** HP FASTest with SS7 (ANSI), ISDN (ANSI), per trunk signaling, data manager module, and external device driver
- **Opt 003** HP FASTest with SS7 (ITU), ISDN (ETSI), per trunk signaling, data manager module, and external device driver
- **Opt 004** HP FASTest with SS7 (ANSI and ITU), ISDN (ANSI and ITU), per trunk signaling, data manager module, and external device driver

For assistance in defining your configuration, please contact your local HP representative.

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Protocol Analyzers

3 Dimensional Network Testing AC
5963-1054EN/EUS
Announcing New Multiprong Testing Brochure
5091-7635E
Frame Relay Message Sets Technical Specifications
5963-0085EN/EUS
Frame Relay Test Software Technical Specifications
5963-6653EN/EUS
Frame Relay/SMDS Seminar Book Solution Note
5963-9501E
Group 4 Fax Testing Product Note
5091-2002E
Hewlett-Packard Protocol Testers Brochure
5091-7634E
Integrated FR Testing with PT502 Data Brief
5091-2003E
Integrated SMDS Testing with PT502 Data Brief
5091-2006E
ISDN Primary Rate Testing Solution Note
5963-2013EN/EUS
ISDN Testing Data Brief
5091-2141E
Executable Test Suites for PT Series Technical Specifications
5963-1090EN
Protocol Testing at Bank of Montreal Solution Note
5962-9750EN/EUS
PT Series Technical Specs Technical Specifications
5963-0082E
V3.0 Test Software Technical Specifications
5963-0086EN/EUS
X.25 Protocol Testing Tech Data Technical Specifications
5962-8746EN/EUS
X.25/X.32/X.75 Testing with HP PTs Brochure
5091-7847E
HP PT Series Protocol Testers
5091-7634E
Intuitive Signaling Analysis for Fixed and Wireless Networks
5968-2796E

Digital Transmission Testers

NIU Quick Isolation of DS3 Network Problems
5965-8345E
3-Slot and 12-Slot Equipment Shelves for E4586A DS3 NIU
5963-7141EUS
HP E485XA Serial Cell Generator and Analyzer
5963-9924A
HP 37722/32A Brochure
5965-3192E
HP 37722/32A Configuration Guide
5965-3194E
HP 37722/32A Technical Specifications
5965-3193E
HP E4540A DNA Software Brochure
5964-2240E
HP 71603B Brochure
5965-1431E
T1 Test Advisor Testing Just Got Easier Brochure
5967-6060E
E1 Test Advisor Brochure
5967-6161E
HDSL Installer's Assistant Brochure
5965-8937E
HP 71612B Brochure
5968-2810E
HP 71603B/04B Brochure
10 Methods for Faster High Speed Digital Communications Design
5966-4258

(PN E4540A) Automated Test Sequences for More Effective Testing of SDH and ATM Networks
5965-4911E
(PN E4540E) Interactive Diagnosis for More Effective Support of SDH and ATM Networks
5965-4912E
(PN 71612B) Locating Errors in Gigabit Transmission Systems and Components
5968-2811E
(PN 71612B) Extending Hi-Speed BER Testing to 20 Gb/s
5964-6133E
(PN 71612B) Testing 10 GB/s SONET/SDH Equipment and Components
5968-2812E

SONET/SDH Test Sets

HP E4480A CERJAC 156 MTS Brochure
5966-2243E
HP E4480A 156 MTS Technical Data
5963-2178EUS
HP E4487A CERJAC Series 31XE Technical Data
5964-2463EUS
HP OmniBER 718 (HP 37718A) Brochure
5968-0974E
HP OmniBER 718 (HP 37718A) Technical Specifications
5968-0974E
HP OmniBER 718 (HP 37718A) Configuration Guide
5968-2041E
HP OmniBER 719 (HP 37719A) Brochure
5968-0761E
HP OmniBER 719 (HP 37719A) Configuration Guide
5968-0975E

(PN E4480A/87A and E4595) Enhanced, Easy-to-Use SONET and T-Carrier Testing
5965-3650E
(PN E4480A/87A) Graphical Control, Measurement and Analysis
5965-3648E
(PN OmniBER 718) PDH Digital Radio Test
5965-4885E
(PN OmniBER 718) Tributary Jitter Testing of SDH Network Equipment Using ITU-T G.783 Pointer Sequences
5965-4862E
(PN OmniBER 718) Automatic Verification of Network Equipment to ITU-T Jitter Tolerance Recommendations
5965-4863E
(PN OmniBER 718) Resolve Finger-Pointing Problems on 140 Mb/s Transport Signals
5965-4886E
((PN OmniBER) Professional Measurement Results Report—At Your Fingertips
5968-2041E
(PN OmniBER) STM-16c/OC-48c Concatenated Payloads: Essential for Testing DWDM and Broadband Systems
5968-2040E
(PN OmniBER) Verifying Protection Switching Mechanisms in Linear and Ring Topology Networks
5965-9915E

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00

ATM/Broadband Test Systems

1993 B-ISDN Seminar Handbook Primer
5962-8794E
1994 B-ISDN Seminar Handbook Primer
5962-0011E
1995 Broadband Communications Map
5963-9489E
BSTS Product Ordering Guide
5964-0393E
Conformance and Interlop Testing—What You Must Know
5965-1457E
HP Broadband Series Test System Product Information
5966-0035E
Implementing ATM Signalling Solution Note
5963-7514E
MPEG-2 Digital Video Technology Solution Note
5963-7511E
Traffic Policing Solution Note
5963-7510E
WAN Interworking with ATM Solution Note
5963-7512E
HP E4829B Product Overview
5964-1667E
HP E4829B Technical Data Sheet
5963-9923E
Ease Your Network's Migration to ATM Brochure
5965-4968E
ATM Testing and LAN Connectivity Measurements Under One Handle Brochure
5966-3293E
HP E5200A Broadband Service Analyzer Technical Data
5965-1376E
Broadband Service Analysis–Coping with the Network Test Challenge White Paper
5965-1377E
HP OmniBER 717 (37717C) Brochure
5964-5817E
HP OmniBER 717 (37717C) Technical Specifications
5968-3132
(PN E4200, 10, 17A) NNI Signalling Test Software Helps Ensure Seamless ATM Networks
5965-6307E
(PN) Proceedings of the 1995 B-ISDN/ATM Protocol Testing Seminar (E4200B, E4210B)
5964-3579E
(PN E4821A, E4829B, E4885A) Implementation of UTOPIA Level 2 for Parallel Cell/Traffic Generator and Analyzer
5965-4856E
(PN E4829B) Cell Transfer Time Measurement Using the Parallel Cell/Traffic Generator and Analyzer
5965-5297E
(PN E482xA/B, E4889A) Real Time Bit Error Rate Analysis at Parallel Interfaces (UTOPIA) with HP E4829B
5965-4855E
(PN E4505A-2) Test Sequences for More Effective Testing of SDH and ATM
5965-4911E
(PN E4505A-2, 37717B/C) Interactive Diagnosis For More Effective Support of SDH and ATM Networks
5965-4912E
(PN OmniBER 717) Physical Layer Jitter Testing in an ATM Environment
5965-4861E

Field Installation & Maintenance

Power Meter Sub-module HP E6007A and Visual Fault Finder Sub-module HP E6007A, Photo Card
5966-0022E
Multimode OTDR Modules HP E6005A, HP E6009A, Photo Card
5966-0023E
HP E6053A, HP E6058A, HP E6060A Rack OTDR Photocard
5966-4227E
HP ODTR Family Accessories Photocard
5966-4878E

Reducing Your Risk in Aerospace and Defense

While cutbacks and consolidations may be forcing you to change the way you do business, the one thing you can not risk is the reliability of your program. HP's products and services reduce risk in developing and supporting your automated test systems (ATE).

Hewlett-Packard understands that your systems can not afford to miss a single critical event—that you need solutions you can trust. That is why HP provides you with products and services that are designed to be easily integrated into ATE systems—everything from stand-alone test equipment to completely customized systems—so you can be confident that all your measurements are accurate and repeatable.

With over 30 years experience developing flexible test systems and promoting open standards, we know how to give you the support you need to get the job done.

Manufacturers

Verify that your design/manufacturing processes have produced a quality product that performs on command. Use ATE instruments, subsystems and turnkey solutions that integrate well with your existing systems, giving you fast, reliable, accurate measurements.

System Integrators

Construct a test system that will test military and aerospace electronics reliably, anywhere in the world. Rely on products and subsystems that are easy to integrate, that protect your Test Program Set investment, and that are small in size for portability.

Government Teams

Increase the readiness of your electronic systems. Expect those systems to answer the call at a moment's notice. Require systems to be as functional 20 years from now as they are today.

Tools for Reducing Your Risk

Electronic Warfare, Radar & Weapons Systems

HP supports you with a variety of off-the-shelf, advanced simulators that give you the highest level of signal integrity to protect your EW, radar and weapons systems. Our advanced simulators with flexible software generate signals such as multi-emitters, threat scenarios, jamming and clutter. And as your advance threat requirements change, HP helps you keep pace by enhancing existing products and evolving capabilities into new standards such as VXI.

Satellite Communications

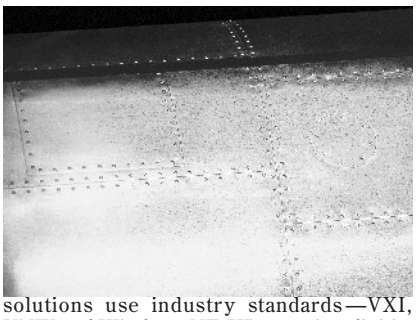
Engineers from HP joined Motorola, the Iridium consortium's prime contractor, to design and integrate flexible test systems using standard and custom HP instruments. Besides providing vector signal analyzers, spectrum analyzers, custom timing generators and peak power meters, HP engineers designed several communication payload test systems—supplying microwave test equipment, oscilloscopes, network analyzers and custom switching hardware. Instead of taking 1-1/2 to 3 years to manufacture each satellite, Motorola technicians produced one satellite every 4-1/2 days. HP also created a sophisticated Iridium network simulator, used for testing phones, that mimicked the behavior of the constellation and the transfer of messages.

Surveillance

HP provides fully integrated systems, as well as VXI tuner and receiver building blocks, that let you create re-deployable systems for remote search, stare, direction finding and more.

Physical Test

COTS-based HP Data Acquisition and Control



solutions use industry standards—VXI, UNIX and Windows NT. HP scanning digitizers, for instance, are ideal for applications that require static measurements and control of the test article. For dynamic and transient measurements, our high-speed digitizers, signal processors and mass-storage modules excel in noise, vibration and structural applications. And built-in or plug-on signal conditioners provide cost-effective test solutions. To help you find the right solution, HP and a host of HP Solution Partners offer proven software along with skilled systems engineering. Off-the-shelf application software enables solutions such as general vibration analysis and multiple-input modal analysis.

Test System Design and System Integration

Part of HP's strategy for developing the Electrical Test Set was to utilize COTS components wherever possible. Not only are COTS solutions typically less expensive and of high quality, they are also readily available, and COTS components such as ac source/analyzers and dc power supplies and electronic loads are easily integrated into ATE systems.

Another key HP strategy is concurrent engineering efforts. As Lockheed Martin was designing and building the spacecraft, HP was gathering technical specifications, enabling concurrent configuration and building of the test set. COTS technology was also HP's solution for a Boeing project commissioned by the Israeli Air Force. HP was able to assemble a radar antenna test system that cut test times in half, reduced paperwork and expanded fault detection.

Once a test system is designed, much time can be lost in the integration details. To expedite your project, skilled HP professionals will procure parts, deliver components that are verified and configured to your needs, take care of cable fabrication and installation, cooling design and verification of the test system.

The Support

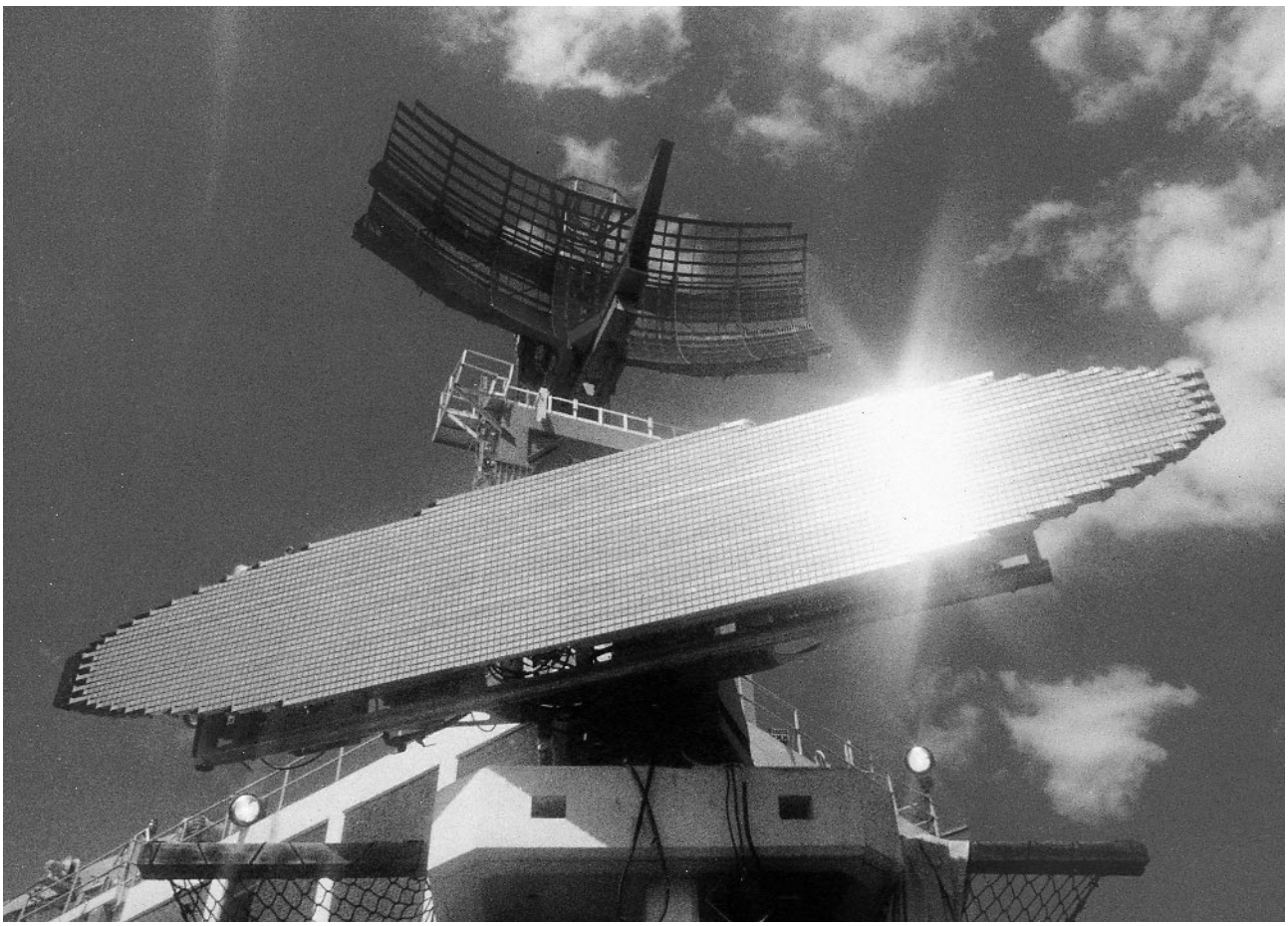
With over 30 years experience developing flexible test systems, we know how to give you the support you need in:

- Design consulting
- Training
- Installation and integration
- Post-purchase support

For more information, please see page 69 in Section 02 of this catalog.

Hewlett-Packard Aerospace and Defense Solutions Quick-Reference Product Guide	For further information, see pages
General Purpose Defense/Satellite	
HP 8720E Microwave Network Analyzers	new
HP 8719ES, 8720ES, 8722ES S-parameter Test Sets	283
HP 8510 Series Microwave Network Analyzers	283
HP ESG-AP, ESG-DP Series RF Signal Generators	363
HP ESA-E, ESA-L Series Spectrum Analyzers	223
HP 70000 Modular Measurement System	81
VXI	
HP E1881A 11-slot Military-Ruggedized VXI Mainframe	new
HP E8408A 4-slot C-size VXI Mainfram	new
HP E6432A VXI Microwave Synthesizer	new
HP E3238 Signal Development System	321
HP E1432/33/34A VXI Digitizers	86
HP E6500/01A VXI Tuner/Receiver	322
HP 81200 Data Generator/Analyzer	439
Satellite	
HP 85121A Payload Test System	new
HP 89400 Series Vector Signal Analyzers	250
Data Acquisition	
HP E1529A Remote Strain Conditioning Unit	408
HP 9801A DAC Express Data Acquisition/Recorder Software	new
Signal Analysis	
HP E3238 Signal Development System	321
HP E6500/01A VXI Tuner/Receiver	322

HP E6432A
HP 70000
HP E3238
HP 85121A



EW Radar

High Performance Tools in Radar/EW

Advanced microwave applications involve high-performance microwave frequency synthesized signals in Radar/EW. The measurement challenges faced by designers, manufacturers and end-users in these advanced microwave applications require fast switching speed, low phase noise, high spectral purity and synthesizer accuracy all in the small footprint required by the next generation of microwave signals.

HP understands these challenges and has created a tool with high-performance microwave capability in the VXI format. The HP E6432A VXI Microwave Synthesizer ushers in the next generation of microwave synthesized signal sources, designed for automated test equipment (ATE) systems. Please refer to page 208 for more information on the HP E6432A VXI Microwave Synthesizer.

In addition, designers, manufacturers and end users in these application areas require transient analysis, phase noise analysis, and precision amplitude and phase measurements. Complete characterization of signals requires instrumentation capable of high-speed capture and analysis in both the frequency and time domains. Please refer to page 81 for more information on the HP 70000 Modular Measurement System.

Key Literature

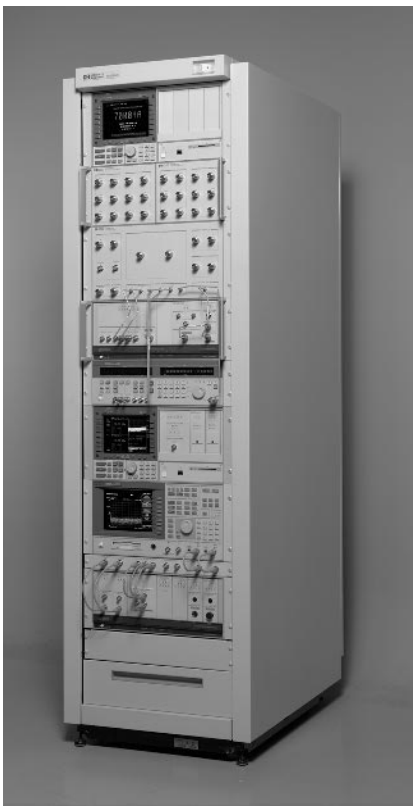
HP E6432A VXI Microwave Synthesizer, p/n 5967-6272E

Ordering Information

Prices vary. For more information, please contact your HP sales representative.

HP E6432A

HP E6432A
HP 70000
HP E3238
HP 85121A



HP 85121A

Payload Test Systems

HP 85121A Payload Test System Family

Product Overview

Satellite-industry manufacturers have shown that automated payload testing improves measurement repeatability and reduces test time, resulting in faster satellite integration cycle time.

- Standard system configuration for 1-20 GHz testing applications
- Frequency extension options available for UHF and Ka bands
- Single setup for testing for multiple transponders
- Complete suite of response and distortion measurements
- Easy-to-use system software in Windows NTTM environment
- High measurement repeatability through automated system calibration
- Customization available for specific requirements

The typical payload test system is customizable for specific measurement requirements.

Payload Test System Configuration

The HP 85121A Payload Test System (PTS) is an automated system for evaluating the radio frequency (RF) performance of communications satellite transponders, telemetry transmitters, and command receivers. The PTS presented in this document is Hewlett-Packard's (HP) typical configuration, which can be customized for specific measurement requirements.

The HP 85121A PTS integrates instrumentation hardware and software to provide a flexible, mobile test system that meets the needs of many test environments in satellite manufacturing and pre-launch operations. Automatic measurements in the Windows NT operating environment provide an easy-to-operate system that significantly reduces test time. Satellite manufacturers using HP's PTS have reduced integration and test cycle time, resulting in reduced labor costs and faster time to satellite launch.

The typical PTS instrumentation configuration is mounted in a rack assembly optimized for mobility within the factory for various testing stations: integration and test, highbay, antenna range, and thermal vacuum test facilities. Because of its compact size, the PTS can also be moved to a launch site for post-transport and pre-launch spacecraft testing.

The PTS design is based on years of HP experience at providing test systems to the major satellite-industry manufacturers worldwide for testing components, subsystems, antennas, and payloads. The HP 85121A PTS provides consistent, repeatable measurements throughout the integration and test manufacturing process. The user can, therefore, expect a high degree of correlation between measurements made during different stages of manufacturing, from panel and payload through spacecraft testing.

The typical PTS has the following characteristics:

- Single channel operation (a second channel can be added with another PTS rack.)
- Single- and two-tone measurements
- 1-20 GHz frequency coverage
- 18 uplink and 18 downlink ports

Enhancements are available for the typical PTS, and HP can evaluate customer-requested customizations for feasibility, cost, and delivery. Some PTS options currently available include the following:

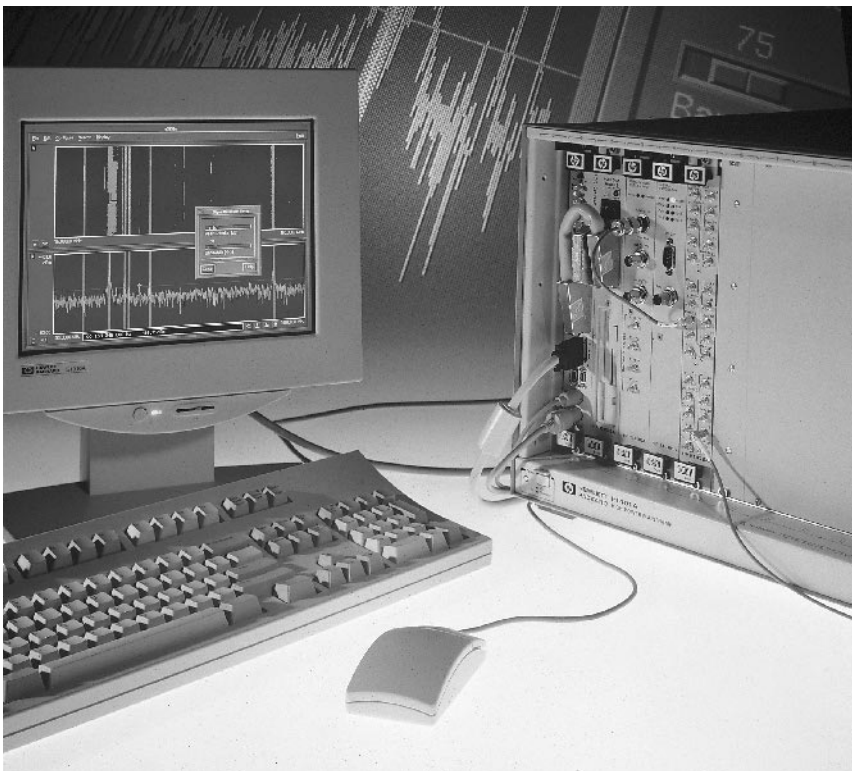
- Frequency extensions
- UHF band: 100-1000 MHz
- Ka band: 27.5-31.0 GHz uplink, 18.0-21.2 GHz downlink
- Multiple-tone measurements, e.g. noise power ratio (NPR)
  - Noise power ratio (NPR)
  - Error vector magnitude (EVM)
- Specific number of uplink and downlink ports
- Additional channels

Key Literature

Payload Test Systems (product overview), p/n 5968-5661E

Ordering Information

Prices vary. For more information, please contact your HP sales representative.



Reducing Your Risk in Surveillance

Today's crowded airwaves make it difficult to identify signals buried in noise and masked by a dense spectrum. You need a fast search receiver, with wide dynamic range, to catch elusive signals that carry analog and digital demodulation. Operational realities compound the problem: you are expected to detect more signals with less equipment and fewer people. Successful missions depend on the highest productivity from system creators, systems and operators. And you rely on adaptable and dependable systems—based on modular COTS components—to provide development and operational functions that enhance productivity and protect your investment. Whether the signals are stationary or moving, burst or continuous, low-level or high-power, you need a solution that gives you the capability to search, detect, collect and exploit signals of interest.

HP provides fully integrated systems, as well as VXI tuner and receiver building blocks, that let you create re-deployable systems for remote search, stare, direction finding and more. The HP systems resolve three key challenges:

Performance

Catching clandestine or intermittent transmissions requires the speed and resolution made possible by the powerful digital signal processing of the HP signal development and intercept solutions. To improve probability of intercept, advanced search functions can characterize overall spectral content and focus on specific segments.

Automation

Operators benefit from automation functions that separate signals from noise, store detected energy, classify that energy, and take action. These functions are easy to implement with solutions such as the HP E3238 signals development system, which includes thresholding, an energy history database, and several alarm modes.

Integration

Once a signal is found, you may need to assign a hand-off receiver for demodulation. The HP E3238 provides interfaces and software features that facilitate tight integration with external equipment, including the HP E6500 family of VXI-based tuners and receivers.

In use around the world, the highly scaleable HP signals development and intercept solutions are proven performers. Based on industry standards such as VXI, UNIX and Windows NT—and fully integrated by HP—our systems meet your needs today and keep your options open tomorrow.

Key Products

HP 3587 Real-time Signal Analysis System

The HP 3587 real-time signal analysis system has the measurement power and flexibility you need to capture and analyze real-world signals. Its combination of speed, dynamic range, presentation flexibility and signal capture memory will help you analyze non-stationary and low-level signals—even those close to much stronger signals—a higher percentage of the time. For more information, please see page 320.

HP E3238 Signals Development System

The HP E3238 signals development system is a turn-key, VXI-based solution for high-speed signal search, classification and monitoring. This high-selectivity receiver has the manual and automatic tools you need to detect, classify and monitor signals of interest. Using digital technology, the HP E3238 improves search speed by 10 or 100 times over narrowband search techniques used in swept systems. For more information, please see page 321.

HP E6500 Series Modular Family of Tuners and Receivers

The HP E6500 series offers system integrators high-performance receiver hardware and VXI plug-and-play software drivers for developing systems for frequency monitoring and surveillance applications. For signal monitoring applications in the VHF/UHF frequency ranges, the HP E6500A VXI tuner brings high dynamic range, preselection, fast tuning, and a flexible, modular architecture. The HP E6501A VXI receiver provides receiver subsystem hardware and accompanying software drivers that help system integrators quickly create cost-effective signal monitoring systems for high-speed signal search, demodulation and direction-finding solutions. For more information, please see page 322.

Key Literature

Reducing Your Risk in Aerospace and Defense. Lit# 5968-3456E

Ordering Information

Prices vary. For more information, please contact your HP sales representative.

Remote Strain conditioning Unit/DAC Express Data Acquisition

HP E1529A
HP E9801A
HP E9812A
HP E9814A

Reducing Your Risk in Physical Test

Aircraft, launch vehicles and other systems have to withstand tremendous physical demands, and the consequences of failure are substantial. Customer requests for lighter weight and lower costs have led to innovative structures and materials that require thorough testing and analysis. And if the test article is one-of-a-kind, your test team needs to quickly acquire hundreds of data points—and hundreds of megabytes of data—for detailed analysis. As you test critical parameters such as temperature, pressure, strain, noise and vibration, you need to verify the quality of the data, analyze it without missing any data, and archive it.

HP Data Acquisition and Control solutions rely on industry standards—VXI, UNIX, Windows NT—to provide dependable systems that meet those needs. HP scanning digitizers, for instance, are ideal for applications that require static measurements and control of the test article. For dynamic and transient measurements, our high-speed digitizers, signal processors and mass-storage modules excel in noise, vibration and structural applications. And built-in or plug-on signal conditioners provide a cost-effective way to handle various test requirements.

To help you create the right solution, HP and a host of HP Solution Partners offer proven software along with skilled systems engineering. Off-the-shelf application software enables solutions such as general vibration analysis, multiple-input modal analysis, shock testing and acoustic analysis.

Key Products

HP E1529A Remote Strain Conditioning Unit

The HP E1529A remote channel strain-conditioning unit offers low cost-per-channel in strain-bridge signal conditioning for static-load and vibration testing. The HP E1529A is designed to simplify stress and fatigue testing of large mechanical structures such as airframes and rockets. Each 32-channel unit features built-in signal conditioning and multiplexed connections, which reduce overall system cost. Strain gage connections—as easy as plugging in a telephone—shorten system set up time. For more information, please see page 406.

HP DAC Express Data Acquisition/Recorder Software

HP DAC Express (HP E9801A) is a Microsoft Windows-based package that improves productivity for mechanical designers and engineers who test product functionality, specification margins, durability and more. With no programming necessary, HP DAC Express speeds up and simplifies the process of system development, data validation, archiving, analysis and report generation. The result is more time for the important tasks of design verification and enhancement. Two HP DAC Express system bundles are also available: the HP E9812A Data Logger and the HP E9814A Data Recorder/Logger. For more information, please see pages 530-533.

Key Literature

Reducing Your Risk in Aerospace and Defense, p/n 5968-3456E

Ordering Information

Prices vary. For more information, please contact your HP sales representative.

HP 8720 E Family

General Purpose Instruments

Microwave Vector Network Analyzers

The HP 8720E family of microwave vector network analyzers provides you with a range of products to meet your measurement needs and budget. These analyzers allow you to characterize devices and components for use in a variety of applications, including communications, satellite, and radar systems. You can test microwave linear and non-linear devices in both coaxial and non-coaxial environments such as waveguide, in-fixture, and on-wafer.

The HP 8719ES, 8720ES, and 8722ES offer integrated source, receiver, and S-parameter test set covering frequencies from 50 MHz to 13.5, 20, or 40 GHz. These analyzers provide a high degree of performance and flexibility, including configurations for high power and mixer testing. The HP 8719ET, 8720ET, and 8720ET cover the same frequencies, but they offer transmission/reflection test sets that provide a more economical solution for users who don't need the accuracy and flexibility of the ES models.

HP ESG-DP Series

RF Signal Generators

New HP ESG-DP and ESG-AP Series RF Signal Generators with Improved Phase Noise

HP extends its popular line of analog and digital RF signal generators by adding eight new models that provide high spectral purity. These new models are targeted towards R&D engineers looking for the ideal general-purpose bench-top instrument.

The new HP ESG-DP series of digital signal generators sets a new price-performance level by offering excelling spectral purity and digital capabilities. This series is ideal for development of existing and evolving digital communications standards, as well as for applications that require a clean signal, such as local oscillator substitution.

The new HP ESG-AP series of analog signal generators provides excellent phase noise performance and analog modulation features for all general-purpose test needs. Also available with this series is a high performance pulse modulation option. This series is the recommended replacement for the 8657A and 8657B economy RF signal generators, which will be removed from CPL on May 1, 2000.

Model numbers include:
E4423B, E4424B, E4425B, E4426B, E4434B, E4435B, E4436B, E4437B

HP ESA-E Series

Signal Analyzers

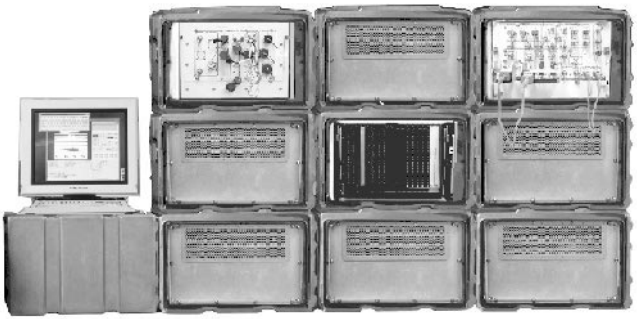
HP ESA-E series Spectrum Analyzers

The HP ESA-E series spectrum analyzers offer a range of performance, features, and flexibility to meet your test budget. The HP ESA-E series integrated applications environment makes a versatile, flexible platform for now and into the future with measurement personalities and application specific solutions.

Now you can get the speed and accuracy you need and still have money left in your budget. HP ESA-L series of portable spectrum analyzers have a remarkable five-millisecond full-span RF sweep time and virtual real-time measurement updates to the display or through HP-IB interface. With excellent accuracy and easy, reliable operation, the HP ESA-L series is full of innovations, like a continuously phase-locked synthesizer, all at a surprisingly low cost.

Model numbers include:
HP E4401A, HP E4402A, HP E4403A, HP E4403B, HP E4404A, HP E4405A, HP E4408B, HP E4411B

HP E1881A



RTCASS

HP E8408V10

HP E6432A

HP VXI in Aerospace/Defense

The HP VXI standard was founded to downsize test-and-measurement equipment in the Aerospace/Defense community. Today, VXI has become synonymous with commercial off-the-shelf test systems (COTS).

For Aerospace applications, HP now provides a rugged and EMI-proof VXI mainframe, as well as the economical and lightweight HP E8408A VXI mainframe.

The HP E1881A is a military-ruggedized and EMI-proven, 11-slot VXI mainframe. This new mainframe mitigates the VXI backplane, modules, power supply, and fans to withstand shock in excess of 170 G's. The HP E1881A has been designed to meet the most stringent needs for various EMI specifications.

The HP E8408A, HP's new 4-slot, C-size VXI mainframe, brings economy and portability to HP's selection of mainframes. It is HP's smallest and lightest-weight C-size mainframe, which saves system rack space in your work area. With the Option 901 Accessory Kit, which includes a shoulder strap and accessory pouch, you can port the HP E8408A Mainframe to a remote test site. This new mainframe offers quiet, efficient cooling and 175 watts of usable power.

The HP E6432A VXI Microwave Synthesizer is suited for test applications ranging from field test sets to avionics, single-radar-target testing, and other military communication systems testing. In addition to its rugged design, the HP E6432A synthesizer features a 10 MHz to 20 GHz frequency range, three C-size VXI slots, –90 dBm to +17 dBm output power, a VXIplug&play driver, fast power and frequency switching speeds.

The HP E3238 Signal Development System is a fast-scanning, high-selectivity receiver system with the manual and automatic tools you need to detect and isolate signals of interest in dense environments. The new HP E3238 has a frequency range of 2 to 2,650 MHz and sensitivity down to –159 dBm/Hz.

In order to provide a more complete solution for Aerospace/Defense customers, HP and Math Works, Inc. developed a total measurement solution that provides engineers with a quick, efficient and cost-effective way to move live-measured data directly into a software environment for analysis. The solution pairs the high-performance HP E1432A/33A/34A VXI digitizers with the flexible analysis power of MATLAB 5.2 software.

Ordering Information

Prices vary. For more information, please contact your HP sales representative.

Debug Tools and Solutions Hewlett-Packard's digital debug tools and solutions help you navigate through the sometimes uncertain processes of board turn on, prototype debugging, hardware/software integration, and functional testing

The HP 16700 Series Logic Analysis Systems combine logic analysis and emulation to provide a complete view—from hardware to software—of digital system prototypes.

The HP 1660/70 Series Benchtop Logic Analyzers allow you to choose from capabilities such as basic hardware/software debugging, parametric and mixed signal testing, hardware simulation and stimulus/response testing, and complex debugging with deep memory, in a number of affordable models.

Logic Analysis Systems
Emulation Solutions
Microprocessor and Bus Interfaces
Post-Processing Tools
Benchtop Logic Analyzers

Verification Tools and Solutions Hewlett-Packard's digital verification tools and solutions offer a range of tools that help to evaluate, optimize and validate the behavior of your PCI system or component.

HP's PCI Exerciser and Analyzer is a PCI optimized state logic analyzer and data generator. It provides fully controllable system-tests, wide coverage, reproducibility, and root-cause-analysis capabilities that reveal system critical problems faster than any hot mock-up testing can.

PCI Exercisers and Analyzers

Characterization Tools and Solutions Hewlett-Packard's characterization tools and solutions offer a wide variety of pulse/pattern generators and the HP 81200 Data Generator/Analyzer Platform, which focus on functional and parametric testing of digital and high-speed devices.

The HP 81200 provides stimulus and response capabilities as well as parallel bit-error-rate capabilities in one platform, to characterize and verify digital subsystems, ICs or boards in R&D and manufacturing.

HP's pulse/pattern generators are highly accurate digital sources for use across all industries

Data Generator/Analyzer Platform
Pulse/Pattern Generators
Digital Transmission Tester

Logic Analysis & Emulation Solutions

Overview

HP provides a broad range of digital system debug tools to help you solve your hardest problems the fastest way.

Creating a Shorter Path from Problems to Insights to Answers

Your design team faces a difficult challenge to deliver quality products to the marketplace faster than your competitors. Part of that challenge is your ability to turn on early prototypes in order to characterize and debug hardware, design and test firmware and software, and perform system integration.

Design problems are getting harder to find and solve. Problems stretch across domains from analog signals to source code. When the prototype does not work as expected, you need debug tools that quickly provide you with reliable insight into your toughest problems.

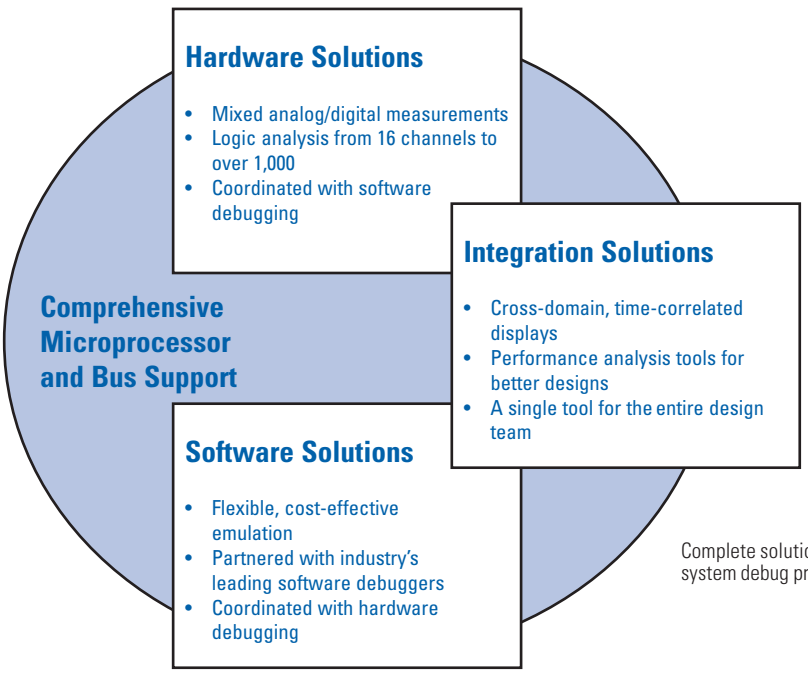
By listening to thousands of designers like you, Hewlett-Packard has developed a wide range of solutions to meet real-world debugging challenges, from 8-bit designs to 64-bit multiprocessor systems using the newest chips on the market.

Solutions from Signals to Source

HP provides a wide variety of logic analyzers for general-purpose debugging at attractive price/performance points. From basic timing analysis to cross domain measurements and from PC-hosted to highly integrated self-contained units, HP offers the right logic analyzer to meet your application and budget.

The HP 16700 Series of scalable debug tools provide the capabilitity to do hardware debug and rapidly integrate complex digital systems. You get the digital hardware debug capabilities and low intrusion factors of a logic analyzer, combined with the software-execution visibility and processor-execution control benefits of an emulator.

HP offers insight into hardware/software interaction, software performance and other system-wide behaviors that extend beyond the processor itself.



Complete solutions for all phases of your digital system debug process.

HP Benchtop Logic Analyzers

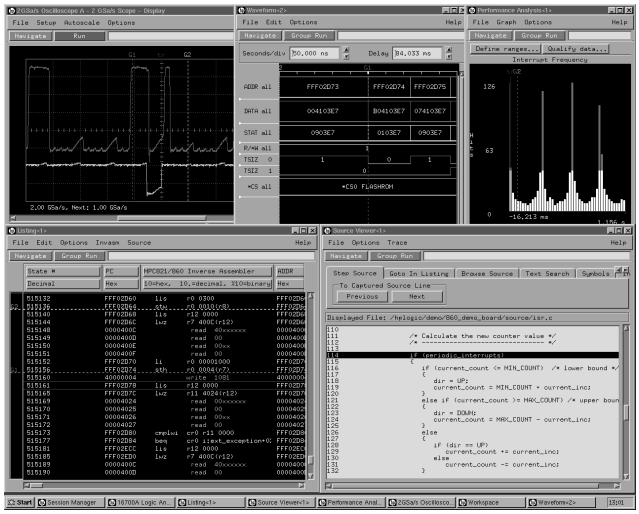
We've Made One Just Your Size

Matching the troubleshooting capabilities you need with the tool budget you have available can be a difficult task. That is why HP offers a wide variety of benchtop logic analyzers so you can choose the model that best matches your exact needs.

Selection Guide

Model Number	**HP 54620A**	**HP 54620C**		
Channels	16	16		
Application	General purpose timing analysis			
Model Number	**HP E9340A (LogicWave)**			
Channels	34			
Application	PC hosted state and timing analysis			
Model Number	**HP 1664A**			
Channels	34			
Application	State and timing analysis with inverse assembly			
Model Number	**HP 1670G**	**HP 1671G**	**HP 1672G**	**HP 1673G**
Channels	136	102	68	34
Application	Full-featured logic analysis with deep memory, integrated oscilloscope or pattern generator			

Turn to pages 417 and 418 for the entire story.



View system resources in multiple domains, all time-correlated.

HP 16700 Series Logic Analysis Systems

The HP logic analysis systems offer a single solution for hardware, software and system debugging.

Hardware designers get the measurement power that made the HP 16500 logic analyzer the top seller for more than a decade, plus processor execution control, register access and other tools to explore software-dependent hardware problems such as interrupt handling.

Software designers get debugging and analysis tools that overcome the drawbacks of traditional emulation, while providing an easier way to solve hardware-dependent software problems that only a logic analyzer can uncover.

System designers get time-correlated views showing system activity from analog signals all the way to source code. The HP logic analysis systems' cross-domain displays minimize the mysteries of hardware-software interaction, helping the team track symptoms back to root causes quickly and confidently. See page 420 for complete details.

Processor Support

Whether it's intrusiveness that changes the behavior of the system under test, poor debugger links, shallow memory or the lack of system-wide analysis, traditional emulators are struggling to keep up with the latest microprocessors.

HP's emulation technology keeps pace with today's most powerful processors, as well as gives you valuable insight into hardware/software interaction, and other system-wide behaviors that extend beyond the processor itself.

HP logic analysis systems can be customized to support your processor by adding one or more of the following components:

- Analysis probes provide a non-intrusive mechanical and electrical connection to your processor, giving you a complete picture of bus activity.
- Source correlation tool set provides a real-time trace linked to the high-level source language, time-correlated to activity captured by the logic analyzer's acquisition modules.
- Emulation module/probe provides control of program execution including fast code download, setting breakpoints and stepping, in addition to having the ability to modify memory and registers. The emulation module or emulation probe can be controlled by a high-level debugger or by HP's emulation control interface.
- HP's emulation control interface. If you are using the emulation module primarily for debugging hardware, control the emulation module using HP's emulation control interface. The interface gives you control over program execution including setting breakpoints and stepping, the ability to modify memory and registers, and memory disassembly.
- Debuggers purchased from vendors (see page 431), the debugger allows you to control the emulation module. This combination gives you the tools necessary to locate elusive software-dependent hardware bugs and hardware-dependent software bugs.

See page 427 for the further details.

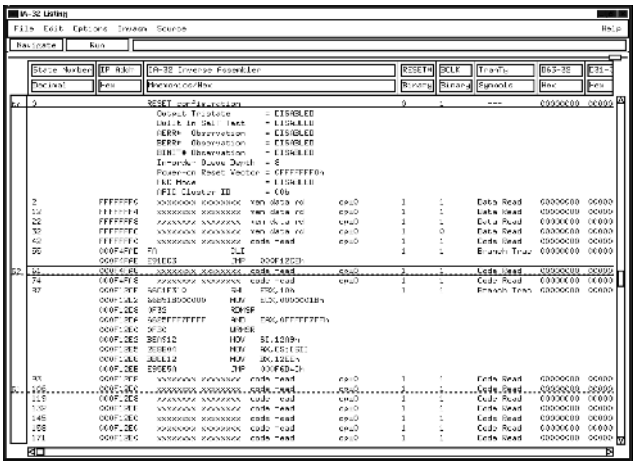
Start-Up Assistance

The Fastest Way to Increase Productivity

HP Response Center Start-Up Assistance provides processor-specific start-up assistance to help your design team become productive quickly with your HP logic analysis and emulation solution. HP digital systems consultants provide a full day of training and productivity assistance at your site. You get help solving complex debug and target system problems specific to your system designs. And the one-day session can be geared to any experience level, so you get relevant information whether you're a veteran or beginner. To learn more about this and other HP productivity solutions, just turn to the HP Services and Support section in this catalog, or go online: **www.hp.com/go/jumpstart.**

Ordering Information

HP 50629L IA32, One-Day Session



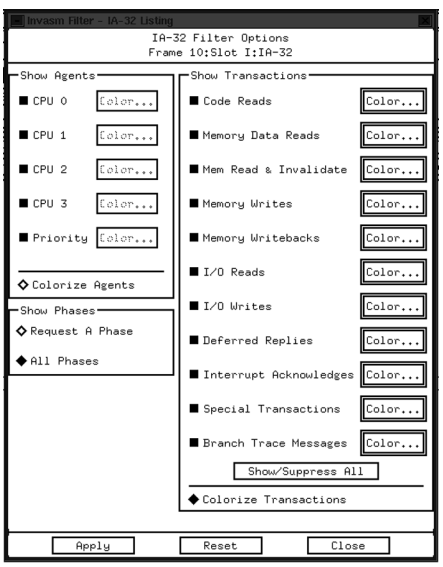
Inverse assembly listing for the Pentium processor.

Isolating the root cause of elusive system turn-on and compatibility problems requires that you track the interactions between the processor(s) and critical buses in the system. When tailored to your system requirements with processor and bus specific analysis probes and emulation modules, the HP 16700 Series logic analysis systems give you invaluable insight into system operation. Here are a few examples of HP's extensive analysis probe support.

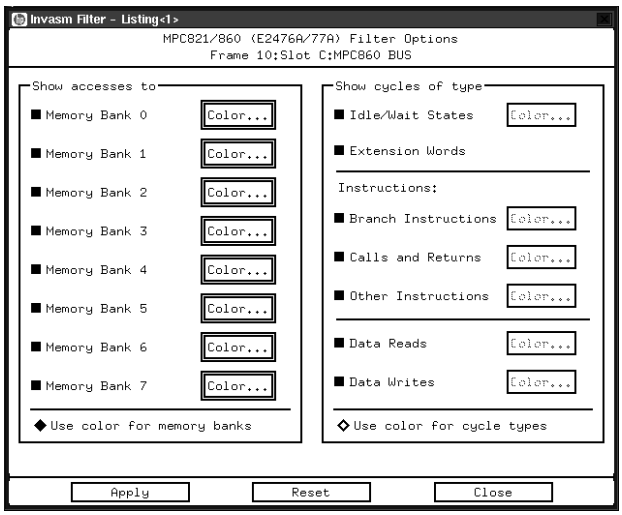
Intel Celeron, Pentium II, III, or Pentium System Debug

To capture the complete picture of your computer system's operation, it is necessary to track activity on multiple buses simultaneously. The HP 16700A and 16702A logic analysis systems allow you to time-correlate your display of data captured on multiple buses in your system. With the HP 16700A and 16702A logic analysis systems, it is simple to display Celeron, Pentium II, III, or Pentium processor bus traffic in the same listing as PCI, ISA and APIC bus traffic. In addition, bus cycles on the Intel i960RP peripheral processor bus can be captured and viewed using an HP analysis probe. Since data captured on each bus in the system is time-correlated, it is easy to measure time delays across bus bridges in your system.

The HP inverse assembler displays code execution in familiar code mnemonics. The inverse assembler takes advantage of the Celeron, Pentium II, III, or Pentium processor's branch trace message (BTM) bus cycles. Branch trace messages are special bus cycles issued by the CPU (when enabled) that indicate the "from" and "to" addresses of a branch. By using BTMs, the inverse assembler can track code flow when cache is enabled.



Inverse assembler options for Pentium processors.



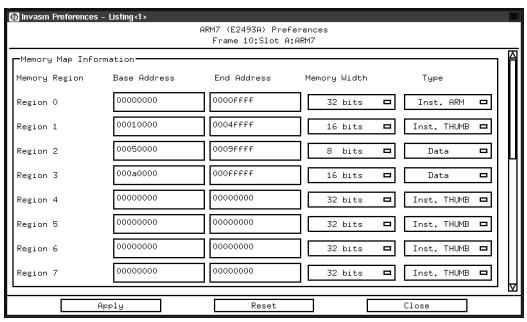
Inverse assembler filter options for MPC 860.

Motorola MPC 800 Series System Debug

HP's solutions for Motorola MPC 800 microprocessors combine the powerful tools of emulation, code download, debugger connections, and logic analysis for a complete, scalable system debug environment.

Using an analysis probe in conjunction with an HP emulation probe or module, you can quickly configure the logic analyzer by labeling address, data and status signals for the MPC 821/823/850/860, as well as control program execution through single stepping, start/stop, run/break and set/modify breakpoints. You can also run code at full speed in the target.

Once the logic analyzer acquires the real-time trace, step through the trace at assembly-code level or source-code level. Locate the cause of a problem by time correlating this measurement to other system activity.



Inverse assembler configuration screen for ARM7.

ARM7 and ARM9 System Debug

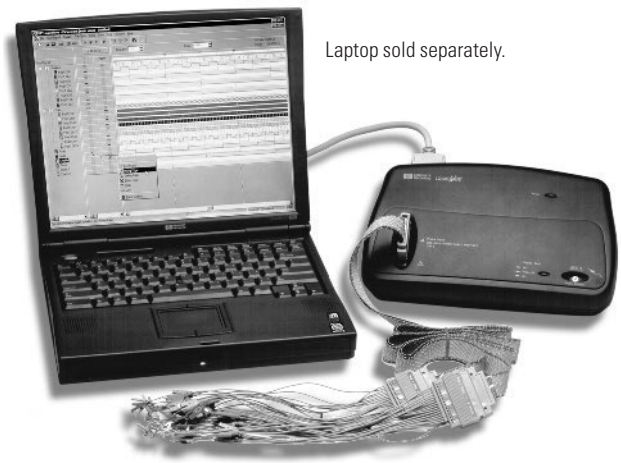
The new trace port analyzer provides realtime, non-intrusive execution and data trace for ARM 7 or ARM 9-based systems which have cache memory or on-board program memory when the processor contains the ARM Embedded Trace Module. The trace port analyzer works in conjunction with an HP emulation probe/module and a third-party debugger to provide a complete emulation capability, including inverse assembly and source code correlation, at an affordable price. An emulation probe or module is available separately, and can be used in conjunction with industry-leading debuggers.

Where address, data and status lines of the ARM processor are available externally for connection to a logic analyzer, the HP inverse assembler provides ARM or THUMB mnemonics in the trace listing for easy correlation between captured data and target code. The inverse assembler can be used with the HP B4620B source correlation tool set. This allows time correlation of an acquired trace to source code.

HP E9340A

NEW

- An affordable logic analyzer that is very user-friendly
- Impressive price performance: 100 MHz state, 250 MHz timing, 128K memory, 34 channels for $3,200
- A well crafted Windows user interface provides efficient single window operation
- A compact, PC hosted form factor makes the product truly transportable, 11.5" x 9" x 2.5", 2.1kg (4.5 lbs)
- An intuitive tool you won't have to relearn every time you use it
- Try it out for yourself by downloading the user interface: **www.hp.com/go/LogicWave**



Laptop sold separately.

HP Logic*Wave* logic analyzer (E9340A)

New Users Find HP Logic*Wave* Intuitive

Infrequent or first time users of logic analyzers will find the product intuitive. Problems that can take days to hunt down using just an oscilloscope can be found in hours with the help of an HP Logic*Wave*.

Experienced Users Find HP Logic*Wave* Handy

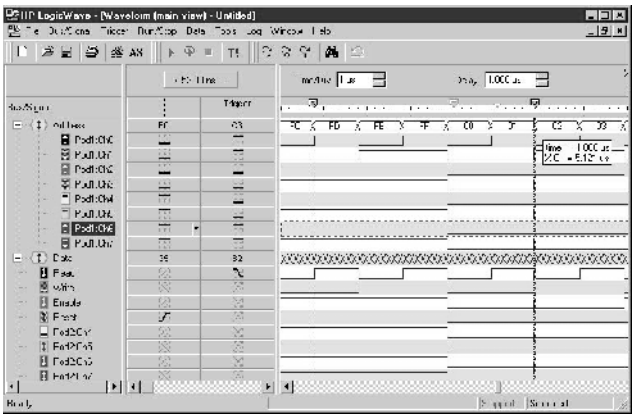
Frequent users of logic analyzers will find the streamlined user interface a delight to use. Owners of an HP Logic*Wave* logic analyzer won't have to wait until the big lab analyzer is free to make their basic measurements.

Ease-of-Use Innovations Abound

We watched how engineers used logic analyzers and listened to their frustrations to develop some breakthrough ease-of-use innovations: "What You Draw is What You Capture" (WYDIWYC) Timing Trigger, Zoom Box, Drag & Drop Labels, Expand/Collapse Buses, Group into Bus, Tool Tip Bus Values, Activity Indicators, Off-line Analysis and more. But don't take our word for it—try it out for yourself by downloading the user interface off of our web site.

Affordable & Friendly Logic Analysis

The HP Logic*Wave* logic analyzer provides impressive performance at our lowest price ever for a full-featured state and timing analyzer. An innovative user interface also makes this logic analyzer user-friendly.



Innovative use of the familiar Windows user interface makes the logic analyzer easy to use. Commonly used features are available in a single window with less frequently used features accessed via a few dialog boxes

Key Specifications and Characteristics for the HP Logic*Wave* Logic Analyzer

Model	E9340A
Channels	34
State Speed	100 MHz
Timing Speed	250 MHz
Memory Depth	128K
Triggering	"What You Draw Is What You Capture" (WYDIWYC) Timing Trigger
Probing	HP Patented, 100 kΩ, 8pF
I/O Ports	Enhanced Parallel, Trigger In/Out BNC
User Interface	Windows 95/98/NT, Pentium or Better, Desktop or Laptop. Runs as an application—no need for a dedicated PC. Fast update rates
Dimensions	11.5"x9"x2.5", 29.1 x 22.8 x 6.3 cm
Weight	4.5 pounds, 2.1 kg

Key Literature

These items can also be downloaded via the internet at:
www.hp.com/go/LogicWave
HP Logic*Wave* (E9340A) Technical Specifications, p/n 5968-5560E
HP Logic*Wave* Product CD (with fully functional user interface) p/n E5968-6655E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

Ordering Information

E9340A HP Logic*Wave* Logic Analyzer
Opt 001 Quick Reference Card & Demo Board

10

HP 1670G
HP 1671G
HP 1672G
HP 1673G
HP 1664A

NEW

- Tailor cost-effective solutions to match your specific application
- Simplify capture and analysis of complex events with up to 2M deep memory
- View analog and digital signals simultaneously with the optional two-channel, 500 MHz oscilloscope
- Stimulate circuits and simulate missing components with the optional pattern generator capability

Get Personalized Power with a Logic Analyzer Built for Your Unique Needs

The HP 1670G Series logic analyzers offer cost-effective 135 MHz state analysis and timing analysis at speeds up to 500 MHz. The high-speed acquisition memory can be configured for depths up to 2M samples over as many as 136 acquisition channels. An optional 2-channel, 500 MHz oscilloscope or a 32-channel pattern generator capable of up to 200 MVector/s can be added to the unit to customize it for signal integrity or stimulus-response applications. Never before has so much measurement power been available in such an affordable package.

You'll make productive use of all the measurement power, too. A commonsense user interface helps you solve your design problems faster, and the ability to view processor mnemonics and waveforms simultaneously makes it easier to see cause/effect relationships in your system. Navigating through the user interface is made simple via a choice of either mouse or front-panel operation. An optional keyboard is also available. The color flat-panel display will help you find information quickly.

Graphical trigger macros assist in making powerful measurements. Trigger setups can be selected from a categorized list of trigger macros. Each macro is shown in a graphical form and has a written description. Macros can be chained together to form a custom trigger sequence.

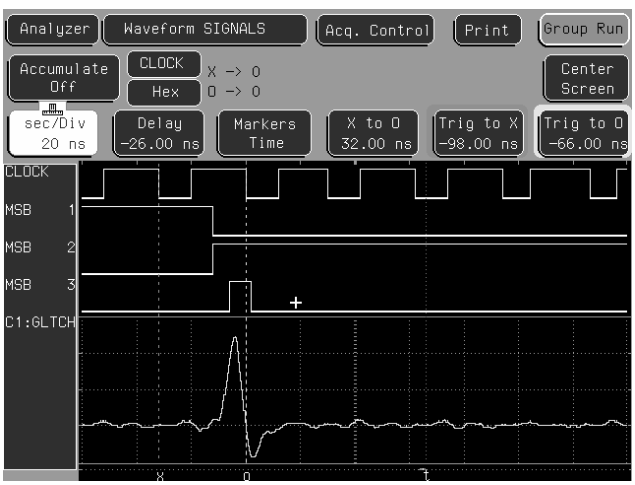
An Excellent Toolset for Hardware Development

Some of the tougher hardware problems can be found only with the digital triggering capabilities of a logic analyzer and solved only with the analog resolution of an oscilloscope. That's why a built-in, 500 MHz, 2-Gsa/s oscilloscope that can be triggered by the logic analyzer may be added to any model. Now, you can see what bus lines really look like at critical moments.

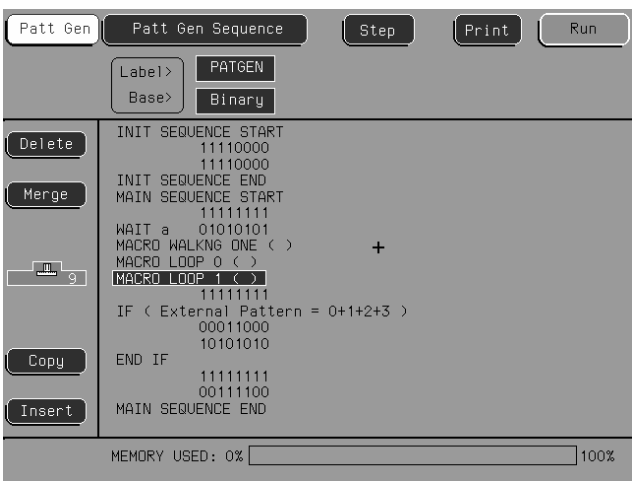
The optional pattern generator capability allows you to functionally test your digital design. You can stimulate the design under test and see how it responds to specific signals or clock speeds. You can also use the pattern generator to substitute for missing subsystems. The data captured with the state or timing analyzer can then be used to verify correct operation.

Get the Whole Picture with Deep Memory

Deep memory can be a valuable logic analyzer feature for solving difficult or poorly understood problems in embedded microprocessor systems. It saves time you might otherwise spend taking multiple traces to piece together a complete picture of prototype behavior. Deep memory can also reduce the need to set up multilevel triggers because you don't have to be as precise about the data you capture. All models in the HP 1670G series can be configured to have up to 2M samples of memory depth.



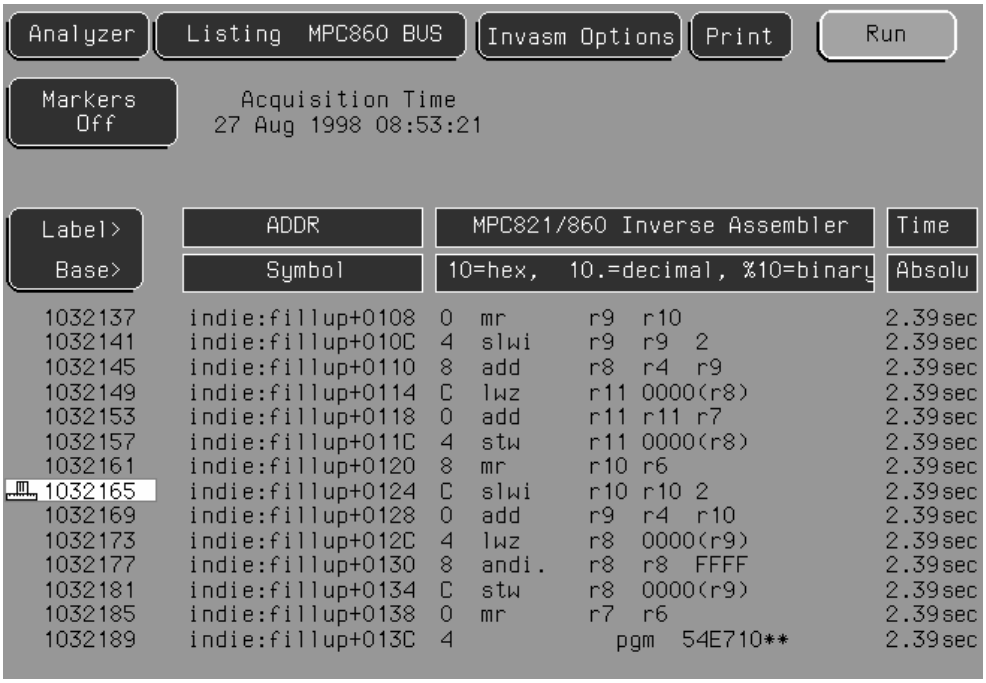
Optional built-in oscilloscope allows correlation of timing, state, and analog signals, to facilitate identification of glitches.



Optional 32-channel pattern generator allows stimulation of subsystems with realistic signals before the entire system is ready for testing.

HP 1670G
HP 1671G
HP 1672G
HP 1673G
HP 1664A

NEW



2 M deep acquisition memory allows analysis of long periods of target system execution.

Key Specifications and Characteristics for HP 1670G Series Benchtop Logic Analyzers

Model	1670G	1671G	1672G	1673G
Channels	136	102	68	34
State Speed	135 MHz			
Timing Speed	250 MHz on all channels, 500 MHz on half channels			
Memory Depth **Option 001** **Option 002**	64K memory standard (128K half channel timing) 256K memory (512K half channel timing) 2M memory (4M half channel timing)			
Setup/Hold Time	3.5/0 ns to 0/3.5 ns adjustable in 500-ps increments			
Probe Input R & C	100 kΩ, 8pF			
Triggering	Up to 12 sequence levels with 10 pattern terms, 2 edge & glitch terms, 2 ranges and timers. Also includes 23 predefined trigger macros with graphical representations and plain language descriptions			
I/O Standards	2-GB hard disk drive, 1.44-MB flexible disk drive Ethernet LAN for file transfers and control HP-IB, Parallel and RS-232 ports DIN mouse and keyboard ports Trigger in and Trigger out BNCs			
Oscilloscope **Option 003**	Number of scope channels: 2 Scope bandwidth: 500 MHz Scope sample rate: 2 Gsa/s Scope vertical resolution: 8 bits Scope memory depth: 32K samples per channel			
Pattern Generator **Option 004**	Number of pattern generator channels: 32 Max clock speed: 100 MHz (32 Ch), 200 MHz (16 Ch) Max memory depth: 258,048 vectors			
Training Kit **Option 005**	Includes a training guide, example setup and data files, and a credit-card-sized target system board			

Key Literature

Both of the following items are also available from the web site: **www.hp.com/go/LAbenchtops.**
HP 1670G Series Technical Specifications, p/n 5968-6421EN/EUS
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS
CD-ROM "Logic Analysis and Emulation Solutions" version 5.0, p/n 5965-7502E

Ordering Information

Model	1670G	1671G	1672G	1673G
Channels	136	102	68	34
Memory Options (choose 1 or none) **Option 001 (256K)** **Option 002 (2M)**				
Companion Tools (choose 1 or none) **Option 003 (Scope)** **Option 004 (PatGen)**				
Training Kit **Option 005**				

The HP 1664A Entry Level Logic Analyzer

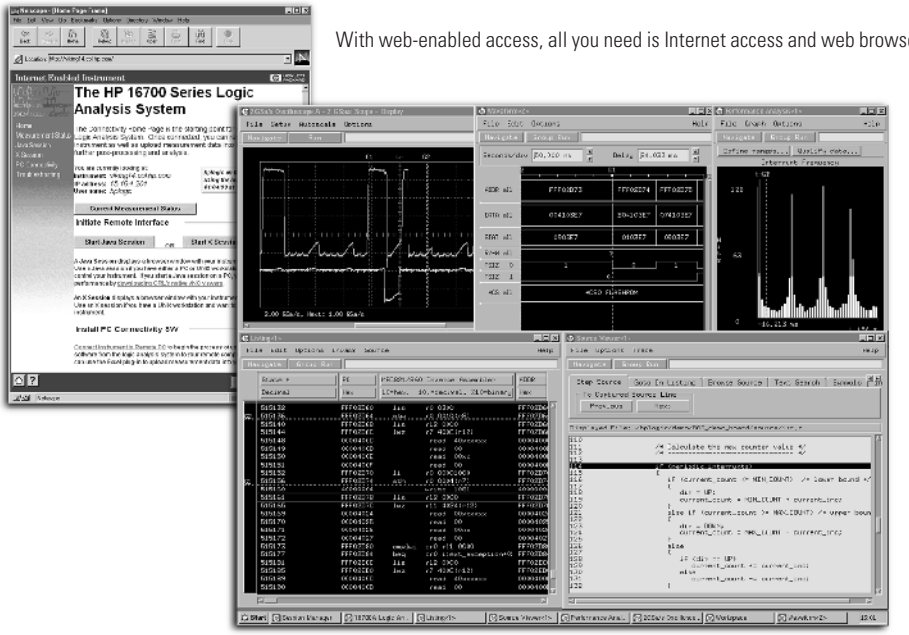
The HP 1664A logic analyzer offers many of the popular features of the HP 1670G series at an entry-level price. Its features include: 50 MHz state analysis, 500 MHz timing analysis, 34 acquisition channels and 4K samples per channel memory depth. The HP 1664A uses a gray scale display and is compatible with a wide variety of processor specific inverse assemblers. The HP 1664A is priced at $5,000. See the technical data sheet or web site for more information regarding the HP 1664A.

10

HP 16700A Logic Analysis Systems

HP 16700A
HP 16701A
HP 16702A

- Precisely correlated displays from analog signals to source code
- Simultaneous measurements on up to 1,020 channels
- Integrated emulation that takes advantage of on-chip debugging
- Tight coupling of logic analysis and emulation enables hardware and software designers to coordinate their debugging effort
- Remote web-enabled access
- Direct import of data into Microsoft Excel using HP BenchLink XL



With web-enabled access, all you need is Internet access and web browser to access and control your logic analyzer.

View system resources in multiple domains, all time-correlated.

Take Advantage of Integrated Insight During Hardware/Software Integration

Debugging today's digital systems is tougher than ever. Increased product requirements, complex software, and innovative hardware technologies all need to come together in a shorter amount of time to meet your market window.

When the prototype does not work as expected or needs tuning to meet performance requirements, you need test equipment that quickly provides reliable insight into your toughest problems. You want the answer to the problem, and you want it right away.

This is why HP has introduced a suite of logic analysis, emulation and software tools to give you the insight you need. Whether you are a hardware or software designer, HP has tools that address your debugging and verification needs.

Debugging Tools That Will Help You Redefine Teamwork

The HP 16700A and 16702A logic analysis systems offer a single solution for hardware, software and systems debugging.

Hardware designers get the measurement power that made the HP 16500 logic analyzer the top seller for more than a decade, plus processor execution control, register access and other tools to explore software-dependent hardware problems such as interrupt handling.

Software designers get debugging and analysis tools that overcome the drawbacks of traditional emulation, while providing an easier way to solve hardware-dependent software problems that only a logic analyzer can uncover.

System designers get time-correlated views showing system activity from analog signals all the way to source code. The HP logic analysis system's cross-domain displays minimize the mysteries of hardware-software interaction, helping the team track problems back to root causes quickly and confidently.

More Windows on the Problem

The HP 16700A and 16702A logic analysis systems allow you to examine system behavior from multiple angles—code execution, bus activity, timing and signal integrity—simultaneously. With integrated emulation capabilities, you gain insight into tough hardware/software integration problems even faster.

On-Chip Emulation Tools Make Fixing Bugs Easier

Combining processor execution control with logic analysis lets you untangle the toughest hardware/software integration problems.

For specific microprocessor families that feature on-chip emulation, you can add an emulation module to connect the on-board debugging resources of the microprocessor to the logic analyzer and to a high-level debugger.

Integrated Debugger Support

The HP 16700A and 16702A logic analysis systems offer you unprecedented visibility into software execution. Gain the ability to control your processor (break, step, run, stop) and modify/read registers with the addition of an emulation module. The emulation module provides the ability to connect to the industry's leading debuggers. This gives you complete hardware-assisted software debugging.

Set-up Assistant Allows for Fast Analyzer Setup

Usability testing revealed that one of the hardest parts of using a logic analyzer is connecting it to the target and setting it up to make measurements. The set-up assistant in the HP 16700A and 16702A logic analysis systems guides you through all the necessary steps to get you to your first measurement quickly.

Easy Access to System Insights

Web-enabled logic analysis. Your logic analyzer can now function as a web server, which means distributed teams can get the data they need, wherever they are. Plus you can launch and monitor tests from home, from the road, from wherever you need to be.

PC file sharing. Access PC disk drives from the logic analyzer or access the logic analyzer from networked PCs.

Doing more with your data. With HP BenchLink XL 16700's add-in toolbar for Microsoft Excel, it's easy to extract specific sets of the data from the analyzer for further analysis on your PC.

HP 16702A
HP 16700A
HP 16701A

HP 16700A and 16702A features:
- 333 MHz state analysis
- 2 GHz Timing Zoom
- Choice of 8K, 32K, 128K, 2M, or 40M memory depth
- VisiTrigger – easy access to commonly used trigger functions
- Scalable solution with simultaneous measurements on up to 1,020 channels

HP 16702A features:
- Built-in 10.3 inch 800X600 display and front panel keyboard
- Small footprint for limited space environments, or where trans-portability is required.

The HP 16702A provides advanced logic analysis and emulation features in a standalone mainframe.

HP 16702A Logic Analysis System Mainframe

For more than a decade, the HP 16500 logic analyzer helped engineers troubleshoot the toughest design challenges around. Now, the HP 16702A is ready to take over that leadership position, with all the power of the HP 16500 and much more.

The flexible and intuitive user interface of the HP 16702A provides you with the familiarity of windows and the ability to control the analyzer directly from the tab menus without searching through several pop-up menus. Debugging is simplified by providing:
- Easy connection to your target and measurement setup using the setup assistant
- Insight into signal integrity problems with the improved full-function oscilloscope interface
- Quick access to the most commonly used features with menu tabs
- Ability to size and position windows on the built-in flat screen monitor to suit your troubleshooting process

Specifications

Mainframe: 5 measurement modules, 2 emulation modules
Expansion Mainframe: 5 measurement modules, 2 emulation modules
Maximum Channel Count: 510 with HP 16702A only; 1,020 by adding HP 16701A expansion mainframe
Maximum State Clock: 100 MHz to 1 GHz/s (depending on module selection)
Maximum Timing Sample Rate: 500 MHz to 4 GHz/s (depending on module selection)
Memory Depth: 4K to 4M (depending on module selection)
Built-in Display: Yes

Key Literature

HP 16600A and 16700A Series Logic Analysis System Mainframes, p/n 5966-3107E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

Ordering Information

HP 16702A Logic Analysis System Mainframe
HP 16701A Expansion Mainframe
- **Opt 001** 17" Color Monitor
- **Opt 003** Performance Upgrade/160MB RAM and 2M video RAM
- **Opt 004** External CD-ROM drive

HP 16700A, shown here with an HP 16701A expansion mainframe, offers comprehensive debugging capabilities for multiprocessor designs.

HP 16700A Logic Analysis System Mainframe

The HP 16700A logic analysis system offers the same comprehensive cross-domain debugging capabilities of the HP 16702A without a built-in display. Hardware designers get high-speed logic analysis on up to 1,020 channels, while software designers get a full suite of emulation tools. And with multiple time-correlated views on screen simultaneously, and access to test data through a shared physical connection, the whole team can work together more effectively and efficiently.

Specifications

Mainframe: 5 measurement modules, 2 emulation modules
Expansion Mainframe: 5 measurement modules, 2 emulation modules
Maximum Channel Count: 510 with HP 16700A only; 1,020 by adding HP 16701A expansion mainframe
Maximum State Clock: 100 MHz to 1 GHz/s (depending on module selection)
Maximum Timing Sample Rate: 500 MHz to 4 GHz/s (depending on module selection)
Memory Depth: 4K to 4M (depending on module selection)

Key Literature

HP 16600A and 16700A Series Logic Analysis System Mainframes, p/n 5966-3107E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

Ordering Information

HP 16700A Modular Mainframe
HP 16701A Expansion Mainframe
- **Opt 001** 17" Color Monitor
- **Opt 003** Performance Upgrade/160MB RAM and 2M video RAM
- **Opt 004** External CD-ROM drive

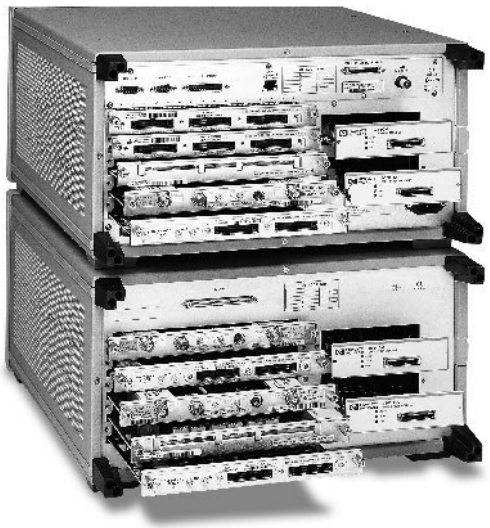
HP 16500C Logic Analyzer System Mainframe

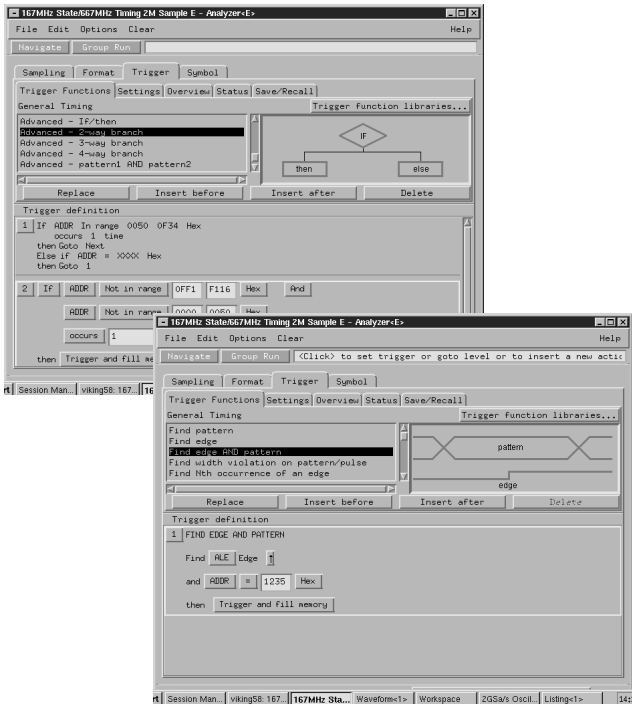
For more information on the availability of the HP 16500C see (Chapter 20) Refurbished Test and Measurement Instruments ,or visit our web site: **http://www.hp.com/go/refurbished**

General-Purpose and High-Speed State and Timing Analysis Modules

HP 16557D
HP 16710A
HP 16711A
HP 16712A
HP 16715A
HP 16716A
HP 16717A

- 333 MHz state analysis
- 2 GHz timing analysis
- 8K, 32K, 128K, 2M and 40M memory depth
- Five timing modes with resolution down to 500 ps
- VisiTrigger triggering capability
- 2 GHz Timing Zoom





Cost-effective State Analysis up to 333 MHz; Timing Analysis to 2 GHz

The HP 16557D and 167XX Series modules offer state analysis up to 333 MHz, with as many as 1,020 channels in a system. The HP 16716A/17A Series modules provide 2 GHz Timing Zoom, high-speed state and 2 GHz timing measurements at the same time on all channels through a single probe. All channels can perform either state or timing analysis, so it's easy to set up simultaneous, time-correlated measurements.

VisiTrigger decreases the time to first measurement by allowing easy access to commonly used trigger functions. Its graphical representation of the trigger waveform helps the user quickly understand exactly how the trigger conditions will be defined.

General-Purpose State and Timing Analysis Modules

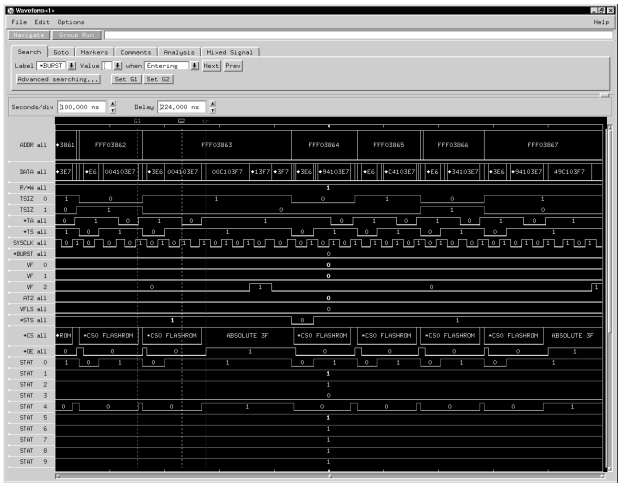
HP Model Number	HP 16557D	HP 16710A	HP 16711A	HP 16712A	HP 16715A	HP 16716A	HP 16717A
Maximum state clock	140 MHz[3]	100 MHz	100 MHz	100 MHz	167 MHz	167 MHz	333 MHZ
Maximum timing sampling rate	500 MHz	500 MHz	500 MHz	500 MHz	333/667 MHz	2 GHz Timing Zoom	
Memory depth (half/full channels)	4/2 M[1]	16/8 K[1]	64/32 K[1]	256/128 K[1]	4/2 M[1]	1 M/512 K[1]	4/2 M[1]
Setup/hold time, window range	3.0 ns 3.0/0 to -.5/3.5 ns[2]	4.0 ns 4.0/0 ns to 0/4.0 ns[2]			2.5 ns 4.5/-2.0 ns to -2.0/4.5 ns in 100 ps increments per ch.[4]		
Channels per card	68	102	102	102	68	68	68
Maximum channels on a single time base and trigger	340	204	204	204	340	340	340
Maximum channels in a single HP 16700A or 16702A mainframe	340	510	510	510	340	340	340
Maximum channels in a system (one HP 16700A or 16702A and one HP 16701A)	680	1020	1020	1020	680	680	680
Number of state clocks/qualifiers (available only on the master card in multicard configurations)	4	6	6	6	4	4	4

[1] Increased memory depth in half channel timing mode only.
[2] Minimum setup/hold time specified for single edge, single clock acquisition. Single clock, multi-edge setup/hold window add 0.5 ns. Multi-clock, multi-edge setup hold window add 1 ns.
[3] Across 4 modules (272 ch.) only. ≥ 272 channel systems state speed = 100 MHz.
[4] Minimum setup/hold time specified for a single edge, single clock acquisition. Multi-clock, multi-edge add 0.5 ns.

Key Literature

State and Timing Modules for HP Logic Analysis Systems, Product Overview, p/n 5966-3367E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

- Trigger directly on setup and hold violations down to 2 ns
- Make timing measurements across as many as 80 channels with the resolution and precision of an oscilloscope
- Characterize the performance of a high-speed ASIC or target system
- Capture the most complex problems with an easy-to-use trigger macro library



View circuit operation with better precision than ever before in a logic analyzer.

HP 16517A/16518A High-Speed Timing Modules

Find the Cause of Elusive Problems

The 64K deep memory lets you capture data over many clock cycles while retaining the highest multichannel accuracy ever in a logic analyzer. Verify the timing of critical edges with 250 ps resolution across up to 40 channels, or 500 ps resolution across up to 80 channels. You can use 1 GSa/s synchronous state analysis to view high-speed data streams across up to 80 channels.

Precisely Characterize Setup or Hold Times

The 250 ps precision (channel-to-channel skew) allows your logic analyzer to be used in place of an oscilloscope for characterization. The high-channel count of a logic analyzer improves the efficiency of the characterization process.

The HP 16517A and 16518A are capable of triggering on violations of timing specifications. This is particularly powerful since it allows the wide channel count of the analyzer to look for setup and hold violations. Advanced setup/hold trigger macros are available to help you easily set up triggering.

Specifications

HP 16517A/16518A
Maximum Timing Speed: 2 GSa/s or 4 GSa/s[1]
Maximum State Speed: 1 GSa/s or 2 GSa/s[2]
Memory Depth: 64K or 128K[1]
Channels-per-Card: 16/16[3]
Probe Input R&C: 0.2 pF, then through 500 Ω, 3 pF and 100 kΩ
Trigger Macro Library: With 4 sequence levels
Channel-to-Channel Skew: 250 ps, typical

[1] Half-channel mode doubles memory depth and doubles timing speed.
[2] Maximum state speed with oversampling.
[3] HP 16518A expansion card requires HP 16517A master card. Up to four HP 16518A cards are supported by each HP 16517A.

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Key Literature

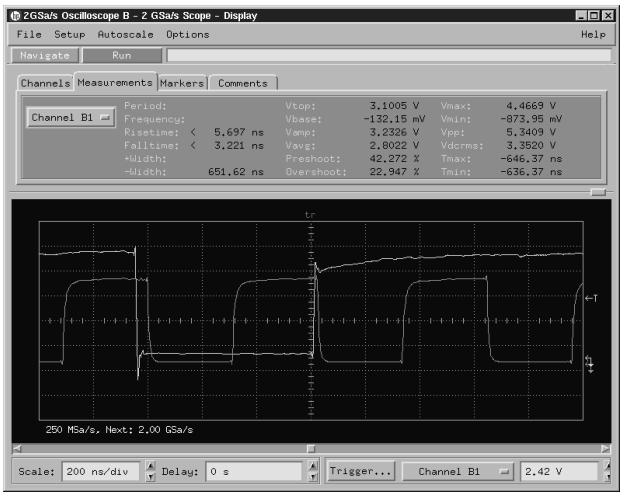
State and Timing Modules for HP Logic Analysis Systems, Product Overview, p/n 5966-3367E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

Ordering Information

HP 16517A 16-Channel, 4 GHz Timing/1 GHz State Master Card
HP 16518A 16-Channel, 4 GHz Timing/1 GHz State Expander

HP 16533A
HP 16534A

- Use automatic measurements to easily analyze a signal's behavior
- Set-up cross-module triggering with parametric and logical trigger conditions
- Combine scope and logic measurements in any configuration
- Quickly access information with windows interface and drag-n-drop features



Explore analog signals and signal parameters using the digitizing oscilloscope modules.

HP 16534A and 16533A Digitizing Oscilloscopes

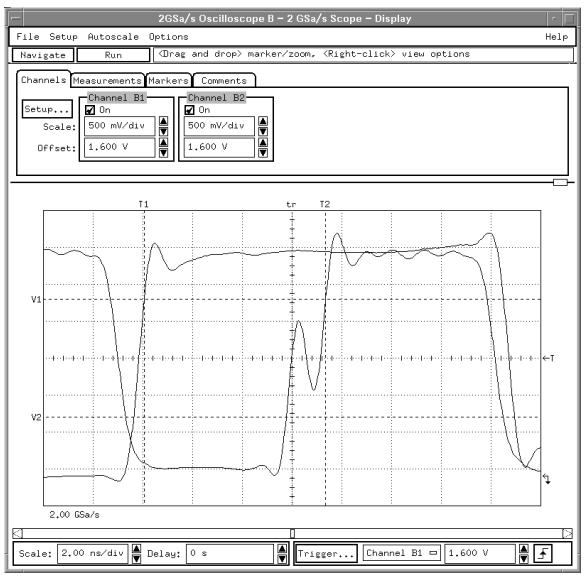
Built-In, Full-Featured Digitizing Oscilloscopes

The HP 16534A and 16533A offer the features of a color digitizing oscilloscope integrated into your logic analysis system. These modules provide digitizing advantages such as autoscale, automatic measurements, powerful triggering, negative-time (pre-trigger) viewing, voltage markers, and time markers.

10

Use as a Standalone Scope with Many Channels

You can capture up to eight analog channels simultaneously (on a single time base). You can measure slow and fast events by adding additional oscilloscope modules to create a multiple time base digitizing oscilloscope. For large channel count measurements, you can configure as many as 20 scope channels in a single system.



All primary oscilloscope control settings, including scale factors and trigger settings, are visible simultaneously.

Get to the Answer Faster with an Intuitive User Interface

When installed in the HP 16700A or 16702A logic analysis system mainframes, these oscilloscope modules make powerful measurement and analysis accessible and uncomplicated, so you can find the answer to tough debugging problems in less time. Oscilloscope controls are easy to find, recognize, and use.

Gain Insight Faster with Automatic Measurements and Time and Voltage Markers

The HP 16534A and 16533A oscilloscope modules allow you to characterize signals quickly with automatic measurements of rise time, voltage, pulse width and frequency. You can also measure timing and voltage margins using convenient time and voltage markers. Four independent voltage markers are available.

The global time markers of the HP logic analysis systems let you make time-correlated measurements across state, timing and oscilloscope measurements. Two local time markers are available in addition to two global time markers.

Specifications

	HP 16534A	HP 16533A
Sample Rate	2 GSa/s	1 GSa/s
Bandwidth[1]	500 MHz	250 MHz
Rise Time[2]	700 ps	1.4 ns
Time-Interval Accuracy	± 100 ps	± 100 ps
ADC Resolution	8 bits	8 bits
Waveform Record Length	32K	32K
Channels-per-Card	2	2
Max. Single Time Base Channels	8	8
Max. Channels-per-System	20	20

[1] Specifications
[2] Rise time is calculated from: Rise time = 0.35/bandwidth

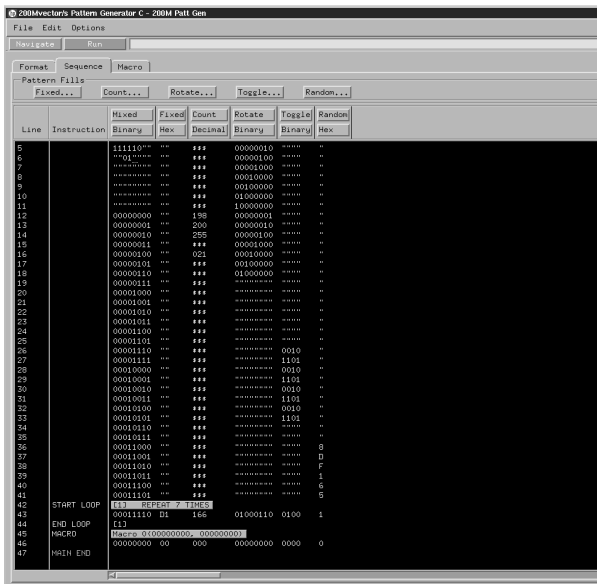
Key Literature

Oscilloscope Modules for HP Logic Analysis Systems, p/n 5966-3150E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

Ordering Information

HP 16533A 2 Channel, 1 GSa/s Oscilloscope Module
HP 16534A 2 Channel, 2 GSa/s Oscilloscope Module

- Test systems under a variety of operating scenarios
- Simulate hardware still under development to speed up software development or system debugging
- Easily develop complex tests with macros, repeat loops, pattern fills, and state-to-pattern conversion



Use the HP 16522A pattern generator module to create virtually any digital stimulus you need.

HP 16522A Digital Pattern Generator Module

Functionally Test Your Designs

The HP 16522A digital pattern generator module is the perfect tool for testing of your digital design. See how your system responds to specific signals or clock speeds. Correlate data captured with other HP 16700A and 16702A modules to verify correct operation.

Digital Stimulus for Prototype Turn-on and Evaluation

The HP 16522A pattern generator provides a number of features to help you turn on and evaluate prototypes quickly:

- Vectors up to 200 bits wide
- Speeds up to 200 Mvectors/sec
- Synchronized clock output
- Wait for input pattern
- Initialize block is run once in a repetitive run
- Conditional branch at 50 MHz
- Macros and repeat loops simplify creation of stimulus programs
- Pattern fills and state to pattern provide quick development of complex stimulus programs
- ASCII input file format

The pattern generator is designed for operation with the external clock and data pods and lead sets. Both the data pods and data cables use standard connectors that you can design into your system.

Lead Set Characteristics

HP 10474A 8-Channel Probe Lead Set: Provides the most cost-effective lead set for the HP 16522A clock and data pods. IC clips are not included.
HP 10347A 8-Channel Probe Lead Set: Provides a 50 Ω coaxial lead set for unterminated signals, required for HP 10465A ECL Data Pod (unterminated). IC clips are not included.

Data Pod Characteristics

HP 10461A TTL Data Pod
Output Type: 10H125 with 100 Ω series
Maximum Clock: 200 MHz
Skew: Typical < 2 ns; worst case = 4 ns

HP 10462A 3-State TTL/CMOS Data Pod
Output Type: 74ACT11244 with 100 Ω series
3-State Enable Pin: High input disables output; low input or no connect enables
Maximum Clock: 100 MHz
Skew: Typical < 4 ns : worst case = 12 ns

HP 10464A ECL Data Pod (terminated)
Output Type: 10H115 with 330 Ω pulldown, 47 Ω series
Maximum Clock: 200 MHz
Skew: Typical < 1 ns; worst case = 2 ns

HP 10465A ECL Data Pod (unterminated)
Output Type: 10H115 (no termination)
Maximum Clock: 200 MHz
Skew: Typical < 1 ns; worst case = 2 ns

HP 10466A 3-State TTL/3.3 Volt Data Pod
Output Type: 74LVT244 with 100 Ω series
3-State Enable Pin: High input disables output; low input or no connect enables
Maximum Clock: 200 MHz
Skew: Typical < 3 ns ; worst case = 7 ns

Clock Pod Characteristics

HP 10460A TTL Clock Pod
Clock Output Type: 10H125 with 47Ω series; true and inverted
Clock Output Rate: 100 MHz maximum
Clock Out Delay: 11 ns maximum in 9 steps
Clock Input Type: TTL – 10H124
Clock Input Rate: DC to 100 MHz
Pattern Input Type: TTL – 10H124 (no connect is logic 1)
Clock-in to Clock-out: Approximately 30 ns
Pattern-in to Recognition: Approximately 15 ns + 1 clk period

HP 10463A ECL Clock Pod
Clock Output Type: 10H116 differential unterminated; and differential with 330 Ω to – 5.2 V and 47 Ω series
Clock Output Rate: 200 MHz maximum
Clock Out Delay: 11 ns maximum in 9 steps
Clock Input Type: ECL – 10H116 with 50 k Ω to –5.2 V
Clock Input Rate: DC to 200 MHz
Pattern Input Type: ECL – 10H116 with 50 k Ω (no connect is logic 0)
Clock-in to Clock-out: Approximately 30 ns
Pattern-in to Recognition: Approximately 15 ns + 1 clk period

Key Literature

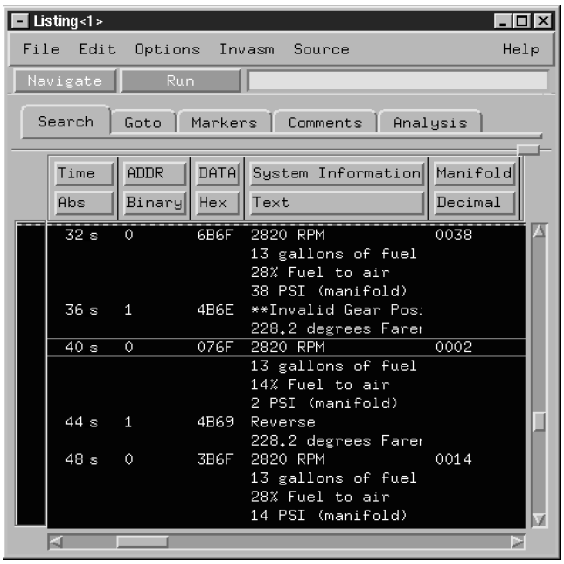
HP 16522A 200 M Vector/sec Pattern Generator Module for the HP Logic Analysis Systems, p/n 5964-2250E
Digital Verification with the HP 16522A Pattern Generator, p/n 5964-6347E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

Ordering Information

HP 16522A 40-Channel 200-MVector/s Pattern Generator Card
Lead Sets
HP 10474A 8-Channel Probe Lead Set
HP 10347A 8-Channel Probe Lead Set
Data and Clock Pods
HP 10461A TTL Data Pod
HP 10462A 3-State TTL/CMOS Data Pod
HP 10464A ECL Data Pod (terminated)
HP 10465A ECL Data Pod (unterminated)
HP 10466A 3-State TTL/3.3 Volt Data Pod
HP 10460A TTL Clock Pod
HP 10463A ECL Clock Pod

HP B4600B
HP B4601B
HP B4605B
HP B4620B

- Uncover hidden timing and code flow problems
- Link causes and events across domains, from analog signals to digital signals to source code
- Move from high-level performance analysis to detailed trouble-shooting in seconds
- View serial data in a parallel format
- Create custom tools to extract information buried by proprietary protocols



A custom tool extracts system information from the ADDR and DATA trace and converts it to easily understood text that speeds insight into system problems.

Get an Accurate Picture of In-Target Software Performance

The post-processing software tool sets available for the HP 16700A and 16702A logic analysis systems rapidly consolidate large amounts of data into displays that provide insight into your system's behavior. The tool sets provide you with the insight needed to solve tough hardware, software, and system integration problems, allowing you to get quality products to market on time.

HP B4600B System Performance Analysis Tool Set

The HP B4600B system performance analysis (SPA) tool set for the HP 16700A and 16702A logic analysis systems provides statistical representations of data captured by the measurement modules. The SPA tool set helps to find the routines that are called most often in your system, identify inefficient peripheral use, and pinpoint processes that use too much CPU time. Profile your system's performance to identify system bottlenecks and to identify areas needing optimization.

The SPA tool set helps evaluate the parameters, performance, and responsiveness of your target system and provides answers to the following questions:

- What functions are most often executed by the processor?
- What is the relative workload of each processor in a multiple-processor system?
- What is the minimum, maximum and average execution time of a function (including calls)?
- How many interrupts does the system receive per time slice?
- What is the response time of my system to an external event?
- Is this function or variable accessed by the application?
- How does the system react when it receives too many interrupts?
- Are the stack and cache sizes adequate?

HP B4601B Serial Analysis Tool Set

The HP B4601B serial analysis tool set for the HP 16700A and 16702A logic analysis systems quickly converts acquired serial bit streams to parallel format for easy viewing and analysis. The serial tool also allows you to process frame information to isolate the data you want to analyze.

HP B4605B Tool Development Kit

NEW

Custom tools can be created with an HP B4605B tool development kit using the C programming language. Custom tools can be used to extract information buried by proprietary protocols. Text can be added to a listing that enhances understanding of what is going on in the system. In addition, states that are unique to your system can be highlighted in color. Perform extensive analysis of your system traces using algorithms developed by you. Write the results of this analysis to a file of virtually any format. Accumulate information about repetitive traces in a file that can then be pulled into an Excel spread sheet.

HP B4620B Source Correlation Tool Set

The HP B4620B source correlation tool set combines the versatility of an HP logic analysis system with an interface that is tailored for correlating software measurements with other system activity. Observe software execution by a microprocessor without halting the system or adding instructions to the code.

The HP source correlation tool set provides a link between your trace listing and high-level source code language. Once a trace is complete, the corresponding high-level source code and microprocessor mnemonics are also displayed.

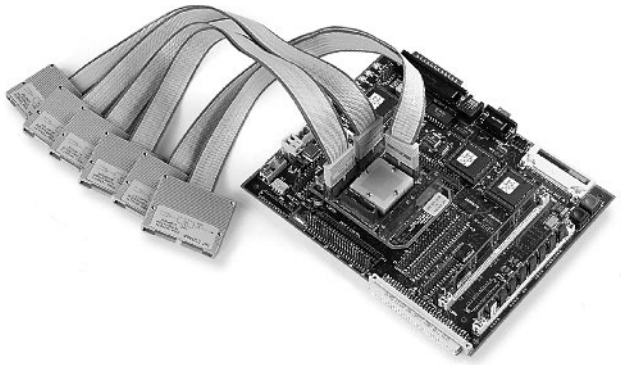
Symbol names from your source code, such as function and variable names, can be used to specify trigger conditions, or can be viewed in trace listings. Examples of supported symbols include: variable names, function and procedure names, and module names. Many file formats are supported.

Key Literature

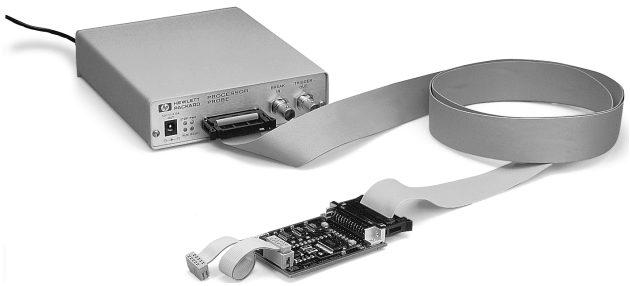
Post-Processing Tool Sets for the HP 16600A and 16700A Series Logic Analysis Systems, p/n 5966-3147E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

Ordering Information

HP B4600B System Performance Analysis Tool Set
HP B4601B Serial Analysis Tool Set
HP B4605B Tool Development Kit
HP B4620B Source Correlation Tool Set



The HP E9484A #002 analysis probe provides an easy way to probe the pinless Motorola PowerPC 821/860 BGA package.



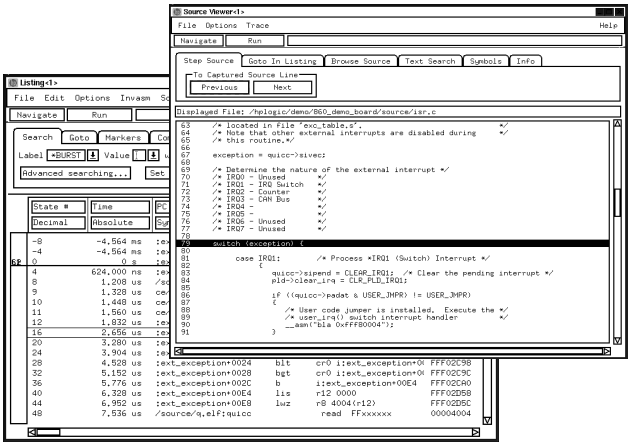
Emulation probes provide an easy, non-intrusive connection to your chip's debug port.

Configure a Logic Analysis or Emulation System

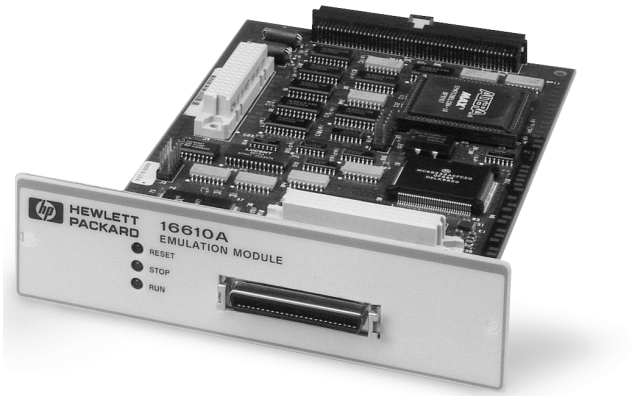
For a complete processor or bus solution you need tools that probe, acquire, and analyze your system's data. HP and its complementary vendors provide an extensive range of quality tools that offer non-intrusive, full-speed, real-time analysis and processor execution control to accelerate your debugging process.

Real-Time Analysis

Component	HP Model #	Description	Feature	Capability
Frame	HP 16700A HP 16701A HP 16702A	5 slot mainframe 5 slot expansion mainframe 5 slot mainframe w/flat panel display		Support up to 1,020 channels of state/timing, oscilloscope, pattern generation and emulation modules.
Logic Analyzer Measurement Module(s)	See page 422	Provides state and timing acquisition.	Real-Time Trace	Capture and analyze code flow and data flow without halting the target system. Monitor processor activity in relation to system buses, other processors, or I/0 devices.
			Time-Tagged Trace Execution	Time-correlate analog, timing and state events across your entire system. Identify real-time performance problems. Check the execution time of specific functions.
			Advanced Triggering	Capture and focus on problems that occur infrequently or only after a specific series of events.
			Non-intrusive	Run target system at full speed.
Analysis Probe	See page 429		Probing	Access all processor signals through reliable, quick, easy target connection.
			Configuration Files	Quick, easy analyzer setup correlated to hardware connection.
			Inverse Assembler	Disassemble trace into processor mnemonics.
Source Correlation Tool Set	HP B4620B	Provides correlation of acquired trace to high-level source code by using information from your object file to build a database of source files, line numbers, and symbol information.		Time-correlate acquired trace to high-level source code. Step through trace at assembly level or source code level. Easily locate a problem's cause by stepping backward from the symptom occurrence.



Inverse assembled trace time-correlated to source code using the HP source correlation tool set.



Emulation modules provide an integrated solution for the HP 16700A and 16702A logic analysis systems that combines logic analysis with non-intrusive connection to your processor's on-chip debug port.

Processor Control

Component	HP Model #	Description	Feature	Capability
Emulation Module	See page 429	Processor control integrated into HP 16700A and 16702A frames.	Easy, non-intrusive connection	Access the debug pins of the target microprocessor without affecting any other signals.
			Program execution control	Reset, run/break, start/stop, single step.
			High-speed code download	Download code to target RAM or FLASHPROM.
Emulation Probe	See page 429	Standalone processor control. Controlled over local area network (LAN).	Easy, non-intrusive connection	Access the debug pins of the target microprocessor without affecting any other signals.
			Program execution control	Reset, run/break, start/stop, single step.
			High-speed code download	Download code to target RAM or FLASHPROM.
Emulation Control Interface	Standard on HP 16700A and 16702A mainframes.	Multiple windowed interface for emulation modules and probes.	Control of emulation module/probe	Setup breakpoints, read and modify memory and I/O in the target system.
High-Level Debugger	Third-Party Vendor	Source-level software debug Control of emulation module/probe.	Hardware-assisted software debug	Debug of C or C++ and the ability to access on-chip debug features via HP emulation module/probe.
Emulation Solution	See page 429	A bundle of products for ordering convenience. Includes an analysis probe, source correlation tool set and emulation module/probe.	Provides real-time trace, emulation, and source correlation.	See pages 427 and 428 for specific details.

HP Support for New Microprocessor and Bus Interfaces

Hewlett-Packard is committed to providing support for the latest microprocessors and bus interfaces. HP works with semiconductor vendors and premier channel partners to ensure early development solutions for new processors and bus interfaces. Please see page 389 for a complete listing of supported devices. If you do not see your processor listed, please contact your local sales office for the latest processor support update.

Custom Inverse Assemblers

Several options are available for custom development. One of these options is HP's Premiere Channel Partner program. Several Premiere Channel Partners, with years of inverse assembly and custom hardware development experience, can deliver quality custom solutions.

Key Literature

Processor and Bus Support for HP Logic Analysis Systems, p/n 5966-4365E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

Selection Guide Key[1]

AD = Adapter
AP = Analysis Probe
EM = Emulation Module
EMG = Emulation Migration
EP = Emulation Probe
ES = Emulation Solution
IA = Inverse Assembler

Device Manufacturer and Name	Package Type	Prod Type	State	Timing	Emulation	Min#/ Max# Pods	HP Product or Channel Partner
Actel FPGA							
ACT1280	176-PGA	AP		•		-/9	Corelis
Altera EPLD							
EPM5192-P	84-PGA	AP		•		-/5	Corelis
AMD							
29000/50	PGA	AP	•	•		5/9	Corelis
29030	PGA	AP	•	•		5/7	Corelis
29040	PGA	AP	•	•		5/9	Corelis
29200	PQFP	AP	•	•		5/10	Corelis
29202	PQFP	AP	•	•		5/8	Corelis
29205	PQFP	AP	•	•		5/6	Corelis
29240/43/45	PQFP	AP	•	•		5/11	Corelis
186EM/ES	PQFP	AP	•	•		4/8	Corelis
	TQFP	AP	•	•		4/8	Corelis
188EM/ES	PQFP	AP	•	•		4/8	Corelis
	TQFP	AP	•	•		4/8	Corelis
Analog Devices							
ADSP2111	PQFP	AP	•	•		3/6	ET[5]
Aptix							
AX1024D FPIC	PGA	AP		•		-/4	Aptix
ARM							
ARM7	IA Only	AP	•	•		4/4	E9595A #001
ARM7 Thumb, ARM9 Thumb							
ARM7 Thumb,	IA Only	ES[4]	•	•	•	4/4	E9495A #001
ARM9 Thumb		EP[4]			•		E5900A #300
Families		EM[4]			•		E5901A #300
		EMG[4]			•		E5902A #300
AT&T							
92010 (Hobbit)	PQFP	AP	•	•		6/6	Corelis
Cyrix							
486SLC	PQFP	AP	•	•		4/5	ET[5]
Dallas							
80C320	DIP	AP	•	•		2/3	ET
	PLCC	AP	•	•		2/3	ET
	PQFP	AP	•	•		2/3	ET[5]
Fujitsu							
MB869860	IA	•				6/6	ALD
Hitachi							
SH3-7708	144-LQFP	AP	•	•		6/10	E8018A
SH3-7709	208-LQFP	AP	•	•		6/10	E8019A
SH7750	208-QFP	AP	•	•		8/10	E9598A #002
		ES	•	•	•	8/10	E9498A #002
		EP			•		E5900A #710
		EM			•		E5901A #710
		EMG			•		E5902A #710
IBM PowerPC 4XX Family							
PPC 403 GA/B/C/CX	IA Only	AP	•	•		5/8	E2449B
PPC 401/403	All	EP[4]			•		E5900A #060
		EM[4]			•		E5901A #060
IBM PowerPC 6XX Family							
PPC 601	IA Only	IA	•	•		8/10	E2449B
PPC 603,	IA Only	AP	•	•		8/10	E9587A #001
603e, 603ev		ES[4]	•	•	•	8/10	E9487A #001
	240-PQFP	AP	•	•		8/10	E9587A #002
		ES[4]	•	•	•	8/10	E9487A #002
PPC 604	289-PGA	AP	•	•		8/11	E9588A #002
		ES[4]	•	•	•	8/11	E9488A #002
PPC 603/e/ev,	All	EP[4]			•		E5900A #060
604/e/ev		EM[4]			•		E5901A #060
		EMG[4]			•		E5902A #060
IBM PowerPC 7XX Family							
PPC 740/750	IA Only	AP	•	•		8/10	E9586A #001
		ES[4]	•	•	•	8/10	E9486A #001
PPC 740,750	All	EP[4]			•		E5900A #070
		EM[4]			•		E5901A #070
		EMG[4]			•		E5902A #070

[1] Refer to publication #5966-4365E for additional information.
[2] Requires purchasing multiple products.
[3] Multiple products are available with varying prices.
[4] Debuggers are available from third-party vendor(s). See page 431
[5] Contact vendor for pricing information.

Device Manufacturer and Name	Package Type	Prod Type	State	Timing	Emulation	Min#/ Max# Pods	HP Product or Channel Partner
IDT							
R3041	PLCC	AP	•	•		5/6	Corelis
R3051/52/81/82	PLCC	AP	•	•		5/6	Corelis
R32364	TQFP	AP	•	•		5/7	Corelis
R36100	MQUAD	AP	•	•		6/12	Corelis
R4000/4400PC	PGA	AP	•	•		8/9	Corelis
R4600/4700	PGA	AP	•	•		6/7	Corelis
	MQUAD	AP	•	•		6/7	Corelis
R4640	PQFP	AP	•	•		4/4	Corelis
R4650	MQUAD	AP	•	•		6/7	Corelis
R5000	PGA	AP	•	•		6/9	Corelis
RC64474	PQFP	AP	•	•		4/4	Corelis
RC64475	MQUAD	AP	•	•		6/7	Corelis
Intel Pentium							
Pentium 567\66	PGA	AP		•		-/12	ET
Pentium and	296-SPGA	AP	•	•		8/10	E9592A #002
Pentium w/MMX		ES[4]	•	•	•	8/10	E9492A #002
		EP[4]			•		E5900A #500
		EM[4]			•		E5901A #500
Pentium Pro	387-SPGA	AP	•	•		10/10	E2466B
Pentium II, III	Slot 1	AP[2]	•			12/12	E2487C
							E2492B
Pentium II, III Xeon	Slot 2	AP[2]	•			12/12	E2487C
							E2492C
Celeron 266, 300, 300A 333, 400, 433 MHz	SEP	AP[2]	•			12/12	E2487C
							E2492B
Celeron 300A, 333, 366, 400, 433, 466 MHz	PPGA	AP[2]	•	•		12/12	E2487C
							E2492D
Pentium II	Mobile	AP	•			12/12	E2494S
Pentium Pro,		EP[4]			•		E5900A #510
II, III, Celeron		EM[4]			•		E5901A #510
Intel 80X86							
8086/8088	DIP	AP	•			3/3	ET
80186/88/XL	PGA	AP	•	•		3/6	ET[5]
	PLCC	AP	•	•		3/6	ET
80C186EB	PLCC	AP	•	•		3/6	ET[5]
	PQFP	AP	•	•		3/6	ET
80286	PGA	AP	•	•		3/4	E2409C
	68-PLCC	AD[1,2]					#1CB
80386CX	PQFP	AP	•			4/6	ET[5]
80386EX	132-PQFP	AP	•	•		4/6	E2454A
	144-TQFP[1,2]						
80386SX	PQFP	AP	•	•		4/4	ET[5]
Intel 80960X							
80960CA	PGA	AP		•		-/5	Corelis
80960H-Series	PGA	AP	•	•		6/7	E2473A
80960J-Series	PGA	AP	•	•		5/6	E2464A
	PQFP	AD[1,2]					E5337A
80960KA/KB/MC	PGA	AP	•	•		5/6	Corelis[1,3]
80960RD,RP	BGA	AP	•	•		5/6	E2484A
80960SA,SB	PLCC	AP	•	•		4/4	ET
Intel Other							
8085	DIP	AP	•			2/3	ET
8031/51	DIP	AP	•	•		2/3	ET[5]
	PLCC	AP	•	•		2/3	ET[5]
8X51GB	PLCC	AP	•	•		2/5	ET[5]
80C196KA/KB	PLCC	AP	•	•		3/5	E2416B
80860XR	PGA	AP		•		-/5	Corelis
SA-110	TQFP	AP	•	•		5/6	Corelis
LSI Logic							
LR33000/33050	PGA	AP	•	•		5/8	Corelis
LR33020	PGA	AP	•	•		7/11	Corelis
LR333X0	PQFP	AP	•	•		5/8	Corelis
Motorola PowerPC 5XX Family							
MPC505/509	160-PQFP	AP	•	•		6/10	E9585A #002
		ES[4]	•	•	•	6/10	E9485A #002
MPC555	IA Only	AP	•	•		6/14	E9610A #001
		ES[4]	•	•	•	6/14	E9510A #001
MPC 505/509/555	All	EP[4]			•		E5900A #050
		EM[4]			•		E5901A #050
		EMG[4]			•		E5902A #050
Motorola PowerPC 6XX Family							
PPC 601	IA Only	IA	•	•		8/10	E2449B
PPC 603/e/ev	IA Only	AP	•	•		8/10	E9587A #001
		ES[4]	•	•	•	8/10	E9487A #001
	240-PQFP	AP	•	•		8/10	E9587A #002
		ES[4]	•	•	•	8/10	E9487A #002
PPC 604	289-PGA	AP	•	•		8/11	E9588A #002
		ES[4]	•	•	•	8/11	E9488A #002
PPC 603/e/ev	All	EP[4]			•		E5900A #060
604/e/ev		EM[4]			•		E5901A #060
		EMG[4]			•		E5902A #060

10

Device Manufacturer and Name	Package Type	Prod Type	State	Timing	Emulation	Min#/ Max# Pods	HP Product or Channel Partner
Motorola PowerPC 7XX Family							
PPC 740/750	IA Only	AP	•	•		8/10	E9586A #001
		ES[4]	•	•	•	8/10	E9486A #001
PPC 740/750	All	EP[4]			•		E5900A #070
		EM[4]			•		E5901A #070
		EMG[4]			•		E5902A #070
Motorola PowerPC 8XX Family							
MPC801	IA Only	AP	•			6/6	Corelis
MPC823	IA Only	AP	•			6/6	Corelis
	BGA	AP	•	•		6/11	Corelis
MPC850	IA Only	AP	•			6/6	Corelis
	BGA	AP	•	•		6/11	Corelis
MPC860	IA Only	AP	•	•		6/12	E9584A #001
		ES[4]	•	•	•	6/12	E9484A #001
	357-BGA	AP	•	•		6/12	E9584A #002
		ES[4]	•	•	•	6/12	E9484A #002
MPC860, 850,860	All	EP[4]			•		E5900A #080
		EM[4]			•		E5901A #080
		EMG[4]			•		E5902A #080
Motorola PowerPC 82XX Family							
MPC8240	IA Only	AP	•	•		8/14	E9611A #001
		ES[4]	•	•	•	8/14	E9511A #001
	352-BGA	AP	•	•		8/14	E9611A #002
		ES[4]	•	•	•	8/14	E9511A #002
MPC8260	IA Only	AP	•	•		8/22	E9603A #001
		ES[4]	•	•	•	8/22	E9503A #001
	480-BGA	AP	•	•		8/22	E9603A #002
		ES[4]	•	•	•	8/22	E9503A #002
MPC8240/60	All	EP[4]			•		E5900A #100
		EM[4]			•		E5901A #100
		EMG[4]			•		E5902A #100
Motorola 68K							
68000/10	DIP	AP	•	•		3/4	ET
	SDIP	AP	•	•		3/4	ET
	PLCC	AP	•	•		3/4	ET
	PGA	AP	•	•		3/4	ET
68000/HC000	PGA	AP	•	•		3/7	E2447AA
68HC000/001	PGA	AP	•	•		3/4	ET[5]
	PLCC	AP	•	•		3/4	ET
68EC000	PLCC	AP	•	•		3/7	E2447AB
68008	DIP	AP	•	•		3/4	ET
68020	PGA	AP	•	•		5/6	E2426A
	PQFP	AD[1,2]					#1CC
68030	PGA	AP	•			5/5	E2406A
	PQFP	AD[1,2]					#1CC
68EC030	PGA	AP	•			5/5	E2406A
68060/68040	PGA	AP	•	•		6/8	E2459A
Motorola CPU32 Family							
68331/32/34/35	132-PQFP	AP	•	•		4/12	E9589A #002
		ES[4]	•	•	•	4/12	E9489A #002
68331/32	144-TQFP	AP	•	•		4/12	E9589A #003
		ES[4]	•	•	•	4/12	E9489A #003
68336/76	160-PQFP	AP	•	•		4/12	E9596A #002
		ES[4]	•	•	•	4/12	E9496A #002
68360, 68EN360, 68MH360	241-PGA	AP	•	•		6/12	E9590A #002
		ES[4]	•	•	•	6/12	E9490A #002
	240-PQFP	AP	•	•		6/12	E9590A #003
		ES[4]	•	•	•	6/12	E9490A #003
68330/1/2/4/5/6, 68340/1/9, 68360/EN/MH, 68376, 68F333, 68CK338		EP[4]			•		E5900A #030
		EM[4]			•		E5901A #030
		EMG[4]			•		E5902A #030
68332	PGA	AP	•	•		4/7	ET[5]
	PQFP	AP	•	•		4/7	ET[5]
68339	QFP	AP	•	•		4/4	ET[5]
68340	PGA	AP	•	•		3/7	Corelis
68340	PQFP	AP	•	•		4/7	ET
Motorola Coldfire							
CF5202/3	100-TQFP	AP	•	•		6/6	ALD
Motorola 6830X							
68302	PGA	AP	•	•		3/6	Corelis
	PQFP	AP	•	•		3/6	Corelis
68EN302	TQFP	AP	•	•		3/7	Corelis
68LC302	PGA	AP	•	•		3/6	Corelis
	TQFP	AP	•	•		3/6	Corelis
Motorola M-Core Family							
M-Core	IA Only	AP	•	•		4/6	E9612A #001
		ES[4]	•	•	•	4/6	E9512A #001
	All	EP[4]			•		E5900A #090
		EM[4]			•		E5901A #090
		EMG[4]			•		E5902A #090

Device Manufacturer and Name	Package Type	Prod Type	State	Timing	Emulation	Min#/ Max# Pods	HP Product or Channel Partner
Motorola DSPs							
56116/156/166	—	IA	•			5/5	Corelis
56303	TQFP	AP	•	•		4/7	Corelis
56309	TQFP	AP	•	•		4/7	Corelis
56L811	TQFP	AP	•	•		4/5	Corelis
Motorola 68HCXX							
68HC11F1	PLCC	AP	•	•		3/4	ET
68HC11KA2	PLCC	AP	•	•		3/4	ET
68HC11K4	PQFP	AP	•	•		2/5	ET
68HC12A4	TQFP	AP	•	•		3/6	ET
68HC12B32	PQFP	AP	•	•		3/4	ET
68HC12D60	QFP	AP	•	•		3/6	ET[5]
NEC							
V25	PLCC	AP	•	•		3/5	ET
V830	LQFP	AP				5/6	Corelis
Vr4100	TQFP	AP	•	•		6/6	Corelis
Vr4111	µBGA	AP	•	•		6/6	Corelis
Vr4200	PQFP	AP	•	•		6/7	Corelis
Vr4300	PQFP	AP	•	•		4/4	Corelis
R5000	PGA	AP	•	•		6/9	Corelis
Vr5432	PQFP	AP	•	•		6/8	Corelis
Vr5464	BGA	AP	•	•		8/12	Corelis
NKK							
NR4645MQF	PQFP	AP	•	•		4/4	Corelis
NR4650GQF	PQFP	AP	•	•		6/7	Corelis
NR4650LQF	PQFP	AP	•	•		6/7	Corelis
NR4700LMQ	PQFP	AP	•	•		6/7	Corelis
PACE							
1750	PGA	AP	•			3/3	Lital
QED							
RM5230/31	PQFP	AP	•	•		6/7	Corelis
RM5260/61	PQFP	AP	•	•		6/11	Corelis
RM5270/71	BGA	AP	•	•		6/12	Corelis
RM7000	BGA	AP	•	•		6/12	Corelis
Siemens							
80C165	PQFP	AP	•	•		3/7	ET
80C166	PQFP	AP	•	•		3/8	ET[5]
80C167	PQFP	AP	•	•		4/9	ET
80C515	PLCC	AP	•	•		2/4	ET[5]
80C517/537	PLCC	AP	•	•		2/4	ET
Texas Instruments							
320C20/25	PGA	AP	•	•		3/3	Corelis
320C30	PGA	AP	•			4/7	Corelis
320C31	PQFP	AP	•			4/7	Corelis
320C32	PQFP	AP	•	•		6/6	Corelis
	TQFP	AP	•	•		6/6	Corelis
320C40	PGA	AP	•	•		5/16	Corelis
320C50/51/53	PQFP	AP	•	•		3/6	Corelis
320C52	PQFP	AP	•	•		4/4	Corelis
320C80	PGA	AP		•		-/8	Corelis
320C542/48/49	TQFP	AP	•	•		4/7	Corelis
370C16	—	IA	•			6/6	Corelis
470R1X	TQFP	AP	•	•		4/4	Corelis
Toshiba							
R3900	PQFP	AP	•	•		6/7	Corelis
TMPR1904	160-QPF	AP	•	•		6-8	E9599A #002
		ES[4]	•	•	•	6-8	E9499A #002
TMPR3901	160-QPF	AP	•	•		6	E9600A #002
		ES[4]	•	•	•	6	E9500A #002
TMPR3903	208-QPF	AP	•	•		6	E9601A #002
		ES[4]	•	•	•	6	E9501A #002
TMPR3904	208-QPF	AP	•	•		6-8	E9602A #002
		ES[4]	•	•	•	6-8	E9502A #002
TMPR1904, 3901/3/4	All	EP[4]			•		E5900A #800
		EM[4]			•		E5901A #800
		EMG[4]			•		E5902A #800
Xilinx LCA							
XC4005/4006	156-PGA	AP		•		-/8	Corelis
XC4008/4010	191-PGA	AP		•		-/8	Corelis
Zilog							
Z80	DIP	AP	•	•		2/3	ET
	PLCC	AP	•	•		2/3	ET
Z180	PLCC	AP	•	•		2/4	ET

[1] Refer to publication #5966-4365E for additional information.
[2] Requires purchasing multiple products.
[3] Multiple products are available with varying prices.
[4] Debuggers are available from third-party vendor(s). See page 431
[5] Contact vendor for pricing information.

Device Manufacturer and Name	Package Type	Prod Type	State	Timing	Emulation	Min#/ Max# Pods	HP Product or Channel Partner
Standard Buses							
AGP2X	N/A	AP	•	•		4/4	FuturePlus
AGP4X	N/A	AP	•			12	FuturePlus
APIC	N/A	AP	•	•		2-4	E2467A
Compact PCI/Ext	N/A	AP	•	•		4-7	FuturePlus
Direct Rambus	N/A	AP	•				FuturePlus
EISA	N/A	AP	•	•		5/10	ALD
Fibre Channel	N/A	AP	•			4-8	FuturePlus
I2C	N/A	AP	•	•		2/2	ALD[1,2]
IBM ISA (AT)	N/A	AP	•	•		6/6	Corelis
ISA/Extender	N/A	AP	•	•		5-6	FuturePlus
IBM ISA (AT)	N/A	AP	•	•		5/5	Lital
IEEE 488 (HPIB)	N/A	AP	•	•		1/2	ALD
IEEE 1284	N/A	AP	•	•		2/2	ALD
IEEE 1394	N/A	AP	•	•		4-6	FuturePlus
JTAG 1149.1	N/A	AP	•	•		1/1	Corelis
JTAG 1149.5	N/A	AP	•	•		1/1	Corelis
PCI-64	N/A	AP	•	•		4-6	FuturePlus[1,3]
PCI/EXT-32	N/A	AP	•	•		4/4	FuturePlus
PCI/EXT-64	N/A	AP	•	•		4-6	FuturePlus[1,3]

Device Manufacturer and Name	Package Type	Prod Type	State	Timing	Emulation	Min#/ Max# Pods	HP Product or Channel Partner	Price
PCI-32/Extender	N/A	AP	•	•		4/4	Corelis	
PCI-32/E	N/A	AP	•	•		6/6	Corelis	
PCI-64/Extender	N/A	AP	•	•		6/6	Corelis	
PCI Mezzanine (PMC)		AP	•	•		4/4	FuturePlus	
PCI EIO	N/A	AP	•	•		4/4	FuturePlus	
PCI Cardbus	N/A	AP	•	•		4/4	FuturePlus	
PCMCIA	N/A	AP		•		-/4	Mobile	
RS232c,RS449	N/A	AP	•	•		2/2	ALD	
SCSI 1,2,3	N/A	AP	•	•		2/4	FuturePlus	
LVD SCSI (Ultra)	N/A	AP	•	•		2/4	FuturePlus	
Univ Serial Bus	N/A	AP	•	•		2-3	FuturePlus	
VME64/VXI	N/A	AP	•	•		5-9	FuturePlus	
168-pin DIMM	N/A	AP		•		-/6	FuturePlus	
72-pin SIMM	N/A	AP		•		-/4	FuturePlus	

[1] Refer to publication #5966-4365E for additional information.
[2] Requires purchasing multiple products.
[3] Multiple products are available with varying prices.
[4] Debuggers are available from third party vendor(s). See page 431
[5] Contact vendor for pricing information.

Complementary Vendor Support

Third Party Debugger Support

Debuggers from several companies can be used to control HP emulation probes and emulation modules. Connections to HP tools through familiar debugger interfaces provide access to emulation features so that in-circuit debugging becomes an extension of the software debugging process under way.

The debuggers (table at right) connect to HP emulation probes and emulation modules, providing support for a variety of processor architectures and real-time operating systems. Contact the HP Call Center in your region for detailed connection information.

Processor Family	Debugger Vendors
ARM	ARM, GHS, WindRiver
IBM PPC4xx	Microtec/Mentor, SDS, WindRiver
IBM PPC 6xx	GHS, Microtec/Mentor, SDS, WindRiver
IBM PPC 7xx	GHS, Microtec/Mentor, SDS, WindRiver
Pentium and Pentium w/MMX	CAD-UL
Pentium II, Pentium Pro and Pentium II mobile	American Arium
Motorola MPC 5xx	GHS, Microtec/Mentor, SDS, WindRiver
Motorola PPC 6xx	GHS, Microtec/Mentor, SDS, WindRiver
Motorola PPC 7xx	GHS, Microtec/Mentor, SDS, WindRiver
Motorola MPC 8xx	GHS, Microtec/Mentor, SDS, WindRiver
Motorola MPC 82xx	GHS, Microtec/Mentor, SDS, WindRiver
CPU32	GHS, Microtec/Mentor, SDS
M-Core	SDS
Toshiba Tx19139	GHS

Complementary Vendors

The following companies provide products that complement HP logic analyzers and emulation probes/modules. Hewlett-Packard works closely with these companies to ensure quality products, but the vendor is responsible for functionality, pre-sales and post-sales support, and warranty. For companies listed below with a "Resell Code", their products are also available from Hewlett-Packard's Corporate Price List. For resale products, the Channel Partner is still responsible for functionality, pre-sales, post-sales, and warranty.

ADVANCED LOGICAL DESIGN
Premier Channel Partner
(Re-sell Code ALO)
Ph 408-446-1004
Fax 408-446-1079
http://www.ald.com

AMERICAN ARIUM
Ph 714-731-1661
Fax 714-731-6344
http://www.arium.com

APTIX CORPORATION
Ph 408-428-6200
Fax 408-944-0646
http://www.aptix.com

ARM INC.
Ph 408-399-5199
Fax 408-399-8854
http://www.arm.com

CAD-UL, INC.
Ph 408-945-8188
Fax 408-945-8177
http://www.cadul.com

CORELIS, INC.
Premier Channel Partner
(Re-sell Code CRL)
Ph 562-926-6727
Fax 562-404-6196
http://www.corelis.com

DS DIAGONAL SYSTEMS AG
Ph 41 1 905 60 60
Fax 41 1 905 60 69
http://www.diagonal.com

EMULATION TECHNOLOGY INC.
Ph 408-982-0660
Fax 408-982-0664
http://www.emulation.com

EUROPE TECHNOLOGIES
Ph 330 493 004 304
Fax 330 493 004 301
http://www.europe-technologies.com

FUTURE PLUS SYSTEMS CORP.
Premier Channel Partner
(Re-sell Code FSI)
Ph 719-380-7321
Fax 719-380-7362
http://www.futureplus.com

GREEN HILLS SOFTWARE, INC.
Ph 805-965-6044
Fax 805-965-6343
http://www.ghs.com

IRONWOOD ELECTRONICS, INC.
Ph 651-452-8100
Fax 651-452-8400
http://www.ironwoodelectronics.com

J M ENGINEERING
Ph 719-591-1119
Fax 719-637-1777
http://www.jmecorp.com

LITAL ELECTRONICS, INC.
Ph 714-731-8123
Fax 714-731-8170
http://www.lital.com

MICROTEC/MENTOR
Ph 408-436-1500
Fax 408-436-1501
http://www.mentor.com/embedded

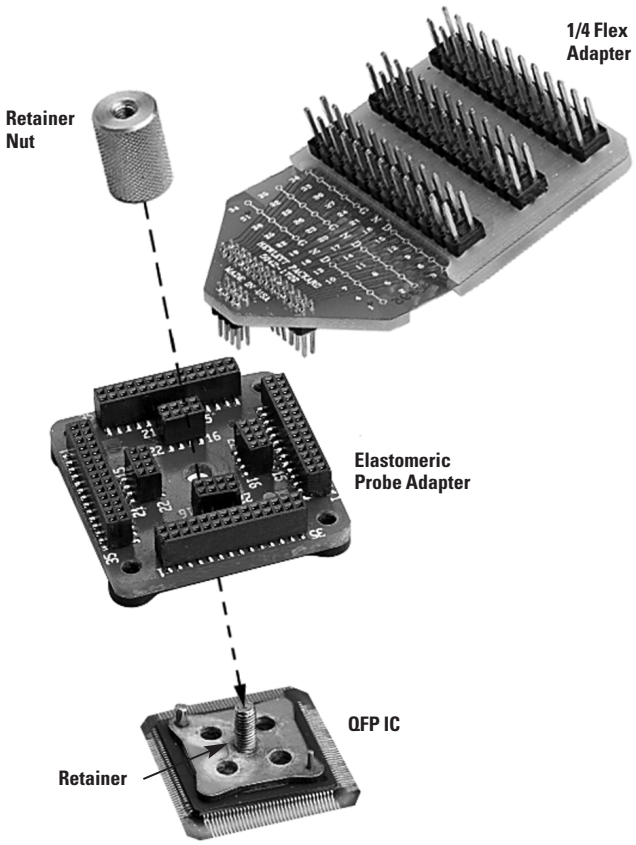
MOBILE MEDIA RESEARCH
Ph 510-657-4891
Fax 510-657-4892
http://www.mobmedres.com

POMONA ELECTRONICS
Ph 909-469-2900
Fax 909-629-3317
http://www.pomonaelectronics.com

SOFTWARE DEVELOPMENT SYSTEMS, INC.
Ph 630-971-5900
Fax 630-971-5901
http://www.sdsi.com

SYNAPTI CAD, INC.
Ph 540-953-3390
Fax 540-953-3078
http://www.syncad.com

WINDRIVER SYSTEMS
Ph 510-748-4100
Fax 510-749-2010
http://www.windriver.com



HP's elastomeric probe adapters offer a simple means of connecting to PQFP and TQFP packages with minimal "keep out" area.

Reliable Measurements Start with Good Probing

Accurate measurements require reliable probing. HP's innovations in probing and accessories assure you of reliable measurements, while making it easy to connect the logic analyzer to your system.

HP's advances in probing minimize your concerns in the following areas:

- Keep out area
- Loading, both resistive and capacitive
- Ease of installation
- Reliability - mechanical and electrical

We Make it Easy to Select and Order the Probes You Need

HP makes it easy for you to select the right probe for your needs. Most HP analysis probes come complete with all the accessories needed to complete the connection to your processor or bus.

Visit the HP web site: **http://www.hp.com/go/LAaccessories** for the latest information on all HP probes and accessories.

Probing Alternatives

Probing Solution	Purpose
HP MicroWedge, SMD Clips .5mm IC clips	Use this option if you are probing a few pins, or need to connect to PC boards/packages in hard-to-reach or already installed systems.
High-Density Adapter Cable	Provides a direct connection to 34 signals on an industry-standard connector. Use this approach if you are beginning to lay out a board and need to access custom parts or buses in your system, or are using BGA packages.
Elastomeric Probing	HP's patented elastomeric probing technology is ideal for low intrusion, easy and reliable connection to today's PQFP and TQFP packages.

Wedge Probe Adapter

The HP Wedge provides an accurate, mechanically non-invasive way to make contact with IC pins with spacing of 0.65 or 0.5 mm. You can connect logic analyzer general purpose leads directly to the adapter or connect scope probes through a dual-head adapter.

High-Density Adapters

The HP E5346A and HP E5351A high-density adapters provide a convenient and easy way to connect an HP logic analysis system to the signals on your target system. With difficult packages to probe, such as BGA, or with other probing restrictions, the adapters provide a high-density logic analysis connection that gives you access to multiple signals with minimal board space.

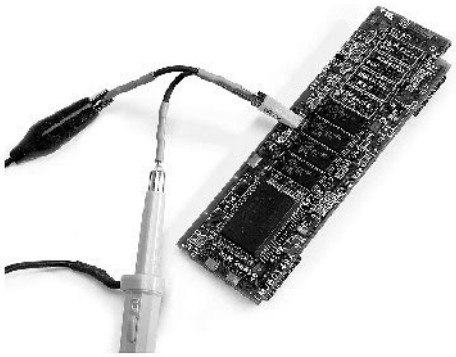
Elastomeric Probing Solutions

An elastomeric probing solution from HP offers you an inexpensive, rugged, and easy-to-use probing solution for both TQFP and PQFP packages. These probes require a minimal "keep out" area around the device.

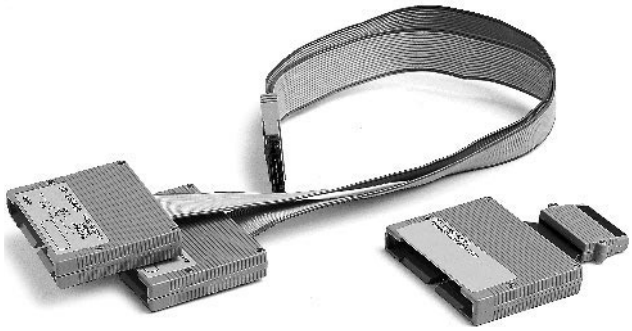
The elastomeric probe makes contact to the pins of a device with an elastomer material. There are redundant connections for each pin, ensuring a reliable and rugged connection. A retainer is glued to the top of the device to ensure a solid connection to each pin of the device.

Termination Adapter

The HP 01650-63203 termination adapter allows you to use 3M 2x10 connectors in your system for connection to an HP logic analysis system. The termination is located at the probe tip of the adapter for easy application. Each connector is used for 16 data channels and one clock.



The HP MicroWedge probe adapter provides mechanically sound, non-invasive connection to three adjacent pins on TQFP and PQFP packages.



The HP E5346A high-density termination adapter provides access to 34 signals per connector; the standard termination adapter (01650-63203) provides 17.

Probing Solutions

Package Type	Pin Pitch	Elastomeric Solutions
240-Pin PQFP/CQFP	0.5 mm	HP E5363A Probe Adapter HP E5371A 1/4 Flexible Adapter
208-Pin PQFP/CQFP	0.5 mm	HP E5374A Probe Adapter HP E5371A 1/4 Flexible Adapter
176-Pin PQFP	0.5 mm	HP E5348A Probe Adapter HP E5349A 1/4 Flexible Adapter
160-Pin QFP	0.5 mm	HP E5377A Probe Adapter HP E5349A 1/4 Flexible Adapter
160-Pin PQFP/CQFP	0.65 mm	HP E5373A Probe Adapter HP E5349A 1/4 Flexible Adapter
144-Pin PQFP/CQFP	0.65 mm	HP E5361A Probe Adapter HP E5340A 1/4 Flexible Adapter
144-Pin TQFP	0.5 mm	HP E5336A Probe Adapter HP E5340A 1/4 Flexible Adapter

Key Literature

Probing Solutions for HP Logic Analysis Systems, p/n 5968-4632E
Processor and Bus Support for HP Logic Analysis Systems, p/n 5966-4365E
HP Digital Design and Debug Tools Catalog, p/n 5968-6355EN/EUS

Ordering Information

High-Density Adapters

HP E5346A High-Density Termination Adapter
HP E5351A High-Density Adapter
HP E5346-44701 Recommended Support Shroud
HP E5346-60002 High-Speed Mictor Break-Out Adapter
HP E5346-68701 Five Mictor Connectors and Support Shrouds

Termination Adapters

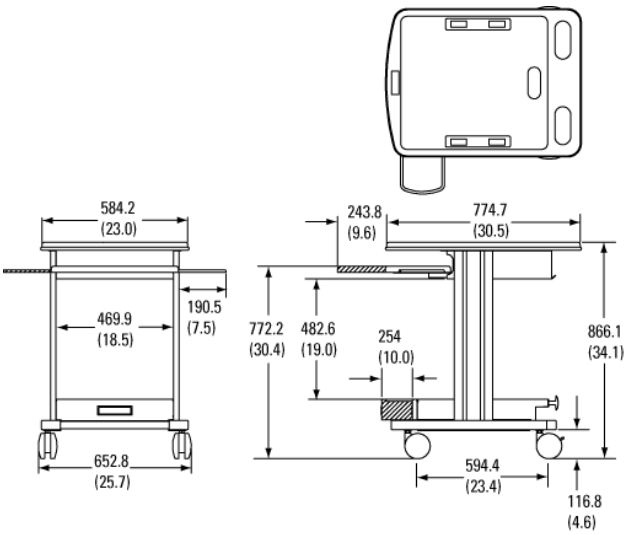
HP 01650-63203 Standard Termination Adapter

Wedge Probe Adapters

HP E2613A (1) HP Wedge 0.5 mm Probe Adapter – 3 Signal
HP E2613B (2) HP Wedge 0.5 mm Probe Adapter – 3 Signal
HP E2614A (1) HP Wedge 0.5 mm Probe Adapter – 8 Signal
HP E2615A (1) HP Wedge 0.65 mm Probe Adapter – 3 Signal
HP E2615B (2) HP Wedge 0.65 mm Probe Adapter – 3 Signal
HP E2616A (1) HP Wedge 0.65 mm Probe Adapter – 8 Signal

HP 1184A
HP 1540-1066

- Keyboard tray with adjustable tilt and height
- Mouse extension on keyboard tray accommodates either right or left hand operation
- HP 16700A frame and HP 16701A expansion frame can be located in the bottom of the cart, leaving the top free to accommodate a monitor
- Locking casters for safety on uneven surfaces
- Strap provided to stabilize the monitor
- Will hold up to 300 lbs. of equipment



HP 1184A testmobile cart dimensions. Dimensions: mm (inches).

Sturdy testmobile design gives your logic analyzer mobility and frees up bench space.

Testmobiles

Make your logic analysis system a portable one with the HP testmobile. Each testmobile is designed to withstand rugged use.

Ordering Information

HP1184A Testmobile

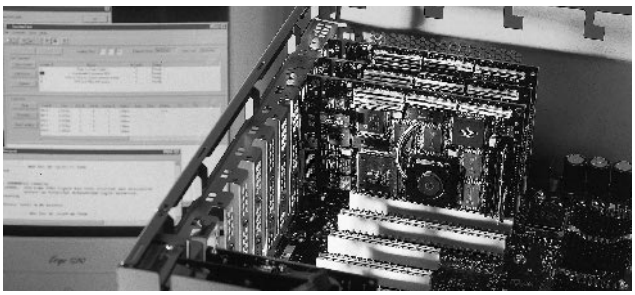
Soft Carrying Case

The HP 1540-1066 soft carrying case allows you to easily carry your HP 670 series benchtop logic analyzer and its accessories to remote sites.

Ordering Information

HP1540-1066 Logic Analyzer Soft Carrying Case

- Complete family of professional PCI system test equipment
- PCI test solutions for the entire design cycle
- 33/66 MHz Exerciser and Analyzer
- Full 32/64 bit solutions including protocol check for 64-bit commands
- CompactPCI test solutions, including hot swap functionality



PCI Server during system validation with the HP E2928A

PCI Series Exerciser & Analyzer

The HP E2920 PCI Series of Verification Tools is a family of test tools designed to provide an early and extensive insight into PCI-based designs, revealing and solving design problems sooner throughout the entire development process, from initial bring-up of devices and systems, through to system validation.

The tools supplied with the HP E2920 PCI Series not only help you get your new designs to market faster, but also give you the confidence of knowing your product will perform in any conceivable situation.

For more information visit or web site: **www.hp.com/info/pci_overview**

Evaluate: Getting Your Design Off to a Good Start

In the early stages of your PCI based prototype evaluation, you need to analyze the behavior of your system, device or firmware and detect the cause of any errors or problems as early as possible during the bring-up and debugging. The HP PCI Analyzer features a PCI state logic analyzer, real-time protocol and timing checkers, real-time performance measures and a PCI optimized trigger, giving you a fast overview of your system status.

PCI bus traffic from the state waveform level up to data transfer level can be captured and analyzed, allowing the observation of traffic at a level meaningful to the problem. The identification and triggering of protocol violations is possible at any time.

For more information visit our web site: **www.hp.com/info/pci_evaluate**

Optimize: Overcoming the First Hurdles

Optimizing a PCI design means applying your expertise to the analysis of traffic and of bus performance and then applying what you find to help improve your devices. The HP PCI Performance Optimizer is a powerful tool, which provides you with an in-depth real-time and post processing performance analysis, giving hints for performance optimization. The HP PCI Exerciser plays an active role in the analysis of complex PCI scenarios by letting you set up worst case traffic patterns quickly and allowing errors to be easily reproduced for deeper investigation. Identifying bottlenecks and true performance potential helps you optimize your design.

For more information visit our web site: **www.hp.com/info/pci_optimize**

Validate: Ensuring Reliability in the Long Run

Validating your PCI device means ensuring its reliability in the long run. The HP E2920 PCI Series use the PCI bus as the "standard" interface to validate a system. Variable levels of background traffic can be generated and typical peripheral traffic patterns emulated to stress arbitration, memory controller, bridges and system interrupts. The System Validation Package (Opt 310) provides a set of tests for testing particular sub-systems. The C-Application Programming Interface (C-API) available with the PCI Protocol Permutator and Randomizer (PPR) (Opt 320) enables full range testing. Automatic PCI protocol permutations within user-defined constraints, enable optimum test coverage of PCI behavior of a device or system, in the minimum amount of time.

For more information visit our web site: **www.hp.com/info/pci_validate**

System Description

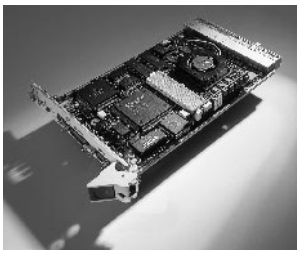
The PCI Exerciser and Analyzer is delivered as a single, short PCI card, which requires plugging into the system that needs to be tested. Plugging other PCI devices into the system-under-test enables these devices to also be tested.

The HP E2920 PCI Exerciser and Analyzer can either be externally controlled by a RS-232 or a 4 MB fast host interface, or through the system-under-test via PCI.

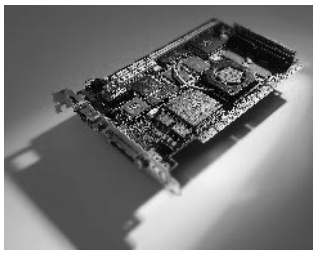
Key Literature

HP E2920 Verification Tools, PCI Series, color brochure, p/n 5968-3507E
HP E2925B, HP E2926B, technical specifications, p/n 5968-3501E
HP E2928A, technical specifications, p/n 5968-3506E
HP E2940A, technical specifications, p/n 5968-1915E

For customer reference stories/application notes and latest ordering information, please visit our web site: **www.hp.com/info/pci_overview**



Compact PCI Exerciser/Analyzer Card



PCI Exerciser/Analyzer Card

Software/Graphical User Interfaces

The HP PCI Analyzer Graphical User Interface is a comprehensive Windows 95/98/NT graphical user interface for the PCI exerciser and analyzer's on-board logic analyzer. It allows the analysis of bus traffic quickly and easily:

- Easy setup of trigger sequences and storage qualification for the on-board PCI state logic analyzer
- Real-time PCI protocol checker
- State Waveform Lister displays waveform trace of all PCI signals, sideband I/O and internal bus state signals
- Bus Cycle Lister disassembles bus traffic at state level, with comprehensive error reporting including cross references to PCI specification
- Bus Transaction Lister summarizes bus transfer at address and data level

The HP PCI Exerciser Graphical User Interface (comes with #300) is a comprehensive Windows 95/98/NT graphical user interface, which controls the PCI exerciser and analyzer's programmable PCI master and target:

- Configuration Space Editor to set up the PCI configuration space
- Master Transaction Editor to set up master transactions and protocol behavior
- Target Attribute Editor to set up protocol behavior for the target
- Data Memory Editor to view/modify the on-board memory content

The HP PCI Performance Optimizer (comes with #200) is a comprehensive Windows 95/98/NT graphical user interface using the PCI exerciser and analyzer capabilities to help engineers optimize performance. It features:

- Performance analysis with real-time counters and in-depth post processing
- Hierarchical data representation for fast problem detection and in-depth root cause analysis with report generation
- Numerable ready-to-go tests: data transfer rate, data efficiency, bus usage, retry rate
- The 4 M memory board is strongly recommended

The System Validation Package (comes with #310), which is a ready-to use software package running on Windows NT to perform system stress test during system validation. It automatically sets-up tests to stress to stress the computers data paths from:

- CPU and PCI Exerciser to system memory
- PCI Exerciser to system memory
- CPU to PCI Exerciser memory space
- CPU to PCI Exerciser I/O space
- Peer to peer traffic
- Master to target traffic

HP E2920 Exerciser and Analyzer, PCI Series

PCI Exerciser and Analyzer Comparison Table

	HP E2925B	HP E2926B	HP E2928A	HP E2940A
Data-path width	32 bit		32 / 64 bit	
Addressing	32 bit		32 bit / 64 bit DAC	
PCI clock range	0...33 MHz	0...33 MHz	0...66 MHz	0…66 MHz Analyzer 0…33 MHz Exerciser
State PCI logic analyzer trace memory		64 K on-board/4 M (HP E2995A)		64 K on board/4 M (HP E2996A)
Mechanical	PCI small card			CompactPCI
Fast back to back (master)	Yes		No	Yes
Exclusive access	Yes		No	Yes
Target Decode speed	Fast/Medium/Slow		Medium/Slow	Fast/Medium/Slow
Target initial/ subsequent latency	0/0		1/0	0/0
LOCK control	No/lock/hide/unlock		No lock control	No/lock/hide/unlock
Programmable clock delay between transactions	0 to 2,000,000		2 to 2,000,000	0 to 2,000,000

C-API and PCI Protocol Permutator & Randomizer library (comes with #320), which provides automatic PCI protocol permutations within user-programmed constraints. It features:

- Reduced and predictable test time, as use of the system CPU is not required
- PCI master and target support
- Comprehensive reports of performed protocol variations

Standard Specifications of the HP E2920 PCI Series

General: Fully programmable PCI master and target, low and high level control of protocol and traffic behavior
Real-time counter size: 64 bit
Real-time measures: 8
PCI signal levels: 3.3 / 5 V
PCI Compatibility: PCI Revision 2.1
Temperature range: –40...70°C
Trigger I/O: 12
External Trigger I/O: 12
Trigger Sequencer: 256 branches/≤64 states
Data Memory: 512 KB (64K*64bit)
Burst length: 1…2,000,000,000 dwords
Data Compare: in hardware (real-time)
Pattern terms: 24
Real-time checked protocol rules: 53
Timing Check: 250 ps resolution at 33 MHz (concurrently checked for all PCI signals)
Protocol permutation: in hardware
Data interfaces: PCI (on system-under-test), RS-232 serial port (via external host PC), Fast host interface (via external host PC)
Mailbox registers: 2x 32 bit
Fast host interface speed: 4 MB/s
Supported PCI command types: all
Built-in test functions: Write, read and compare, guarantee asynchronous stress, test data integrity
Additional interf aces: CPU port interface (direct manipulation of system or devices), 8 static I/O pins (observing/controlling additional signals)
Additional features: Programmable PCI configuration space, expansion EEPROM, programmable interrupt generator, port into system-under-test's memory, I/O and configuration spaces

Ordering Information

PCI Analyzer Protocol checker, 64 K state PCI logic analyzer, 64-level trigger sequencer, 4 MB fast host interface, timing checker, real-time performance measures, GUI
Opt 200 Performance optimizer: Post processed and real-time performance analysis, performance report, GUI
Opt 300 PCI Exerciser: PCI master and target, GUI, CLI, 512 KB on-board data memory
Opt 310 System validation package: Peer-to-peer test, system memory test, system load test, protocol check, GUI
Opt 320 C-API/PPR: C programming interface library, protocol, permutation and randomizer lib

Accessories

For more information visit our web site: **www.hp.com/info/pci_products**

For the HP E2925B, HP E2926B and HP E2928A the following accessories are available:

E2991A External Power Supply

This device is available for applications where the PCI Exerciser and Analyzer should be transparent to the system. It prevents the card from drawing power from its slot.

E2993A Logic Analyzer Adapter

An add-on daughter card with terminated connectors enables you to connect an external HP logic analyzer for system-wide analysis.

E2994A Universal Logic Analyzer Adapter

This adapter provides all of the on-board PCI analyzer signals to connect to an external logic. Appropriate terminators, depending on the selected logic analyzer, have to be added.

E2995A 4 M Memory Board

This piggyback board provides a deeper trace memory for up to 4 M PCI trace samples. It is strongly recommended for PCI performance measurement applications.

Accessories for the HP E2940A

E2996A 4 M Memory Board

This piggyback board provides a deeper trace memory for up to 4 M PCI trace samples. It is strongly recommended for PCI performance measurement applications.

- Characterizes digital hardware from ICs to systems
- Integrates easily into standard VXI test platforms
- Function and margin tests, error analysis
- Stimulus and response in one platform
- Stimulus up to 660 Mb/s (RZ)
- Response sampling rate up to 660 MSa/s
- 2 to 120 channels (2 to 240 NRZ/330 MSa/S channels)
- 100 ps resolution, 50 ps accuracy
- Semi-automatic deskew
- Auto adjustment of the analyzers' sampling point

Confirm Digital Hardware Early in the Product Cycle

The HP 81200 Data Generator/Analyzer Platform helps engineers in design and engineering environments to characterize digital hardware such as ICs, boards, modules, frames and systems. The HP 81200 configurations are compact and accessible so that characterization under near-to-real conditions can be performed at an early stage in the design or manufacturing cycle, thus reducing risks, costs and time-to-market.

Application Examples

- CMOS, ECL and LVDS logic characterization
- Emulate clock, data and control signals
- Functional test, margin test, error analysis
- Computer clock, multi-phase clocks
- High speed DACs
- High speed digital transmission devices

Emulate the Device's Environment

Communication and computing devices can require very complex stimuli. To meet this need, the HP 81200 provides sequencing and looping so that its 1 Mb/channel memory can generate very deep patterns. The internal editor includes memory-based prbs/prws (pseudo-random binary/word sequences) to simulate traffic and allow multiplexer testing.

Programmable output levels, pulsewidth, delay and transitions are independent for each channel so that performance at and beyond working conditions can be measured. RZ/NRZ (return to zero/non-return to zero) and R1 (return to one) formats are available, and RC (return to complement) can be arranged by the logical addition of two channels using the EX-OR output addition feature. Analog addition of channels allows the generation of real-world signals, such as pulses with glitches, spikes or reflection, as well as 3 and 4 level signals.

For high-speed devices, fast, stable edges with rates up to 660 Mb/s, RZ/NRZ are available. For higher data rates, the EX-OR feature allows 2:1 multiplexing for data rates up to 1.32 Mb/s NRZ, without halving the voltage because an external adder is not required. This feature can be of use in communications applications where prbs (pseudo-random binary sequences) up to 2^{15}–1 are adequate. (If the device requires a clock for the multiplexed signal, an external source such as the HP 8133A, is needed to clock the HP 81200 at up to 660 MHz, and at the same time, clock the device at twice that frequency.)

For less demanding applications (control signals, slower logic), dual output/input module front-ends are available which can reduce investment.

Easy Performance Measurement

Performance measurements are easy because they are implemented under the same user interface as the stimulus. The HP 81200 captures, and displays data in a state list. Data can also be compared in real-time, with the results displayed as an error map, a state list or as an error count or rate. Skews introduced by the user's cabling and fixturing can be compensated by a software-guided procedure (HP E4805A and Option 003 required). The routine for automatic adjustment of the analyzers' sampling point, contributes to a fast setup of the test procedure (part of the HP E4874A Characterization Software Components).

Bench and System Operation

Manual operation is via a Windows NT-based user interface. Channel allocation, pattern and parameters are among the items that can be set up. Patterns can be imported and exported in ASCII via GPIB (SCPI), LAN or 3.5" disk. For system operation, the GPIB can be used in one of two ways: to control other GPIB instruments (for this, a suitable controller language such as C, HP Basic or HP VEE must be installed by the user in the built-in PC), or another computer can control the HP 81200.

The HP 81200 Data Generator/Analyzer Platform shown in the 10- and 3-slot mainframes. In front, the optional Display and Entry Panel.

Convenient and Upgradeable

Bench users, in particular, will appreciate the HP 81200's "switch on and go" philosophy and will adapt rapidly to the Windows-type instrument control.

The HP 81200 is supplied ready-to-use[1] with the desired number and types of channels. The software supports any channels that the user may choose to add at a later date. Additionally, the HP 81200 modules can be integrated easily into standard VXI test platforms with the supplied Plug&Play drivers.

The modular structure (mainframes, modules, module front-ends and user interfaces) allow required channel counts to be implemented economically. The following table gives some examples using the small frame:

Requirement	Minimum	Optional
Generator-only, max. 10 channels, up to 660 Mbit/s	Small frame, Clock/data module, 1 or 2 HP E4843A front-ends	2 HP E4841A modules 8 HP E4843A front-ends
Generator-only, max. 20 channels, up to 200 Mbit/s	Small frame, Clock/data module, 1 or 2 HP E4846A front-ends	2 HP E4841A modules 8 HP E4846A front-ends
Generator/analyzer, max. 8 channels, up to 660 Mbit/s and 660 Msa/s	Small frame Clock module HP E4841A module Up to 4 HP E4843A/44A front-ends, any mix	HP E4841A Up to 4 HP E4843A/44A front-ends, any mix
Generator/analyzer, max. 16 channels, up to 200 Mbit/s and 200 Msa/s	Small frame Clock module HP E4841A module Up to 4 HP E4845A/46A front-ends, any mix	HP E4841A module Up to 4 HP E4845A/46A front-ends, any mix

HP 81200 Brief Specifications (50 Ω load, 10°C to 40°C)

HP E4805A Clock and HP E4831A Clock/Data Modules

Frequency: 1 kHz to 660 MHz
Resolution: 1 Hz (HP E4831A: 4 digits)
Accuracy: 100 ppm
Jitter: 10 ps rms, typ.
Ext. Clock: 170 kHz to 666.66 MHz
Front-End Slots: None (HP E4831A: 2 generator)
Ck Fan-Out: 11 x HP E4841A + 2 x HP E4805A (HP E4831A: 6 x HP E4841A)

[1]All software and hardware is in place and connected. However, expander modules and monitors are packaged separately, and these items must be connected for initial use. In the case of expander modules, the mainframe clock generator must be removed and opened in order to connect a ribbon cable to the expander clock module(s).

Data Generator/Analyzer Platform

Data Generator Configurations (HP E4831A, E4841A)

Front-End Slots per Module: 4 (HP E4831A: 2)
Memory Depth: 1 Mb per HP E4831A/41A front-end slot
Pattern Up/Download: ASCII file via LAN, 3.5" disk or GPIB to/from the internal database. Transfer between database and hardware is executed by the supplied HP 81200 user interface
Segments: The memory can be divided into segments. The segments, which are loopable, can contain user-defined patterns or a prbs, or represent a pause
Prbs/Prws: 2^n-1 (n = 7, 9, 10, 11, or 15).
Loops: The maximum number of loops is 60 minus the number of segments
Delay: Zero to 3 μs (2 ps resolution). Each channel is independent
Pulsewidth: Variable in RZ mode with 2 ps resolution. For limits, see table "Generator Front-Ends", below
Edge-Placement Accuracy: ± 50 ps ± 50 ppm
Output Skew: < 50 ps typ. after deskew. Constant levels and frequency
Output Levels: See Table "Generator Front-Ends", below
Output Impedance: 50 Ω typ; output connector: SMA

Generator Output Front-Ends

	HP E4843A	HP E4846A
Target Logic	ECL, PECL, CMOS	CMOS, TTL
Frequency	660 MHz	200 Mbit/s
Outputs	1, differential	2, single-ended
Format	RZ, R1, NRZ	NRZ
Amplitude 50 Ω into 50 Ω	0.3 to 2.50 Vpp	0.25 to 3.50 Vpp
Window 50 Ω into 50 Ω 50 Ω into 1 kΩ	–2.0 to +3.0 V –4.0 to 6.0 V	–1.75 to +3.50 V –3.50 to + 7.0 V
Transition Time	350 ps fixed[1]	1.2 ns fixed[2]

[1] At ECL levels, 20–80% of amplitude [2] 10–90% of amplitude

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Data Analyzer Configurations (HP E4841A)

Front-End Slots per Module: 4, generator or analyzer, any mix
Memory Depth: 1 Mb per HP E4841A front-end slot. In compare mode, memory is shared between expected data and captured data
Sampling Point Delay: Zero to > 1 period, worst case 3 μs (2 ps resolution). Each channel is independent
Capture Mode: State list, max. sample rate is 660 MSa/s
Compare Mode: State list (with highlighted errors), error map, error count or bit error rate. Max. sample rate is 333.33 MSa/s
Other Characteristics: See following table "Analyzer Front-Ends"

Analyzer Input Front-Ends

	HP E4844A	HP E4845A	HP E4847A
Sampling Rate	660 MSa/s	330 MSa/s	330 MSa/s
Inputs	1	2	2
Input Sensitivity	100 mV typ.	100 mV typ.	200 mV
Impedance	50 Ω	50 Ω	50 Ω/high -z
Input Threshold	–2.1 v to +5.1 V, 5 mV resolution	–2.1 v to +5.1 V, 5 mV resolution	–2.1 v to +5.1 V, 5 mV resolution

New Differential Front-Ends

	HP E4837A (Analyzer)	HP E4838A (Generator)
Target Logic	LVDS, (P) ECL	LVDS, (P) ECL
Frequency	660 MHz	660 MHz
Output	–	1 differential
Input	1 differential	–
Format	–	RZ, R1, NRZ
Amplitude	–	0.1 to 3.50 Vpp
Input Sensitivity	< 50 mV typ.	–
Window 50 Ω into 50 Ω	–	–2.2 to 4.4 V
Impedance	50 Ω	–
Transition Time	–	0.5 – 5 ns[1]
Input Threshold	–2.0 to +4.5V 2 mV resolution	–

[1] 10–90% of amplitude

General

Programming Interface: From an external controller over GPIB, SCPI (1992) commands. Alternatively, use the embedded PC to control other test equipment via GPIB, Plug&Play drivers for easy programming
Graphical User Interface: Windows NT-based, color, on-line help, graphical sequencing and channel connection windows
Display and Entry Panel: TFT display and alpha-numerical entry pad. Alternatively, monitor, keyboard and mouse
Save/Recall: Multiple settings and test patterns can be stored in an internal database
Built-in Diagnostics: Module and system self-tests can be implemented
Mainframe Dimensions
HP E4840A: 177 mm H x 426 mm W x 498 mm D
HP E4849B: 352 mm H x 424.5 mm W x 631 mm D
Operating Temperature: 10° C to 40° C
Interfaces: LAN 10baseT (AUI, BNC), RS232, SVGA port, SCSI, Centronics parallel port, mini-DIN connectors for keyboard and mouse, GPIB, 3.5" floppy drive
Warranty: 3 years
Standards: CE-mark, designed and produced according to ISO 9001, IEC1010-1, CSA 1010.1, En 55011/CISPR 11, Group 1, Class A +10 dB

Key Literature

HP 81200 Data Generator/Analyzer Platform, Color Brochure, p/n 5968-4261E
HP 81200 Data Generator/Analyzer Platform, Technical Specifications, p/n 5965-3415E
HP 81200 Data Generator/Analyzer Platform, Configuration Guide, p/n 5965-3417E

For more information, visit our web site: **http://www.hp.com/go/dvt**

Ordering Information

Mainframes
HP E4840A Small mainframe with 3 slots
Includes embedded PC and installed software
(Windows NT operating system and HP E4873A user software)
Opt 001 Display and entry panel HP E4807A
Opt 003 15" VGA monitor
Opt 004 17" VGA monitor
Opt 005 21" VGA monitor
Opt 006 Keyboard, US/English
Opt 007 Mouse, 2-key, mini-DIN connector
Opt 008 External CD-ROM drive, SCSI, required for HPE4873A user software updates
HP E4849B Mainframe with 10 free slots (9 with Option 002)
Includes HP E4806A PC module and installed software
(Windows NT operating system and HP E4873A user software)
Opt 002 VXI extender module HP E1482B required for 1 or 2 expander frames
(Other options as HP E4840A)
HP E4848B Expander frame, includes HP E1482B VXI extender module and all cables for connecting to the mainframe. HP E4805A clock module required

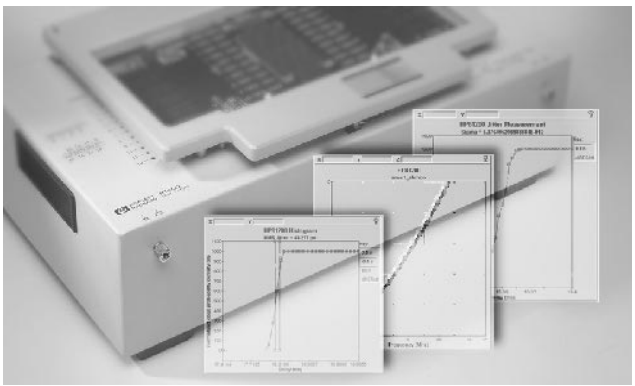
Modules
HP E4805A 660 MHz clock module
Opt 002 8-line trigger input
Opt 003 Deskew probe HP 1144A
HP E4831A 660 MHz clock and data module
HP E4841A 660 MHz data generator/analyzer module

Generator Front-Ends
HP E4838A 660 Mbit/s RZ/NRZ, variable transitions
HP E4843A 660 Mbit/s RZ/NRZ
HP E4846A 200 Mbit/s NRZ, dual channel

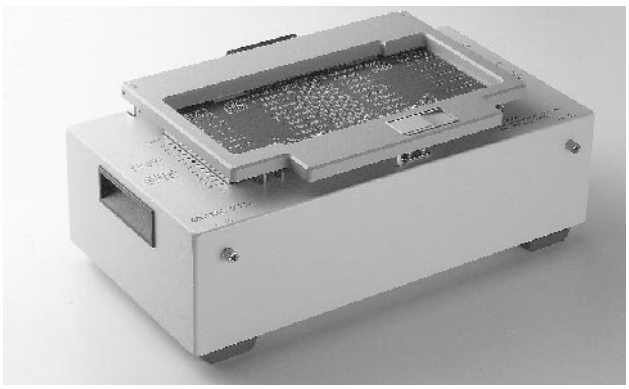
Analyzer Front-Ends
HP E4837A Differential input 50 Ω
HP E4844A Single input, 50 Ω
HP E4845A Dual input, 50 Ω
HP E4847A Dual input, 50 Ω/hi-z

Accessories
SMA components see pages 442.

NEW



Comprehensive characterization with the HP 81200.

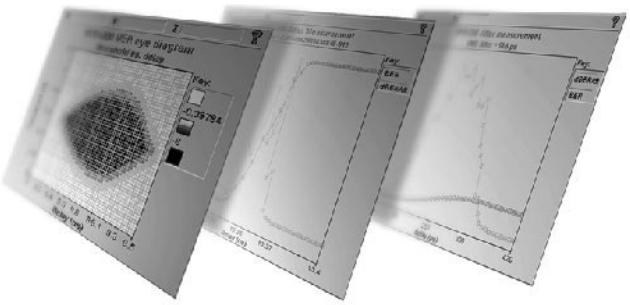


HP E4839A Test Fixture

To speed-up and simplify the characterization of your digital and mixed signal devices with the HP 81200, HP has developed an IC/Circuit Characterization Package.

This combination provides you with the performance (of clock speeds up to 660 MHz and data rates up to 1.3 Gbit/s), and increases your confidence that your design will work under real world conditions. The package comprises three different products:

HP E4874A Characterization Software Components



The HP E4874A Characterization Software Components enable you to spend more time testing and less time setting up the test equipment. With only a few commands you can design and automate your own measurement tasks easily.

Using the examples included in the HP E4874A, you can create your test functions in the software environment that best suits you: Labview, HP VEE, C++ or even Excel spreadsheets with Visual BASIC.

The HP E4874A is a selection of common engineering test templates and ActiveX graphic control components. The automated parameter sweep creates, for example, Shmoo plots, which show you immediately the device performance in two dimensions. You can easily tailor the supplied templates to your own needs. Additionally, a routine for automatic adjustment of the analyzer sampling point delay is supplied in the package.

Examples included in the HP E4874A Characterization Software Components:

	Fast Shmoo	Eye Diagram	Jitter Measurement
HP VEE		•	•
Labview		•	•
MS Visual C++	•	•	•
MS Excel Vba	•	•	•

For more information, visit our web site: **http://www.hp.com/info/ic_characterization.**

HP E4839A Test Fixture

The HP E4839A Test Fixture works with the HP 81200 to provide a complete solution for digital device characterization. The combination provides a 50Ω signal path all the way from the HP 81200 platform port to the pin of the DUT. This provides a high-quality signal up to a data rate of 660 Mbit/s. Signals from other test equipment can also be connected to the DUT. The test fixture supports "Infinite Plane" DUT interface boards, and up to four power supplies.

The HP E4839A Test Fixture makes it easy to wire DUTs with up to 192 pins. It consists of a chassis, a universal board, twenty 50-[ohm] SMA to Pogo coax cables, and one pre-mounted power supply cable assembly for four power supplies. The chassis provides the framework to hold the test board in place, providing a reliable and reproducible connection to the DUT. Once the test fixture is set up, exchanging boards between tests is both quick and easy, as you can deskew data and measurement settings in the HP 81200 which can be recalled as and when required.

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BestLink/81200 Simulation Data Link

You can now leverage the knowledge and data gained while simulating a new design by automatically moving simulation data to the prototype test setup.

BestLink/81200 is an intelligent EDA tool that employs a sophisticated algorithm that analyzes and converts your simulation data for your particular HP 81200 hardware configuration. What is more, it reports, and can optionally mask, any glitch or data instability that cannot be reproduced or measured on your platform. BestLink/81200 is optimized to process simulation data coming from commercial VHDL and Verilog simulators.

BestLink/81200 is available from Diagonal Systems. For details, please refer to: **http://www.diagonal.com**

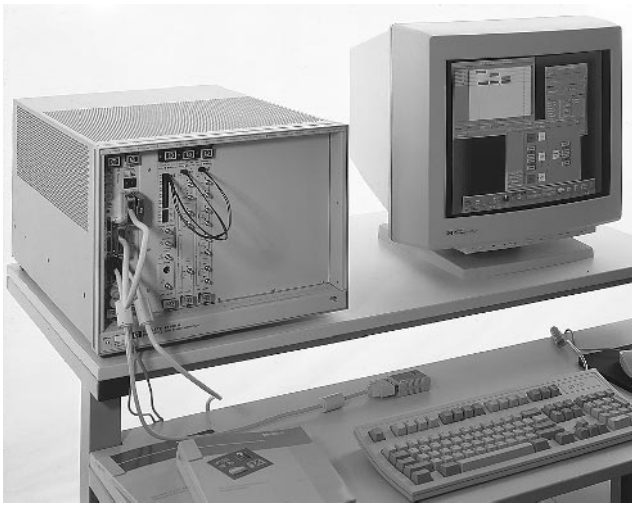
Key Literature

HP 81200 IC/Circuit Characterization Package, Color Brochure, p/n 5968-4260E
HP E4874A Characterization Software Components, Technical Specifications, p/n 5968-4259E
HP E4839A Test Fixture, Technical Specifications, p/n 5968-3580E
BestLink/81200 Simulation Data Link for the HP 81200 Data Generator/Analyzer Platform, Product Information, p/n 5968-2548E

Serial Cell Generator and Analyzer System

HP E4859A
HP E4853A
HP E4854A

- Error performance analysis of burst-mode data
- Up to 16 serial cell generators
- Cells with mixed PRBS/user-defined pattern
- Variable cell lengths and cell timing
- Bit rate 170 kb/s to 250 Mb/s (optional 660 Mb/s)
- Auto-adjust cell transfer delay and threshold
- Detect mode with clock and data input



HP E4859A, with HP E4854A and peripherals

HP E4859A Serial Cell Generator and Analyzer Entry System

GPIB

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The HP E4859A Serial Cell Generator and Analyzer Entry System provides one bursted serial cell generator, a companion cell error analyzer, and a central synthesized clock source. For configurations requiring multiple generators or analyzers, modules can be added to the entry systems.

The HP E4859A is used in research and development to characterize the transmission performance of Time Division Multiple Access (TDMA) and other burst-mode transmitters/receivers used in communication systems.

Generation of All Types of Burst-Mode Data

Multiple HP E4854A dual serial cell generators can be set up to emulate burst-mode data in a network. Cell length, cell content and cell timing can be varied for each generator to allow characterization of the transmission performance under real network conditions, even for designs using proprietary cell formats.

Error Performance Analysis of Burst-Mode Data

The HP E4853A serial cell analyzer measures the bit error performance of burst-mode cells transmitted from one of the generators. The generator and analyzer are synchronized by auto-adjust.

Applications

Applications include characterization of burst-mode transmitter/receiver, components, modules, and sub-systems during research and development:

- Time Division Multiple Access (TDMA). TDMA technology is typically used in point-to-multipoint networks, especially for upstream transmission in local access networks for interactive B-ISDN. Such networks are Passive Optical Network (PON), Passive Double Star (PDS), Fiber To The Curb (FTTC), and ground stations for Personal Handy Phone System (PHS).
- Time Compression Multiplex (TCM or pingpong)
- Wavelength Division Multiplex (WDM)
- Point-to-point burst-mode transmission
- Optical bus, optical computer interconnects, LAN
- Digital/optical CATV transmission
- Military communication system

Specifications (typical)

HP E4854A provides two serial cell generators.
HP E4853A provides one serial cell analyzer and one generator.
Bit Rate: 170 kb/s to 250 Mb/s, optional 660 Mb/s
Cell Content: Up to 28 segments of user-defined pattern and/or PRBS
User-Defined Pattern: 64 Kb per channel
PRBS: 2^7-1 to $2^{31}-1$
Segment Length: 1 bit to 64 Kb
Guardtime Between Cells in Burst-Mode: 0 to 24 ms, resolution 10 ps
Output Amplitude: 0.3 V to 2.5 V, TTL, ECL, PECL
Auxiliary Output (opt.)**:** Cell envelope, bursted clock, continuous clock
Auto-Adjust: Synchronization of analyzer and generator
Clock Input (opt.)**:** Detect mode with clock and data input for the analyzer
Measurements: Bit error count, bit error ratio; individual cell segments can be selected
Decision Threshold Voltage: –2.1 V to +5.1 V
Module Size: VXI C-size, one slot

Key Literature

Product Overview, p/n 5963-9985E
Technical Data, p/n 5963-9924E
Configuration Guide, p/n 5964-0004E

For more information, visit our web site: **http://www.hp.com/go/dvt**

Ordering Information

The entry system is needed. Optionally, the free slots can be used for additional HP E4853A and HP E4854A modules. For assistance in defining your configuration, please contact the HP Call Center in your region.

HP E4859A Entry System* (seven free slots)
  Opt 001 Auxiliary Output
  Opt 002 Clock Input for Analyzer
  Opt 660 Bit Rate 660 Mb/s max.
HP E4853A Generator/Analyzer Module (one slot)
  Opt 001 Auxiliary Output
  Opt 002 Clock Input for Analyzer
  Opt 660 Bit Rate 660 Mb/s max.
HP E4854A Dual Generator Module (one slot)
  Opt 001 Auxiliary Output
  Opt 660 Bit Rate 660 Mb/s max.

*The entry system comes pre-installed and includes mainframe, clock source and sequencer, one HP E4853A (one generator/one analyzer) module, controller with operating system, application software, licenses, and documentation. Monitor, keyboard, and mouse have to be ordered separately.

An HP 81100 setup for characterizing designs with low channel counts. For lasers and diodes needing more power, use the HP 8114A. For fast technologies requiring low jitter and high timing resolution, use the HP 8133A. If more than two channels are needed, refer to page 437.

Pulse generators provide variable parameters for characterizing a wide range of digital devices such as memory cells, PLLs and transponders. Good repeatability and a viable feature set help you make fast, credible measurements easily.

Pattern capability combined with pulse generator features adds a new dimension because you can now carry out function test under worse case conditions. Thanks to the channel-add feature, you can also simulate distortion (such as unequal timing, glitches, and cross talk) and, with analog channel addition, 3-level signals so that measurements can be performed under true-life conditions. These capabilities let you test your device thoroughly much earlier in the product cycle.

Matching your needs better

The Hewlett-Packard range of pulse generators extends from the HP 8114A 100 V, 2A Pulse Generator to the HP 8133A 3 GHz Timing Generator. The HP 81100 Family of Pulse/Data Generators bridges the extreme and in addition to replacing the HP 8110A Pulse Generator with a compatible instrument with new standards of reliability and performance, also provides a spectrum of instruments with the same look and feel. Cost-effective solutions are now available for simpler low frequency applications right up to precision high-speed requirements.

Selection Table

	HP 81100 Family of Pulse/Pattern Generators								
Mainframe	**HP 8114A**	**HP 81101A**	**HP 81104A**	**HP 8110A**[1]	**HP 81110A**[1]		**HP 81130A**		**HP 8133A**
Channel module	included	included	HP 81105A	HP 81103A[1]	HP 81111A[1]	HP 81112A	HP 81131A	HP 81132A	included
Max clock rate	15 MHz	50 MHz	80 MHz	150 MHz	165 MHz	330 MHz	400 MHz	660 MHz	3 GHz
Max data rate	–	–	–	–	–	–	800 MBit/s[4]	1.32 GBit/s[4]	–
Accuracy									
Triggerable	± 5%+100 ps	± 5%	± 5%	± 5%+100 ps	± 3%[2]	± 3%[2]	–	–	–
With PLL	–	0.01%	± 0.01%	± 0.1%	± 0.01%	± 0.01%	± 0.01%	± 0.01%	± 0.5% (YIG)
Jitter, rms									
Triggerable	± 0.03% +25 ps	± 0.01% +15 ps	± 0.01% +15 ps	± 0.03% +25 ps	± 0.01% +15 ps	± 0.01% +15 ps	–	–	–
With PLL	–	0.001% + 15 ps	± 0.001% +15 ps	± 0.003% +20 ps	± 0.001% +15 ps	± 0.001% +15 ps	± 0.001% +10 ps	± 0.001% +10 ps	± 5 ps (YIG)
Width/delay									
Resolution	3 digits	3 ½ digits	3 ½ digits	3 digits	3 ½ digits	3 ½ digits	4 digits	4 digits	4 ½ digits
Best case	10 ps	5 ps	5 ps	10 ps	5 ps	5 ps	2 ps	2 ps	1 ps
Accuracy	± 5% ± 250 ps/ ± 1 µs	± 5% ± 500ps/ ± 1 µs	± 5% ± 250/ 500 ps	± 5% ± 250 ps/ ± 1 µs	± 3%[2] +250/ 500 ps	± 3%[2] +250/ 500 ps	0.01% +200/ 100 ps[3]	0.01% +200/ 100 ps[3]	150 ps
Jitter, rms	± 0.03% +25 ps	± 0.01% +15 ps	± 0.01% +15 ps	± 0.03% +25 ps	± 0.01% +15 ps	± 0.01% +15 ps	± 0.001% +200 ps	± 0.001% +200 ps	± 5 ps
Transition time Fixed/variable	7 ns Fixed	5 ns Variable	3 ns Variable	2 ns Variable	2 ns Variable	0.8/1.6 ns Selectable	0.8/1.6 ns Selectable	0.5 ns Fixed	100 ps Fixed
Output into 50 Ω									
50 Ω source	50 Vpp	10 Vpp	10 Vpp	10 Vpp	10 Vpp	3.8 Vpp	3.8 Vpp	2.4 Vpp	3 Vpp
Hi-Z source	100 Vpp	20 Vpp	20 Vpp	20 Vpp	20 Vpp	–	–	–	–
Bits/channel	–	–	16 kbit	4 kbit	16 kbit	16 kbit	64 kbit sequencing	64 kbit sequencing	Opt 002: 32-bit or 2^{23}-1 prbs
Channels	Single	Single	1 or 2	1 or 2	1 or 2	1 or 2	1 or 2	1 or 2	1 or 2
Internal channel add	–	–	Analog	Analog	Analog	–	EXOR	EXOR	–
Catalog page	447	443	443	446	443	443	443	443	448

[1] The HP 81110A is a form/function replacement for the HP 8110A. Great care has been taken to ensure compatibility so that the user may take immediate advantage of the HP 81110A's glitch-free range-changing and improved price and performance. However, for those customers who prefer to continue using the HP 8110A in existing test systems or products, the HP 8110A will remain available for an interim period. The HP 81110A (with one or two HP 81111A output modules) is equivalent to the HP 8110A with the HP 81106A PLL module (plus one or two HP 81103A output modules).

[2] ±0.5% with self-calibration.

[3] Frequency > 170 kHz

[4] Applicable with internal channel addition only

Accessories

1. With BNC connectors
HP 15104A Pulse Adder/Splitter: 50 ohm delta network, rise time 150 ps, 6 dB insertion loss, 2 W
HP 15116A Pulse Inverter: 50 ohm pulse transformer, 5% droop (500 ns pulse), 0.3 dB insertion loss, 0.75 W
HP 15115A Splitter-Inverter: 50 ohm delta network with pulse transformer in one output. Output skew: 1 ns, other specs as HP 15104A/15116A.
2. With SMA connectors
HP 11667B Pulse Adder/Splitter: 50 ohm series network, 26.5 GHz bandwidth, 6 dB insertion loss, 0.5 Ω

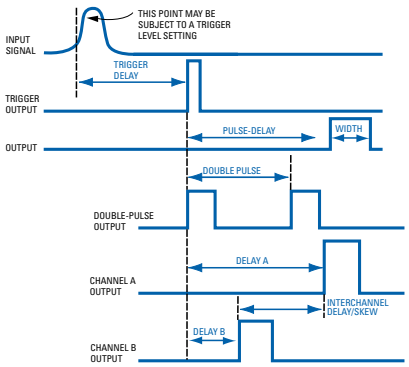
Transition Time Converters:

These components are for use when a very smooth pulse is needed, or when the stimulus is too fast for the DUT (as evidenced by excessive cross-talk, ringing, etc). The converters use a patented absorption technique for minimum reflection and to allow cascading.

Model	Output Transition
HP 15435A	150 ps
HP 15432B	250 ps
HP 15433B	500 ps
HP 15434B	1 ns
HP 15438A	2 ns

Pulse Parameter Definitions of Terms Used in Instrument Specifications

Time Reference Point: Median (50% amplitude point on pulse edge).
Pulse Period: The time interval between the leading edge medians of consecutive trigger output pulses.
Trigger Delay: Interval between trigger point of input signal and the trigger output pulse's leading-edge median. Applies in trigger, external width, gate and burst modes.

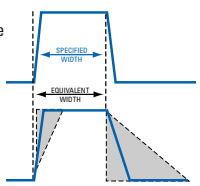


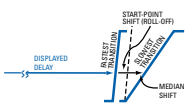
Pulse Delay: Interval between leading-edge medians of trigger-output pulse and output pulse.
Double-Pulse: Interval between leading-edge medians of the double-pulse.
Interchannel Delay/Skew: Interval between corresponding leading-edge medians.
Pulsewidth: Interval between leading and trailing-edge medians.

Additional Information for Pulse Generators with Variable Transition Times

Pulsewidth: The specified and displayed value are those which are obtained with the fastest edges, essentially equal to the interval from the start of the leading edge to the start of the trailing edge.

By designing the pulse edges so that they turn about their start points, the interval from leading-edge start to the trailing-edge start stays unchanged* when transition times are varied. This is more convenient for programming, and the width display is easy to interpret.

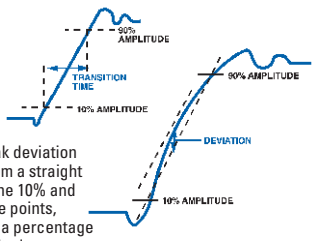




* In practice, start points may shift with changes in transition time.

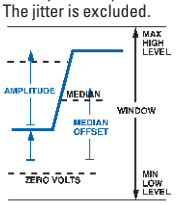
Delay: The specified and displayed values are those obtained with the fastest leading edge. For a slower edge, the actual delay exceeds the displayed delay by the combined shift of the start point and the median.

Transition Time: Interval between the 10% and 90% amplitude points on the leading/trailing edge.

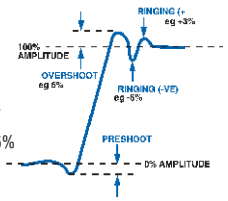


Linearity: Peak deviation of an edge from a straight line through the 10% and 90% amplitude points, expressed as a percentage of pulse amplitude.
Jitter: Short-term instability of one edge relative to a reference edge. Usually specified as an rms value, which is one standard deviation or "sigma". If the distribution is assumed to be Gaussian, six sigma represents 99.74% of the peak-to-peak jitter.

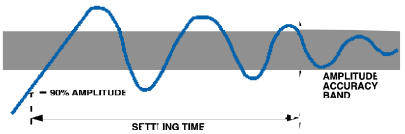
The reference edge for the period jitter is the previous leading edge, whereas the reference edge for the delay jitter is the leading edge of the trigger output. Width jitter is the stability of the trailing edge with regard to the leading edge.
Stability: Long-term average instability over a specific time, for example, an hour, or a year. The jitter is excluded.
Pulse Amplitude: Pulse output is specified as pulse top and pulse base (usually referred to as high level and low level), or as peak-to-peak amplitude and median offset. A "window" specification shows the limits within which the pulse can be positioned.



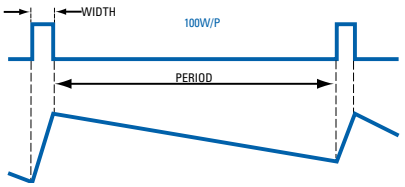
Preshoot, Overshoot, Ringing: Preshoot and overshoot are peak distortions preceding/following an edge. Ringing is the positive-peak and negative-peak distortion, excluding overshoot, on pulse top or base. A combined preshoot overshoot, ringing specification of e.g. ±5% implies:
- Overshoot/undershoot <5%
- Largest pulse top oscillation < ±5% of pulse amplitude



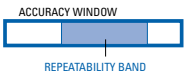
Settling Time: Time taken for pulse levels to settle within a level specification, measured from a 90% point on the leading edge.



Duty Cycle: Percentage ratio of pulsewidth to period. In pulse/function generators, this term is also used to define sine and triangle symmetry. Note that in pulse generators, this is a secondary parameter derived from the period and width settings. The duty cycle achieved is therefore subject to width and period accuracies.



Output Impedance/Resistance: Effective pulse source impedance/dc resistance.
Reflection Coefficient: Reflection at the pulse generator output expressed as a percentage of the incident pulse amplitude. (Test pulse edges correspond to the generator's fastest transitions.)
Repeatability: When an instrument operates under the same environmental conditions and with the same settings, the value of a parameter will lie within a band inside the accuracy window. Repeatability defines the width of this band.



HP-IB Programming Times

Listen Time: The time an instrument occupies the bus to receive and verify a message. The NRFD signal is active during this period.

Settling Time: The time taken by the instrument to execute an HP-IB message and for the output to settle within the accuracy specification. NRFD inactive.

Execution Time: The sum of Listen Time and Settling Time.

Talk Time: The time an instrument occupies the bus to output a specified string. Output data is typically instrument error status, or current or stored parameters.

For more information, visit our web site:
http://www.hp.com/go/dvt

Applications

Typical application areas are:
- clock distribution
- disk drive testing
- general-purpose logic testing
- laser/optoelectronic testing
- LCD-display testing
- memory/flash memory testing
- Mixed signal/A/D-, D/A converter testing
- Physical research
- Radar/microwave testing
- Transmission test
- Trigger Source for system test

If you would like to learn more about these applications or customer case studies, please refer to the application section under **www.hp.com/go/dvt.**

HP 81100 Family of Pulse/Pattern Generators (50 MHz – 660 MHz/1.32 GBit/s)

HP 81101A
HP 81104A
HP 81110A
HP 81130A

- Sychronizable from an external clock (fixed and variable delay)
- 2 ns variable transitions up to 10 Vpp (20 Vpp) into 50 Ω
- Fast transitions up to 500 ps (ECL)
- 2 ps timing resolution
- 0.01% frequency accuracy
- Dropout- and glitch-free change of any timing parameters
- Pulse, burst, pattern (data) modes, data sequencing
- Analog or digital channel addition
- 1 or 2 channels
- 100% SW compatibility for all 4 models

The HP 81100 Family of Pulse/Data Generators uses the same operating principle throughout (front-panel and programming), and is compatible with the well-established HP 8110A to protect current and future investments. Growing with future needs is easy as the HP 81110A is a true superset of the HP 81104A and HP 81101A.

Signals for Testing Digital Designs and Components

The HP 81100 Family generates all standard pulses, multi-level waveforms, digital patterns and data needed to test the current logic technologies (CMOS, TTL, LVDS, ECL, etc.) up to 660 MHz/1.32 Gbit/s. Continuous operation is enabled through the dropout- and glitch-free change of any timing parameters (e.g. to measure a PLL's pull-in/hold range) for all models except the HP 81130A.

Smooth Integration Into Automated Test Systems

Accessories and the HP 81101A's and HP 81104A's 100% upward compatibility to the HP 81110A permit growth based on future needs through the physical exchange of instruments.

Please see our new VXI based C-size Pulse Generators. They are available in 165 MHz as well as in 330 MHz max. frequency range. Please refer to page 445 or visit us: **www.hp.com/go/vxi.**

Specifications

50 Ω load, 0°C and 55°C
Please refer to the tables overleaf.

Channel Addition (with two HP 81105A and HP 81111A output channels): Simulates digital signals with interference pulses, or 3 or 4 level communication signals. When channel 2 is added internally to channel 1, channel 2 is disabled. 48/500 Ω source selectable.
Logic Channel Addition: Both the HP 81131A and HP 81132A output channels add channels logically (EXOR) to the HP 81130A on channel 2. All specifications remain the same as for one channel.

User Interface/Remote Control

Non-volatile Memory: Current setting is saved on power-down. Up to nine user settings and one fixed default setting can be stored in the instrument memory
Memory Card: 99 settings can be stored on a 1MB PCMCIA card (MS-DOS)
Remote Control: Operates according to IEEE standard 488.2, 1987 and SCPI 1992.0 with the function codes SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0.

General

Operating Temperature: 0°C to +55°C
Storage Temperature: –40°C to +70°C
Humidity: 95% r.h. up to 40°C ambient temperature
EMC: conforms to EN50082-1, EN 55011, Class A
Noise Emission: 5.7 bel typical
Battery: Lithium CR2477-N
Safety: IEC1010, CSA1010
Power Requirements: 100-240 Vac ±10%, 50-60 Hz, 100-120 Vac ±10%, 400 Hz
Power Consumption: 300 VA max.
Max. Dimensions (H * W * D)**:** 89 mm * 426 mm * 521 mm
Weight Net: 9.2 kg
Weight Shipping: 13.8 kg
Recalibration Period: 1 year recommended
Warranty: 3 years standard

Key Literature

HP 81100 Family of Pulse/Pattern Generators, Color Brochure, p/n 5967-6236E
HP 81101A Pulse Generator, Technical Specifications, p/n 5967-6274E
HP 81110A/HP 81104A Pulse/Pattern Generators, Technical Specifications, p/n 5967-5984E
HP 81130A Pulse/Data Generator, Technical Specifications, p/n 5967-6237E

Ordering Information

The minimum configuration for a working instrument consists of a mainframe and one output module (except for the HP 81101A which is supplied with one module). A second output module may be added later, but must be of the same model number as the first.

The English Quick Start Guide (811xx-91010)[1] and Reference Guide (811xx-91011)[1] is supplied with each mainframe for all configurations. A memory card is not included.

HP 81101A 50 MHz 1 channel Pulse Generator

HP 81104A 80 MHz Pulse/Pattern Generator Mainframe
HP 81105A 80 MHz, 10 V Output Channel
(one or two channels must be added to the HP 81104A)

HP 81110A 165/330 MHz Pulse/Pattern Generator Mainframe
HP 81111A 165 MHz, 10 V Output Channel
(one or two channels must be added to the HP 81110A)
HP 81112A 330 MHz, 3.8 V Output Channel
(one or two channels must be added to the HP 81110A)

HP 81130A 400/660 MHz/1.32 Gbit/s Pulse/Data Generator Mainframe
HP 81131A 400 MHz, 3.8 V Output Channel
(one or two channels must be added to the HP 81130A)
HP 81132A 660 MHz/1.32 Gbit/s, 2.5 V Output Channel
(one or two channels must be added to the HP 81130A)

The following accessories are available for each mainframe.
Opt 1CP Rack Mount and Handle Kit (5063-9219)
Opt 1CM Rack Mount Kit (5063-9212)
Opt 1CN Handle Kit (5063-9226)
Opt 1CR Rack Slide Kit (1494-0059)
Opt UFH 1MB SRAM Memory Card (0950-3380)
Opt UN2 Rear (instead of front) Panel Connectors
HP 15104A Pulse Adder/Splitter

Quick Start Guide Language Options
Opt ABF French Guide (811xx-91210)
Opt ABJ Japanese Guide (811xx-91510)
Opt AB0 Taiwan Chinese Guide (811xx-91610)
Opt AB1 Korean Guide (811xx-91710)
Opt AB2 Chinese Guide (811xx-91810)

Additional Documentation Options
Opt 0BW Service Manual (811xx-91021)
811xx-91031 Service Documentation (Component Level)

[1] xx is used to denote that the product is available to order for each mainframe. Please substitute xx for 01, 04, 10, 30 (the last two digits of the relevant mainframe) when ordering.

HP 81100 Family of Pulse/Pattern Generators (50 MHz – 660 MHz/1.32 GBit/s) (cont'd)

Mainframe Output Channel	HP 81101A Included	HP 81104A HP 81105A	HP 81110A HP 81111A	HP 81110A HP 81112A	HP 81130A HP 81131A	HP 81130A HP 81132A
Timing[1]						
Frequency Range **50 Ω Source**[2]	1 mHz to 50 MHz Up to 50 MHz typ.	1 mHz to 80 MHz Up to 50 MHz typ.	1 mHz to 165 MHz Up to 60 MHz typ.	1 mHz to 330 MHz –	1 Hz to 400 MHz –	1 Hz to 660 MHz –
Max. Data Rate	–	160 Mbit/s	330 Mbit/s	660 Mbit/s	800 Mbit/s[7]	1.32 Gbit/s[7]
Timing Resolution **Accuracy with PLL** (without PLL) **RMS Jitter with PLL** (without PLL)	3.5 digits, 5 ps best case 0.01% (5%)[3] 0.001% + 15 ps (0.01% + 15 ps)[3]	3.5 digits, 5 ps best case 0.01% (5%)[3] 0.001% + 15 ps (0.01% + 15 ps)[3]	3.5 digits, 5 ps best case 0.01% (0.5% typ. after self-cal., 3% without self-cal.)[3] 0.001% + 15 ps (0.01% + 15 ps)[3]	3.5 digits, 5 ps best case 0.01% (0.5% typ. after self-cal., 3% without self-cal.)[3] 0.001% + 15 ps (0.01% + 15 ps)[3]	4 digits, 2 ps best case 0.01% (± 100 ppm) 0.001% + 10 ps	4 digits, 2 ps best case 0.01% (± 100 ppm) 0.001% + 10 ps
Width Range **Accuracy**	10 ns to (period - 10 ns) ± 5% ± 500 ps	6.25 ns to (period - 6.25 ns) ± 5% ± 250 ps	3.03 ns to (period - 3.03 ns) After self-cal. ± 0.5% typ. ± 250 ps Without self-cal. ± 3% ± 250 ps	1.515 ns to (period - 1.515 ns) After self-cal. ± 0.5% typ. ± 250 ps Without self-cal. ± 3% ± 250 ps	1.25 ns to (period - 1.25 ns) > 170 KHz ± 0.01% ± 200 ps < 170 KHz ± 0.06%	750 ps to (period - 750 ps) > 170 KHz ± 0.01% ± 200 ps < 170 KHz ± 0.06%
Deskew	–	–	–	–	± 25 ns	± 25 ns
Delay (ext. in to out) (ext. in to trig. out)	28.5 ns fixed typ. 12 ns fixed typ.	27 ns fixed typ. 12 ns fixed typ.	26 ns fixed typ. 12 ns fixed typ.	22 ns fixed typ. 12 ns fixed typ.	47 ns typ. ± 1 period 15 ns ± 1 period	47 ns typ. ± 1 period 15 ns ± 1 period
Additional Variable Delay Range **Accuracy**[4]	0 ns to (period - 20 ns) ± 5 % ± 1 ns	0 ns to (period - 12.5 ns) ± 5 % ± 0.5 ns	0 ns to (period - 3.03 ns) After self-cal. ± 0.5% typ. ± 0.5ns Without self-cal. ± 3% ± 0.5 ns	0 ns to (period - 3.03 ns) After self-cal. ± 0.5% typ. ± 0.5ns Without self-cal. ± 3% ± 0.5 ns	0 ns to 3.00 µs < 170 KHz ± 0.01% ± 100 ps > 170 KHz ± 0.035% of period	0 ns to 3.00 µs > 170 KHz ± 0.01% ± 100 ps < 170 KHz ± 0.035% of period
Double Pulse Delay Range	(Width + 10 ns) to (period - width – 10 ns)	(Width + 6.25 ns) to (period - width – 6.25 ns)	(Width + 3.03 ns) to (period - width – 3.03ns)	(Width + 1.5 ns) to (period - width – 1.5 ns)	–	–
Transition Time Range (10/90)	5 ns to 200 ms variable	3 ns to 200 ms variable	2 ns to 200 ms variable	0.8 ns or 1.6 ns selectable	0.8 ns or 1.6 ns selectable	500 ps typ. at 2.2V 250 ps typ. at ECL fixed
At 1 KΩ Source Imped.	6 ns typ.	5 ns typ.	5 ns typ.	–	–	–
Level/Pulse Performance[5]						
Amplitude **50 Ω into 50 Ω** **1 KΩ into 50 Ω**	100 mVpp to 10.0 Vpp 200 mVpp to 20.0 Vpp	100 mVpp to 10.0 Vpp 200 mVpp to 20.0 Vpp	100 mVpp to 10.0 Vpp 200 mVpp to 20.0 Vpp	100 mVpp to 3.8 Vpp –	100 mVpp to 3.8 Vpp –	100 mVpp to 2.4 Vpp –
Level Window **1 KΩ into 50 Ω**	–10.0 V to +10.0 V –20.0 V to +20.0 V	–10.0 V to +10.0 V –20.0 V to +20.0 V	–10.0 V to +10.0 V –20.0 V to +20.0 V	–2.0V to +3.8 V –	–2.0V to +3.8 V –	–2.0 V to 3.0 V –
Accuracy **50 Ω into 50 Ω** **1 KΩ into 50 Ω**	± (3% + 75 mV) ± (5% + 150 mV)[6]	± (3% + 75 mV) ± (5% + 150 mV)[6]	± (1% + 50 mV) ± (1% + 100 mV)[6]	± (2% + 50 mV) –	± (2% + 50 mV) –	± (5% + 50 mV) –
Output Connectors	BNC single-ended	BNC single-ended	BNC single-ended	BNC differential	SMA (f) 3.5 mm differential	SMA (f) 3.5 mm differential
Source Impedance **Accuracy**	Selectable 50 Ω or 1 KΩ Typ. ± 1 %	Selectable 50 Ω or 1 KΩ Typ. ± 1 %	Selectable 50 Ω or 1 KΩ Typ. ± 1 %	50 Ω Typ. ± 1 %	50 Ω Typ. ± 1 %	50 Ω Typ. < ± 5 %
Max. External Voltage	± 24 V	± 24 V	± 24 V	–2.2 V to +5.5 V	–2.2 V to +5.5 V	–2 V to 4 V
Short Circuit Current	± 400 mA max. (doubles for channel addition)	± 400 mA max. (doubles for channel addition)	± 400 mA max. (doubles for channel addition)	–84 mA to + 152 mA	84 mA to + 152 mA	–80 mA to 120 mA

[1] Measured at 50% amplitude at fastest transitions in continuous mode and with 50 Ω source impedance
[2] Source impedance is selectable from 50 Ω or 1KΩ for the HP 81105A and HP 81111A
[3] If the startable oscillator is used (PLL not active)
[4] Constant amplitude
[5] Level specifications are valid after a 5 ns (HP 81112A, HP 81131A) or 30 ns (HP 81111A, HP 81105A, HP 81132A) typical settling time
[6] Applies to pulses within a ± 19 V window
[7] Applicable only with internal channel addition

Mainframe Output Channel (1 or 2)	HP 81101A 1 included	HP 81104A HP 81105A	HP 81110A HP 81111A	HP 81110A HP 81112A	HP 81130A HP 81131A	HP 81130A HP 81132A
Dynamic Crosstalk **Baseline Noise** **Overshoot/ Preshoot/Ringing**	< 0.1% typ. 10 mV RMS typ. ± 5% of amplitude ± 20 mV	< 0.1% typ. 10 mV RMS typ. ± 5% of amplitude ± 20 mV	< 0.1% typ. 10 mV RMS typ. ± 5% of amplitude ± 20 mV	< 0.1% typ. 4 mV RMS typ. ± 5% of amplitude ± 50 mV	< 0.1% typ. 4 mV RMS typ. ± 5% of amplitude ± 50 mV	< 0.1% typ. 2 mV RMS typ. ± 5% of amplitude ± 50 mV typ.
Pattern/ Data Capabilities	–	16 Kbit/channel and strobe output	16 Kbit/channel and strobe output	16 Kbit/channel and strobe output	64 Kbit/channel	64 Kbit/channel
Sequencing	–	–	–	–	Up to four segments, one loop (loop count 1 to 2^{20} times), one jump	Up to four segments, one loop (loop count 1 to 2^{20} times), one jump
Format	–	RZ, NRZ, DNRZ	RZ, NRZ, DNRZ	RZ, NRZ, DNRZ	R1, RZ, NRZ, DNRZ	R1, RZ, NRZ, DNRZ
Burst	Single or double pulses Burst count from 2 to 65536	Single or double pulses Burst count from 2 to 65536	Single or double pulses Burst count from 2 to 65536	Single or double pulses Burst count from 2 to 65536	Single pulses Burst count from 2 to 65536	Single pulses Burst count from 2 to 65536
Trigger Modes	Continuous Triggered (ext., int., man.) Gated (ext., int., man.) External width	Continuous Triggered (ext., int., man.) Gated (ext., int., man.) External width	Continuous Triggered (ext., int., man.) Gated (ext., int., man.) External width	Continuous Triggered (ext., int., man.) Gated (ext., int., man.) External width	Continuous Gated (ext. or man.), Start(ext. or man.)	Continuous, Gated (ext. or man.), Start(ext. or man.)
Inputs	PLL Ref. In, Clock In, Ext.In	PLL Ref. In, Clock In, Ext.In	PLL Ref. In, Clock In, Ext.In	PLL Ref. In, Clock In, Ext.In	PLL Ref. In, Clock In, Ext.In	PLL Ref. In, Clock In, Ext.In
Load Compensation	Actual load value can be entered to display actual outputs	Actual load value can be entered to display actual outputs	Actual load value can be entered to display actual outputs	–	–	–
Additional Outputs	Trigger out, strobe out	Trigger out, strobe out (16 Kbit user-defined pattern)	Trigger out, strobe out (16 Kbit user-defined pattern)	Trigger out, strobe out (16 Kbit user-defined pattern)	Trigger out	Trigger out
Limits	Programmable high and low levels to protect the device-under-test	Programmable high and low levels to protect the device-under-test	Programmable high and low levels to protect the device-under-test	Programmable high and low levels to protect the device-under-test	Programmable high and low levels to protect the device-under-test	Programmable high and low levels to protect the device-under-test
Channel Addition	–	Analog	Analog	–	EXOR	EXOR

Analog Channel Addition	HP 81104A with Two Output Modules (HP 81105A)	HP 81110A with Two Output Modules (HP 81111A)
Amplitude 50 Ω into 1 KΩ **1 KΩ into 50 Ω**	100 mVpp to 20.0 Vpp 200 mVpp to 20.0 Vpp	100 mVpp to 20.0 Vpp 200 mVpp to 20.0 Vpp
Source Impedance	Selectable from 50 Ω or 1 KΩ	Selectable from 50 Ω or 1 KΩ
Level Window 50 Ω into 1 KΩ **1 KΩ into 50 Ω**	–20.0 V to +20.0 V –20.0 V to +20.0 V	–20.0 V to +20.0 V –20.0 V to +20.0 V
Max. Frequency 50 Ω Channel **1 KΩ Channel**	60 MHz typ. 15 MHz typ.	60 MHz typ. 15 MHz typ.
Min.Transitions 50 Ω Channel **1 KΩ Channel**	2.5 ns typ. (channel one), 5 ns typ. (channel two) 20 ns typ. on both channels	2 ns typ. (channel one), 5 ns typ. (channel two) 20 ns typ. on both channels

The New Versatile VXI Pulse/Pattern Generators NEW

The HP E8312A and E8311A VXI Pulse/Pattern Generators derive from the HP 81100 family. They are the functional compatible equivalents (programming and features) to the HP 81110A in a VXI C-1 mechanical format. The HP E8311A has a frequency range of up to 165 MHz and the HP E8312A up to 330 MHz. Both generators feature two output channels, 16 kbit pattern capability and high frequency accuracy (please see VXI table on page 87.) The modules are shipped with VXI Plug&Play drivers.

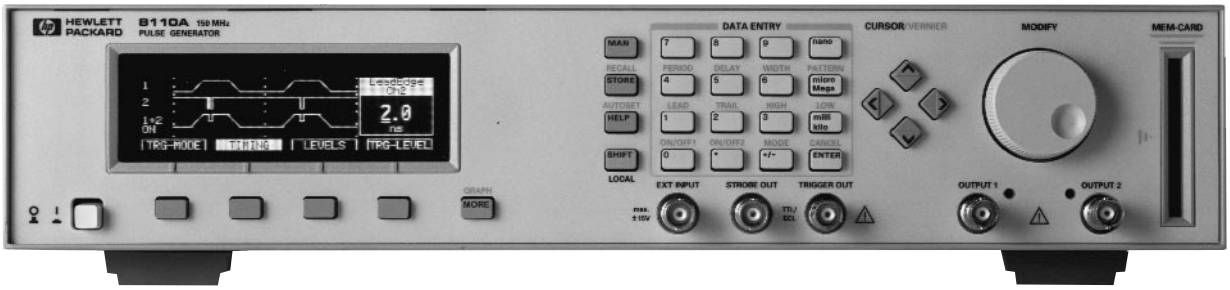
Please refer to the technical data sheet (5968-5814E) for detailed specifications or the VXI Catalog, or visit: **www.tmo.hp.com/tmo** or **www.hp.com/go/vxi.**

New HP E8811A/12A VXI C-1 Pulse/ Pattern Generators

150 MHz Pulse Generator for Real-World Digital Signals

HP 8110A

- sychronizable from an external clock (fixed and variable delay)
- 10 ps resolution
- 2 ns variable transitions
- 20 V into 50 Ω
- Pulse, burst and data modes
- 3 and 4 level signals
- Configurable
- Master/slave capability



HP 8110A and two HP 81103As

HP 8110A Brief Specifications
50 Ω load, 0° C to 55° C

HP 8110A Mainframe

Frequency: 1.00 Hz to 150 MHz (**Period:** 6.65 ns to 999 ms)
Modes: Continuous/externally-triggered/externally-gated sequences of pulses, double-pulses, bursts, and patterns. Also external width
Burst Length: 2 to 65536 pulses or double-pulses
Strobe Channel: 2 to 4096 bits, freely programmable, NRZ, TTL/ECL, 50 Ω typical

HP 81106A PLL/Ext. Clock Module

Frequency: 1.000 mHz to 150.0 MHz (**Period:** 6.65 ns to 999.0 seconds)
Clock Modes:
Int. Clock: With int. or ext. references (as period source or trigger for bursts and patterns)
Ext. Clock: For synchronization to a system clock or for master/slave operation

HP 81103A Channel Module

Timing
Delay: 0.00 ns to 998 ms or **Double-Pulse:** 6.65 ns to 998 ms
Width: 3.30 ns to 998 ms
Transitions (10 to 90% amplitude)**:** 2.00 ns to 200 ms
Accuracy: 10% + 200 ps
Overshoot, Ringing: 5% + 20 mV

Output Parameters (into 50 Ω load)

	50 Ω source	1 kΩ source
Amplitude, p-p	100 mv to 10.0 V	200 mV to 20.0 V
High level	–9.90 to + 10.0 V	–18.8 to + 19.0 V
Low level	–10.0 to + 9.90 V	–19.0 to + 18.8 V

Also programmable as current ±4.00 to ±400 mA.
Limits: programmable to suit and protect device.

Source Resistance: 50 Ω/1 kΩ, selectable
Load Resistance: Values 0.1 Ω to 999 kΩ can be entered for direct reading display of output level
Modes: Normal/complement, on/off
Channel Addition (with two HP 81103A output channels)**:** Simulates digital signals with interference pulses, or 3 or 4 level communications signals. 48/500 Ω source selectable
Pattern Capabilities: 2 to 4096 bits. Edit capabilities include prbs 2^n–1, where n is selectable from 7 to 12. Value 12 is CCITT O.151-compatible
Format: RZ (width and delay programmable), DNRZ (delay programmable)

HP 81107A Two Channel Deskew Module

Compensates for unequal propagation times in the test setup, or for slave propagation delay in master/slave setups.
Delay (each channel)**:** 0.00 to 28.00 ns + typ. 6.5 ns. Independent of period

General

GPIB Capability
Conformity: IEEE-488.2, 1987, SCPI 1992.0
Function Code: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, CO
Storage of Instrument Settings: One power-down, one default setting and nine user locations. Additionally, 40 settings can be stored on the HP 8110A Option UFH memory card
Environmental
Temperature: 0° to 55° C operating, –40° to 70° C storage
Humidity: 95% RH at 0° to 40° C
Power: 100 to 240 V ac ± 10%, 50 to 60 Hz; 100 to 120 V ac ± 10%, 50 to 60/400 to 440 Hz
Consumption: 300 VA (max. configuration)
EMC Conformity: CISPR 11, A; EN55011, A; EN50082-1
Size: 426 mm W x 89 mm H x 445 mm D (17 in x 3.3 in x 17.5 in)
Weight: Net, 9.2 kg; shipping, 20.2 kg
Recal. Period: 1 year recommended
Warranty: 3 years

Key Literature

Color Brochure, p/n 5964-6335E

For more information, visit our web site: **http://www.hp.com/go/dvt**

Ordering Information

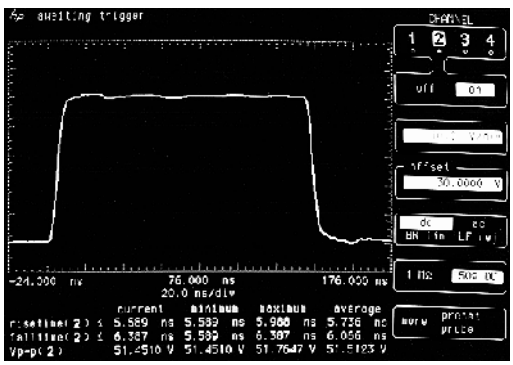
HP 8110A Mainframe (includes English operating and programming manual 08110-91012).
Always order at least one HP 81103A with each HP 8110A.
A second HP 81103A or an HP 81106A or HP 81107A–in any combination–can be ordered at the same time or fitted retrospectively.
HP 81103A Output Module
HP 81106A PLL/Ext. Clock Module
HP 81107A Deskew Module
HP 8110A Options
Opt 0B2 Additional Manual 08110-91012
Opt UFH 128 kB Memory Card
Opt UK6 Commercial Cal. Certificate
Opt UN2 Rear (instead of front) Panel Connectors
Opt 1CN Front Handle Kit (5062-3988)
Opt 1CP Rack Mount/Handle Kit (5062-3975)
Opt 1CM Rack Mount Kit (5062-3974)
Opt 1CR Rack Slide Kit (1494-0060)
Opt 1BP MIL-45662A Cal with Test Data
Opt OBV Service Manual, Component Level
Opt OBW Service Manual, Assembly Level
Opt 503 Front and Rear Panel Connectors

- 100 V, 2 A pulses into 50 Ω
- 7 ns transitions (50 Ω into 50 Ω)
- Counted burst and external width
- SCPI programming commands
- Variable baseline ± 25 V (Option)
- Inhibit Input

HP 8114A 100 V, 2 A Pulse Generator

Tests High Power Devices Reliably

The HP 8114A programmable pulse generator delivers fast-transition 100 V pulses into 50 Ω loads at rates of up to 15 MHz. In addition to simulating transients and glitches, it is well-equipped to characterize and test devices requiring high voltage or current pulses, such as flash memories, power MOS devices, IR/laser diodes and radar devices.



Typical 2 A pulse into 50 Ω for IR-diode test

Protects Your Device

The HP 8114A gives you fast, clean, and reliable pulses without risking damage to the device-under-test. You can also set voltage, current, and duty cycle limits to prevent accidental damage, and use an external TTL control signal at the Inhibit Input to inhibit/enable the pulse output.

Integrates Easily into Test Systems

SCPI programming commands for GPIB control and optional rear-panel connectors make the HP 8114A ideal for automated test systems. In addition, the Variable Baseline option allows a dc voltage of up to ± 25 V to be added to the pulse baseline, making an additional dc power supply unnecessary. The HP 8114A output is protected against excessive power dissipation.

Specifications

Output: 50 Ω into 50 Ω
Amplitude: 1.00 Vp-p to 50.0 Vp-p, 20.0 mAp-p to 1.00 Ap-p (doubles when Hi-Z source selected)
Resolution: 3 digits, best case 10 mV
Accuracy: ± 1% of amplitude ± 0.5% baseline ± 100 mV
Baseline: 0 V ± 100 mV ± 0.5% of amplitude
Variable Baseline Option 001: –25 V to + 25 V, 50 Ω source impedance only
Accuracy: ± 1/± 100 mV ± 0.5% of amplitude
Polarity: Positive or negative baseline selectable
Source Impedance: High impedance or 50 Ω selectable
Max. Short Circuit Current: 2 A

Pulse Performance

Overshoot/Preshoot/Ringing: < 5% of amplitude ±100 mV
Setting Time: < 100 ns typical
Transition Times (10/90% amplitude):
50 Ω into 50 Ω: < 7 ns (amplitude > 5 V); High-Z into 50 Ω: < 12 ns

Timing Parameters

Measured at 50% of amplitude with 50 Ω source impedance into 50 Ω load
Period: 66.7 ns to 999 ms (**Frequency:** 1.00 Hz to 15 MHz)
Accuracy: ± 5% ± 100 ps
Resolution: 3 digits best case 100 ps
Width: 10.0 ns to 150 ms
Duty Cycle: 0.1 % to 100% (maximum duty cycle limited for amplitude > 20 V, worst case 15%)
Accuracy: ± 5% ± 500 ps
Resolution: 3 digits best case 100 ps
Delay: 0.00 ns to 999 ms (maximum value = period – 4 ns)
Accuracy: ± 5% ± 1 ns
Resolution: 3 digits best case 100 ps
Fixed Delay: 42 ns (trigger output to output) typical
Double Pulse: (Delay and Double-Pulse are mutually exclusive)
20.0 ns to 999 ms, minimum period 133 ns
Resolution: 3 digits best case 100 ps

Inhibit Input

External TTL signal inhibits the pulse output, holding the output signal at its baseline level.
Edge Mode: An active edge inhibits the pulse signal, reset from front panel or GPIB.
Level Mode: An active level inhibits the pulse signal, an inactive level enables the signal level.

Trigger Modes

Continuous: Continuous pulse train
Triggered: External Input transition or manual trigger key generates pulse, double-pulse or burst of pulses
Gated: Active level at External Input or manual trigger key enables pulses, double-pulses or burst of pulses
External Width: Width of signal at External Input determines pulsewidth (maximum amplitude 20 V, 50 Ω into 50 Ω)
Burst: Bursts of 2 to 65536 pulse periods can be programmed

General

Operating Temperature: 0° to +55° C
Power: 100 to 240 Vac ± 10%, 50 to 60 Hz; 500 VA max.
Size: 426 mm W x 133 mm H x 422 mm D (16.8 in x 5.2 in x 16.6 in)
Weight: Net, 14 kg; shipping, 17 kg

Key Literature

Color Brochure, p/n 5965-1111E

For more information, visit our web site: **http//www.hp.com/go/dvt**

Ordering Information

HP 8114A 100 V, 2 A Pulse Generator*
Opt 001 Variable Baseline ±25 V
Opt OB2 Additional Users' Guide
Opt OBV Service Guide, Component Level
Opt OBW Service Guide
Opt UFH 128 kB Memory Card
Opt UK6 Commercial Cal. Certificate
Opt UN2 Rear (instead of front) Panel Connectors
Opt 1BP MIL-45662A Cal. with Test Data
Opt 1CM Rack Mount Kit
Opt 1CN Front Handle Kit
Opt 1CP Rack Mount/Handle Kit
Opt 1CR Rack Slide Kit
Opt 503 Front and Rear Panel Connectors.

* Memory card not included.

1 ps Resolution Timing Generator

HP 8133A

- Transitions typically < 60 ps
- 1 ps resolution, 350 fs with HP-IB
- Optional data and PRBS capabilities
- Jitter typically < 1 ps
- Optional second pulse channel
- Synchronization of up to three instruments

HP 8133A Timing Generator with Option 002

HP 8133A Timing Generator

When timing is critical, the ability to characterize a digital product begins and ends with accurate edge-placement of the test signal. The HP 8133A makes an outstanding contribution through high resolution, very low jitter and very fast, linear transitions.

These attributes are required in digital designs with clock rates from a few hundred MHz and upwards. Some examples are:

- Circuits for distributing clock signals of several hundred MHz. At these frequencies, parametric effects cause asymmetry so that designers need to test performance under conditions where the duty cycle is not 50%.
- Microprocessor boards—the faster the processor, the more acute the HF problems. At high frequencies, the effects cannot be fully emulated, and therefore measurements on hardware are essential.
- The same applies to fast chip-to-chip communication, especially in integrated designs where discovery of timing problems late in the design cycle can be disastrous.
- Datacom/Telecom chips where clock rates go from several hundred MHz to a few GHz.

The HP 8133A means more efficiency in manufacture as well as design because the tightly-toleranced test signal reduces the reject rate and avoids overspecification.

As mentioned, a fast edge contributes to placement accuracy. On the other hand, if the edge is too fast, measurements can be impaired through unnecessary ringing or reflections. For this reason, a range of transition time converters are available which match the requirements of today's faster technologies and provide signals with very level pulse top, and little or no overshoot.

When several channels must be stimulated at the same time in order to perform a measurement, multi-channel accessory kits allow two or three HP 8133As to be master/slaved for up to six channel operation.

To investigate pattern effects or to make rapid performance checks using the eye-pattern technique with the HP 54120 series oscilloscope, the HP 8133A can be fitted with a pulse/data channel in place of the second pulse channel. This supports 32 bit patterns and the CCITT 0.151 2^{23}–1 prbs.

HP 8133A Configuration Overview

Channel	Standard	Option 001[1]	Option 002[1]	Option 003[1]
1	Pulse channel width or delay	Pulse channel width and delay	Pulse channel width and delay	Pulse channel width and delay
2	None	None	Data channel 32 bit or PRBS	Pulse channel width or delay

[1]Options are mutually exclusive.

Brief Specifications

Timing
Frequency: 33.0 MHz to 3.0000 GHz, 100 KHz resolution
Period: 300 ps to 30.000 ns, 1 ps resolution
Accuracy: ± 0.5%, ± 0.1% nominal
Pulse Channel(s)
Square Mode (50% duty cycle):
Delay: 0.000 to 10.000 ns (–5.000 to +15.000 ns in Channel 1 if Option 001, 002, or 003 used)
Pulse Mode:
Delay: No variation (–5.000 to +5.000 ns in Channel 1 if Option 001, 002, or 003 used)
Width: 150 ps to 10.000 ns (max.: period –150 ps)
Duty Cycle: 0.0 to 100.0%, 0 and 100% mean dc at outputs
Accuracy: Typically 30 ps
Delay Drift Against Delay: 50 ps
Phase: –360.0 to +360.0°, subject to delay limits
Outputs, Channels 1 and 2 and (Trigger Output)
Amplitude: 0.30 to 3.00 Vp-p (0.5 to 1.80 Vp-p)
Level Window: –2.00 to +4.00 V (–4.00 to +4.00 V)
Outputs: Differential outputs, invertible (single)
Transition Times: 10% to 90% of amplitude: < 100 ps, 60 ps nominal; 20% to 80% of amplitude: < 60 ps, 40 ps nominal (< 100 ps)
EMC Conformity: CISPR II, EN5501, EN50082-1

Key Literature

Brochure, p/n 5091-7678E

For more information, visit our website: **http://www.hp.com/go/dvt**

Ordering Information

HP 8133A Pulse Generator
Opt 001 Delay Channel 1
Opt 002 Pulse/Data Channel 2
Opt 003 Pulse Channel 2
Note: Option 002 and Option 003 contain Option 001. These options are mutually exclusive. Extended warranty options (see page 70) available on request.
Opt OB2 Additional Users' Guide
Opt OBV Service Manual, Component Level
Opt OBW Service Manual, Assembly Level
Opt UK6 Commercial Cal. Certificate
Opt 1BP MIL-45662A Cal. with Test Data
Opt 1CM Rackmount Kit
Opt 1CN Handle Kit
Opt 1CP Rackmount/Handle Kit
Opt 1CR Rack Slide Kit (requires Opt H01)
Opt H01 Peparation for Rack Slides
Accessories
HP 1250-1462 Adapter SMA (m) to SMA (f)
HP 8120-4948 50 Ω Cable, SMA (m-m)
HP 8710-1582 Torque Wrench, 5 in/lb
HP 8493A Series Attenuator
Opt 003 3 dB
Opt 006 6 dB
Opt 010 10 dB
Opt 020 20 dB
Opt 030 30 dB
HP 11667B Power Splitter
HP 15436A Multi-channel Accessory Kit for three HP 8133As (additional HP 11667B Power Splitter is needed)
HP 15439A Multi-channel Accessory Kit for two HP 8133As
HP 15435A 150 ps Transition Time Converter
See page 430 for other transition time converters.

Indicates QuickShip availability.

Verification Tools & Solutions

PCI Timing Check using the HP E2920 PCI Series Exerciser/Analyzer, Application Note
5968-5816E
HP E2910A Brochure
5964-1621E
HP 2910A Technical Data
5965-1438E

Characterization Tools & Solutions

(PN) How to Transfer Data between Design, Simulation and the HP 81200 Data Generator/Analyzer Platform
5967-6276E
(PN) Panel Link Chip Set Test
5968-3024E
(PN) How to Use the HP 81200 Data Generator/ Analyzer Platform Together with HP VEE for Signal Integrity Analysis
5968-3857E
(PN) Measuring Jitter with the HP E4874A Characterization Software Components
5968-6033E
(PN) Radar Distance Test to Airborne Planes
5968-5843E
(PN) The Dual Clock Gbit Chip Test
5968-5844E
(PN) Magneto-Optical Disk Drive Research
5968-5845E
(PN) Simulation of Jittering Sychronization Signals for Video Interfaces
5968-5846E
(PN) E6280A PNNI Signalling Test Software for the Broadband Series Test System
5965-9079E
(PN 16522A) Digital Verification with the HP 16522A Pattern Generator
5964-6347E

Digital Testing Under Real-World Conditions? HP 8110A Application Brief
5091-7601E
HP 8114A Pulse Testing 980-nm Pump Laser-Diodes in Optical Fiber Amplifiers
5963-6988E
HP 81100 Family of Pulse/Pattern Generators Flyer
5968-0212E

HP 8164A

NEW

- Mode-hop free tuning at continuous power
- Built-in wavelength control loop
- Output power up to +8 dBm
- Ultra low source spontaneous emission output

HP 8164A

The HP 8164A—A New Platform for the Test of Fiber Optic Components

The HP 8164A Lightwave Measurement System supports a whole range of tunable laser modules and all modules of the HP 8153A and HP 8163A Lightwave Multimeter series. The HP 8164A mainframe features connectivity to a wide range of controlling equipment through GPIB, RS-232C and PC Card interface. Configurable hardware input and output trigger ports complete the HP 8164A's ability to operate in an automated test environment. A 3.5" floppy drive, VGA port, keyboard connector and parallel printer port are included.

- Tunable lasers for all gain bands
- The HP 81680A and 81682A modules operate in the 1550 nm band whereas the HP 81640A covers the wavelength range from 1500 nm to 1640 nm.
- Optimum tuning precision for the test of critical dense-WDM devices

The HP 81640A, 81680A and 81682A Tunable Laser modules with their built-in wavelength control loop push today's performance limits. As they are all mode-hop free tunable with continuous output power, they qualify for the test of the most critical DWDM components. All three modules fit into the bottom slot of the HP 8164A mainframe.

Polarization Maintaining Fiber for the Test of Integrated Optical Devices

The HP 81640A, 81680A and 81682A modules are ideally constructed to characterize integrated optical devices. Their Panda PMF output ports provide a well-defined state of polarization to ensure constant measurement conditions on waveguide devices. A PMF cable easily connects an external optical modulator.

Low Spontaneous Emission for Maximum Measurement Range

The HP 81640A and 81680A tunable laser modules are equipped with two optical outputs. One output port delivers a signal with ultra-low source spontaneous emission (SSE). It enables accurate crosstalk measurement of dense-WDM system components with many channels at narrow spacing. A power meter module alone is sufficient to characterize steep notch filters such as Fiber Bragg Gratings.

The second output port provides increased optical power and allows adjustment by more than 60 dB through a built-in optical attenuator.

Test of Optical Amplifiers and Passive Components

The HP 81682A Tunable Laser module provides the high stimulus power needed to test today's optical amplifiers. An optional, built-in optical attenuator allows an output power dynamic of more than 60 dB. Its excellent wavelength precision makes it a multi-purpose instrument for all kinds of component test.

Compact Module for Multichannel Test

A variable amount of the compact, yet fully remote controlled HP 81689A Tunable Laser modules, in combination with the HP 81682A high power Tunable Laser, is the ideal solution to characterize optical amplifiers for use in dense-WDM applications. Furthermore the HP 81689A allows a realistic multi-channel test bed for dense WDM transmission systems to be set up.

Its continuous, mode-hop free tuning makes it quick and easy to set even the most complex configurations to the target wavelengths and power levels, just by dialing or using the vernier keys. The HP 81689A is available with both standard single-mode fiber and Panda-type PMF.

Each HP 8164A mainframe can host up to four units of the HP 81689A in its upper slots. The HP 8166A Lightwave Multichannel System mainframe, however, allows you to combine up to 17 of the compact tunable laser modules in a single frame.

Smart Tunable Loss Test Set

Inserted into the HP 8163A Lightwave Multimeter mainframe, together with a power meter module the HP 81689A compact tunable laser forms a smart, portable loss test set. Its tunability allows devices and links at all wavelengths in the DWDM window to be checked.

Specifications

Specifications describe the instrument's warranted performance. They are measured at the end of a 2 m long patchcord and are valid for the output power and wavelength ranges as stated below. Supplementary performance characteristics provide information about non-warranted instrument performance in the form of nominal values, and are printed in italic typeface.

	HP 81680A	HP 81640A	HP 81682A	HP 81689A
Primary Application	To-the-limits-test of critical DWDM components	Test of critical components in both DWDM bands	Test of critical amplifiers and passive components	Multiple channel test of optical amplifiers and transmission systems, compact form factor
Wavelength Range	1460 to 1580 nm	1500 to 1640 nm	1460 to 1580 nm	1525 to 1575 nm
Absolute Wavelength Accuracy	± 0.01 nm	± 0.015 nm	± 0.01 nm	± 0.3 nm, typical
Relative Wavelength Accuracy	± 5 pm (± 2 pm, typical)	± 7 pm (± 3 pm, typical)	± 5 pm (± 2 pm, typical)	± 0.3 nm
Wavelength Resolution	0.1 pm	0.1 pm	0.1 pm	10 pm
Signal to Source Spontaneous Emission Ratio	63 dB/ nm (output 1) 45 dB/ nm (output 2)	60 dB/ nm (output 1) 45 dB/ nm (output 2)	45 dB/ nm	40 dB/ nm, typical
Signal to Total Source Spontaneous Emission Ratio	60 dB (output 1) 30 dB (output 2, typical)	55 dB (output 1) 27 dB (output 2, typical)	30 dB, typical	–
Maximum Output Power	–6 dBm (output 1) +5 dBm (output 2) (1520–1570 nm)	–7 dBm (output 1) +2 dBm (output 2) (1530–1610 nm)	+6 dBm (1520–1570 nm)	+6 dBm (1525–1575 nm)
Maximum Output Power (Peak, Typical)	–4 dBm (output 1) +6 dBm (output 2)	–5 dBm (output 1) +4 dBm (output 2)	+8 dBm	–

For further details, please contact your HP representative and ask for literature number 5968-0063E (technical specifications).

Ordering Information

HP 8164A Lightwave Measurement System (mainframe)
HP 8166A Lightwave Multichannel System (mainframe)
HP 81640A Tunable Laser Module, ±3 pm, Low SSE, 1600 nm[a]
HP 81645A Filler Module
HP 81680A Tunable Laser Module, ± 2 pm, Low SSE, 1550 nm[b]
HP 81682A Tunable Laser Module, +8 dBm, 1550 nm[a]
- **Option 003** Built-in Optical Attenuator with 60 dB attenuation range (available with HP 81682A only, reduces max. output by 1.5 dB)

HP 81689A Compact Tunable Laser Module, +6 dBm, 1550 nm[a]
Tunable laser must be ordered with one connector option:
- **Option 021** Single mode fiber, straight contact connector (available with HP 81689A)
- **Option 022** Single mode fiber, angled contact connector (available with HP 81689A)
- **Option 071** Polarization Maintaining Fiber, straight contact connector
- **Option 072** Polarization Maintaining Fiber, angled contact connector

[a] one HP Series 81000xI Connector Interface is required; see page 454
[b] two HP Series 81000xI Connector Interfaces are required; see page 454

11

HP 8166A
HP 8167B

NEW

- Output power up to +4 dBm
- Tuning linearity ± 1 pm possible
- 2 year re-calibration period
- Auto-realignment of laser cavity for even better reliability
- Minimizes test cost
- Increases throughput
- Saves rack space

HP 8167B

HP 8167B Tunable Laser Source 1300 nm

Within Hewlett-Packard's family of tunable lasers, the HP 8167B addresses the 1300 nm transmission window. A built-in sidemode filter ensures that a true single-mode laser line is generated for every wavelength point, eliminating any possible multimoding. Independent control of the instrument parameters ensures that the output power is kept stable over time and wavelength. In manufacturing applications, the instrument can be integrated into a fully-automated production test environment for precise, fast and repeatable testing. In a manual setup, single or dual channel loss, return loss and coupling ratio measurements can be performed using the built-in application software.

Specifications

Wavelength range: 1255 nm to 1365 nm
Absolute wavelength accuracy: ± 0.1 nm, typical
Relative wavelength accuracy: ± 0.035 nm, typical [1]
Wavelength resolution: 0.001 nm
Wavelength stability: < ± 100 MHz
Wavelength repeatability: ± 0.035 nm, typical [1]
Linewidth: 100 kHz, typical
Effective linewidth when broadened: 10 to 500 MHz, typical
Signal to source spontaneous emission ratio: > 35 dB/1 nm
Sidemode suppression ratio: > 40 dB, typical
Maximum output power: 3 dBm
Minimum output power: - 7 dBm (–47 dBm with option 003)
Dimensions: 145 mm H, 426 mm W, 545 mm D (5.8" x 16.9" x 21.6")
Weight: Net, 18 kg (40 lb.); shipping, 21 kg (46 lb.)
Power: 100 to 240 Vrms ± 10%, 260 VA max.

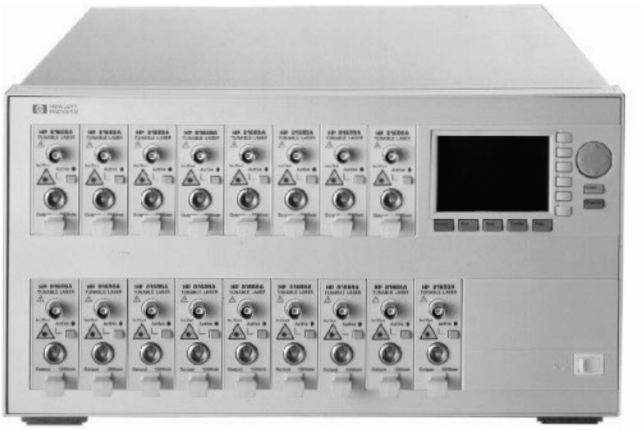
[1] ± 0.001 nm when controlled with appropriate wavelength meter.

Key Literature

HP 8167B Technical Specifications, p/n 5964-9000E
HP 8167B Configuration Guide, p/n 5964-9001E

Ordering Information

HP 8167B Tunable Laser Source
  Opt 021 Straight Contact Output Connector
  Opt 022 Angled Contact Output Connector
  Opt 023 Angled Non-Contact Output Connector (Diamond HMS-10/HP/HRL)
  Opt 003 Built-in Variable Attenuator
  Opt 007 Polarization Maintaining Fiber
HP 81000AI/FI/GI/KI/NI/PI/SI/VI/WI Connector Interface



The HP 8166A–Lightwave Multichannel System–Stimulus-Response Solutions

HP 8166A Lightwave Multichannel System NEW

The HP 8166A Lightwave Multichannel System is a base system with 17 slots for plug-in modules of the HP 8163A Lightwave Multimeter series. All these modules can be used in any configuration.

The compact form and small footprint of this system saves valuable rack or bench space and gives an excellent price/performance ratio per channel.

The Ideal System for Manufacturing and Research & Development

In manufacturing, the HP 8166A Lightwave Multichannel System helps to increase throughput with its fast, simultaneous and synchronized measurement capabilities.

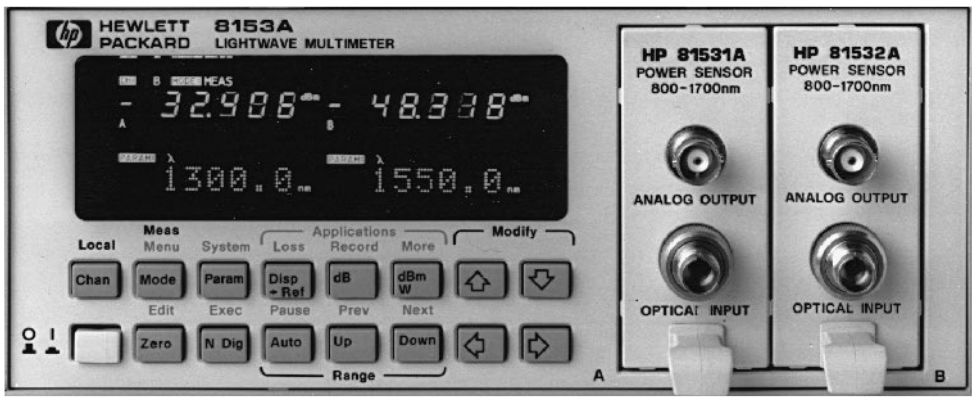
R&D engineers will value the quick multichannel or system characterizations, as well as easy troubleshooting. The HP 8166A Lightwave Multichannel System is a versatile tool for accelerated multiple stimulus/response measurements at fixed or at variable wavelengths.

Key Literature

Product Overview, p/n 5968-3406E

Ordering Information

HP 8166A Lightwave Multichannel System



HP 8153A

HP 8153A Lightwave Multimeter

The HP 8153A Lightwave Multimeter mainframe offers two slots for plug-in modules. Since modules can be combined in any configuration, the instrument can be used as a 1/2 channel power meter, a 1/2 channel light source, a loss test set, or even as a return loss test set.

Four different power sensor modules, with different sensitivities from –70 dBm down to –110 dBm, cover the 450 nm to 1700 nm wavelength range. Each is individually calibrated over its entire wavelength range and is traceable to NIST and PTB for precise optical power measurements. The excellent linearity and high stability of the source modules provides the basis for precise determination of optical insertion loss for both single-mode and multimode components.

The external power sensors (optical heads) cover the power range from +27 to –90 dBm. They are especially suitable for obtaining the highest requirements in absolute accuracy, e.g. for calibration services, and also for open beam measurements.

The source modules offer very good short-term and long-term stability. The high output power can be internally attenuated by up to 6 dB. All sources are able to output CW or pulse-modulated light (internal modulation at 270 Hz, 1 kHz, or 2 kHz).

Key Literature

Modular Systems for Optical Power, Loss and Return, Color Brochure, p/n 5962-9321E
HP 8153A Lightwave Multimeter, Configuration Guide, p/n 5963-3366E

Ordering Information

HP 8153A Lightwave Multimeter Mainframe
HP 81530A Si, +3 to –100 dBm, 450 to 1020 nm
HP 81531A InGaAs, +3 to –90 dBm, 800 to 1700 nm
HP 81532A InGaAs, +3 to –110 dBm, 800 to 1700 nm
HP 81536A InGaAs, +3 to –70 dBm, 800 to 1700 nm
HP 81534A Return Loss Module, InGaAs, 60 dB/65 dB return loss range, 1250–1600 nm
HP 81533B Optical Head Interface Module
HP 81520A Optical Head, Si, +10 to –100 dBm, 450 to 1020 nm
HP 81521B Optical Head, Ge, +3 to –80 dBm, 900 to 1700 nm
Opt 001 0.003 dBp-p polarization sensitivity, +3 to –64 dBm
HP 81524A Optical Head, InGaAs, +3 to –90 dBm, 800 to 1650 nm
HP 81525A Optical Head, InGaAs, +27 to –70 dBm, 800 to 1650 nm
HP 81551MM 850 nm, LD, Multimode
HP 81552SM 1310 nm, LD, Single-Mode
HP 81553SM 1550 nm, LD, Single-Mode
HP 81554SM 1310/1550 nm, LD, Single-Mode
HP 81542MM 1300 nm, LED, 50 µm Multimode Fiber Output
HP 81002FF Integrating Sphere

HP 8163A Lightwave Multimeter

HP 8163A

- Variety of plug-in modules for optimized set-ups
- Power meters at lowest PDL and spectral ripple
- Output power of laser sources (FP) up to 13 dBm
- ITU channel sources (DFB) with high precision
- Optimized return loss solutions

The HP 8163A–Modular Stimulus-Response Solutions with Excellent Performance

NEW

The HP 8163A Lightwave Multimeter is a basic measurement tool in the fiberoptic industry. It ensures accurate and fast results even for the most demanding measurements on optical components and systems.

Its modular format makes it flexible enough to meet changing measurement needs whether measuring optical power, insertion loss or return loss for single- or multimode components.

Precise, Sensitive, Stable and Fast Power Measurements

Four different power sensor modules and three external power sensors (optical heads) cover the important wavelengths and power ranges. Thanks to the excellent accuracy, high linearity and low polarization dependent loss (PDL) best measurement results are ensured. The measurement speed can come down to 200μs which further optimizes the power measurements. Each power sensor and each optical head is individually calibrated over its wavelength range and is traceable to NIST and German PTB for precise optical power measurements.

A broad variety of advanced interfaces and adapters make it easy to connect the test devices.

Stable Fixed Laser Source Modules

The source modules are stabilized for short and long term applications and are also not sensitive to backreflections. There is a choice of single and dual wavelength source modules, available with an output power of up to 13 dBm. The output power can be attenuated by up to 6 dB. All source modules are able to output CW or pulse-modulated light (internal modulation 270Hz to 10kHz).

For ITU source modules (DFB) please refer to the ordering guide to select the appropriate wavelength.

Compact Tunable Laser Source Modules

These modules enable measurements at freely selectable fixed wavelengths or allow characterization of the test device as a function of wavelength. One compact tunable laser module and one single or dual power sensor can be hosted in the HP 8163A Lightwave Multimeter mainframe. This set-up is a compact and complete solution for wavelength dependent loss measurements.

The compact tunable laser module offers continuous, mode-hop free tuning, and is set quickly and easily to the target wavelengths and power levels, even for the most complex configurations, just by using the vernier keys. The compact tunable laser modules are available with both standard single-mode fiber and Panda-type PMF.

Return Loss Solutions

The return loss modules offer high precision and high accuracy for the best possible measurements. In addition the return loss modules give the convenience of self-calibration, possible due to the excellent stability of the built-in laser source, when speed is of the essence.

Compatibility

The HP 8163A Lightwave Multimeter mainframe is compatible with the modules from its successful predecessor, the HP 8153A Lightwave Multimeter series. Also both the modules of the HP 8163A series and the HP 8153A series can be used together in the 8163A mainframe.

The programming syntax used by the HP 8153A Multimeter is compatible with the HP 8164A Lightwave Measurement System (the tunable laser mainframe) the HP 8166A Lightwave Multichannel System and with the HP 8163A Lightwave Multimeter.

Key Literature

HP 8163A Lightwave Multimeter, Product Overview, p/n 5968-3404E

Ordering Information

The HP 8163A Mainframe has two slots for any combination of the modules listed or modules of the HP 8153A Lightwave Multimeter series. Connector interfaces should be ordered for each input and output. The HP 8163A supports a wide range of fiber connectors. For details please refer to the HP 8163A Configuration Guide. Optical heads require an interface module HP 81618A (single) or HP 81619A (dual).

Mainframe
HP 8163A Lightwave Multimeter Mainframe

Power sensor modules
HP 81632A InGaAs, +10dBm to –80dBm, 800 to 1650nm
Opt 001 ± 0.015 polarization sensitivity
HP 81635A (dual sensor) InGaAs, +10dBm to –80dBm, 800 to 1650nm
Opt 001 ± 0.015 polarization sensitivity
HP 81633A InGaAs, +10dBm to –90dBm, 800 to 1700nm
HP 81634A InGaAs, +10dBm to –110dBm, 800 to 1700nm
Optical heads
HP 81623A Ge, +10dBm to –80dBm, 750 to 1800nm
HP 81624A InGaAs, +10dBm to –90dBm, 800 to 1700nm
HP 81625A InGaAs, +20dBm to –80dBm, 850 to 1650nm

Source modules 0 dBm (Fabry Perot)
HP 81650A 1310nm, single mode
HP 81651A 1550nm, single mode
HP 81652A 1550/1625nm, single mode
HP 81653A 1650nm, single mode
HP 81654A 1310/1550nm, single mode

Source modules 13 dBm (Fabry Perot)
HP 81655A 1310nm, single mode
HP 81656A 1550nm, single mode
HP 81657A 1310/1550nm, single mode

Compact tunable source module
HP 81689A 1525 to 1575nm, 6dBm

ITU source modules
HP 81661A (please see separate ordering guide)

Return loss modules
HP 81610 A InGaAs, no internal source, dynamic range 70dB
HP 81611A InGaAs, 1300nm, dynamic range 75dB
HP 81612A InGaAs, 1550nm, dynamic range 75dB
HP 81613A InGaAs, 1310/1550nm, dynamic range 75dB
HP 81614A InGaAs, 1550/1625nm, dynamic range 75dB

HP 8156A
HP 11896A
HP 8169A

- 0.05 dB attenuation accuracy, 0.001 dB resolution
- 0.02 dBp-p polarization sensitivity
- Optional monitor output
- Back reflector mode

HP 8156A

HP 8156A Attenuator

The HP 8156A is a high performance attenuator for single-mode and multimode applications.

Options are available to select the desired return loss performance (up to 60 dB.) An optional 13 dB monitor output allows you to measure the signal power at the output of the attenuator. Using the built-in back reflector mode and an external reference reflector (HP 81000BR), the HP 8156A can be used as a programmable back reflector to measure component and system sensitivity against reflections.

The attenuation range is 60 dB with 0.001 dB resolution between 1200 nm and 1650 nm. Due to a novel single filter design, no ranging occurs. This completely eliminates dark spots or potential attenuation overshoots or undershoots. Attenuation accuracy is typically better than ±0.05 dB with a polarization sensitivity of less than 0.02 dB peak-to-peak.

For more detailed information, see the *Lightwave Test and Measurement Catalog*.

Specifications

	HP 8156A Opt 100	HP 8156A Opt 101/201	HP 8156A Opt 121/221	HP 8156A Opt 350
Wavelength range	1200 to 1650 nm			
Fiber type	single-mode			50 µm multimode
Attenuation range	60 dB			
Resolution	0.001 dB			
Return loss	>35 dB	>45 dB/>60 dB	>45 dB/>60 dB	>22 dB
Insertion loss (typical)*	4.5 dB	2.5 dB	3.3 dB	3.0 dB
Attenuation accuracy (typical)	±0.1 dB	±0.05 dB	±0.05 dB	±0.08 dB
Polarization sensitivity (typical)	<0.075 dBp-p	<0.02 dBp-p	<0.03 dBp-p	—
Repeatability (typical)	±0.005 dB			
Switching time	20–400 ms			
Maximum input power	+23 dBm			

*Includes insertion loss of two HMS-10 connectors.

Size: 212.3 mm W x 89 mm H x 345 mm D (8.36 in x 3.5 in x 13.6 in)
Weight: Net, 5.3 kg (11.7 lb); shipping, 9.6 kg (21.2 lb)

Ordering Information

Two connector interfaces (three for Option 121/221) are required for each HP 8156A
HP 8156A Optical Attenuator Mainframe
- **Opt 100** Standard Performance Version
- **Opt 101** High Performance Version
- **Opt 121** Monitor Output, 45 dB Return Loss
- **Opt 201** High Performance, High Return Loss Version
- **Opt 203** Back Reflector Kit for Option 201*
- **Opt 221** Monitor Output, 60 dB Return Loss
- **Opt 350** 50/125 µm Multimode

HP 81000AI/FI/GI/KI/NI/PI/SI/VI/WI Connector Interfaces

* Kit consists of one each: 81000SI, 81000FI, 81113PC, 81000UM, and 81000BR.

- ±0.002 dB insertion loss variation with adjustment (HP 11896A)
- 1250 nm to 1600 nm coverage (HP 11896A)
- Synthesis of states of polarization (HP 8169A)

HP 11896A and 8169A

HP 11896A Polarization Controller

The HP 11896A adjusts polarization and not power. Its optical fiber loop design provides all states of polarization with extremely small optical insertion-loss variations (±0.002 dB) over a wide spectral range (1250 to 1600 nm). This performance combination maximizes measurement accuracy for power-sensitive applications like polarization-dependent loss and gain. This is because the measurement uncertainty contributed by the polarization controller is minimized.

HP 8169A Polarization Controller

The HP 8169A provides polarization synthesis relative to a built-in linear polarizer. The internal quarter-wave plate and half-wave plate are individually adjusted to create all possible states of polarization. Predeterministic algorithms within the HP 8169A enable the transition path from one state of polarization on the Poincare sphere to another to be specified along orthogonal great circles. These features are important because device response data can be correlated to specific states of polarization input to the test device.

Specifications

	HP 11896A	HP 8169A
Operating Wavelength Range (nm):	1250 to 1600	1470 to 1570
Insertion Loss:	<1.5 dB	<1.5 dB
Variation with Adjustment:	<±0.002 dB	<±0.03 dB
Variation with Wavelength:	<±0.1 dB	<±0.1 dB

Note: Fiber pigtail interface assumed in all cases.

Key Literature

HP 11896A and HP 8169A Technical Specifications, p/n 5962-0017E

Ordering Information

HP 11896A Lightwave Polarization Controller
Standard instrument includes FC/PC connector interfaces
- **Opt 025** One Meter Pigtail Fiber w/ FC/PC Connector Interfaces

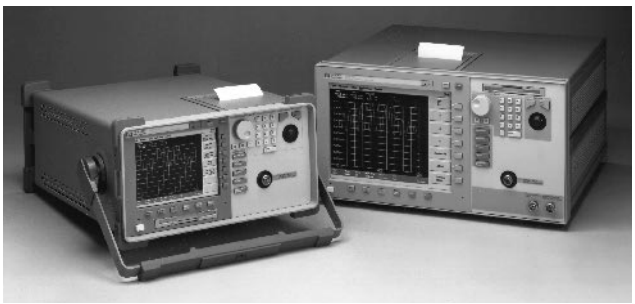
HP 8169A Lightwave Polarization Controller
(Polarization controller must be ordered with connector option)
- **Opt 020** Pigtailed Fiber Ports
- **Opt 021** Straight Contact Connector Output
- **Opt 022** Angled Contact Connector Output

HP 81000AI/FI/GI/KI/NI/PI/SI/VI/WI Connector Interfaces

Optical Spectrum Analyzers, 600 nm to 1700 nm

HP 86140A
HP 86142A
HP 86143A
HP 86145A

- Ideal for WDM applications
- Real time sweep rates for maximum throughput
- High 50 pm wavelength accuracy
- Excellent 'close-in' dynamic range performance
- -90 dBm sensitivity
- Available in benchtop & portable platforms
- Built-in printer & floppy disk
- Optional 1550 & 1300 nm EELED sources
- Two year calibration cycle



HP 86140 series benchtop and portable optical spectrum analyzers

HP 86140A, 86142A, 86143A, 86145A Optical Spectrum Analyzers

GPIB

The HP 86140/42/43/45A are a family of grating-based optical spectrum analyzers that operate over a 600 to 1700 nm wavelength range. The OSA family uses a patented double-pass monochromator design to achieve high sensitivity and dynamic range with exceptional sweep time. This performance is essential for characterizing WDM components and systems, especially in a manufacturing environment where speed, accuracy and throughput are critical.

The family consists of benchtop HP 86140/42A and portable HP 86143/45A models. All have an integral printer and floppy disk drive to allow easy documentation of results and transfer electronic copies to a PC. The benchtop models have a high clarity 10.4" LCD display while the portable have all the same performance capabilities while having a smaller footprint. The VGA port enables a PC monitor to be connected directly to the OSA screen and a parallel interface allows clear color copies of measurement results to be generated. The uncluttered front panel has been designed to compliment the intuitive graphical user interface (GUI) which can be operated from the front panel keys or by a mouse.

High Performance Models

The benchtop HP 86142A and portable HP 86145A analyzers are top of the range high performance units ideally suited for critical WDM and EDFA applications where wavelength accuracy, dynamic range and low polarization dependency are essential. In these units, many of the OSA high performance parameters have been optimized to simultaneously cover the WDM C (conventional) and L (long) wavelength bands (1530 nm to 1600 nm). This extended WDM wavelength range also makes these OSAs ideal for testing WDM passive components (filters, multiplexors and Bragg Gratings), characterizing DWDM transmitter lasers and analyzing DWDM multi-channel system performance.

High Caliber Standard Models

The HP 86140/43A standard OSAs are high caliber analyzers ideal for a broad range of applications. The standard versions maintain many of the high performance characteristics of the HP 86142/45A models while providing solutions at value prices. These analyzers have what it takes to quickly and accurately characterize 100 GHz WDM systems, optical sources and broadband components using the enhanced marker functionality, integrated power measurement capability and fast sweep speed.

Benchtop Platform

The benchtop OSA has a large bright 10.4" active matrix color LCD display and a reduced 16.7" x 16.8" footprint. This OSA is ideal for R&D and manufacturing environments where exceptional display clarity and ease of use are important.

Portable Platform

The high performance portable platform has a small 12.8" x 16.8" footprint and weighs in at just over 30 lb. This is designed for applications where space is a premium and yet full optical spectrum analyzer capability (not offered by today's mini OSAs) is required. This makes the OSA ideal for both field and factory use, particularly in high level system installation or situations where bench space is limited. The portable unit has a high clarity 6.4" active matrix LCD display.

Built-In Applications

HP has introduced a new concept for on-board OSA applications. This is very powerful, maintaining a high degree of flexibility while being easy to customize and simple to operate using the guided setup panels. In addition, a simple Excel spreadsheet wizard enables you to quickly and simply customize the measurement application for your specific device. In particular, the passive component test (PCT) uses component specific parameters such as Bandwidth, Ripple and Mean Wavelength to create a test sequence with pass/ fail limits that can be loaded into the OSA.

The manufacturing mode enables a guided measurement mode that allows simple single key step guided measurement of the device. When the testing is complete, a summary report is generated either from the internal printer or in color using a printer attached to the parallel interface.

Features

The OSA family has many features and enhanced capabilities including wavelength line markers for localized trace searches, sweeps and power integration. A compliment of four independent markers allow easy measurement of wavelength separation (GHz or nm), power density and optical signal to noise ratio.

	Benchtop OSA	Portable OSA
High Performance	HP 86142A	HP 86145A
Standard	HP 86140A	HP 86143A
Options		
004	1300nm/1550nm EELED	
005	1550nm EELED	
006	Wavelength Calibrator	Wavelength Calibrator
025	Multimode Fiber Input (HP 86140A)	Multimode Fiber Input (HP 86143A)

For more complete information, order the Lightwave Test and Measurement Catalog. See detailed description on page 604.

HP 86120C
HP 86121A

NEW

- Accurate characterization of WDM signals
- Simultaneously measure up to 200 wavelengths and powers
- Characterize Fabry-Perot lasers using the built-in automated measurement routine
- ±2 ppm wavelength accuracy
- 10 GHz wavelength resolution
- Signal-to-noise ratio measurements for tightly spaced WDM systems
- Channel drift measurements

HP 86120C

HP 86120C Multi-Wavelength Meter

GPIB

R & D and Manufacturing Applications

The HP 86120C multi-wavelength meter, allows you to accurately measure the average wavelength of the input signal. In addition, the HP multi-wavelength meter—with advanced digital signal processing—accurately and easily differentiates and measures up to 200 discrete wavelengths. This Michelson interferometer–based instrument can simultaneously measure the individual powers of the discrete wavelengths, offering the following measurement capabilities:

- 1 to 200 wavelengths and powers
- Average wavelength and total power
- 2 ppm wavelength accuracy (0.003 nm at 1550 nm)
- 10 GHz wavelength resolution
- Calibrated for elevation in air or vacuum
- Wavelength units in nm, Thz, or wave number (cm-1)
- Amplitude units in dBm, mW, or μW
- SNR and averaged SNR for WDM SONET/SDH systems
- Rugged design to withstand even strong shocks and vibration

Laser Manufacture and Test

The superior wavelength and amplitude measurement capabilities of the HP 86120C multi-wavelength meter enable you to maximize the performance of your components in the factory. You can measure DFB, FP, and multiple DFB-laser wavelengths and amplitudes during burn-in, environmental evaluation, final test, and incoming inspection.

WDM Systems

With the HP 86120C, you can simultaneously resolve the individual optical carriers and accurately confirm wavelengths, powers, channel spacing, drift, and signal-to-noise ratios in WDM systems.

Combining measurement performance with a rugged and portable package, the multi-wavelength meter lets you easily and accurately verify the optical carrier performance of transmission systems during design and development in the lab as well as on the manufacturing floor.

- Up to 200 WDM channels characterized with single keystroke operation
- Unparalleled ruggedness
- ±2 ppm absolute wavelength accuracy
- Lightweight and portable
- Built-in printer and disk drive
- On-board serial and parallel interfaces

HP 86121A

HP 86121A WDM Channel Analyzer

GPIB NEW

WDM System Installation, Verification & Maintenance Applications

The HP 86121A is a high performance Michelson interferometer-based channel analyzer for installation, commissioning, maintenance and monitoring of dense wavelength-division multiplexed (DWDM) systems. It is designed for easy, accurate and complete characterization of up to 200 simultaneous optical carriers. Extremely accurate measurements of channel wavelength, powers and optical signal-to-noise ratio are obtained easily with single button operation. The simplified user interface makes advanced measurements like channel spacing anddrift easily.

The WDM channel analyzer allows you to verify the wavelengths of your system to within ±2 ppm. The analyzer's outstanding performance, simplified user interface, unparalleled rugged design, light weight (9 kg), and portability, make it the ideal field instrument for DWDM system turn-up and commissioning, as well as for preventative and reactive maintenance applications. The new analyzer is offered standard with on-board disk drive and printer. This allows archiving and/or future analysis of measurement results, as well as documentation capability in remote settings.

Input/output interfaces such as RS-232 (serial) and GPIB, facilitate communications with the instrument and the WDM system under test. The availability of universal plug and play drivers enables remote connectivity with the instrument, allowing you to customize and centralize your measurements.

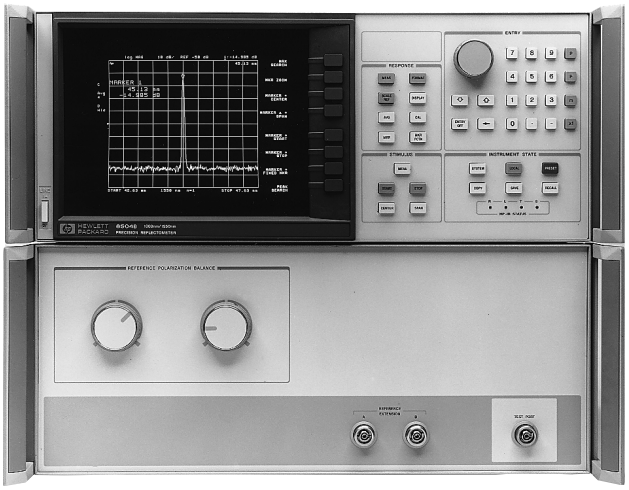
For more complete information, order the Lightwave Test and Measurement Catalog. See detailed description on page 603.

Precision Reflectometer & Polarization Analyzer

Precision Reflectometer and Polarization Analyzer

HP 8504B
HP 8509B

- Return loss measurement range beyond 80 dB
- 25 μm two-event resolution (in air, 16 µm in glass)
- 1300 and 1550 nm wavelengths
- 1 mm to 400 mm scan widths
- Automated polarization-mode dispersion (PMD) measurements using Jones matrix eigenanalysis and swept wavelength scanning technique
- Fast, automatic measurements of polarization-dependent loss (PDL) in optical components
- Calibrated, real-time measurements of state and degree of polarization (SOP and DOP)
- Built-in routine to align polarization maintaining fiber



HP 8504B

HP 8509B

HP 8504B Precision Reflectometer

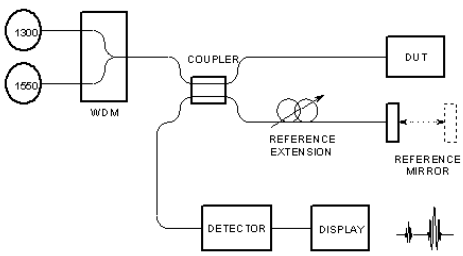
The HP 8504B precision reflectometer provides state-of-the-art lightwave reflection measurements. Individual reflections are measured and displayed as a function of distance or position. Return loss measurements beyond 80 dB are achievable, even when larger reflections are present in the measurement path. Two reflections can be closer than 25 μm (equivalent distance in air) and still be individually identified. Engineers and scientists now have a tool to precisely locate, identify, and quantify individual reflections within lightwave components and assemblies. Designs are optimized easily in the development phase. In product manufacturing, problems are solved quickly as even very small faults and discontinuities are found easily. Calibrated measurements are performed in seconds using a simple user interface and a rapid scan rate.

The HP 8504B precision reflectometer measures connectorized components in single-mode fiber. (Performance is good, but not optimum in multimode fiber.) The measurement span can be varied from 1 mm to 40 cm. The location of the 40 cm measurement window can be offset by adding the appropriate length of extension cable. Measurements are made using internal 1300 nm and 1550 nm light sources.

The HP 8504B can also be an important tool in preventing and solving component failure modes. Determining the precise location of a crack or break in a small optical assembly is easily achieved.

In addition to measuring reflections, there are also a variety of other applications including source coherence functions, precision length measurements, and characterization of the effects of birefringence (including polarization mode dispersion and fiber beat length).

Block diagram of HP 8504B



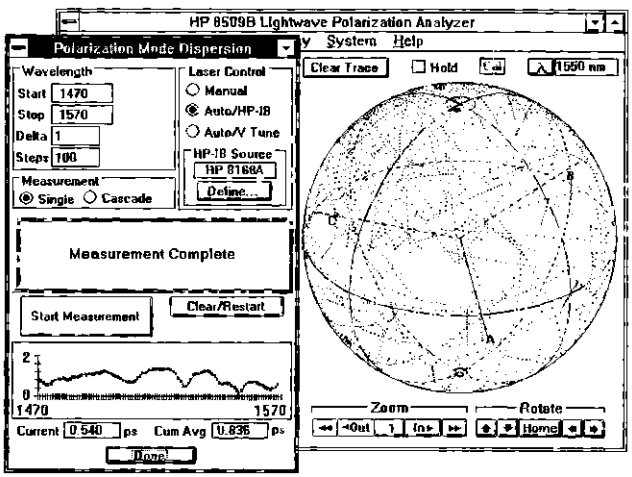
For more complete information, order the Lightwave Test and Measurement Catalog. See detailed description on page 604.

HP 8509B Lightwave Polarization Analyzer

The HP 8509B lightwave polarization analyzer system offers calibrated polarization measurements of optical signals and components. These capabilities are provided by innovations in hardware, software, and mathematics.

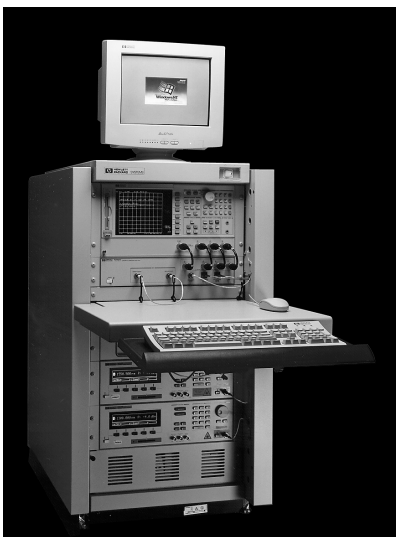
The HP8509B contains built-in applications to make automated PMD and PDL measurements. PMD measurements can be made using Jones Matrix Eigenanalysis (JME) or the Wavelength Scanning (WS) technique with an HP tunable laser source. The JME method provides accurate PMD characterization of fiber and other components by providing differential group delay (DGD) measurements as a function of wavelength. The HP 8509B makes fast PDL measurements using the Power Max-Min (or polarization scanning) technique or Jones Matrix Eigenanalysis.

The HP 8509B system software provides easy-to-understand data display of the state of polarization (SOP) using the Poincare sphere or polarization ellipse, relative stokes parameter values, degree of polarization (DOP), average power, and polarization reference frames. A built-in polarization maintaining (PM) fiber launch routine offers a fast and intuitive way of aligning PM fiber to other optical components.



A polarization-mode dispersion graph is generated automatically as the system computer conducts the measurement.

- Flexible solution platforms
- High accuracy
- Fast throughput
- Custom capabilities



Chromatic Dispersion Measurement System

HP 86037B Chromatic Dispersion (CD) Test Solution

NEW

The HP 86037B CD test solution provides highly accurate and flexible dispersion measurements for testing fiber, gratings, and dispersion compensating devices. The racked configuration is ideal for manufacturing and R&D environments. The "B" version features a patented algorithm for improved accuracy in narrow-band devices and extended wavelength capability for measurement in the L-Band (up to 1640 nm) region.

The HP dispersion measurements are based on the modulation phase-shift/delay technique that has been adopted as the preferred method in system, sub-system and component level applications. An innovative "CD Side-Band" algorithm, patented by Hewlett-Packard, is used to achieve greater group delay accuracy on narrow-band devices. The HP 86037B can be used to measure chromatic dispersion, group delay, length, and gain versus wavelength measurements. The "B" version now offers measurements at the 1600 nm wavelength range along with the 1300 and 1550 nm bands. Dual-band configurations are also available as standard options to measure dispersion at 1300 and 1550 nm or 1600 nm regions in a single rack.

In addition to the many standard options offered, custom solutions are available to meet your specific measurement requirements. For more complete information, contact your local HP field representative or regional HP Call Center to discuss how HP might best address your needs.

HP 86060C Series of Lightwave Switches

The HP 86060C series of programmable lightwave switches cover a broad range of switching capacity and provide easy signal routing for accurate and repeatable measurement automation. These switches provide an important building block for implementing automated test systems.

HP's switch family features an easy-to-use front panel interface with signal routing display, low insertion loss, and temperature stabilized performance. These switches can be easily integrated into automated test systems using SCPI-compatible commands via HP-IB or RS-232 interfaces. Custom configurations are also available to meet specific customer needs.

For more complete information order the Lightwave Test and Measurement catalog. See detailed description on page 604.

Lightwave Test and Measurement Catalog

The *Lightwave Test and Measurement Catalog* has information and specifications on HP's full line of lightwave test equipment and accessories. Measurement tutorials in the catalog cover:

- Standards, Calibration, and Traceability
- Fiber-Optic Connectors–The Right Choice and Care
- Power Measurements
- Wavelength Measurements
- Spectral Measurements
- Optical Amplifier Testing
- Testing DWDM Components
- Polarization Measurements
- Return Loss Measurements
- Frequency-Domain Measurements
- Communications Waveform Measurements
- Error Performance and SONET/SDH Analysis
- Field Service and Installation
- Common Opto-Electronic Signal Relationships

A product matrix, at the front of the catalog, helps you find the Hewlett-Packard instrument to meet your lightwave measurement needs.

To receive your free copy, complete and return the business reply card at the end of this catalog or call your local HP sales office and ask for literature number 5968-2222. Visit HP on the World Wide Web: **http://www.hp.com/go/tmcatalogs**, and order a copy.

HP 83437A Broadband Light Source
HP 83438A Erbium ASE Source

In conjunction with an OSA, the incoherent light sources HP 83437A and 83438A allow you to measure insertion loss, crosstalk, bandwidth, polarization dependencies, and other parameters of passive optical components versus wavelength.

Built to order, the HP 83437A can incorporate up to four edge-emitting LEDs (EELEDs), with five available wavelengths (1200 nm/–17 dBm, 1310 nm/–13 dBm, 1430 nm/–13 dBm, 1550 nm/–13 dBm, 1650 nm/–17 dBm). The peak power density of each EELED in a single-mode fiber is more than 25 dB stronger than that of a white light source. It is also the ideal noise source for the NGP technique mentioned above.

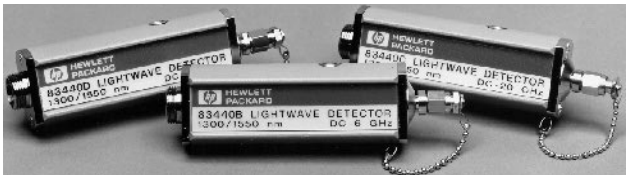
The HP 83438A provides more than +6 dBm in the 1550 nm window, allowing you to characterize advanced components such as isolators, circulators, add/drop multiplexers, gratings, or demultiplexers for dense wavelength-division multiplexing (DWDM) systems.

For more complete information, order the Lightwave Test and Measurement Catalog. See detailed description on page 603.

High-Speed DC-Coupled Lightwave Converter, Digital Source and Clock/Data Receiver

HP 11982A
HP 83430A
HP 83440B
HP 83440C
HP 83440D
HP 83446A

- DC-coupled optical-to-electrical converter
- Bandwidths from dc to 30 GHz
- Fast-pulse response
- Optical receiver for BERT or oscilloscope
- Clock and data recovery at 2488 Mb/s
- High sensitivity



HP 83440 Series

HP 11982A

HP 83446A

DC-Coupled Optical Converter

Optical communication systems that incorporate time-domain instruments often require optical-to-electrical (O/E) converters in order to make optical pulse and eye-diagram measurements. Whether to use an unamplified or an amplified O/E converter depends on the measurement application. If signal power levels are high enough, a simple photodiode-only converter such as the HP 83440 offers well-behaved pulse response performance. To measure low power signals, an RF-amplified O/E converter such as the HP 11982A may be required.

In frequency-domain applications, O/E converters allow frequency-domain instruments such as network and spectrum analyzers to accept optical signals for basic lightwave measurements. Users can measure, quantify, and model modulation characteristics such as spectral purity, harmonic content, and noise spectral density.

HP 83440 Series Unamplified Lightwave Converters

The HP 83440 series offers a variety of bandwidth options for converting incoming modulated optical power or optical pulses into electrical current. Ideal for optical pulse parameter measurements, these fully-integrated hermetic InGaAs photodetectors feature very low noise and pulse aberrations, fast, accurate O/E conversion, and a standard user-interface compatible with most electrical instruments. The converters mount directly on test-instrument front panels. Simple internal structure ensures low-signal distortion for improved output-signal fidelity, a novel optical launch ensures low optical reflection, and integral dc-bias regulation ensures stable frequency response performance.

The HP 83440 series can be used with high-speed digitizing oscilloscopes to accurately measure rise and fall time, overshoot, undershoot, ringing, peak power (pulse amplitude), pulse width, amplitude noise, and extinction ratio. The HP 83440 series also makes excellent mask measurements when sufficient optical power is available.

The HP 83440B Option 050 provides 50 Ω output required for use with external SDH Bessel-Thomson filters such as the HP 87441 family.

When using the HP 83440 with an ac-coupled instrument (except Option 050), a bias tee such as the HP 11612A or, alternatively, a 3 dB fixed attenuator on the output is required to provide a dc-bias return path.

HP 11982A Amplified Wide Bandwidth Lightwave Converter

A wide-bandwidth, sensitive O/E converter for characterizing lightwave systems and components, the HP 11982A combines a PIN photodetector with a low-noise dc-coupled preamplifier to create a general-purpose front end. It covers wavelengths from 1200 to 1600 nm and bandwidths from dc to 15 GHz. With 300 V/W conversion gain and 0.05 percent input optical reflections, it significantly improves the sensitivity of the measurement system. The converter comes with a calibration chart of instrument-specific data for making corrected frequency-response measurements.

Combine the HP 11982A with an HP 83480 series digital communications analyzer to make optical eye-pattern and impulse-response measurements. Use the results to verify optical and optoelectronic components and optical system level performance.

The HP 11982A can be used with an electrical spectrum analyzer to display optical modulation power as a function of frequency. Intensity modulation, distortion, and laser intensity noise are also measured. The Option 001 memory card programs an HP 8590 E series spectrum analyzer with frequency-response corrections, and menus for easy, accurate lightwave measurements to 22 GHz. Using this converter with the HP 11980A interferometer, you can measure linewidth (with a gateable modulation source), chirp, and frequency modulation of single-line lasers.

HP 83430A Lightwave Digital Source and HP 83446A Lightwave Clock/Data Receiver

With the HP 83430A and 83446A, Hewlett-Packard offers complete optical parametric test systems for test needs up to 2.5 Gb/s. A complete system includes the HP 71603B error performance analyzer as well and can perform measurements, such as optical receiver sensitivity and dispersion power penalty of single-mode fiber.

The HP 83430A is a modulatable DFB laser source that converts digital input signals to a preset optical output level that is SDH/SONET compliant. It is designed to evaluate the performance of high-speed TDM (time division multiplexed) and WDM (wavelength division multiplexed) optical receivers and systems to SDH/SONET OC-1 (51.84 Mb/s) through STM-16/OC-48 (2.488 Gb/s) standards. The HP 83430A can be combined with the HP 83480A digital communications analyzer to provide transceiver waveform testing, such as filtered conformance mask testing, extinction-ratio and eye-diagram measurements.

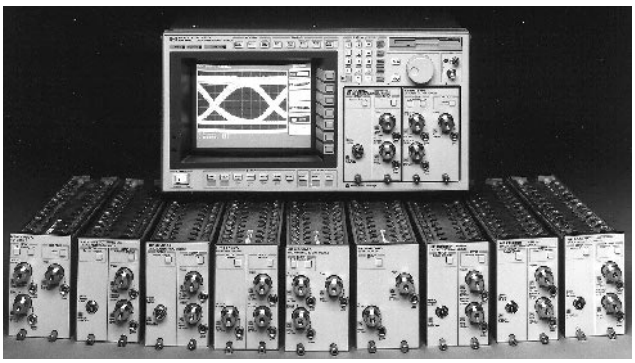
The HP 83446A lightwave clock/data receiver is used to extract clock and data signals from SDH/SONET optical signals operating at the 2488 Mb/s (STM-16/OC-48) rate. The HP 83446A operates over the full range of power levels specified in SDH/SONET standards (–27 dBm sensitivity) at both 1300 nm and 1550 nm wavelengths, using multimode or single-mode fiber. Designed for use with high-speed BERTs such as the HP 71603B bit-error rate tester, BER testing can now be performed directly on optical signals. A third port routes the high-gain avalanche photodiode output to the front panel, previous to clock/data regeneration for analysis of the optical waveform. An electrical input allows clock and data recovery from 2488 Mb/s.

For more complete information, order the Lightwave Test and Measurement Catalog. See detailed description on page 603.

- Automated mask measurements
- Integrated optical channels for accuracy and ease of use
- High-measurement throughput
- Filtered measurements for compliance test or full bandwidth for waveform analysis
- Fast statistical waveform analysis
- Wide range of standard telecom and datacom masks

HP 11898A
HP 83480A
HP 83481A
HP 83482A
HP 83483A
HP 83484A
HP 83485A
HP 83485B
HP 83486A
HP 83487A
HP 83491A
HP 83492A
HP 83493A

NEW



HP 83480A with plug-in modules

HP 83480A Digital Communications Analyzer GPIB

The HP 83480A represents a significant advancement in the instrumentation used to view waveforms in high-speed digital communications. Industry-standard tests including mask tests as well as eye-diagram analysis including extinction ratio are made using easy-to-use, built-in measurements. For measuring optical signals, lightwave receivers are integrated into the instruments to provide highest accuracy and waveform fidelity.

With up to 50 GHz of bandwidth, the HP 83480A can be used on low-rate tributary signals through 10 Gb/s optical waveforms.

Industry Standard Masks

Achieve high-throughput waveform testing with both optical and electrical masks and templates including SDH, SONET, Gigabit Ethernet, and Fibre Channel standards. For guardband testing, use mask margins. Custom/user-defined masks can also be generated. Masks are automatically aligned and scaled.

Integrated Optical Receivers

The HP 83480A is a modular platform with a family of optical receivers with very high-speed internal photodiodes (2.5 GHz, 20 GHz, or 30 GHz bandwidths). For filtered measurements, filters are switched in with a simple keystroke to produce a calibrated reference receiver, or switched out for full bandwidth waveform analysis.

The HP 83480A can accept one or two plug-in modules for up to four measurement channels. Modules have two electrical channels or one optical channel and one electrical channel. The following optical/electrical plug-ins have 9/125 μm single-mode optical interfaces for 1310 and 1550 nm applications. The HP 83481A has a 20 GHz electrical channel and a 2.5 GHz optical channel with 155 and 622 Mb/s switchable filters. The HP 83482A provides a 40 GHz electrical channel and a 30 GHz optical channel. The HP 83485A provides a 20 GHz electrical channel and a 20 GHz optical channel with a 622 or 2488 Mb/s switchable filter. The HP 83485B provides a 40 GHz electrical channel and a 10 Gb/s filtered channel.

Two optical/electrical plug-ins have 62.5/125 μm optical interfaces for both single-mode and multimode measurement applications. For 1310 and 1550 nm applications, the HP 83486A has a 2.5 GHz optical channel with 155 and 622 Mb/s switchable filters for SDH/SONET/ATM applications or 1063 and 1250 Mb/s switchable filters for Fibre Channel and Gigabit Ethernet. For 850 nm applications, the HP 83487A has a 2.5 GHz optical channel with 1063 and 1250 Mb/s switchable filters (Fibre Channel and Gigabet Ethernet). Both modules also have a 20 GHz electrical channel.

Accurate Eye-Diagram Analysis

Integrated optical receivers are the key to accurate eye-diagram analysis of lightwave signals. Internal photodiodes have well-behaved frequency responses which are not degraded by external cabling and adapters. This yields the highest in waveform fidelity and measurement accuracy. Extinction-ratio measurements are accurate and repeatable.

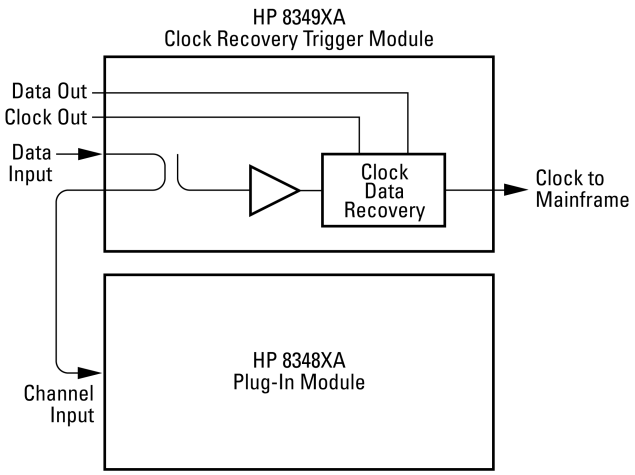
General-Purpose Oscilloscopes

In addition to digital communications analysis, the HP 83480A can be used as a general-purpose, high-speed, sampling oscilloscope. The HP 83483A electrical plug-in provides two 20 GHz electrical channels, the HP 83484A has two 50 GHz electrical channels. Add TDR capability to the HP 83480A with the HP 54755A software and TDR module HP 54753A or HP 54754A (see page 116). The HP 11898A module extender provides a 1.5 meter extension cable for placing the electrical module adjacent to the high-speed circuit-under-test.

HP 83491/92/93A Clock Recovery/ Trigger Modules NEW

The HP 83480A/54750A DCA series now offers single connection measurements—no external trigger is required. With the addition of the HP 83491/92/93A series of clock recovery receiver modules, reliable parametric testing becomes easy even when you do not have access to a clock signal trigger.

The HP 8349X series of plug-in receiver modules cover the three most popular transmission media in use today—electrical lines, multimode fiber and single-mode fiber. A built-in coupler/splitter reduces external hardware required for triggering. No more need for awkward cables just to get a trigger—simply plug in your test signal, select your data rate, and make your measurements.



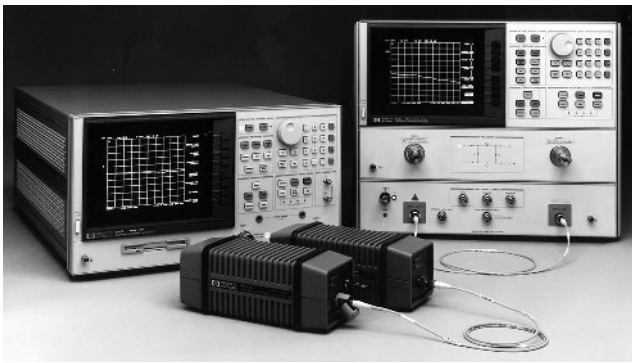
Time-domain measurements are only as accurate as the clock source that you are triggering on. All three modules have exceptional jitter performance to ensure an accurate display of jitter on the incoming data. The high sensitivity/wide bandwidth receivers also provide electrical recovered clock and electrical data regeneration for simultaneous testing with other instruments, such as the HP 71603B or 71612B error performance analyzers.

For more complete information, order the Lightwave Test and Measurement catalog. See detailed description on page 603.

Lightwave Component and Signal Analyzers

HP 8702D
HP 8703A
HP 71400C
HP 71401C
HP 70810B

- 300 kHz to 20 GHz modulation frequency
- 850, 1300 or 1550 nm operation
- Calibrated frequency response measurements of high-speed optical, electro-optical, and electrical components
- RIN measurements
- Laser linewidth and chirp measurements
- Modulation response, distortion and depth measurements



HP 8702D and 8703A

Lightwave Component Analyzers

The HP 8702D and 8703A precisely characterize the swept modulation frequency response of wide bandwidth fiber optic system elements such as WDM components, lasers, LEDs, photodiodes, and electro-optical modulators. Both the HP 8702D and 8703A operate at a fixed wavelength and sweep the frequency of the intensity modulation signal over the bandwidth you select.

The HP 8702D has 1300 and 1550 nm lightwave sources and receivers as well as an 850 nm receiver. The 8703A can operate at 1300 or 1550 nm. These sources and receivers are characterized to allow calibrated measurements of electro-optical test devices.

When used to measure linear electrical components, such as filters, amplifiers, and transmission lines, the lightwave component analyzers provide the full measurement capability of a microwave network analyzer. Typical measurements are bandwidth, insertion loss/gain, phase, impedance, match, and group delay.

HP 8702D Lightwave Component Analyzer

GPIB

300 kHz–3 GHz (850 nm) 300 kHz–6 GHz (1300, 1550 nm)

The HP 8702D offers several significant improvements in versatility, performance and productivity.

- high optical calibration accuracy
- built-in 3.5-inch floppy disk drive with LIF/DOS formats
- integrated S-parameter test set
- serial and parallel printer interfaces
- test sequencing for automated measurements
- multiple source and receiver choices

HP 8703A Lightwave Component Analyzer

GPIB

130 MHz–20 GHz (1300 or 1550 nm)

The standard configuration includes one 1300/1550 nm receiver and one lightwave directional coupler. An optional 1300 or 1550 nm DFB internal laser source must be specified. The external lightwave source input (Option 100) can be used for additional wavelength flexibility. Lasers with center wavelength between 1530 and 1570 nm can be used with HP 8703A Option 210 (1550 nm). Lasers with center wavelength between 1290 and 1330 nm can be used with HP 8703A Option 220 (1300 nm).

HP 71400C

HP 71400C and 71401C Lightwave Signal Analyzers

GPIB

Calibrated Measurements of Intensity Modulation from 100 kHz to 22 GHz

The HP 71400C combines a high-performance microwave spectrum analyzer with a wideband, sensitive optical receiver. This system measures modulated light from 1200 to 1600 nm on single-mode optical fibers from 100 kHz to 22 GHz. Optical modulation, noise, and average power are presented on a fully-calibrated display.

With the HP 11980A fiber-optic interferometer, the analyzer can also measure linewidth. With an interferometer and a gated source, the analyzer can measure chirp and FM characteristics of distributed-feedback (DFB) and other single-line lasers. Or, for higher performance, replace the interferometer with a tunable laser.

This system is also a microwave spectrum analyzer with all the capability of the HP 71210C. Because the analyzer is modular, its measurement capabilities can be expanded easily. For example, you can add a tracking generator module for modulation response measurements to 18 GHz, or an optical spectrum analyzer for wavelength analysis.

The HP 71400C measures intensity modulation up to 22 GHz and operates over wavelengths from 1200 to 1600 nm or, with Option 850, from 750 to 870 nm. It can achieve an optical sensitivity of better than –60 dBm. The analyzer also offers average-power measurement, displayed both as a real-time vertical power bar and as a digital readout. Full calibration of both average power and modulation power makes this system a reference receiver for measuring and characterizing optical detectors and receivers.

A program for enhanced relative intensity noise (RIN) measurement is included. This program subtracts thermal noise and shot noise components of the measurement and calculates RIN to –165 dB/Hz.

The HP 71401C has an upper frequency limit of 2.9 GHz but the same functions and features as the HP 71400C. Both models provide lightwave optical or electrical units in either log (dB) or linear (watts) units, as well as microwave units for electrical spectrum analysis.

HP 70810B Lightwave Receiver Module

The HP 70810B lightwave section is a receiver module with a built-in average power meter and attenuator, a wavelength range of 1200 to 1600 nm (750 to 870 with Option 850), a detected modulation bandwidth of 100 kHz to 22 GHz, and a built-in, 32 dB RF amplifier that gives an optical sensitivity of –60 dBm in a 10 Hz bandwidth. It can be used in standalone applications as a lightwave receiver or housed in an HP 70000 series electrical spectrum analyzer.

For more complete information, order the Lightwave Test and Measurement Catalog. See detailed description on page 603.

Overview

Lightwave Test & Measurement Catalog
5968-2222E/EUS

Optical Component Test

EDFA HP 81600 Series 200 Are You Certain of Your Measurements?
5091-7728E
EDFA Testing—Problems and Solutions
5963-2273E
HP E5574A Optical Loss Analyzer Sources Configuration Guide
5963-6886E
Brochure
5963-6889E
Technical Specifications
5964-1524E
PDL Measurements Using the HP 8169A Polarization Controller.
5964-9937E
HP 8153A Modular System for Optical Power Loss and Return-Loss Measurements Brochure
5963-7132E
HP 8156A Optical Attenuator Brochure
5091-7758E
HP 8156A Optical Attenuator Configuration Guide
5963-3367E
HP 8156A Optical Attenuator Technical Data Sheet
5962-8631E
Lightwave Test & Measurement Catalog
5968-2222E/EUS
(PN 8167B) Tunable Laser Source HP 8167B, HP 8168D, HP 8168E, HP 8168F
5964-9542E
(PN 8168E/F) HP 8168E and HP 8168F Tunable Laser Sources
5965-5877E
(PN 11896-2) Polarization-dependent Loss Measurements Using Modular Test System Configurations
5965-5720E
(PN 81534A) Measuring the Return Loss of Fiber Optic Components–HP 81534A Return Loss Module
5091-2639E

Lightwave Test System Solutions

HP 86060 Series of Lightwave Switches Product Overview
5967-5902E
HP 86037B Chromatic Dispersion Test System
5968-5699E
Lightwave Test & Measurement Catalog
5968-2222E/EUS

Precision Reflectometers & Polarization Analyzers

Lightwave Test & Measurement Catalog
5968-2222E/EUS
HP 8504B Lightwave Component Return Loss Measurements Brochure
5963-6730E
HP 8509B Lightwave Polarization Analyzer Product Overview
5966-1557E

(PN 8504-1) Measurements of Lightwave Component Reflections with the HP 8504B Precision Reflectometer
5963-7191E
(PN 8509-1) Polarization Measurements of Signals and Components
5091-2879E
(PN 8509-2) Narrow-band PMD Measurements with the HP 8509B
5968-5587E

(cont'd.)

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00

Spectrum, Component & Signal Analyzers

Lightwave Test & Measurement Catalog
5968-2222E/EUS
HP 11982A Amplified Lightwave Converter Product Overview
5966-1583E
HP 70880A, 71400C, 71401C LW Personality Data Sheet
5091-5541E
HP 71400C, 71401C, 70810B LW Signal Analyzers Data Sheet
5091-7030E
HP 8702D LW Component Analyzer Brochure
5965-5624E
HP 8702D LW Component Analyzer Configuration Guide
5965-6403E
HP 8702D LW Component Analyzer System Technical Specifications
5965-6404E
HP 8703A LW Component Analyzer Technical Specifications
5952-1754E
HP 8614XA Optical Spectrum Analyzer Family Technical Specifications
5968-1124E
HP 8614XA OSA Family for Factory & Field Applications Brochure
5968-1123E
HP 86140 OSA Family CD-ROM
5968-3959
HP 83737A Broadband Light Source
HP 83738A Erbium ASE Source Product Overview
5965-3252E

(PN 71400-1) Lightwave Signal Analyzers Measure Relative Intensity Noise
5091-2196E
(PN 71400C-2) Lightwave Signal Analyzers with the HP 70810B LW Section
5091-2324E
(PN 86120-1)WDM System Test with the HP 86120
5964-6896E
(PN 71452-1) HP 71452 Optical Spectrum Analyzer—EDFA Testing with the Interpolation Technique
5963-7146E
(PN 71452-2) HP 71452B Optical Spectrum Analyzer—EDFA Testing with the Time Domain Technique
5963-7147E
(PN 71452-4) HP 71452B Optical Spectrum Analyzer—Synchronizes Its Internal Activities With External Signals
5964-6416E
(PN 71452-3) HP 71452B OSA-EDFA Noise Gain Profile
5963-7148E

Digital Communications Analyzers

Lightwave Test & Measurement Catalog
5968-2222E/EUS
HP 11982A Amplified LW Converter Product Overview
5966-1583E
HP 83446A Clock/Data Receiver Product Overview
5964-1682E
HP 83440B/C/D High-Speed Lightwave Converters Product Overview
5091-5536E
HP 83480A 10 Methods for Faster High-Speed Digital Communication Design Brochure
5966-4258E
HP 83480A Series Digital Communication Analyzer Product Overview
5964-2238E
HP 83491A/92/93A Clock Recovery Modules
5968-4154

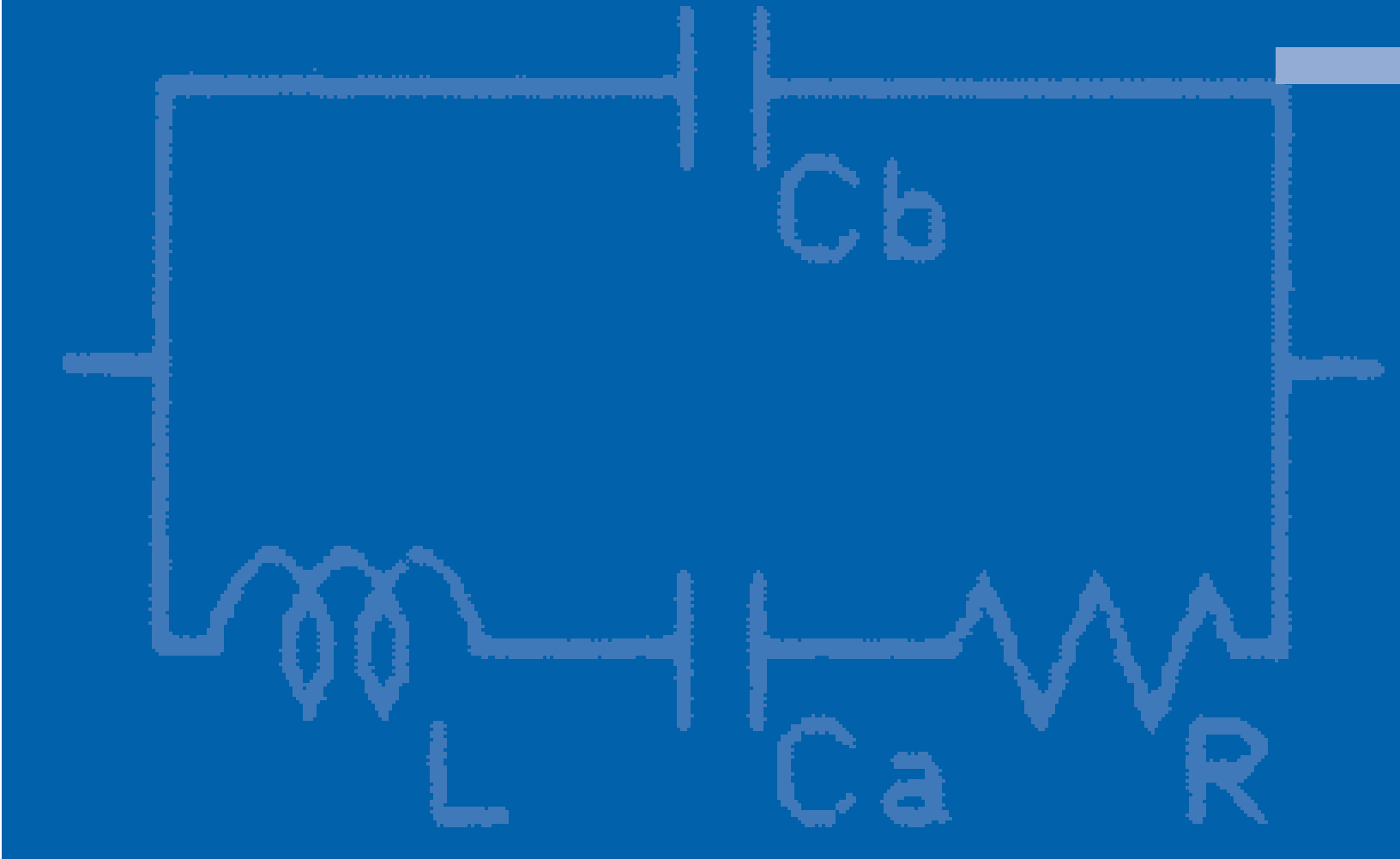
(PN 83480-1) Measuring High Power Waveforms with the HP 83480A/83487A
5968-1245E

Optical Wavelength Meter

HP 86120C Multi-Wavelength Meter Brochure
5968-1044E
HP 86120C Multi-Wavelength Meter Technical Specifications
5968-1045E
HP 86121A WDM Channel Analyzer Brochure
5968-6422
HP 86121A WDM Channel Analyzer
5968-6434

(PN 86120-1) WDM System Test
5964-6896

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00



Component Test Instruments

Overview

Component Measurement

Today's electronic components are designed for higher performance, while being reduced in size, power consumption, and cost. Efficient and accurate component characterization, design evaluation, and manufacturing test are critical to the success of component users and suppliers. HP offers the industry's broadest line of component test instruments for passive as well as active components. The products in this section are designed to measure fundamental impedance-related parameters of electronic components and materials.

Impedance Measuring Instruments

Impedance measuring instruments can be divided into two general categories: LCR meters and impedance analyzers. LCR meters primarily measure inductance, capacitance, and resistance of the test device at spot frequencies. Impedance analyzers, in addition to all the functions of the LCR meter, measure impedance, phase, and sometimes transmission parameters. These analyzers have extended frequency range, a synthesized source, swept frequency capability, and excellent frequency resolution. Combination network/spectrum/impedance analyzers offer the benefits of impedance analysis as well as vector-network and spectrum analysis. See the Selection Guides that follow for general instrument capabilities. For higher frequencies (above 3 GHz) in a 50Ω environment, a dedicated vector-network analyzer is the best solution for impedance measurements. See Network Analyzers.

Selecting a test fixture is as important as selecting the right instrument. HP offers a wide range of accessories for axial, radial, and SMD chip devices. See page 470.

Materials Measurements

Materials have two properties that determine how they interact with electromagnetic fields:

- Permittivity (ε) or dielectric constant for electric fields
- Permeability (μ) for magnetic fields

Permittivity ($\varepsilon^* = \varepsilon' - j\,\varepsilon''$) and permeability ($\mu^* = \mu' - j\,\mu''$) are complex values. The real part (ε' or μ') is a measure of how much energy is stored in a material. The imaginary part (ε'' or μ'') is a measure of how much energy is lost in a material. These properties are not constant and may change with frequency or temperature, for example. Accurate measurements of these material properties during characterization or inspection help to achieve the best performance for a given application while shortening design cycles and minimizing scrap.

A materials measurement system consists of an instrument, a fixture to hold the material, and software or firmware to calculate complex permittivity or permeability values and display the results. For material testing applications, HP currently offers three types of solutions: LCR meter-based (up to 1 GHz), impedance analyzer-based (up to 1 GHz), and network analyzer-based systems (up to 110 GHz).

HP offers fixture accessories based on the open-ended coaxial probe, the transmission line measurement, the parallel plate capacitance, and the inductor impedance technique. These choices allow you to best match the fixture, frequency range, and measurement technique with your material's physical and electrical test requirements. The chart of material test applications and solutions is shown in the next page.

Other Component Test

HP provides another high performance test solutions for specific applications such as hard disk read/write testing, VCO/PLL signal measurements and resonator and filter measurements. See pages 525, 526 for hard disk read/write testing, pages 324, 325 and 326 for VCO/PLL signal measurements, pages 267 and 268 for resonator and filter measurements.

Impedance Analyzer Selection Guide

Model	Frequency Range	Impedance Range/Other	Additional Information	Page
HP 4192A	5 Hz to 13 MHz	1 Ω to 1 MΩ*, gain-phase	Floating or grounded devices	471
HP 4194A	100 Hz to 40 MHz 10 kHz to 100 MHz 10 Hz to 100 MHz	0.1 Ω to 1 MΩ* 0.1 Ω to 1 MΩ* gain-phase	Color display, equivalent circuit analysis, auto sequence program	471
HP 4294A	40 Hz to 110 MHz	25 m Ω to 40 MΩ*	Color display, equivalent circuit analysis, I-Basic, LAN I/F, SMD fixtures	474, 475
HP 4395A**	100 kHz to 500 MHz	2 Ω to 5 kΩ* S-parameters, gain-phase	Color display, vector-network and spectrum analysis , IBASIC	254
HP 4396B**	100 kHz to 1.8 GHz	2 Ω to 5 kΩ* S-parameters, gain-phase	Color display, vector-network and spectrum analysis, IBASIC	256, 257
HP 4291B	1 MHz to 1.8 GHz	0.1 Ω to 50 kΩ*	Color display, IBASIC, SMD fixtures, equivalent circuit analysis, material	472, 473

* 10% accuracy range ** with Opt 010 and HP 43961A

LCR and Resistance Meter Selection Guide

Model	Frequency Range	Impedance Range/ Other	Additional Information	Page
HP 4263B	100 Hz to 100 kHz (5 test frequencies)	1 mΩ to 100 MΩ	Optional transformer test	479
HP 4268A	120 Hz/1 kHz	0.0001 nF to 2000 μF	High-value ceramic capacitor test	483
HP 4284A	20 Hz to 1 MHz (8610 freq. points)	0.01 mΩ to 100 MΩ	HP 42841A for high-current dc bias	480, 481
HP 4285A	75 kHz to 30 MHz (100 Hz steps)	0.01 mΩ to 100 MΩ	HP 42851A Q adapter for high Q measurement	480, 481
HP 4286A	1 MHz to 1 GHz (10 kHz steps)	200 mΩ to 3 kΩ	High-accuracy, high-speed RF LCR meter	482
HP 4287A	1 MHz to 3 GHz (100 kHz steps)	200 mΩ to 3 kΩ	Higher-accuracy, higher-speed RF LCR meter	482.
HP 4278A	1 kHz/1 MHz	0.00001 pF to 200 μF	High-speed capacitor test	483
HP 4279A	1 MHz	0.00001 pF to 1280 pF	C-V meter, 0 to ± 38 V	
HP 4339B	dc	1 kΩ to 1.6 x 10^{16} Ω	High-resistance meter, volume and surface resistivity, current	485
HP 4338B	1 kHz test signal	10 μΩ to 100 kΩ	Milliohmmeter	484

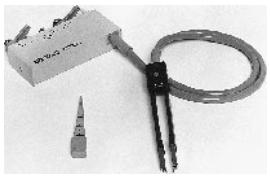
Material Test Applications and Solutions

	DC resistivity cell (HP 16008B) Page 485	Dielectric test fixture (HP 16451B) Page 478	Liquid dielectric test fixture (HP 16452A) Page 478	Dielectric and magnetic test fixtures (HP 16453A) (HP 16454A) Page 477	Dielectric probe system (HP 85070M) Page 476	HP material measurement software (HP 85071B) Page 476
Absorber					•	•
Ceramic	•	•		•	•	
Fermentation					•	
Film (thin)		•		•		
Food					•	
Gel, semi-solid					•	
Liquid			•		•	
Loss		•	•	•	•	
Permeability				•		•
Permitivity (dielectrics)		•	•	•	•	•
Plastic	•	•		•	•	
Powder					•	
Printed circuit board		•		•		
Resistivity	•					
Rubber	•	•		•	•	
Solid	•	•		•	•	
Substrate	•	•		•	•	

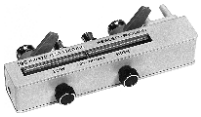
Other Component Test Solutions

Model	Frequency Range	Brief Description	Page
Hard Disk Read/Write Test E5022A	50 Mbps to 600 Mbps	High bit rate and wide band width Read/Write Test System for evaluating the advanced MR and GMR heads. The system can measure both the traditional Read/Write parameters (TAA, Pulse Width, Track Width, etc.) and Bit Error characteristics (option).	525, 526
VCO/PLL Signal Test 4352S	10 MHz to 12.6GHz	A simple and multifunctional signal test system for VCO/PLL evaluation and test.Main VCO/PLL parameters (RF power, frequency, phase noise, spectrum, frequency transient, DC consumption current and FM deviation) can be measured.	324, 325, 326
Resonator/ Filter Test E5100A	10 kHz to 180/300 MHz	Network analyzer best fitted for production line especially for resonator and filter manufacturer with fast measurement speed, low noise floor and powerful dedicated commands.	267
E5100B	10 kHz to 300 MHz	Economy model with limited functions	268

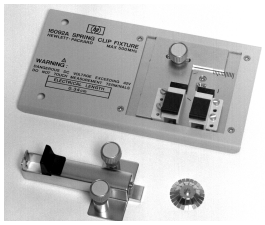
NEW



HP 16334A

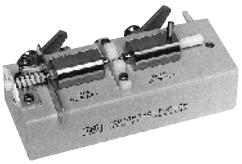


HP 16047C



HP 16092A

HP 16089B



HP 16034E

Test Accessories/Fixtures

			HP 4192A	HP 4194A	HP 4194A and HP 41941A/B	HP 4263B	HP 4268A	HP 4278A	HP 4279A	HP 4284A	HP 4285A	HP 4286A	HP 4287A	HP 4291B	HP 4294A	HP 4294A and HP 42942A	HP 4395A, Opt 010 and HP 43961A	HP 4396B, Opt 010 and HP 43961B
HP 16034E	SMD/Chip Test Fixtures	DC-40MHz	•	•		•	•	•	•	•	•				•			
HP 16034G	SMD/Chip Test Fixture, Small	DC-110MHz	•	•		•	•	•	•	•	•				•			
HP 16034H	SMD/Chip Test Fixture, General	DC-110MHz	•	•		•	•	•	•	•	•				•			
HP 16044A	SMD/Chip Test Fixture, Four-Terminal, 10MHz	DC-10MHz	•	•		•	•	•	•	•	•				•			
HP 16047A	Axial and Radial	DC-13MHz	•	•		•	•	•	•	•	•				•			
HP 16047C	HF Axial and Radial	DC-40MHz	•	•		•	•	•	•	•	•				•			
HP 16047D	Axial and Radial	DC-40MHz	•	•		•	•	•	•	•	•				•			
HP 16047E	Axial and Radial, 110MHz	DC-110MHz	•	•		•	•	•	•	•	•				•			
HP 16048A	One Meter Test Leads, BNC	DC-30MHz	•	•		•	•	•	•	•	•							
HP 16048B	One Meter Test Leads, SMC	DC-30MHz	•	•		•	•	•	•	•	•							
HP 16048D	Two Meter Test Leads, BNC	DC-30MHz				•	•	•	•	•	•							
HP 16048E	Four Meter Test Leads, BNC	DC-1MHz				•	•			•								
HP 16048G	One Meter Test Leads, BNC, 110MHz	DC-110MHz													•			
HP 16048H	Two Meter Test Leads, BNC, 110MHz	DC-110MHz													•			
HP 16060A	Transformer Test Fixture	DC-100KHz				•												
HP 16065A	Ext. Voltage Bias with Safety Cover (<=200 vdc)	50Hz-2MHz	•	•		•	•	•	•	•	•				•			
HP 16065C	External Bias Adapter (<=40 vdc)	50Hz-1Mz				•	•											
HP 16085B	Four-Terminal Pair to APC-7 Adapter	DC-40MHz	•	•		•	•	•	•	•	•							
HP 16089A/B/C/D/E	Kelvin Clip Leads	5Hz-100KHz	•	•		•	•	•	•	•	•				•			
HP 16092A	RF Spring Clip : Axial, Radial and SMD	DC-500MHz	•[1]	•[1]	•[2]	•[1]	•[1]	•[1]	•[1]	•[1]	•[1]	•[6]	•[6]	•		•		
HP 16093A	RF Two Terminal Binding Post	DC-250MHz	•[1]	•[1]	•[2]	•[1]	•[1]	•[1]	•[1]	•[1]	•[1]	•[6]	•[6]	•		•	•	•
HP 16093B	RF Three Terminal Binding Post	DC-250MHz	•[1]	•[1]	•[2]	•[1]	•[1]	•[1]	•[1]	•[1]	•[1]	•[6]	•[6]	•		•	•	•
HP 16094A	RF Probe Tip/Adapter	DC-125MHz	•[1,3]	•[1,3]		•[1,3]	•[1,3]	•[1,3]	•[1,3]	•[1,3]	•[1,3]	•[6,3]	•[6,3]	•[3]		•[3]	•[3]	•[3]
HP 16095A	LF Probe Adapter	DC-13MHz	•	•[5]		•[5]	•[5]	•[5]	•[5]	•[5]	•[5]				•[5]			
HP 16099A	RF Probe to APC-7 Adapter	DC-100MHz			•													
HP 16191A	Side-Electrode SMD Test Fixture	DC-2GHz	•[1]	•[1]	•[2]	•[1]	•[1]	•[1]	•[1]	•[1]	•[1]	•[6]	•[6]	•		•	•	•
HP 16192A	Parallel Electrode SMD Test Fixture	DC-2GHz	•[1]	•[1]	•[2]	•[1]	•[1]	•[1]	•[1]	•[1]	•[1]	•[6]	•[6]	•		•	•	•
HP 16193A	Small Side Electrode SMD Test Fixture	DC-2GHz	•[1]	•[1]	•[2]	•[1]	•[1]	•[1]	•[1]	•[1]	•[1]	•[6]	•[6]	•		•	•	•
HP 16194A	High Temperature Component Text Fixture	DC-2GHz	•[1]	•[1]	•[2]	•[1]	•[1]	•[1]	•[1]	•[1]	•[1]	•[6]	•[6]	•		•	•	•
HP 16196A/B/C	Side-Electrode SMD Test Fixture	DC-3GHz	•[1]	•[1]	•[2]	•[1]	•[1]	•[1]	•[1]	•[1]	•[1]	•[6]	•[6]	•		•	•	•
HP 16200A	External DC Bias Adapter	1MHz-1GHz										•[6]	•[6]	•				
HP 16314A	4-Terminal Balun	100Hz-10MHz	•	•		•	•	•	•	•	•				•			
HP 16315/6/7A	Single BNC connector Baluns	100Hz-10MHz	•	•		•	•	•	•	•	•	•[6]	•[6]	•		•	•	•
HP 16334A	SMD/Chip Tweezer	DC-15MHz	•	•		•	•	•	•	•	•				•			
HP 16451B	Dielectric Material Test Fixture	20Hz-30MHz	•	•						•	•				•			
HP 16452A	Liquid Test Fixture	20Hz-30MHz	•	•						•	•				•			
HP 16453A	Dielectric Material Test Fixture	1MHz-1GHz												•				
HP 16454A	Magnetic Material Test Fixture	10kHz-1GHz	•	•						•	•			•		•		
HP 42842A/B	High Bias Current 20A/40Test Fixture	20Hz-1MHz								•						•		
HP 42842C	High Bias Current 10A Test Fixture	75kHz-30MHz									•							
HP 42942A	Four-Terminal Pair to APC-7 Adapter	DC-110MHz													•			

Note : Refer to the accessory descriptions for frequency and operational limits.
[1] Compatible when used in conjunction with HP 16085B.
[2] Compatible when used in conjunction with HP 16099A
[3] APC-7 to APC-7 cable is required
[5] Do not connect the ground lead to the instrument
[6] APC-3.5 to APC-7 Adapter is required

HP 4192A
HP 4194A

- Wide range impedance measurement:
  100 Hz to 40 MHz, 10mΩ to 100MΩ
  10 kHz to 100 MHz, 0.1Ω to 1MΩ, when used with HP 41941A/B
- 10 Hz to 100 MHz Gain-phase measurement
- Flexible measurement, computation, and analysis capabilities on a color graphic display
- 5 Hz to 13 MHz variable frequency
- Gain-phase measurement: amplitude, phase, group display
- Floating or grounded devices
- Impedance measurement: |Z|,|Y|,θ,R,X,G,B,L,C,D,Q,Δ,Δ%
- Standard GPIB

HP 4194A with HP 41941A

HP 4194A Impedance/Gain-Phase Analyzer

The HP 4194A impedance/gain-phase analyzer is an integrated solution for efficient measurement and analysis or go/no-go testing of components and circuits. Detailed impedance and transmission characteristics, including secondary parameter derivations, can be simply and quickly evaluated or tested. The HP 4194A can contribute to improving engineering productivity and reducing test cost. The analyzer has wide measurement capabilities in both impedance and transmission measurements.

Specifications

Impedance Measurements

Measurement Parameters: |Z|,|Y|,θ,R,X,G,B,L,C,D,Q
Measurement Range: 10 mΩ to 100 MΩ
Test Frequency: 100 Hz to 40 MHz
OSC Level: 10 mV to 1 V (≤10MHz), 10 mV to 0.5 V (>10MHz)
DC Bias: 0 to ± 40 V
Basic Accuracy: 0.17%

Gain-Phase Measurements

Measurement Frequency: 10 Hz to 100 MHz
OSC Level: –65 dBm to +15 dBm
Basic Accuracy: 0.1dB, 0.5°

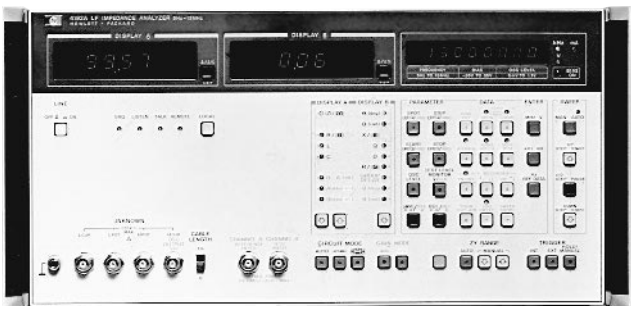
Impedance Measurements Using the HP 41941A/B

The specifications listed are for the HP 4194A when used with the HP 41941A/B.
Test Frequency: 10kHz to 100MHz
OSC Level:
Opt 350: 10 mV to 1.28 V
Opt 375: 10 mV to 1.54 V
DC Bias: 0 to ± 40 V
Measurement Range: 100mΩ to 1MΩ
Basic Accuracy: ± 1.5% to 3% (≥ 100kHz), ± 3% to 6% (<100 kHz)

Ordering Information

HP 4194A Impedance/Gain-Phase Analyzer
Opt 350* 50Ω System
Opt 375* 75Ω System
Opt 001 High-Stability Frequency Reference
HP 41941A Impedance Probe Kit (1.5m)
HP 41941B Impedance Probe Kit (3m)

* Must select either Option 350 or 375



HP 4192A (shown with Option 907 handles)

HP 4192A LF Impedance Analyzer

Specifications

(Refer to data sheet for complete specifications.)
Frequency Range: 5 Hz to 13 MHz
OSC Level: 5 mV to 1.1 mV
DC Bias: 0 to ± 35V
Measurement Range: 1.0000 Ω to 1.000MΩ
Basic Accuracy: 0.15%

Ordering Information

HP 4192A LF Impedance Analyzer

RF Impedance Material Analyzer, 1 MHz to 1.8 GHz

HP 4291B

- Basic accuracy ±0.8%
- Advanced calibration and error compensation
- Four component test fixtures (DUT size: 0.5 mm to 20 mm)
- Independent parameter selection in 2 channels
- Direct read-out permittivity, permeability (option)
- Two material fixtures (operating temperature: –55° to +200° C)
- Versatile analysis (temperature, cole-cole plot, relaxation time)
- Sweep parameters (frequency, ac level, dc bias, temperature)

HP 4291B

HP 4291B RF Impedance/ Material Analyzer

GPIB

Excellent Performance

The HP 4291B RF impedance/material analyzer provides a total solution for high-accuracy and easy measurement of surface-mount components and dielectric/magnetic materials. The HP 4291B uses a direct current-voltage measurement technique, opposing the reflection measurement technique, for more accurate impedance measurement over wide impedance range. Basic impedance accuracy is ± 0.8%. High Q accuracy enables low-loss component analysis. An internal synthesizer sweeps frequency from 1 MHz to 1.8 GHz with 1 mHz resolution. A 1.8-m error-less cable connects the analyzer to a test station so you can extend your test point away from the analyzer without losing accuracy. Advanced calibration and error compensation function eliminate measurement error factors in fixtures and assure high accuracy and repeatability at DUT/MUT.

The HP 4291B also provides automatic level control and monitor of test signals by using IBASIC programming function; devices can be measured under a constant voltage or current. Measure bias-dependent impedance characteristics with optional dc bias (up to 40 V and 100 mA). At the push of a button, the built-in Equivalent Circuit Analysis Function automatically calculates the circuit constant values of five circuit models.

The HP 4291B has two measurement channels; each channel can be set to measure a single (e.g. Z) or dual (e.g. Z-theta) impedance parameter. The color TFT with split-display can show both active traces and memory traces (stored in RAM). A built-in floppy disk drive stores programs and test data in either LIF or MS-DOS format.

With built -in IBASIC, you can control external test equipment such as a temperature chamber or wafer prober directly from the HP 4291B. You do not need a separate instrument controller.

Material Evaluation

The HP 4291B enables easy and sophisticated material evaluation and improves material evaluation quality and efficiency. The HP 4291B provides the total dielectric/magnetic material measurement solutions in wide frequency range (1 MHz to 1 GHz). See page 477 for more information.

Key Features

- Direct material parameter read-out (permittivity, permeability)
- Material analysis functions (Cole-Cole plots, relaxation time analysis)
- Versatile evaluation using a variety of swept parameters (frequency, signal level, temperature, etc.)

Test Fixtures

Select from four types of component test fixtures: HP 16191A, HP 16192A, HP 16193A, and HP 16194A. These test fixtures directly connect to the test station's APC-7 connector. Each fixture is designed for a different component size range, from 0.5 mm to 20 mm, and can handle different types of termination. These adjustable fixtures simplify device connection. For temperature coefficient testing, the HP 16194A high-temperature component test fixture can be used in a temperature oven from –55° to +200° C. Together with the HP 4291B's built-in compensation software, the fixtures ensure impedance accuracy and measurement repeatability. The HP 16453A dielectric material test fixture and HP 16454A magnetic material test fixture improve the accuracy and ease of use for permittivity or permeability measurements. These material fixtures have wide operating temperature of –55° to +200° C.

For measuring thin-film devices and semiconductors, the HP 4291B easily interfaces to a wafer prober. An extension cable connects the HP 4291B's test head to a probe station. For temperature and humidity testing, the HP 4291B can control an external temperature humidity chamber via GPIB and display the measurement result vs. temperature or humidity.

Ease of Use

With the HP 4291B, impedance testing is easy. The analyzer comes with on-line calibration and compensation routine to simplify the task. Markers and limit-line function offer quick data analysis.

Specifications

Measurement Parameters

Impedance Parameters: |Z|, |Y|, Θ, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q
Converted Parameters: |Γ|, U, Γx, Γy
Material Parameters: |ε|, Θ, ε′, ε″, |μ|, μ′, μ″
Operating Frequency: 1 MHz to 1.8 GHz
Frequency Resolution: 1 mHz
Frequency Reference Accuracy: < ± 10 ppm/year @ ± 5° C
Precision Frequency Reference (Option 1D5)
Accuracy: < ± 1 ppm/year @ 0° to 55° C, referenced to 23° C

Basic Measurement Accuracy

Frequency (Hz)	Impedance %	Phase (radian)
1 M to 100 M	0.8	8 m
200 M	1.0	10 m
500 M	1.5	15 m
1 G	2.5	25 m
1.8 G	4.0	40 m

Source Characteristics

OSC Level:
0.2 mV to 1 V rms (1 MHz to 1 GHz)
(Output terminal open)
0.2 mV to 0.5 V rms (1 GHz to 1.8 GHz)
Basic OSC Level Accuracy: 2 dB + 6 dB X f[MHz]/1800 @ 23 ± 5°C; (terminated with 50 Ω) @ V ≥ 250 mV
Display Level Unit: V,I, dBm
Level Monitor Function: Voltage, current
Connector: APC-7
Output Impedance (nominal value): 50 Ω

DC Bias

DC Level: 0 to ± 40 V, 0 to ± 100 mA
DC Level Accuracy:
Voltage Level: 0.1% + 4 mV + (Idc[mA] X 5 [Ω] mV @ 23 ± 5°C
Current Level: 0.5% + 30 μA + (Vdc [V]/10 [kΩ]) mA @ 23 ± 5°C
DC Level Monitor Function: DCV, DCI

Sweep Characteristics

Sweep Parameter: Frequency, ac signal level, dc bias voltage/current (temperature by using IBASIC)

Capacitor Calibration

Open/Short/50 Ω Calibration, low loss CAL
Open/Short/Load Compensation, port extension, fixture electrical length

Key Specifications of Test Fixtures

Type of fixture	HP 16191A	HP 16192A	HP 16193A	HP 16194A
Operating freq. (typ.)	dc to 2 GHz	dc to 2 GHz	dc to 2 GHz	dc to 2 GHz
Operating temperature	–55° to +55°C	–55° to +85°C	–55° to +85°C	–55° to +200°C
DUT size (length: mm)	2.0 to 12.0	1.0 to 20.0	0.5 to 3.2	2.0 to 15.0

Display

CRT
Type: Color TFT
Size: 8 inch
Number of Display Channels: 2
Format: Single, dual, active + memory, graphic, and tabular

Storage

Type: Built-in 3½-inch floppy disk drive; volatile RAM disk memory
Disk Format: LIF, DOS
Programming: Instrument BASIC (built-in)
Input and Output Characteristics
External Reference Input: 10 MHz ± 100 Hz typically
Internal Reference Output: 10 MHz nominal
Reference Oven Output (Option 1D5): 10 MHz nominal
External Trigger Input: BNC female, TTL Level

General Specifications

Operating Temperature/Humidity: 10° to 50° C/15% to 80% RH
Warm-Up Time: 30 min.
Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 to 66 Hz, 500 VA max.
Size/Weight
Mainframe: 426 mm W x 234 mm H x 537 mm D/24.2 kg
Test Station: 275 mm W x 95 mm H x 205 mm D/3.7 kg

Key Literature

HP 4291B 1.8GHz Impedance/Material Analyzer Product Overview, p/n 5966-1501E
HP 4291B 1.8GHz Impedance/Material Analyzer Technical Specifications, p/n 5966-1543E

Ordering Information

HP 4291B RF Impedance/Material Analyzer
Furnished Accessories: High-Impedance Test Head, Calibration Kit, Operation Manual, Floppy Kisk, and Power Cable. (No test fixture is supplied with the HP 4291B.)
Options
Opt 1D5 Add High-Stability Frequency Reference
Opt 001 Add DC Bias
Opt 002 Add Material Measurement Software
Opt 011 Delete High-Impedance Test Head
Opt 012 Add Low-Impedance Test Head
Opt 013 Add High-Temperature High-Impedance Test Head
Opt 014 Add High-Temperature Low-Impedance Test Head

Support Options
Opt W30 Extended Repair Service
Opt W32 Calibration Service

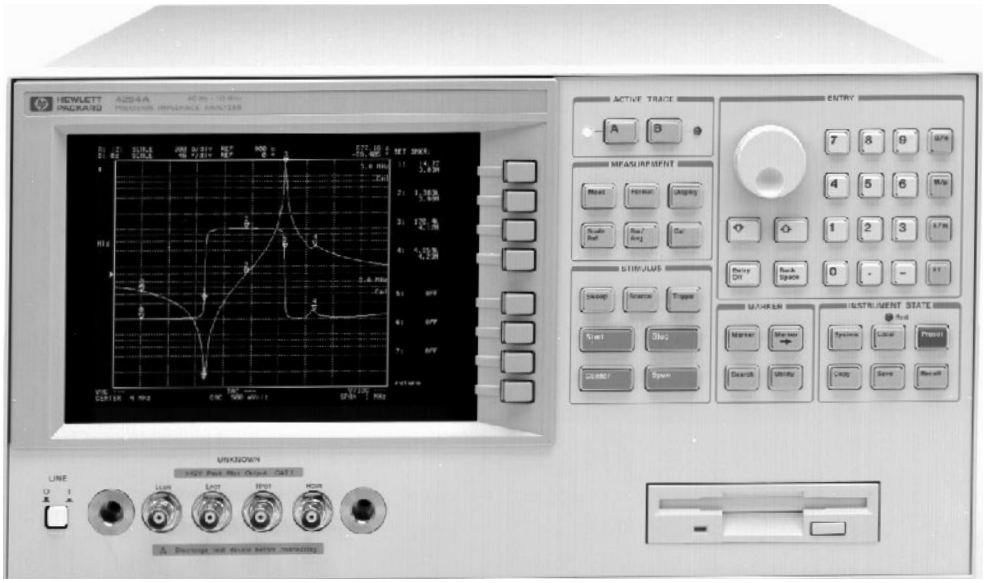
Accessories
HP 16190A HP 4291B Performance Test Kit
HP 16191A Side Electrode Test Fixture
HP 16192A Parallel Electrode Test Fixture
HP 16193A Small Side Electrode Test Fixture
HP 16194A High-Temperature Component Test Fixture
HP 16453A Dielectric Material Test Fixture
HP 16454A Magnetic Material Test Fixture

474 Precision Impedance Analyzer

HP 4294A

NEW

- Accurate measurement over wide impedance range and wide frequency range
- Basic impedance accuracy: ± 0.08%
- 40 Hz to 110 MHz, 3 mΩ to 500MΩ
- Powerful impedance analysis function
- Ease of use and versatile PC connectivity



HP 4294A

HP 4294A Precision Impedance Analyzer

GPIB NEW

The HP 4294A Precision Impedance Analyzer is an integrated solution for efficient impedance measurement and analysis of components and circuits. The HP 4294A covers a broader test-frequency range (40Hz to 110MHz) with Basic impedance accuracy:±0.08%. Excellent High Q / Low D accuracy enables analysis of low-loss components. The wide signal-level ranges enable device evaluation under actual operating conditions. The test signal level range is 5mV to 1Vrms or 200µA to 20mArms, and the DC bias range is 0V to ±40V or 0mA to ±100mA. Advanced calibration and error compensation functions eliminate measurement error factors when performing measurements on in-fixture devices. The HP 4294A is a powerful tool for design, qualification and quality control, and production testing of electronic components. Circuit designers and developers can also benefit from the performance/functionality offered.

Wide-Range Accurate Measurement

The HP 4294A enables impedance measurement using the auto-balancing bridge technique over the frequency range 40 Hz to 110 MHz. The basic impedance accuracy is ± 0.08%, and the typical Q accuracy is ±3% @Q=100, ≤10MHz. This advantage permits accurate evaluations of impedance characteristics for a wide variety of electronic devices as well as electronic and non-electronic material within a wide frequency range.

Versatile Analysis

The HP 4294A graphically displays impedance measurement results. This permits easy analysis of the resonant frequency and impedance values of electronic components using the marker functions. The marker functions offer a simple method to pinpoint the resonant frequency of components, as well, these functions assist users in many other observations. The combination of the accumulate mode (to superimpose traces) and the list sweep functions permits observation of the change in a DUT's characteristics due to a change in the measurement condition. Versatile and high-speed automatic testing is possible using the list sweep function in conjunction with the limit line function. The list-sweep function provides the ability to enhance test throughput by segmenting the sweep to include only necessary measurement frequencies, while the limit-line function (for Go/No-Go Testing) provides the ability to apply test limits within each segment. These functions greatly support the quality and performance required evaluating modern and improved electronic components, equipment and materials.

Equivalent Circuit Analysis

The equivalent-circuit analysis function provides advanced modeling (three and four element models) based on circuit constant values of five available circuit models. This function simulates the frequency characteristics of components by using derived circuit values or user-specified values. Comparison of design values to measurement values can assist with efficient component design.

Programming

Full programmability is provided using built-in Instrument (IBASIC). Desired measurements and computations, including graphics analysis, can be programmed simply by storing front-panel keystroke operations. The one-key execution function allows easy selection and execution of customized IBASIC programs. Several forms of storage are built-in (10Mbyte no-volatile memory, RAM disk or Floppy Disk).

Good PC Connectivity

Features fit to the latest PC environment include LAN (Local Area Network) capability, VGA monitor output, and the TIFF file format. LAN capability permits simplified networking ability when collecting, sharing and analyzing data. VGA monitor output improves productivity and reduces eyestrain. TIFF file format allows easy transfer of graphics to a PC.

Abundance of Accessories

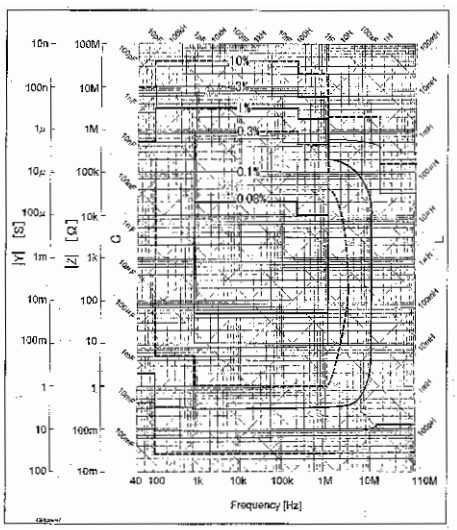
Various four-terminal-pair test fixtures can be used with the HP 4294A. The HP 42941A Impedance Probe Kit (1.5m), which covers 40 Hz to 110 MHz, enables in-circuit impedance measurement of electronic circuits or components. Grounded devices can also be measured. The HP 42942A Terminal Adapter, which covers 40 Hz to 110 MHz, converts the four-terminal-pair port configuration to an APC-7 (7mm) Test Port. This adapter permits the use of familiar APC-7 (7mm) test fixtures. Again, grounded measurement is available. The permittivity of a dielectric solid or liquid material can be accurately measured using existing dielectric test fixtures such as the HP 16451B or the HP 16452A. Impedance measurement, permittivity calculation, and data analysis can be automatically and efficiently executed using the built-in Instrument BASIC programming function and/or the GPIB or LAN interface. The HP 16454A magnetic material (APC-7) test fixture for toroidal cores can also be used with the HP 4294A/HP 42942A configuration for permeability evaluation. These various accessories satisfy a wide variety of fixture needs.

HP 4294A

NEW

Specifications

Measurement Parameters
|Z|-θ, R-X, Ls-Rs, Ls-Q, Cs-Rs, Cs-Q, Cs-D, |Y|-θ, G-B, Lp-G, Lp-Q, Cp-G, Gp-Q, Cp-D, |Z|-Ls, |Z|-Cs, |Z|-Cp, |Z|-Q, |Z|-D, |Z|-Ls, Complex Z-Y, Lp-Rp, Cp-Rp
Basic Measurement Accuracy
Basic Impedance Accuracy (Four Terminal Pair): ± 0.08%
(See figure in detail)
Basic Impedance Accuracy with HP 42941A: ± 0.8%
Basic Impedance Accuracy with HP 42942A: ± 0.6%



HP 4294A Impedance Accuracy @Four-Terminal-Pair, OSC=0.5V)

Source Characteristics

Test Frequency: 40 Hz to 110 MHz
Frequency Resolution: 1 mHz
Frequency Accuracy:
± 20 ppm (±0.13ppm with Opt.1D5)
OSC Level: 5mV to 1Vrms/200µA to 20mArms
OSC Level Resolution: 1mVrms/20µA
OSC Level Accuracy
Voltage: ± ((10+0.05 * f(MHz))% + 1mV) @ UNKNOWN Terminal OPEN
Current:: ± (10+0.3*f(MHz))% + 50µA)@ UNKNOWN Terminal SHORT
Level Monitor Function: Voltage, Current

DC Bias

DC Bias Level: 0 to ±40V, 0 to ± 100mA (Auto level control function available)
DC Bias Level Resolution: 1mV/40µA
DC Bias Voltage Accuracy: ± (0.1% + (5+30*Imon (mA)))mV
DC Bias Current Accuracy: ± (2% + (0.2 * Vmon (V)/20) mA
DC Level Monitor Function: DCV, DCI

Sweep Characteristic

Sweep Parameter: Frequency, ac voltage, ac current, dc bias voltage, dc bias current
Sweep Type: Linear, Log, List, Zero Span, Manual Sweep, Up/Down Sweep
Number of Points: 2 to 801

Calibration/Compensation/Adapter Type

Calibration: Open/Short/Load
Compensation: Open/Short/Load, port extension (electrical length)
Adapter Type: None, 1m. 2m, APC7 Adapter (HP 42942A), Probe (HP 42941A)

Display

Size: 8.4 inch
Type: Color LCD (TFT)

Analysis

Marker: 8 markers, delta marker function, search function, analysis function
Equivalent Circuit Function: Approximation, simuration
Others: Instrument BASIC, Limit Line, Accumulate mode

Interface

LAN Interface: 10 Base-T Ethertwist, RJ45 Connector, TCP/IP
Other Interface: GPIB Interface, Printer (Centronics), 8 bit I/O, 24 bit I/O, VGA monitor output

Storage

Type: Built-in 3.5inch floppy disk drive, 10 Mbyte non-volatile memory, 512kbyte volatile RAM disk memory
Disk Format: DOS
Programming: HP Instrument BASIC

General Information

Operating Temperature and Humidity: 0 to 40° C, 15% to 80% RH
Power Requirements: 90 V to 132 V, or 198V to 264 V, 47 to 63 Hz, 300 VA Max.
Size: 426 mm W * 222 mm H x 502 mm D
Weight: 25kg

Key Literature

HP 4294A Precision Impedance Analyzer Profile, p/n 5968- 3808E
HP 4294A Technical Specification, p/n 5968-3809E

Ordering Information

HP 4294A Precision Impedance Analyzer
Furnished Accessories: Operation manual, floppy disk, and power cable. (No test fixture is supplied with the HP 4294A.)
Opt 1D5 Add High-Stability Frequency Reference
Opt UK6 Supplies commercial Calibration certificate with test data
HP 42941A Impedance Probe Kit
HP 42942A Terminal Adapter
Opt 001 Delete APC-7 Open/Short/Load set
HP 16047E Test Fixture for axial lead components
HP 16034G SMD Test Fixture
HP 16048G 1m Cable
HP 16048H 1m Cable
HP 16451B Dielectric Test Fixture
HP 16454A Magnetic Material Fixture

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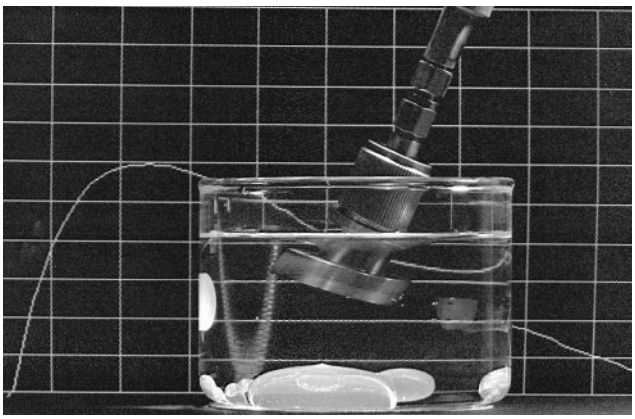
HP 85070C
HP 85071C

- Accessories for characterizing the dielectric properties of materials
- Fast and convenient
- Wide frequency ranges from 30 kHz to 110 GHz
- Addition of markers
- Split screen view showing simultaneous plot and listing of data
- Ability to copy/paste menu items to other applications in plot or list format
- IEEE-488 instrument support - HP 82335, HP 82340, HP 82341, HP 82350, National Instruments cards
- On-line manual
- Compatible with the HP 8712E, 8752, 8753, 8719, 8720, 8722 and 8510 network analyzers
- Software runs on Windows 95, 98, or NT 4.0

HP 85070C Dielectric Probe Kit



Measure the dielectric properties of materials quickly and conveniently with the HP 85070C dielectric probe. Measurements made with a probe-based system are nondestructive and require no sample preparation—saving you time, trouble, and material. The dielectric probe is well-suited for measurements of liquid or semisolid materials. Simply immerse the probe into the material; there is no need for special fixtures. The dielectric probe is not recommended for thin (substrates) or low-loss (resonators) materials.

Knowledge of the dielectric loss of food, rubber, plastic, and ceramic products can assist researchers in the design and optimization of materials in microwave heating processes. Dielectric properties also correlate directly with other material properties—such as moisture content, phase transitions, molecular structure, polarizability, and relaxation constants. For example, this information has been useful in the development of microwaveable prepared foods.

A measurement system based on the HP 85070C dielectric probe yields permittivity (dielectric constant), loss factor, loss tangent, or Cole-Cole diagrams—versus frequency—from 200 MHz to 20 GHz (depending on the network analyzer and material). Measurement accuracy for the dielectric probe is typically five percent.

The HP 85070C high-temperature dielectric probe kit features a hermetic glass-to-metal seal, which makes it resistant to corrosive or abrasive chemicals. It withstands a wide –40˚ to +200˚C temperature range, which allows measurements versus frequency and temperature. This is an important variable, since the dielectric constant of a material can vary significantly as a function of temperature. A special refresh calibration simplifies measurements over temperature. The probe kit contains software and accessories including cables, port/cable adapters, switch, short circuit, mounting bracket, software, adapters, 50 ohm termination, stand, vials, and stoppers.

HP 85071C Materials Measurement Software

Calculate the permittivity and permeability of material samples loaded into sections of coaxial airline or rectangular waveguide using the HP 85071C software. This measurement technique works well for solid materials that can be machined to fit precisely inside a transmission line.

A dielectric measurement can provide critical design parameter information for materials used in state-of-the-art RF and microwave electronic component applications. The loss of a cable or the impedance of a substrate can be related to its dielectric properties. This information is also useful for improving ferrite, radome, absorber, and packaging designs.

There are a variety of different measurement models to choose from in the HP 85071C software. A complete system requires the addition of a fixture (coaxial or waveguide transmission line), network analyzer, and controller. Measurement accuracies of one percent to two percent are typical from 100 MHz to 110 GHz (depending on the material, fixture, and network analyzer).

The standard version of the software runs on Windows 98 or NT.

Other Solutions

Other measurement techniques based on RF or microwave network analyzers exist and offer their own unique advantages. For example, free-space methods are noncontacting and suitable to temperature extremes. (The HP 85071C materials measurement software is compatible with free-space measurements.) Resonator or cavity methods provide the highest accuracy and sensitivity to low-loss materials.

Below 30 MHz, the HP 16451B dielectric test fixture (coupled with an LCR meter or impedance analyzer) provides accurate low-frequency measurement of materials.

Key Literature

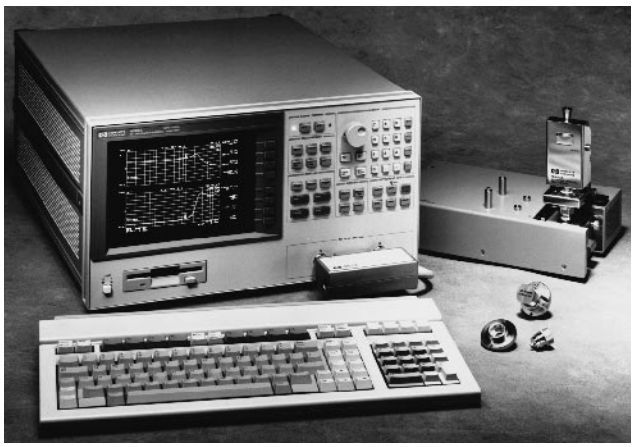
HP 85070C Dielectric Probe Kit Product Overview, p/n 5968-5330E
HP 85071C Materials Measurement Software Product Overview, p/n 5968-5331E

Ordering Information

HP 85070C High-temperature dielectric probe kit
Kit includes probe, software, cable, adapters,termination, shorting block, probe bracket, remote trigger and vials. Not included, but required is a computer and network analyzer.
Opt 001 Adds probe stand (highly recommended)
Opt 002 Adds high temperature cable
Opt 070 Windows 95, 98 or NT 4.0 upgrade software (upgrade from any version of HP 85070 software)
Opt 300 Substitutes HP 85070B HP Basic software
Opt 370 HP Basic software upgrade to HP 85070B (revision 1.05)

HP 85071C Materials measurement software
Windows 95, 98 or NT 4.0 compatible software. Not included, but required is a computer, network analyzer and fixtures or antennas to complete the system.
Opt 071 Upgrade any HP 85071 to Windows 95, 98 or NT 4.0 HP 85071C. Upgrade from any version of HP 85071 software.
Opt 300 Substitutes HP 85071B HP Basic software.
Opt 371 HP Basic software upgrade to HP 85071B (revision 1.05)

- Integrated system for permittivity and permeability measurement from 1 MHz to 1 GHz
- Versatile fixtures for substrate materials and toroids
- Built-in firmware for direct parameter measurement and easy data analysis



HP 4291 System (HP 4291B, 16453A, and 16454A)

HP 4291B Impedance/Material Analyzer (Option 002 required)

The HP 4291B impedance/material analyzer provides an easy and versatile material test solution from 1 MHz to 1 GHz. The analyzer measures impedance accurately and automatically calculates permittivity and permeability data from impedance. Various interchangeable test fixtures, designed specifically to work with the HP 4291B, let you measure dielectric materials and magnetic materials easily.

HP 16453A Dielectric Test Fixture

The HP 16453A dielectric test fixture is best used for measuring substrate materials (solid, sheet material samples) less than 3 mm in thickness such as PC boards, substrates, and polymer materials. When used with the HP 16453A, the firmware (HP 4291B Option 002) built into the analyzer automatically calculates permittivity parameters. Typical accuracy is ±8% for real part of permittivity and ±0.005 for loss tangent. The flexible firmware also lets you display data as a Cole-Cole plot or find relaxation time.

HP 16454A Magnetic Test Fixture

For permeability analysis, the HP 16454A magnetic test fixture is designed for testing toroidal-shaped samples up to 20 mm in diameter. Examples of suitable materials-under-test are soft ferrite and magnetic cores. The HP 16454A comes with different sizes of sample holders for different toroid sizes for maximum flexibility. Built-in firmware (HP 4291B Option 002) automatically computes permeability parameters, eliminating cumbersome coil-winding or lengthy calculation. Typical accuracy is ±4% for real part of permeability and ±0.002 for loss tangent.

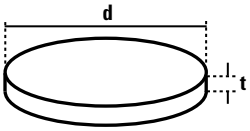
Temperature Coefficient Testing

Both HP 16453A and HP 16454A have an operating temperature range from –55° to +200° C. Two hardware options are available for interfacing the fixtures to a temperature chamber. Choose the HP 4291B Option 013 high-temperature, high-impedance test head for the HP 16453A, or the HP 4291B Option 014 high-temperature, low-impedance test head for the HP 16454A.

Specifications

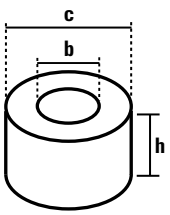
HP 4291B Option 002
Material Parameters: $|\varepsilon_r|$, ε_r', ε_r'', $|\mu_r|$, μ_r', μ_r'', tan δ
Operating Frequency: 1 MHz to 1 GHz
Basic Accuracy: Permittivity: ε_r: ±8% at ε_r < =10, tan δ: ±0.005 (typical)
Permeability: μ_r: ±4%, tan δ: ±0.002 (typical)

HP 16453A Dielectric Test Fixture



Sample Material Specifications
t: 0.3mm≤ t ≤3mm
d: ≥15mm
Operating Frequency Range: 1 MHz to 1 GHz
Operating Temperature Range: –55° to +200° C

HP 16454A Magnetic Test Fixture



Sample Material Specifications

Fixture Holder	Small A	B	Large C	D
c	≤8 mm	≤6 mm	≤20 mm	≤20 m
b	≤3.1 mm	≤3.1 mm	≤6 mm	≤5 mm
h	≤3 mm	≤3 mm	≤10 mm	≤10 mm

Operating Frequency Range: 1 MHz to 1 GHz
Operating Temperature Range: –55° to +200° C

Key Literature

HP 4291B 1.8 GHz Impedance/Material Analyzer Product Overview, p/n 5966-1501E
Permittivity Measurements of PC Board and Substrate Materials using the HP 4291B and HP 16453A, AN Application Note 1300-3, p/n 5966-1844E
Permeability Measurements using the HP 4291B and HP 16454A, AN application Note 1300-4, p/n 5966-1844E

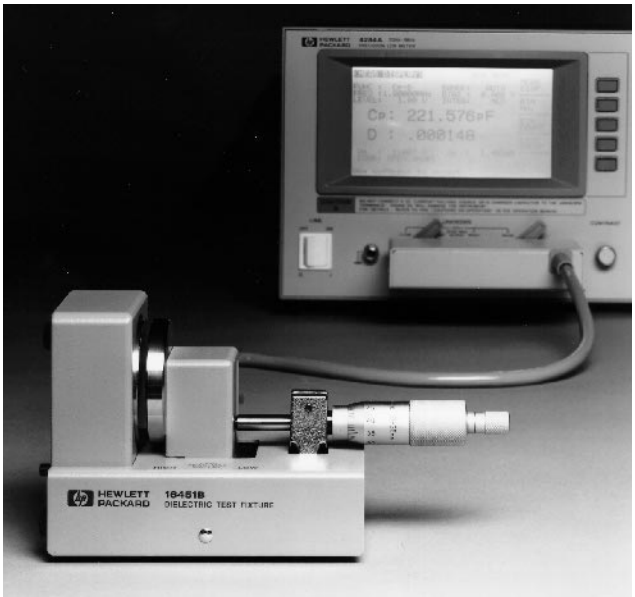
Ordering Information

HP 4291B RF Impedance/Material Analyzer
Opt 002 Material Measurement
Opt 013 High-Temperature, High-Impedance Test Head
Opt 014 High-Temperature, Low-Impedance Test Head
HP 16453A Dielectric Test Fixture
HP 16454A Magnetic Test Fixture

Dielectric and Magnetic Material Test Solutions

HP 16451B
HP 16452A

- For measuring capacitance or dielectric constant of solid materials
- Designed for HP four-terminal-pair LCR meters or impedance analyzers



HP 16451B Dielectric Test Fixture

- For measuring capacitance or dielectric constant of liquids
- Designed for HP four-terminal-pair LCR meters or impedance analyzers

HP 16452A Liquid Test Fixture

HP 16451B Dielectric Test Fixture

For dielectric constant evaluation of solid materials such as polymer, electric insulator, PC board, ceramic substrate, etc., use the HP 16451B dielectric test fixture with any HP four-terminal-pair LCR meter or impedance analyzer up to 30 MHz. The HP 16451B has four types of electrodes which can be replaced according to sample size or measurement technique. Stray admittance and residual impedance of the test fixture can be eliminated by the OPEN/SHORT error correction function of the measurement instrument by using the furnished OPEN/SHORT attachments.

Specifications

Frequency Range: ≤ 30 MHz (depends on instruments)
Operating Temperature: 0 to +55° C
Sample Size: Diameter 10 to 56 mm, Thickness ≤10 mm
Parameters: Capacitance, Loss Tangent, $\varepsilon r'$, $\varepsilon r''$ (must be calculated using external computer or IBASIC)
Electrical Interface: Four-terminal pair

Key Literature

HP 16451B Dielectric Test Fixture Data Sheet, p/n 5950-2368
Dielectric Constant Measurements Using the HP 16451B Test Fixture, p/n 5962-9522E

Ordering Information

HP 16451B Dielectric Test Fixture

HP 16452A Liquid Test Fixture

For convenient testing of liquids, use the HP 16452A liquid test fixture with any HP four-terminal-pair LCR meter or impedance analyzer. With the HP 16452A, you will be able to measure permittivity and impedance characteristics of liquid materials like plastic resins, or petrochemical products. The fixture has inlet/outlet ports which allow continuous measurements of liquids flowing in a process monitoring environment. The internal cell allows accurate measurements to be performed on a small amount of liquid samples.

Specifications

Operating Frequency: ≤ 30 MHz (depends on instruments)
Operating Temperature: –20° to +125° C
Sample Size: 3.4 ml to 6.8 ml
Parameters: Capacitance, Loss Tangent, $\varepsilon r'$, $\varepsilon r''$ (must be calculated using external computer or IBASIC)
Electrical Interface: Four-terminal pair

Note: The HP 16452A is not capable of measuring salt or ionic solutions, or other liquids with bulk conductivity due to the electrode polarization phenomenon.

Key Literature

HP 16452A Liquid Test Fixture Data Sheet, p/n 5091-9228E

Ordering Information

HP 16452A Liquid Test Fixture
Recommended measurement cables for connecting the HP 16452A to a HP four-terminal-pair LCR meter or impedance analyzer: HP 16048A Test Lead (0° to +55° C) or HP 16452-61601 (–20° to +125° C)

HP 4263B

- 0.1% basic accuracy
- 100 Hz, 120 Hz, 1 kHz, 10 kHz, 100 kHz test frequencies
- 20 m to 1 Vrms in 5m Vrms steps
- Test signal level monitor function
- High-speed measurement: 25 ms
- High-speed contact check
- Wide capacitance test range
- Transformer parameter measurements (optional)

HP4263B

HP 4263B LCR Meter

The HP 4263B LCR meter is Hewlett-Packard's most cost-effective low-end LCR meter, designed for both component evaluation on the production line and fundamental impedance testing for bench-top applications. The HP 4263B has five test frequencies that allow you to simulate testing under the correct conditions: 100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz. An optional 20 kHz test frequency can be added to those five frequencies (Option 002).

High-Speed Measurements

The HP 4263B can boost throughput with a measurement speed of 25 ms at any test frequency. This ability improves the throughput of electrolytic capacitor and transformer testing. The HP 4263B can check the contact condition between the test terminals and the device-under-test (DUT). This function ensures the reliability of PASS/FAIL testing with automatic handlers in production. The quick recovery system of the HP 4263B improves throughput. Normal operation is resumed the instant a faulty DUT is removed from the handler, so the handler can always be operated at its full speed.

Electrolytic Capacitor Measurements

The HP 4263B's accuracy and wide measurement range are the right tools to make precise measurements of electrolytic capacitors. Charged capacitors can discharge through the front end and destroy an instrument. The HP 4263B's front end is designed for protection and maintains test integrity.

Transformer Parameter Measurements

With the HP 4263B's ability to make turns ratio (N), mutual inductance (M), and dc resistance (DCR) measurements, data calculations and changing test setups are no longer time-consuming tasks (Option 001). The flexible signal level setting and the voltage-and-current monitor function facilitate the use of the HP 4263B for level dependent DUTs, such as core inductors.

Specifications

(Refer to Product Overview for complete specifications.)

Measurement Functions

Measurement Parameters: |Z|, |Y|, θ, R, X, G, B, L, C, Q, D, ESR
Option 001: Add DCR (dc resistance), N (turns ratio), and M (mutual inductance) measurement
Measurement Circuit Mode: Series and parallel

Mathematical Functions: Deviation and percent deviation

Test Cable Lengths: 0 m, 1 m, 2 m, 4 m (freq. = 100/120/1k Hz); 0 m,1 m, 2 m (freq. = 10k/20k Hz); 0 m, 1 m (freq. = 100 kHz)

Test Signal Information

Test Frequency: 100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz
Option 002: Add 20 kHz test frequency
Frequency Accuracy: ± 0.01% (freq. = 100 Hz, 1 kHz, 10 kHz, (20 kHz, 100 kHz), ± 1% (freq. = 120 Hz)
Output Impedance: 100 Ω ± 10%, 25 Ω ± 10% (≤ 1 Ω range)
AC Test Signal Level: 20 m to 1 Vrms in 5m Vrms steps
Accuracy: ± (10% + 10 mV)
Internal dc Bias
Level: 1.5 and 2 V; **Accuracy:** ± (5% + 2 mV)
External dc Bias: 0 to +2.5 V

Measurement Range

Parameter	Measurement range
|Z| , R, X	1 mΩ to 100 MΩ
|Y| , G, B	10 nS to 1000 S
C	1 pF to 1 F
L	10 nH to 100 kH
D	0.0001 to 9.9999
Q	0.1 to 9999.9
θ	–180° to +180°
DCR	1 mΩ to 100 MΩ
N	0.9 to 200 (unspecified)
L, M	1 μH to 100 H (unspecified)
Δ%	–999.99% to +999.99%

Measurement Accuracy: ± 0.1% (basic) (for |Z|, R, X, |Y|, G, B,C, L)

Measurement Time

Mode	Time (typical)
SHORT	25 ms
MEDIUM	65 ms
LONG	500 ms

Test Signal Level Monitor: Voltage and current
Front-End Protection: Internal circuit protection when a charged capacitor is connected to the input terminals. The maximum capacitor voltage is: Vmax = √(8/C) typical @ Vmax ≤ 250 V; Vmax = √(2/C) typical @ Vmax ≤ 1000 V, C is in Farads.
Display Digits: 3, 4, or 5 (selectable)
Correction Function
Zero OPEN/SHORT: Eliminates measurement errors due to stray parasitic impedances in the test fixtures.
Load: Improves measurement accuracy by using a calibrated device as a reference.
Comparator Function: HIGH/IN/LOW for each primary measurement parameter and secondary measurement parameter.
Contact Check Function: Contact failure between the test fixture and device can be detected. Additional time for contact check: 5 ms.
Other Functions
Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory.
Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings (except dc bias on/off) are automatically memorized (≤ 72 hours at 23° ± 5° C).
GPIB Interface: All control settings, measured values, and comparator information.
Handler Interface: All output signals are negative-logic, optically isolated open collectors. Output signals include HIGH/IN/LOW, no contact, index, end of measurement, and alarm. Input signals include keylock and external trigger.

General Specifications

Power Requirements: 90 to 132 V or 198 to 264 V, 47 to 66 Hz, 45 VA max.
Operating Temperature: 0 to 45° C
Size: 320 mm W x 100 mm H x 300 mm D (12.6 in x 3.94 in x 11.81 in)
Weight: 4.5 kg (9.9 lb)

Key Literature

HP 4263B LCR Meter Product Overview, p/n 5964-6181E
Effective Electrolytic Capacitors Testing, p/n 5967-5378E
Effective Transformer/LF Coil Testing, p/n 5967-5377E

Ordering Information:

HP 4263B LCR Meter
Opt 001 Add Transformer Parameter Measurement Function
Opt 002 Add 20kHz Test Frequency
Opt ABA US-English Localization
Opt ABJ Japan-Japanese Localization
Opt 0B0 Delete Manual Set
Opt W30 Extended Repair Service
HP 16060A Transformer Test Fixture (Option 001 Required)
HP 16065C External Bias Adapter (up to 40Vdc)
HP 16034G Small SMD Test Fixture (0603[mm]/0201[in] SMD)
HP 16044A Kelvin Contact SMD Test Fixture
HP 16047A 4-Terminal Contact Lead Component Test Fixture
HP 16047C 2-Terminal Contact Lead Component Test Fixture
HP 16334A Tweezers Contact SMD Test Fixture
HP 16064B Comparator LED Display/Trigger Box

LCR & Resistance Meters

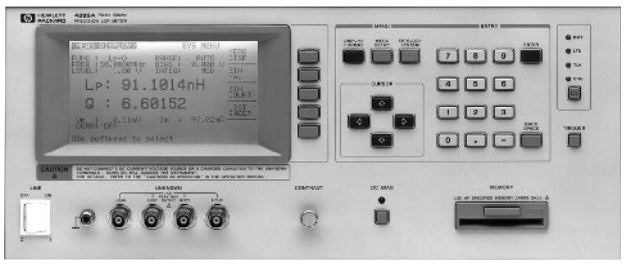
Precision LCR Meters

HP 4284A
HP 4285A

- 20 Hz to 1 MHz, with over 8,600 test frequencies
- 0.05% basic accuracy, 6-digit resolution
- Constant V or I test signal level
- 20 Vrms level option (Option 001)
- 40 Adc with HP 42841A
- List sweep measurement capability

- 75 kHz to 30 MHz in 100 Hz steps
- 0.1% basic accuracy
- High-speed measurements: 30 ms/meas.
- Constant V or I test signal level
- 10 Adc with HP 42841A
- Accurate Q measurement with HP 42851A
- List sweep measurement capability

HP 4284A



HP 4285A

HP 4284A, HP 4285A Precision LCR Meters

The HP 4284A and HP 4285A precision LCR meters are cost-effective solutions for component and material measurement. They can be used to improve component quality by providing an accurate, high-throughput test solution. The wide 20 Hz to 1 MHz test frequency range and superior test-signal performance allow the HP 4284A to test components to the most commonly-used test standards, such as IEC/MIL standards, and under conditions that simulate the intended application. For demanding RF component tests, the HP 4285A offers a higher test-frequency range, from 75 kHz to 30 MHz. Whether in research and development, production, quality assurance, or incoming inspection, the HP 4284A and HP 4285A will meet all of your LCR meter test and measurement requirements.

Specifications

(Refer to Data Sheet for complete specifications.)
Parameters Measured: |Z| -θ, |Y| -θ, R-X, G-B; C-D, Q, ESR, G, Rp; L-D, Q, ESR, G, Rp; Deviation and % deviation
Measurement Circuit Modes: Series and parallel
Ranging: Auto and manual
Trigger: Internal, external, manual, and bus (GPIB)
Delay Time: 0 to 60.000s in 1 ms steps
Measurement Terminals: Four-terminal pair
Test Cable Length:
HP 4284A: Standard: 0 and 1 m; with Option 006: 0, 1, 2 and 4 m
HP 4285A: 0, 1 and 2 m
Integration Time: Short, medium, and long
Averaging: 1 to 256, programmable
Test Signal:
HP 4284A: 20 Hz to 1 MHz ± 0.01%, 8610 selectable frequencies
HP 4285A: 75 kHz to 30 MHz ± 0.01%, 100 Hz steps
Test Signal Modes:
Normal: Programs selected voltage or current at the measurement terminals open or shorted, respectively, and not at the device-under-test.
Constant: Maintains selected voltage or current at the device-under-test independent of changes in the device's impedance.

Test Signal Levels (rms)	Normal	Constant
HP 4284A	5 mV to 2 V, 50 μA to 20 mA	10 mV to 1 V, 100 μA to 10 mA
Option 001	5 mV to 20 V, 50 μA to 200 mA	10 mV to 10 V, 100 μA to 100 mA
HP 4285A	5 mV to 2 V, 200 μA to 20 mA	10 mV to 1 V, 100 μA to 20 mA

DC Bias:
HP 4284A Standard: 0 V, 1.5 V and 2 V
HP 4284A/4285A Option 001: 0 V to ± 40 V

Measurement Display Range

Parameter	Range
|Z|, R, X	0.01 mΩ to 99.9999 MΩ
|Y|, G, B	0.01 nS to 99.9999 S
C	HP 4284A: 0.01 fF to 9.9999 F HP 4285A: 0.01 fF to 999.999 μF
L	HP 4284A: 0.01 nH to 99.9999 kH HP 4285A: 0.001 nH to 99.9999 H
D	0.000001 to 9.99999
Q	0.01 to 99999.9
θ	–180.000° to 180.000°
Δ%	–999.999% to 999.999%

Basic Measurement Accuracy

	|Z|, C, L	D
HP 4284A	0.05%	0.0005
HP 4285A	0.1%	0.001

@ 23° ± 5° C, after OPEN and SHORT correction

Supplemental Characteristics

Measurement Time: Typical measurement time from the trigger command to the end of measurement (EOM) output at the handler interface connector

	HP 4284A at 1 KHz	HP 4285A 75 kHz to 30 MHz
SHORT	40 ms	30 ms
MEDIUM	190 ms	65 ms
LONG	830 ms	200 ms

Option 001 DC Bias Current Output: 100 mA max.

Display

LCD dot-matrix display: Displays measured values, control settings, comparator limits and decisions, list sweep tables, self-test messages, and annunciations.

Correction Function

Zero OPEN/SHORT: Eliminates measurement errors due to the test fixture's stray parasitic impedance.
Load: Improves measurement accuracy by using a calibrated device as reference.

List Sweep Function

A maximum of ten frequencies or test signal levels can be programmed. Single or sequential testing can be performed. When Option 001 is installed, dc voltage bias testing can also be performed.

Comparator

Ten-bin sorting for the primary measurement parameter. IN/OUT for the secondary measurement parameter.
Bin Count: 0 to 999999
List Sweep Comparator: HIGH/IN/LOW decision output for each measurement point in the list sweep table

Other Functions

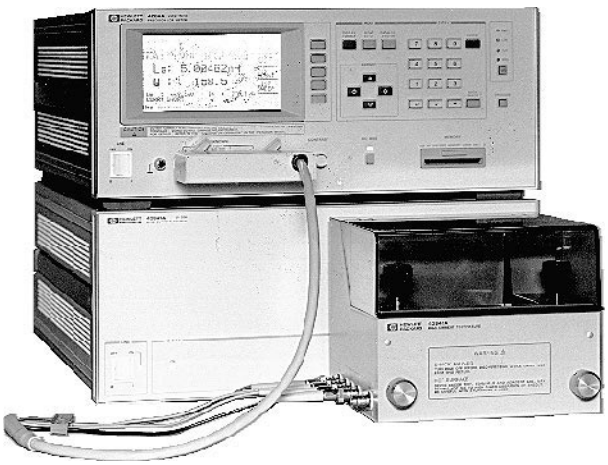
STORE/LOAD: Ten instrument setups can be stored/ loaded from the internal non-volatile memory. Ten additional setups can also be stored/loaded from a memory card.
GPIB: All instrument control settings, measured values, comparator limits, list sweep table, and self-test results.
Memory: The memory buffer can store a maximum of 128 measurement results and output the data over GPIB, ASCII, and 64-bit binary data formats.

General Specifications

Power Requirements: 100/120/220 V ± 10%, 240 V 5%/–10%, 47 to 66Hz
Power Consumption: 200 VA max.
Operating Temperature and Humidity: 0° to 55° C, ≤ 95% RH at 40° C
Size: 426 mm W x 177 mm H x 498 mm D (16.77 in x 6.97 in x 19.61 in)
Weight: Approximately 16 kg (35.2 lb)

Accessories

HP 42841A Bias Current Source
Bias Current Output: (23 ± 5° C); 0.01 A–20.0 A
Basic Impedance Accuracy: 1% when used with the HP 4284A/4285A (1 kHz to 1 MHz)
Interface: Custom, directly controllable by the HP 4284A/4285A with Option 002
HP 48242A/B Bias Current Test Fixture
Used with the HP 4284A and HP 42841A for high dc bias current measurements:
HP 42842A: 20 A max.
HP 42842B: 40 A max.
HP 42842C Bias Current Test Fixture
Used with the HP 4285A and HP 42841A for high dc bias current measurement. 10 A max.
HP 42843A Bias Current Cable
Used with the HP 4284A, HP 42841A (2 units), and HP 42842B for 40 A maximum applications (necessary for Idc > 20A)



HP 4284A with HP 42841A and HP 42842A

HP 42851A Precision Q Adapter

Used with the HP 4285A for resonant Q measurements
Parameters Measured: Q-L, Q-C
Q Measurement Range: 5.00 to 999.99
Basic Q Accuracy: 5%
Measurement Time: 75 ms to 1.5 s
Interface: Custom, directly controllable by the HP 4285A with Option 002
Option 001: SMD Text Fixture

HP 4285A with HP 42851A

Key Literature

HP 4284A/HP 4285A/HP 4286A Precision LCR Meter Family Data Sheet, p/n 5963-5391E
HP 4284A Technical Data, p/n 5963-5390E
HP 4285A Technical Data, p/n 5963-5395E
LCR Meters, Impedance Analyzers and Test Fixtures Selection Guide, p/n 5952-1430E

Ordering Information

HP 4284A Precision LCR Meter
HP 4285A Precision LCR Meter
Opt 001 Power Amplifier/DC Bias (HP4284A)
DC Bias (HP 4285A)
Opt 002[1] Bias Current Interface(HP 4284A)
Accessory Control Interface (HP 4285A)
Opt 004* Memory Card (HP 4284A)
Opt 004* Memory Card (HP 4285A)
Opt 006 2m/4m Cable Length Operation(HP 4284A only)
Opt 109 Delete GPIB Interface(both)
Opt 201 General Purpose Handler Interface(both)
Opt 202 Handler Interface(both)
Opt 301 Scanner Interface(both)
HP 42841A Bias Current Source
HP 42842A Bias Current Test Fixture (20A max.)
HP 42842B Bias Current Test Fixture (40A max.)
HP 42842C Bias Current Test Fixture (10A max.)
Opt 001 SMD Test Fixture (HP 42842C only)
HP 42843A Bias Current Cable
HP 42851A Precision Q Adapter
Opt 001 SMD Test Fixture

[1] Options 001 and 002 do not operate simultaneously.
* Common options

HP 4287A
HP 4286A

NEW

- 1 MHz to 3 GHz, with 100 kHz steps
- Wide impedance measurement range from 200 mΩ to 3 kΩ
- Superior measurement repeatability at low test signal level
- 1% basic accurasy
- High-speed measurements: 10 ms

HP 4287A

HP 4287A RF LCR Meter

NEW GPIB

The HP 4287A RF LCR meter offers accurate, reliable and fast measurements from 1 MHz to 3 GHz to improve quality and throughput of electronic component testing in production lines. The HP 4287A employs the direct-current voltage-measurement technique, as opposed to the reflection-measurement technique, which yields accurate measurements over a wide impedance range.

High Throughput and Reliable Measurement

The HP 4287A is suitable for testing electronic components in the RF range. The HP 4287A's measurement speed is remarkably fast. In addition, the superior measurement repeatability at low test currents such as 100μA provides a fast throughput since less averaging is required.

Simplified System Integration

The test head cable (1m or 2m by using extension cable) can be easily connected closely to the tip of the device-under-test (of the component handler) without any increase in error. The built-in comparator function, a high-speed GPIB interface, and an handler interface, are available for simple integration with the component handler and PC. The enhanced comparator function makes sophisticated binning possible for multi-frequency or array chip testing.

Ease of Use

The 8.4-inch color display provides a clear view of measurement settings and results. The newly developed user interface makes operability easy and error-free. The built-in statistical analysis functions provide a process for monitoring test quality and efficiency. The optional LAN interface helps centralize production control and monitor. Also, a number of APC-7 SMD test fixtures can be used with the HP 4287A's furnished fixture stand and APC-3.5-to-APC-7 adapter, eliminating the need to build custom fixtures.

Specifications

(Refer to Data Sheet for complete specifications)
Measurement Parameters: |Z|, |Y|, L, C, R, D, Q, X, G, B,θ
Measurement Circuit Mode: Series and parallel
Operating Frequency: 1 MHz to 3 GHz
Frequency Resolution: 100 kHz
Source Characteristics:
OSC Level: 5 mVrms to 0.25 Vrms;(output terminal open);
Display Level Unit: V, I, dBm
Connector: APC-3.5
Output Impedance (Nominal Value): 50Ω
Trigger : Internal, external, manual, and GPIB
Impedance Measurement Range: 200 m Ωto 3 k Ω
Basic Measurement Accuracy : |Z| : 1%, D:0.01
Measurement Time: 10 ms
Interface : GPIB, handler interface
Display: 8.4-inch color LCD display
Storage: Built-in HDD/FDD, backup SRAM memory
General Specifications
Operating Temperature/Humidity: 10˚ to 40˚ C/15% to 80% RH
Warm-Up Time: 30 min.
Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 66 Hz, 500 VA max.
Size: Main Frame: 426 mm (W) x 234 mm (H) x 446 mm (D)

Key Literature

HP 4287A RF LCR Meter Product Overview, p/n 5968-5443E
HP 4287A Technical Specifications, p/n 5968-5758E
LCR Meters, Impedance Analyzers and Test Fixtures Selection Guide, p/n 5952-1430E

Ordering Information

HP 4287A RF LCR Meter
Furnished Accessories: Right Angle Test Head(1m), APC-3.5-to-APC-7 Adapter, HP 16195B APC-7 Calibration Kit, Mouse, Key board, Operation Manual and Power Cable. (No test fixture is supplied with the HP 4287A.)
Options
Opt 001 Delete HP 16195B Calibration Kit
Opt 002 Delete Keyboard and Mouse
Opt 003 Delete APC-3.5-to-APC-7 Adapter
Opt 004 Add Working Standard Set
Opt 005 Flash Disk System Memory
Opt 020 Test head cable extension (1m)
Accessories Available
HP 16190B Performance Test Kit
HP 16195B APC-7 Calibration Kit
HP 16192A Parallel Electrode SMD Fixture
HP 16196A Parallel Electrode SMD Fixture for 1608(mm)
HP 16196B Parallel Electrode SMD Fixture for 1005(mm)
HP 16196C Parallel Electrode SMD Fixture for 0603(mm)
HP 16191A Side Electrode SMD Fixture
HP 16193A Small Side Electrode SMD Fixture
HP 16194A High-Temperature Test Fixture

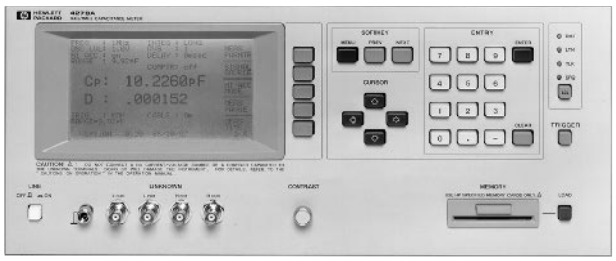
HP 4286A RF LCR Meter

NEW GPIB

The HP 4286A RF LCR meter offers accurate and reliable measurements from 1 MHz to 1 GHz. The HP 4286A employs direct-current voltage-measurement technique as well.

HP 4268A
HP 4278A

- Measurement speed: 6.5 ms/10 ms/21 ms
- Measurement parameters: C-D,Q,ESR,G
- C-D measurement accuracy: 0.07%, 0.0005 (1 kHz, 21 ms); 0.05%, 0.0002 (1 MHz, 21 ms)



HP 4278A

HP 4278A 1 kHz/1 MHz Capacitance Meter

The HP 4278A 1 kHz/1 MHz capacitance meter is a high-speed, highly reliable, precision test instrument aimed at incoming/outgoing capacitor inspection applications on the production line and in quality control. The HP 4278A will improve test efficiency by performing comparative measurements of low to medium value capacitors (up to 200 μF—a range that covers most ceramic and film capacitors).

Specifications

(Refer to Data Sheet for complete specifications.)
Measurement Parameters: C-D,Q,ESR,G
Test Signals
Frequency: 1 kHz and 1 MHz, ± 0.02%
Signal Level: 0.1 to 1 V rms, ± 10% (C≤ 20 μF), in 0.1 V rms steps
Measurement Time: 6.5 ms/10 ms/21 ms (typical)

Measurement Range

Measurement Parameter	1 KHz	1 MHz normal mode 1 MHz high accuracy
C	0.001 pF to 200.000 μF	0.00001 pF to 1280.00 pF; 0.00001 pF to 2663.00 pF
D	0.00001 to 9.99999	0.00001 to 9.99999; 0.00001 to .99999

Cable Length Compensation: 0, 1, or 2 m
Comparator: Ten-bin sorting for capacitance, and go/no-go testing for D, Q, ESR, and G
Memory Card Slot: Memory card slot for external memory for storing and recalling control settings and comparator limits (memory card is optional–see Option 004 below)

General Specifications

Operating Temperature/Humidity: 5° to 45°C, 95% RH @ 40° C
Power: 100, 120, 220 Vac ±10%, 240 Vac +5 –10%, 48 to 66 Hz, 200 VA max.
Size: Approximately 426 mm W x 177 mm H x 498 mm D
(16.77 in x 6.97 in x 19.61 in)
Weight: Approximately 15 kg (33 lb, standard)

Ordering Information

HP 4278A 1 kHz/1 MHz Capacitance Meter
Opt W30 Extended Repair Service
Opt 001 1 kHz Test Frequency Only
Opt 002 1 MHz Test Frequency Only
Opt 003 +1% Frequency Shift: Prevents possible test signal interference when component test contacts are located close to those of other test units
Opt 004 Memory Card
Opt 005 –1% Frequency Shift
Opt 006 +2% Frequency Shift
Opt 101 HP-IB Compatibility
Opt 201 Handler Interface
Opt 202 Handler Interface
Opt 301 Scanner Interface
Accessories Available
HP 16270A Memory Card Set

- Constant test level for high value ceramic capacitor tests
- High speed measurement: 25 ms
- Quick contact check
- 9-bin comparator

HP 4268A

HP 4268A 120 Hz/1 kHz Capacitance Meter

The HP 4268A capacitance meter offers the ability to test high value multi-layer ceramic capacitors at a constant large test signal level and at high speed. The constant test level feature allows the MLCCs to be tested, in compliance with IEC 384-10 standard, for up to 70 μF at 1 V rms at 1 kHz. 120 Hz measurement ensures the constant 1 V test signal for up to 600 μF. The HP 4268A can provide measured values along with comparator results within 25 ms, maximizing test throughput in MLCC production lines.

Major Specifications

Measurement parameters: Cs, Cp, D, Q, Rs, Rp, G
Test Frequency: 120 Hz and 1 kHz
Test Signal Level: 0.1 V to 1 V rms, ±10%, in 0.01 V rms steps

Measurement Range:

Measurement Parameter	120Hz	1kHz
C	0.001nF to 9.9999mF	0.0001nF to 999.99μF
D	0.0001 to 9.9999	0.0001 to 9.9999

Constant Test Level Range (Typical)

Test Voltage	120 Hz	1 kHz
0.5 V rms	C ≤ 1200 μF	C ≤ 140 μF
1 V rms	C ≤ 600 μF	C ≤ 70 μF

Measurement Time: 25 ms./45 ms/60 ms (typical)
Contact Check: Detects contact failure in 4T connection within 5 ms
Comparator: 9 bin output to Handler Interface
Interface: Handler, GPIB and optional scanner interface

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 Vac, 47 to 66 Hz, 100 VA max.
Operating Temperature/Humidity: 0° to 45° C, ≤95%RH @ 40° C
Size: 320 mm W x 100 mm H x 450 mm D (12.6 in x 3.94 in x 17.72 in)
Weight: Approximately 5 kg

Key Literature

HP 4268A Capacitance Meter Product Overview, p/n 5967-5873E

Ordering Information

HP 4268A 120 Hz/1 kHz Capacitance Meter
Opt 001 Scanner Interface
Accessories Available
HP 16044A 4-Terminal Test Fixture for Chip Components
HP 16034E Chip Component Test Fixture
HP 16334A Tweezer-Type Test Fixture
HP 16048A Test Leads, BNC(1m)
HP 16048B Test Leads, SMC(1m)
HP 16048D Test Leads, BNC(2m)

HP 4338B

- Low and selectable test signal current: 1 μA to 10 mA
- Wide measurement range: 10 μΩ to 100 kΩ
- 10 μΩ resolution
- Contact check function
- 1 kHz ac measurement
- High-speed measurement: 34 ms
- Built-in comparator
- Auto-measurement mode

HP 4338B

HP 4338B Milliohmmeter

The HP 4338B milliohmmeter is a precise, reliable, high-speed test tool for measurements of low resistance.

Precise, Low-Resistance Measurement

Contact failure of electromechanical components in a low-current circuit is a key issue for component reliability. The HP 4338B offers selectable low ac test signals (1 μA to 10 mA). Users can now characterize low resistances of electromechanical components under low-current conditions. A high resolution of 10 μΩ allows you to determine the slightest differences in contact resistance testing of relays, switches, connectors, PC board traces and cables. The 1 kHz test signal eliminates potential errors introduced by thermoelectric effects on the device-under-test (DUT) contacts. The 1 kHz ac test signal is the best solution to evaluate the internal resistance of batteries, because it avoids dc energy consumption.

High-Speed Measurements

The high-speed (34 ms), built-in comparator and GPIB/handler interfaces make it possible to construct a measurement system using an automatic handler and external computer to minimize production test time.

Auto-Measurement Mode

When performing gross continuity testing where the test signal level is not a significant factor in the test, the auto-measurement function allows the instrument to select an appropriate test signal and measurement range setting.

Specifications

(Refer to Product Overview for complete specifications.)
Measurement Function
Measurement Parameters: R (ac resistance), X (reactance), L (inductance), |Z| (impedance), θ (phase [°])
Combinations: R, R–X, R–L, |Z| –θ (series mode only)
Mathematical Functions: Deviation and percent deviation
Display Digits: 3, 4, or 5 (selectable)
Test Signal Characteristics
Test Frequency: 1 kHz
Frequency Accuracy: ± 0.1%
Test Signal Level: 1 μA, 10 μA, 100 μA, 1 mA, 10 mA rms
Level Accuracy: ± (10% + 0.2 μA)
Maximum Voltage Across Sample: 20 mV peak in any case

Measurement Range

Parameter	Measurement range
R	10 μΩ to 100 kΩ
X, |Z|	10 μΩ to 100 kΩ (typical)
L	10 nH to 10 H (typical)
θ	–180° to +180° (typical)

Measurement Accuracy: ± 0.4% Basic for R

Measurement Time: Time interval from a trigger command to the end of measurement (EOM) signal output at the handler interface port

Mode	Time (typical)
SHORT	34 ms
MEDIUM	70 ms
LONG	900 ms

Correction Function
Zero SHORT: Eliminates measurement errors due to parasitic impedances in the test fixture
Comparator Function
HIGH/IN/LOW for each primary measurement parameter and the secondary measurement parameter
Contact Check Function
Contact failure between the test fixture and device can be detected
Other Functions
Superimposed dc: ± 42 Vdc maximum may be present on measurement terminals.
Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory.
Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings are automatically memorized (≤ 72 hours at 23 ± 5° C).
GPIB Interface: All control settings, measured values, and comparator information
Handler Interface: All output signals are negative-logic, optically isolated open collectors.
Output Signals Include: HIGH/IN/LOW, index, end of measurement, and alarm. Input signals are keylock and external trigger.

General Specifications

Power Requirements: 90 to 132 V or 198 to 264 V, 47 to 66 Hz, 45 VA max.
Operating Temperature: 0° to 45° C
Size: 320 mm W x 100 mm H x 300 mm D (12.6 in x 3.94 in x 11.81 in)
Weight: 4.5 kg (9.9 lb)

Furnished Accessories

Operation manual, power cable (mating cable and test leads, or HP 16338A test lead set, must be ordered separately)

Key Literature

HP 4338B Milliohmmeter Product Overview, p/n 5964-6183E

Ordering Information

HP 16338A Test Lead Set
HP 16143B[1] Mating Cable (0.6 m)
HP 16005B[2] Kelvin Clip Lead (0.4 m, with large clip)
HP 16005C[3] Kelvin IC Clip Lead (0.4 m, with red IC clip)
HP 16044A SMD Kelvin Contact Test Fixture
HP 16006A[4] Pin-Type Probe Lead (0.4 m)
HP 16007A[5] Alligator Clip Leads (0.4 m, with 2 red clips)
HP 16007B[5] Alligator Clip Leads (0.4 m, with 2 black clips)
HP 16005D[3] Kelvin IC Clip Lead(0.4m, with black IC clip)
HP 16064B LED Display/Trigger Box
HP 4338B Milliohmmeter
Opt ABA US-English Localization
Opt ABJ Japan-Japanese Localization
Opt OBO Delete Operation Manual
Opt W30 Extended Repair Service

[1] Needed when using HP 16005B/C/D, HP 16006A and HP 16007A/B
[2] Need one pair of HP 16005B for measurement
[3] Use with HP 16005C(*1ea) and HP 16005D(*1ea)
[4] Need one pair of HP 16006A for measurement
[5] Use with HP 16007A(*1ea) and HP 16007B(*1ea)

- Wide measurement range: 1 x 10^3 Ω to 1.6 x 10^{16} Ω
- Stable test fixtures: resistivity cell, component test fixture
- High-speed measurement: 10 ms
- Test sequence programming
- Resistivity calculations
- Grounded DUT measurement

HP 4339B

HP 4339B High-Resistance Meter

The HP 4339B high-resistance meter is Hewlett-Packard's most advanced tool for making precision high-resistance measurements.

Precise and Stable Measurement

The measurement range is from 1 x 10^3 Ω to 1.6 x 10^{16} Ω, with a basic accuracy of 0.6%. This wide range allows accurate, high-resistance measurement of capacitors, relays, switches, connectors, materials, cables, and PC boards. The grounded device-under-test (DUT) measurement capability of the HP 4339B gives you the ability to evaluate cables and transformers under grounded conditions. The HP 16008B resistivity cell and the HP 16339A component test fixture are designed for stable and safe measurements of materials or components.

Simple Operation

The test-sequence program function allows you to control a series of resistance measurements in a sequence (charge-measure-discharge). You can set the charge time, measurement interval time, and number of measurements in a sequence through the front panel. The remaining time can be displayed when executing the sequence measurements. Surface resistivity (ρs) and volume resistivity (ρv) functions can be called to act upon measurement data. Calculated results are then automatically displayed, saving you time and effort.

High-Test Throughput

The 10 ms measurement time, 2 ms high-speed contact check function, built-in comparator, and GPIB/handler interfaces deliver high-speed test throughput for production environments.

HP 4339B Specifications

(Refer to Product Overview for complete specifications.)
Measurement Parameters: R (dc resistance), I (dc current), ρs (surface resistivity), ρv (volume resistivity)
Mathematical Functions: Deviation and percent deviation
Display Digits: 3, 4, or 5 (selectable)
Test Voltage: 0.1 to 1000 Vdc, 0.1 V steps @ 0.1 to 200 V, 1 V steps @ 200 to 1000 V
Voltage Accuracy: (0.16% + 100 mV) @ ≤ 200 V, (0.16% + 500 mV) @ > 200 V
Maximum Current: 10 mA @ ≤ 100 V, 5 mA @ ≤ 250 V, 2 mA @ ≤ 500 V, 1 mA @ ≤ 1 kV
Current Compliance Setting: 0.5 mA, 1 mA, 2 mA, 5 mA, 10 mA
Output Resistance: 1 kΩ ± 10%
Input Resistance: 1 kΩ ± 10%
Test Cable Lengths: 2 m maximum

Measurement Range/Accuracy

Parameter	Measurement range	Basic accuracy
I	60 fA to 100 μA	± 0.4%
R (Ω)	1 x 10^3 Ω to 1.6 x 10^{16}	± 0.6%

Measurement Time: Time interval from a trigger command to the end of measurement (EOM) signal output at the handler interface port (range: hold, display, off)

Mode	Time (typical)
SHORT	10 ms
MEDIUM	30 ms
LONG	390 ms

Correction Function
Zero OPEN: Eliminates measurement errors due to stray parasitic resistance in the test fixtures
Test Sequence Program: Controls a series of resistance measurements. Charge time, measurement internal time, and measurement number can be programmed.
Comparator Function: HIGH/IN/LOW for the measurement parameter
Contact Check Function
Contact failure between the test fixture and device can be detected
Available DUT Type: Capacitive DUTs only
DUT Capacitance: ≥ 1 pF + 5% of residual stray capacitance
Residual Stray Capacitance of the Fixture: ≤ 50 pF
Additional Measurement Time for Contact Check: 2 ms
Other Functions
Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory
Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings are automatically memorized (≤ 72 hours at 23° ± 5° C)
GPIB Interface: All control settings, measured values, and comparator information
Handler Interface: All output signals are negative-logic, optically isolated open collectors. Output signals include: HIGH/IN/LOW, no contact, index, end of measurement, and alarm. Input signals include: high voltage off, keylock, and external trigger.

General Specifications

Power Requirements: 90 to 132 V or 198 to 264 V, 47 to 66 Hz, 45 VA max.
Operating Temperature: 0° to 45° C
Size: 320 mm W x 100 mm H x 450 mm D (12.6 in x 3.94 in x 17.72 in)
Weight: 6.5 kg (14.3 lb)
Complies with 73/23/EEC and 92/68/EEC safety standard EN61010-1

Furnished Accessories

Operation manual, shunt connector, power cable (Test fixtures and/or test leads must be ordered separately.)

Key Literature

HP 4339B/HP 4349B High Resistance Meters Product Overview, p/n 5964-6182E
Insulation Resistance Measurement of Plate Type Materials, p/n 5968-3400E
Insulation Resistance Measurements of Electro-mechanical Components, p/n 5968-0325E

Ordering Information

HP 4339B High-Resistance Meter
Opt ABA US-English Localization
Opt ABJ Japan-Japanese Localization
Opt OBO Delete Operation Manual
Opt W30 Extended Repair Service
HP 16339A Component Test Fixture
HP 16008B Resistivity Cell (50 mm Diameter Electrode)
Opt 001 Add 26/76 mm Diameter Electrodes
Opt 002 Add 26 mm Diameter Electrode
Opt 003 Add 76 mm Diameter Electrode
HP 16117B Low-Noise Test Leads (1 m, 2 clips)
Opt 001 Add Pin Probes
Opt 002 Add Soldering Sockets
Opt 009 Delete Alligator Clips
HP 16117C Low-Noise Test Leads (1 m, connectors)
HP 16118A Tweezer Test Fixture
HP 16064B LED Display/Trigger Box

Impedance Measuring Instruments

HP 4291B 1.8 GHz Impedance/Material Analyzer Product Overview
5966-1501E
HP 4291B 1.8 GHz Impedance/Material Analyzer Technical Specifications
5966-1543E
HP 4192A LF Impedance Analyzer Data Sheet
5952-8896
HP 4294A Precision Impedance Analyzer 40 Hz to 110 MHz, Overview
5968-3808E
Accessories Selection Guide for Impedance Measurements Configuration Guide
5965-4792E

(PN 16451B-1) Dielectric Constant Measurements Using the HP 16451B Test Fixture
5962-9522E
(PN 4291-1) New Technologies for Wide Impedance Range Measurements to 1.8 Ghz
5966-2046E
(PN 4291-2) Evaluating Temperature Characteristics Using a Temperature Chamber and the HP 4291B
5966-1927E
On-Chip Semiconductor Device Impedance Measurement Using the HP 4291B (AN1300-7)
5966-1845E

Materials Test Equipment

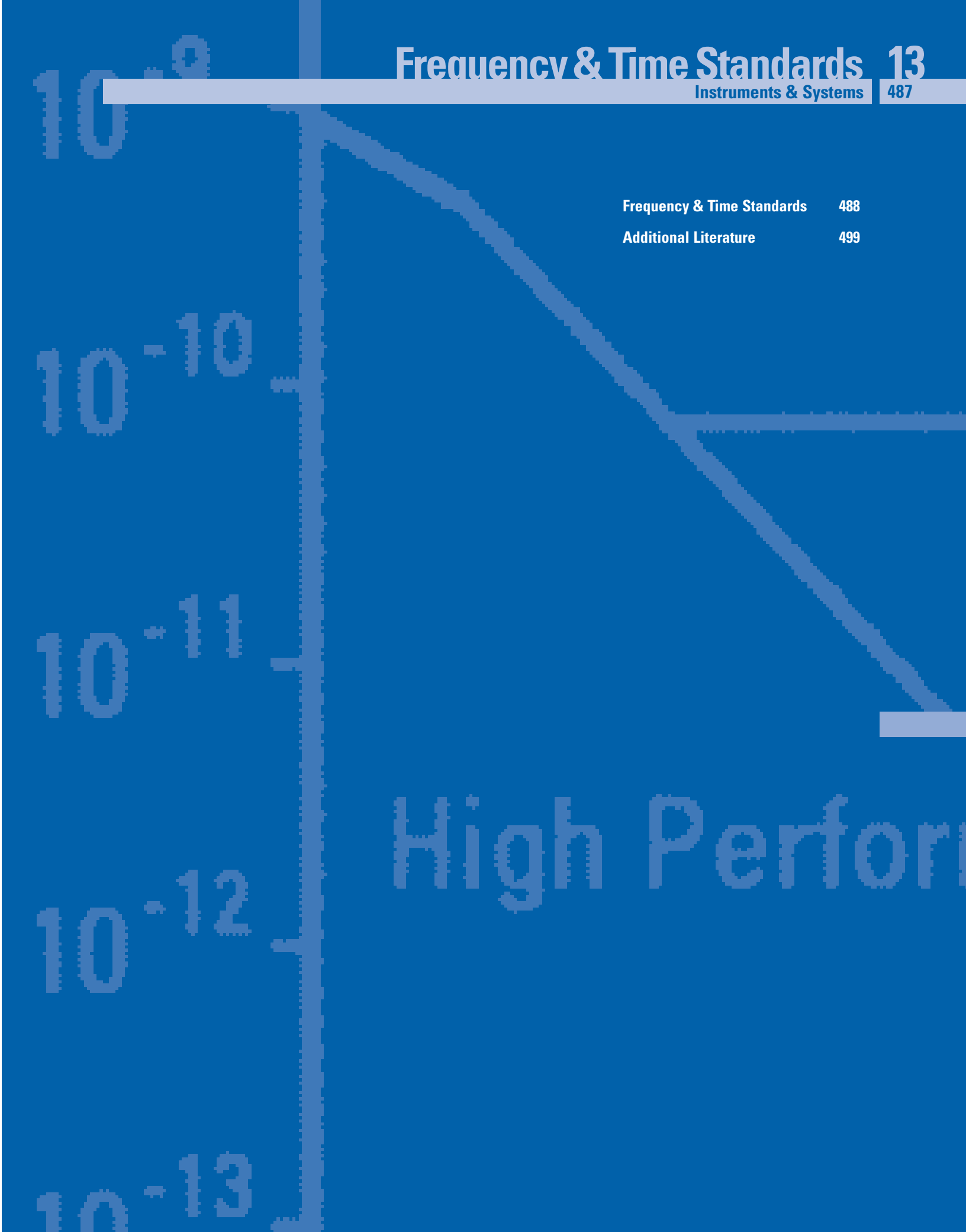
HP 4291B 1.8 GHz Impedance/Material Analyzer Product Overview
5966-1501E
HP 4291B 1.8 GHz Impedance/Material Analyzer Technical Specifications
5966-1543E
HP 85070C High-Temperature Dielectric Probe Kit
5968-5330E
HP 85071C Materials Measurement Software Technical Data
5968-5331E
HP 16200A DC Bias Adapter Product Overview
5964-6700E
HP16451B Dielectric Test Fixture Data Sheet
5962-9522E
HP16452A Liquid Test Fixture Product Overview
5091-9228E

(PN 4291B) Impedance Measurements Using the HP 4291B and the Cascade Microtech Prober
5966-1928E
(PN 4291A-5) Dielectric constant Evaluation of Rough Surface Materials
5966-1926E
Solutions for Measuring Permittivity and Permeability
5965-9430E

LCR & Resistance Meters

LCR Meter Family Brochure
5963-5391E
LCR Meters, Impedance Analyzers and Test Fixtures Selection Guide
5952-1430E
HP 4268A Specification Sheet
5968-3970E
HP 4278A Capacitance Meter Data Sheet
5952-7882
HP 4286A Specification Sheet
5963-5394E
HP 4287A Product Overview
5968-5443E
HP 4338B Milliohm Meter Data Sheet
5964-6183E
HP 4339B/HP 4349B High Resistance Meters
5964-6182E
HP 4284A Technical Data
5963-5390E
HP 4285A Technical Data
5963-5395E
HP 4263B LCR Meter Product Overview
5964-6181E

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00



HP Keeps the World's Time

HP's industry-leading cesium frequency standards set and keep the world's time and frequency at national timekeeping bureaus and standards labs around the globe. HP cesium clocks, which provide more than 80 percent of the weighting of Universal Coordinated Time (UTC), virtually define the world's standard second and the stability of the atomic second.

For decades, HP has led the industry, not only with the world's most stable cesium standard, but also with quartz and counter/modulation-domain analyzer (MDA) technology. HP's quartz has reliability greater than 500,000 hours mean time between failures (MTBF). HP's counters provide 20 picoseconds of resolutions per single shot time-interval measurement and MDAs provide 50 picoseconds of time-interval resolution. MDA technology—developed by HP in 1991—allows users in the lab and on communication networks to view signal dynamics without fear of missing events by making continuous, back-to-back measurements.

Today, global positioning system's (GPS) precise time and frequency and breakthrough intelligent oscillator technology (see "HP SmartClock Technology" in "Key Technologies" on page 489) have been added to HP's comprehensive family of timing and synchronization solutions. HP SmartClock Technology adds intelligence in the form of firmware algorithms to oscillators that are referenced to GPS or other time-reference signals. This intelligence improves the performance of low-cost, highly-reliable quartz to near-cesium quality when locked to GPS and to near-rubidium quality during holdover when the primary reference is not available.

High reliability is a key feature of HP SmartClock Technology. Because the technology continuously calibrates the oscillator to GPS and steers the oscillator during holdover when the reference signal is not available, time-consuming and expensive calibration is no longer needed. The combined technologies of GPS, HP SmartClock and quartz have revolutionized timing by making available low-cost, highly-precise solutions.

Timing/Frequency Sources

Different levels of precise time and frequency are provided by sources ranging from the GPS and cesium atomic clocks to rubidium and quartz clocks:

Cesium: Before GPS and HP SmartClock Technology, the more expensive the frequency source, the better its accuracy. Cesium atomic clocks, for example, maintain accurate frequency indefinitely without the need for calibration. Because cesium oscillators are higher cost, they are applied only to the most critical applications as primary reference clocks at the top of a network's hierarchy. By using cesium, networks and labs gain independence from other potentially less-reliable timing references.

Rubidium: Rubidium atomic oscillators are lower cost than cesium and have excellent short-term stability (ability to consistently produce accurate time and frequency), but require frequent access to a primary reference signal or synchronization source to maintain long-term, cesium-level accuracy.

Quartz: High-quality quartz oscillators are extremely reliable, inexpensive and have excellent short-term stability. But until HP SmartClock Technology, the effects of aging and temperature on signal stability have made quartz oscillators less accurate over time than either cesium or rubidium.

GPS: Global positioning system (GPS) is the satellite system that provides continuous access to precise time and frequency anywhere on Earth. It is available for commercial use at no cost.

Oscillator Continuum

	Cesium	Rubidium	Quartz	Quartz w/GPS
Long-Term Accuracy	$\pm 7 \times 10^{-12}$ for life of cs. beam tube	$\pm 3 \times 10^{-11}$/mo.	$\pm 5 \times 10^{-10}$/day	$< 1 \times 10^{-12}$/day avg. when locked to GPS
Long-Term Aging	N/A	1×10^{-12}/day	1×10^{-10}/day	N/A
Oscillator Reliability (MTBF)*	120,000–150,000 hrs.	50,000–150,000 hrs.	>500,000 hrs.	>500,000 hrs.

*Mean time between failures

Standards Labs

HP's frequency standards and clocks provide accurate frequency, time-interval and timekeeping capabilities to compare against national standards in timekeeping, R&D and standards labs.

Cesium-beam frequency standards are used in labs where the goal is a very high-accuracy primary frequency standard. HP quartz oscillators are used in virtually every frequency-control application, including atomic standards. The excellent short-term stability and spectral purity of the quartz oscillators contributes to the high quality of the output signal. For less demanding applications where some long-term drift can be tolerated, quartz oscillators are used as independent frequency sources.

HP's own standards lab in Santa Clara, CA is designated as the U.S. Naval Observatory (USNO) West Coast time-reference station. The lab maintains an ensemble of three high-performance HP cesium-beam standards to verify timing accuracy using GPS time-transfer techniques.

Communication and Power Utility Networks

Leveraging this expertise and leadership in timing, HP continues to broaden its family of timing synchronization solutions for wireline and wireless telecommunication service providers, power utilities and network equipment manufacturers.

Timing Synchronization Systems and Services

Responding to the needs of customers, HP has taken a comprehensive systems approach to help plan, implement, manage and support the increasingly complex timing synchronization system:

- HP's growing line of products improve timing and synchronization to enable networks to operate reliably and accurately at higher speeds. Even with increasing customer loads, quality of service is improved. Products include a cesium primary-reference clock (PRC), quartz or rubidium GPS primary-reference source (PRS), and quartz or rubidium synchronization supply unit (SSU). A complete line of accessories is available.
- Custom-designed timing subsystems enable network equipment manufacturers to improve time to market and reduce project risk by outsourcing this increasingly-specialized engineering task. HP acts as the manufacturer's off-site R&D team to design a custom module and move quickly to prototype and high-volume production.
- A network synchronization audit uses cesium and MDA technology to quantify timing performance and identify the locations of poor timing.
- Services such as synchronization planning help network designers plan and deploy their increasingly complex timing synchronization subsystems.
- HP's telecom support organization is specially trained in timing to help carriers keep their synchronization networks running smoothly, 24-hours per day, seven days per week. Network equipment manufacturers also rely on the support organization to provide service for the timing subsystem that is not their core competency.
- Synchronization network management software manages synchronization across the entire multivendor network. A major development, HP's software is the first to provide operators a comprehensive view of the synchronization of all network offices and elements, allowing prompt identification of problem areas. The software operates on the telecom industry's defacto platform—HP OpenView—and is the final piece of HP's total network management solution that includes computers, software and interconnectivity products.

Why is Better Timing Needed?

For telecom carriers who are beginning to deploy on a large scale broadband services based on next-generation SONET/SDH, the potential problems are many. When timing or synchronization are inadequate, quality issues range from distorted, unreadable faxes and corrupted or lost data to frozen images on video-conference screens and unintelligible encryption messages requiring re-transmission.

Similarly, wireless carriers—who are increasing capacity and moving from older, analog technologies to next-generation CDMA, TDMA and two-way paging technologies—face timing-related problems of crosstalk and blocked or dropped calls. Wireless carriers are also learning that the timing they receive from the T1 or E1 lines of their wireline counterparts—who are often competitors—does not always provide the accuracy needed.

Frequency Standards and Synchronization Systems Applications

	Wireless Communications	Wireline Telecommunications	Power Transmission	Defense/Aerospace	General Purpose
Network Equipment Manufacturers	**HP 58000 Series and 58503B, 58533A, 58534A, 58540A** Base station frequency and timing synchronization	**HP 58000 Series** **HP 55300A and 55400A** Central office frequency and timing synchronization	**HP 59551A** Fault location Wide area sync for higher capacity	–	–
Service Providers	**HP 55300A and 58503B, 58533A, 58534A, 58540A** MTSO, BSC, BTS frequency and timing synchronization **HP 55460A and 55461A*** Sync audit and planning services	**HP 5071A** International Gateway timing **HP 55300A and 55400A** Main Office, Central Office and Local Exchange timing synchronization **HP 55460A and 55461A*** Sync audit and planning services	**HP 59551A** Fault location Wide area sync for higher capacity	–	–
R&D, Manufacturing and Production Test	**HP 58503B, 58533A, 58534A, 58540A** Frequency and time reference	**HP 58503B and 55300A, 58533A, 58534A, 58540A** Frequency and time reference	**HP 58503B and 59551A, 58533A, 58534A, 58540A** Frequency and time reference	**HP 58503B and 5071A, 58533A, 58534A, 58540A** Frequency and time reference	**HP 58503B, 58533A, 58534A, 58540A** Frequency and time reference
Metrology and Calibration	**HP 5071A and 58502A Opt 010** Frequency standards **HP 58503B** Inexpensive time and frequency reference **HP 58533A and 58540A** Low cost, compact size time & frequency reference receivers	**HP 5071A and 58502A Opt 010** Frequency standards **HP 58503B** Inexpensive time and frequency reference **HP 58533A and 58540A** Low cost, compact size time & frequency reference receivers	**HP 5071A and 58502A Opt 010** Frequency standards **HP 58503B** Inexpensive time and frequency reference **HP 58533A and 58540A** Low cost, compact size time & frequency reference receivers	**HP 5071A and 58502A Opt 010** Frequency standards **HP 58503B** Inexpensive time and frequency reference **HP 58533A and 58540A** Low cost, compact size time & frequency reference receivers	**HP 5071A and 58502A Opt 010** Frequency standards **HP 58503B** Inexpensive time and frequency reference **HP 58533A and 58540A** Low cost, compact size time & frequency reference receivers

* Contact HP for pricing and details on the HP 55460A Sync Audit Service and the HP 55461A Sync Planning Service.

Note: Products in this table are described on the following pages:
HP 58502A Opt 010, page 492
HP 5071A, page 490
HP 55300A and 55400A, pages 503 and 505
HP 58000 Series, page 498
HP 58503B, page 494
HP 59551A, page 493
HP 58533A, HP 58534A, HP 58540A, pages 495 and 496

Key Technologies

The following new technologies have revolutionized timing by making low-cost, highly-precise solutions available to communication networks and in the lab:

Global Positioning System Precise Time

The global positioning system (GPS) provides continuous access to precise time and frequency, at low cost—anywhere on Earth. The 24-satellite global positioning system, designed by the United States as a dual-use system for commercial and military applications, transmits data for precise time and position (latitude, longitude and altitude).

The signal is accurate to within 340 nanoseconds of Universal Coordinated Time (UTC). All ground stations for monitoring and providing master control for the GPS system are based on HP atomic clocks.

HP SmartClock Technology

HP SmartClock Technology adds intelligence to oscillators that are referenced to GPS or other time-reference signals.When locked to a reference signal, HP SmartClock Technology compares the frequency of the unit's oscillator to that of the reference signal and uses this information to adjust the frequency of the oscillator to match the reference signal. Corrections automatically are issued over time, keeping the performance of the oscillator as close as possible to that of the reference source.

If the incoming reference signal is lost, HP SmartClock Technology automatically switches the timing system into an intelligent holdover mode. HP SmartClock Technology takes control of the oscillator so that it continues to distribute highly-stable synchronization outputs. Having learned the oscillator's behavior (aging rate and effects of temperature) when it was locked to the reference signal, HP SmartClock Technology adjusts the oscillator as needed. When the reference signal is restored, the unit automatically relocks.

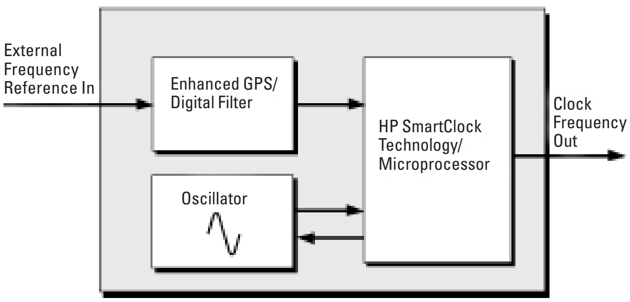
HP SmartClock Technology also evaluates the received GPS signal data. Bad data resulting from a satellite malfunction, temporary reception problems or an erroneous upload to a satellite is not used. As a result, the HP SmartClock Technology unit avoids errant timing that causes errors in the timing system.

HP Quartz Oscillator

HP's oven-controlled quartz oscillators provide best-in-the-industry performance. The HP 10811D/E quartz oscillator (see page 508), currently used in most HP timing products, has a proven record of reliability with mean time between failures (MTBF) of more than 500,000 hours.

HP Enhanced GPS/Digital Filter

The adverse effects of selective availability (SA), which occur because jitter is added to the GPS signal to maintain security for U.S. military applications, are minimized by a digital filter called HP Enhanced GPS. HP uses a similar filter technology to remove jitter from other external reference sources such as T1 or E1 lines from the wireline network.



HP SmartClock Technology Block Diagram

HP 5071A
HP 55000

Accuracy: ±5 x 10^{-13}
- Settability: ±1.0 x 10^{-9}
- "Flicker floor": ≤ 5.0 x 10^{-15} typical
- Fast warmup
- No adjustments before or during operation
- Remote operation

HP 5071A

HP 5071A Primary Frequency Standard

The HP 5071A primary frequency standard delivers unsurpassed accuracy and stability for both laboratory and field applications. Its improved cesium-beam tube reduces the effects of Ramsey pulling. New beam optics use cesium more efficiently. The combined results—increased accuracy and stability, and increased tube life—ensure that your calibration lab services are available longer.

The HP 5071A is easy to use. Automatic startup is simple and requires no adjustments. A logical menu structure simplifies front-panel operations, selections, and status reporting.

The HP 5071A can be operated and maintained anywhere. All controls are programmable, status can be checked remotely, and no adjustments or alignments are necessary during operation. An internal battery provides 45 minutes of backup in case of ac power failure.

Unmatched Accuracy and Stability

The HP 5071A uses Cesium II technology to double the accuracy of its predecessor, the HP 5061B. Cesium II technology includes a new cesium tube and redesigned electronics. The improved accuracy ensures that any HP 5071A Option 001 can power up to within ±5 x 10^{-13} of the accepted standard for frequency. This is achieved under full environmental conditions in 30 minutes or less.

Cesium II technology brings a new level of stability to the cesium clock. The HP 5071A is the first cesium standard to specify its stability for averaging times longer than a day. It is the first standard to specify a "flicker floor"—the point at which the standard's stability does not change with longer averaging. Under laboratory conditions, the standard HP 5071A has a flicker floor better than 5 parts in 10^{14}.

Hewlett-Packard has been producing cesium frequency sources since 1964. The exceptional accuracy and stability of the HP 5071A are a result of this experience and are characterized by improved reliability. Backing up this reliability is a ten-year warranty on the standard cesium tube and a three-year warranty for the optional high-performance tube.

Ease of Use

Startup and operation of the HP 5071A are extremely simple. Once connected to an ac or dc power source, the instrument automatically powers up to its full accuracy specifications. No adjustments or alignments are necessary during powerup or at any time during the lifetime of the cesium tube.

Intuitive menus logically report status and facilitate control of the instrument. These menus—Instrument State, Clock Control, Instrument Configuration, Event Log, Frequency Offset, and Utilities—are accessible via the front-panel LCD display and keypad.

High-Performance Tube: Option 001

For the most demanding operations, the HP 5071A Option 001 high-performance cesium-beam tube offers increased performance. Accuracy is two times better than the standard tube, and stability is superior as well. The high-performance tube allows a flicker floor of better than 1 x 10^{-14} and measurements at NIST show that the flicker floor is typically better than 5.0 x 10^{-15}.

Telecommunications Options

The HP 5071A primary frequency standard may be optionally equipped to provide output frequencies, impedances, and signal formats required of a Primary Reference Clock in modern telecommunication networks. Configurations are available for both DSI and CEPT standards. The HP 5071A can also be equipped to operate from a 48 Vdc central office battery.

Clock rates of 1.544 and 2.048 Mb/s are available. Impedance choices and signaling formats for all current ITU-T specifications are available. The HP 5071A with 2.048 Mb/s options are ITU-T G.811 compliant. All features found in a standard HP 5071A are retained when a 1.544 or 2.048 Mb/s option is installed. This includes both programmable 5/10 MHz outputs and the 1 MHz and 100 kHz outputs. The 1 pps output and sync are only available on the front panel of the instrument.

The HP 5071A Option 048 equips the frequency standard to operate from 48 Vdc power. Two independent 48-volt power sources may be supplied. The power sources must be of the same polarity but either polarity may be used. The frequency standard draws power from the source with the higher voltage. Upon source failure the frequency standard will automatically switch to the good source—ensuring uninterrupted operation.

The HP 5071A Option 048 automatically uses a 48 Vdc source if one is present. The instrument will attempt to use ac power if no dc source is available. The internal battery normally supplied with the HP 5071A is not available when Option 048 is installed.

Specifications

Accuracy and Stability

Full Environmental Range
Conditions (any combination of):
Temperature: 0° to 50° C
Humidity: 0 to 80% (40° C maximum)
DC Magnetic Field: 0 to 2 gauss
Warmup Time (typical):
15 minutes to normal operating status
30 minutes to full specs
Settability
Resolution: 6.3 x 10^{-15}
Range: ±1.0 x 10^{-9}
Frequency Change Due to Environment: ±1 x 10^{-13} (±8 x 10^{-14} Option 001)
Accuracy: ±1 x 10^{-12} ±5 x 10^{-13} (Option 001)

Time domain stability[1], 5/10-MHz outputs:

Averaging Times	HP 5071A	HP 5071A Option 001
10^4 s	≤2.7 x 10^{-13}	≤8.5 x 10^{-14}
10^5 s	≤8.5 x 10^{-14}	≤2.7 x 10^{-14}
5 days	≤5.0 x 10^{-14}	≤1.0 x 10^{-14}
30 days	≤5.0 x 10^{-14}	≤1.0 x 10^{-14}
30 days (typical)	≤1.5 x 10^{-14}	≤5.0 x 10^{-15}

[1] Based on long-term measurement at NIST.

Flicker Floor:
≤5.0 x 10^{-14} (≤1.5 x 10^{-14} typical)
≤1.0 x 10^{-14} (Option 001 ≤5.0 x 10^{-15} typical)
Reproducibility: ≤5.0 x 10^{-13}

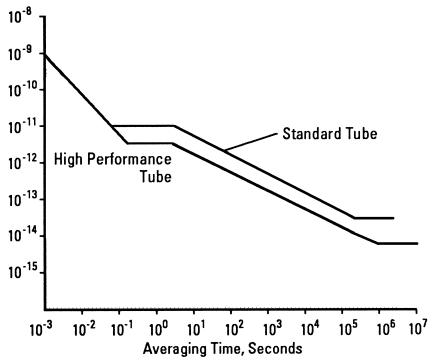
Sinusoidal Output Characteristics (all located on rear panel)

Parameter	Ports 1 and 2[2]	1 MHz, 100 kHz
Amplitude into 50 Ω load	>1 V rms	>1 V rms
Isolation between ports	>110 dB (typ.)	not specified
Harmonic and sub-harmonic signals (typical)	< –40 dBc	< –40 dBc
Non-harmonic distortion	< – 80 dBc	not specified
Connector type	N	BNC
Source impedance (nominal)	50 Ω	50 Ω

[2] Each output can be set to either 5 or 10 MHz from the front panel or by remote command.

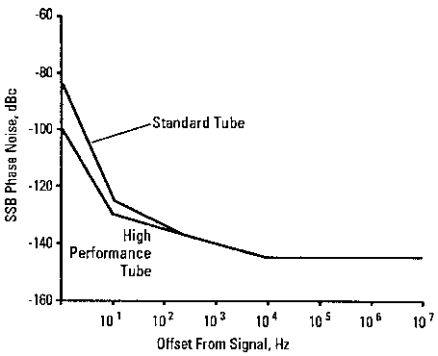
Frequency Stability (5/10-MHz Outputs)

Time Domain Stability (Allan Deviation)



	$\sigma y(2, \tau)$	
Averaging time (seconds)	**Standard cesium-beam tube**	**High-performance cesium-beam tube (Option 001)**
10^{-2}	$\leq 7.5 \times 10^{-11}$	$\leq 7.5 \times 10^{-11}$
10^{-1}	$\leq 1.2 \times 10^{-11}$	$\leq 1.2 \times 15^{-11}$
10^{0}	$\leq 1.2 \times 10^{-11}$	$\leq 5.0 \times 10^{-12}$
10^{1}	$\leq 8.5 \times 10^{-12}$	$\leq 3.5 \times 10^{-12}$
10^{2}	$\leq 2.7 \times 10^{-12}$	$\leq 8.5 \times 10^{-13}$
10^{3}	$\leq 8.5 \times 10^{-13}$	$\leq 2.7 \times 10^{-13}$
10^{4}	$\leq 2.7 \times 10^{-13}$	$\leq 8.5 \times 10^{-14}$
10^{5}	$\leq 8.5 \times 10^{-14}$	$\leq 2.7 \times 10^{-14}$
5 days	$\leq 5.0 \times 10^{-14}$	$\leq 1.0 \times 10^{-14}$

Frequency Domain Stability



	SSB Phase Noise dBc	
Averaging time (seconds)	**Standard cesium-beam tube**	**High-performance cesium-beam tube (Option 001)**
10^{0}	≤ -85	≤ -100
10^{1}	≤ -125	≤ -130
10^{2}	≤ -135	≤ -135
10^{3}	≤ -140	≤ -140
10^{4}	≤ -145	≤ -145
10^{5}	≤ -145	≤ -145

Internal Standby Battery (nominal values)

Capacity: 45 minutes at 25° C from full charge
Charge Time: 16 hour maximum from fully discharged state
Charge Source: AC input power only

Remote System Interface and Control

RS-232-C (DTE configuration): Complete remote control and interrogation of all instrument functions and parameters
- **Interface Circuits:** Optically isolated
- **Software Command Set:** SCPI, version 1990.0
- **Connector:** 9-pin male rectangular D subminiature type

Status Output: Logic output for externally monitoring normal and abnormal operation (user-defined)
- **Output:** TTL open collector with internal pull-up resistor
- **Circuit Sink Capability:** Up to 10 mA
- **Connector:** BNC on rear panel

Environmental and Physical

Temperature
- **Operating:** 0° to 55° C
- **Non-operating:** –40° to +70° C

Size: 425.5 mm W x 133.4 mm H x 523.9 mm D (16.75 in x 5.25 in x 20.63 in)
Weight: 30 kg (65 lb)

Ordering Information

HP 5071A Primary Frequency Standard
- **Opt 001** High-Performance Cesium-Beam Tube
- **Opt 0B2** Extra Operating and Programming Manuals
- **Opt 0BW** Assembly-Level Service Manual
- **Opt 908** Rack Flange Kit (for use without handles)
- **Opt 913** Rack Flange Kit (for use with handles included with HP 5071A)
- **Opt W30** Extended Repair Service (see page 584)
- **Opt W50** Extended Repair Service (not available with Option 001)

Telecommunications Options
- **Opt 048** 48 Vdc Power
- **Opt 104 or 105** 1.544 Mb/s, 100 Ω Balanced
- **Opt 220, 221 or 222** 2.048 Mb/s, 120 Ω Balanced
- **Opt 270, 271 or 272** 2.048 Mb/s, 75 Ω

HP 10811D/E Oscillators

The HP 10811D/E crystal oscillators are oven-controlled, high-performance component oscillators. Both offer unmatched quality, high performance, and low cost. The low aging rate and fast warmup time reduce maintenance costs and downtime. Low power consumption gives the HP 10811D/E oscillators longer battery-backup time. Low phase noise translates to lower system phase noise when using HP oscillators.

The HP 10811D has a PCB connector for all external connections; the HP 10811E uses filter feedthrough terminals for power connections and oven monitor. The HP 10811E also has SMB snap-on RF connectors for the 10 MHz output and EFC input, and provisions for shock mounting.

The HP 105B quartz frequency standard uses the HP 10811D and is available as a complete standalone instrument.

Ordering Information

HP 10811D 10 MHz Oscillator, PCB/Edge Connector
HP 10811E 10 MHz Oscillator, SMB Connectors
Options for HP 10811D or HP 10811E
- **Opt 001** Low Aging Rate
- **Opt 002** Low Phase Noise
- **Opt 003** Integrated Option 001 and Option 002
- **Opt 100** Reduced Specifications

Distribution Amplifier

HP 58502A

- 12-Channel broadband (0.1 to 10 MHz) sine wave distribution
- Low output phase noise and spurious signals
- High isolation/low cross-talk between output channels
- Available internal oscillator for standalone operation or backup
- Autoswitching between two inputs
- Easy-to-read front panel status lights
- Channel fault alarm

HP 58502A

Introduction

The HP 58502A Broadband Distribution Amplifier is the one frequency standard distribution system that provides multiple features to ensure continuous distribution of your critical signals. It is designed to meet today's demanding requirements for frequency distribution in manufacturing, R&D, and standards lab environments. It also provides economical distribution of precision signals from cesium, rubidium, quartz or GPS frequency standards.

The HP 58502A Broadband Distribution Amplifier features low signal distortion and high isolation between output channels. Low output phase noise and exceedingly low spurious signal content help maintain signal integrity.

Continuous Availability of Critical Frequencies

The following features ensure your critical frequencies are always present, 1) When the unit detects one of its inputs is removed or the amplitude of the input is greatly reduced, it will automatically switch (autoswitch) to the other input; 2) The HP 58502B is compatible with the alarm signals from the HP 58503B GPS Time and Frequency Reference Receiver and the HP 5071A Primary Frequency Standard. If the alarm of one of these sources is active, and this source is driving the distribution amplifier outputs, the HP 58502A will automatically switch to a backup source. In addition, this change will be reflected in the HP 58502A alarm outputs so it may be monitored by external equipment.

Autoswitching between two inputs ensures continuous availability of critical frequencies, and a fault alarm is activated when the system does not function correctly. These alarm and switching features can also be monitored and controlled through the unit's RS-232C interface.

Great Flexibility

Flexibility of the HP 58502A is enhanced when purchased with its optional internal oscillator. With this option, the HP 58502A can be used as a high quality quartz reference source with 12 outputs. Or, if operated with one external source, the HP 58502A will switch to its optional internal oscillator should the external source fail.

Simplified Verification of System Health

The RS-232C interface allows you to query the individual distribution input and output channels for the presence or absence of a signal. Easy-to-read front panel status lights also provide you with a quick visual indication of individual channel health. These features greatly simplify monitoring the system.

Performance for Your Demanding Applications

While cost per channel has been lowered, no compromises have been made in signal distribution quality. The amplifier provides high channel-to-channel isolation and low phase noise for demanding applications. The HP 58502A has an internal automatic gain control that ensures extremely low AM-to PM conversion.

HP's Complete Solution

The HP 58502A is an excellent companion to the HP 58503A or B GPS Time and Frequency Reference Receiver or the HP 5071A Primary Frequency Standard. Combined, with these products, the HP 58502A provides you a very clean, stable, redundant frequency reference.

Specifications

Electrical Specifications

Input, A or B

Frequency Range: 0.1 MHz to 10 MHz
Impedance: 50 Ω nominal; SWR <1.5
Amplitude: +15 dBm maximum; +7 dBm minimum
Connector: BNC (female)

Outputs (Into 50 Ω)

Amplitude: +13 dBm, +1 dB/-3 dB
Harmonics: ≤32 dBc
(for Option 010): ≤20 dBc
Spurious: ≤110 dBc, ≤113 typical
(for Option 010): ≤80 dBc
Connectors: BNC (female)

Mechanical Specifications

Weight: 2.95 kg
Shipping Weight: 6.35 kg
Dimensions: Height: 45 mm; Width: 426 mm; Depth: 344 mm

Supplemental Characteristics

Outputs

Single Sideband Phase Noise (1 Hz bandwidth)

Offset Frequency	Phase Noise
100 Hz	≤127 dBc/Hz
1 kHz	≤142 dBc/Hz
10 kHz	≤148 dBc/Hz
Port-to-Port Isolation:	≤100 dBc typical

(measured by switching between open and short loads on output port and measuring associated phase noise on adjacent output port)

Environmental

Temperature:
Operating: 0° C to +55°C
Non-operating: -40° C to +70° C
EMI: CISPR 11, Group 1, Class B

Remote System Interface and Control Data Communicators: RS-232C, DTE
Connector: DE-9P (male)

Alarm/Status Input and Output

Connector: DE-9P (male)
Normal State: TTL High
Alarm State: TTL Low
Output Configuration: Open-collector output, 10 k Ω pull-up to 5 vDc

Power Requirements

ac input: 100-132 or 175-240 Vac; 47-63 Hz; 80 VA Max

Stability:

Temperature Stability: 6×10^{-9} (0 to +55°C)
Aging/Day: 5×10^{-10}
Aging/Year: 1×10^{-7}
Tuning Range: 7×10^{-7} (minimum)

Ordering Information

HP 58502A Broadband Distribution Amplifier
Opt 010 Internal Backup Oscillator
Opt AX4 Rack Mount Kit
Contact factory for dc option

HP E1750A
HP E1752A
HP 59551A

HP E1750A VXI Distribution Amplifier

These VXI distribution amplifier modules buffer and distribute standard clock and other signals in laboratory, factory, and general ATE environments. They feature one input and six outputs per module, and are suited to distributing a wide variety of signals in a single ATE system or throughout a building. Principal features of the product include:

- Broadband sine wave or pulse buffering/distribution
- Built-in AGC for no level adjustments
- Preservation of input phase and frequency characteristics with changing environment (temperature, humidity, etc.)

General Specifications

Input Ranges

	HP E1750A	HP E1752A
Freq. min.	100 KHz	1 pps
Freq. max.	10 MHz	10 million pulses per second
Level, min.	+7 dBm	Logic LO: ≤0.8 V
Level, max.	+19 dBm	Logic HI: 2.0 V ≤ V_{in}
Damage	+27 dBm	+14 V, –9 V
Impedance	50 Ω	50 Ω
HP E1750A Outputs, 50 Ω load		
Level		+13 dBm ±1 dBm
Phase noise		< –145 dBc
Port-to-port isolation (open/short loads)		
phase modulation		< –100 dBc
phase change, peak		< ±.0012°
HP E1752A Outputs, 50 Ω load		
Rise-fall time		<5 ns
Pulse amplitude		>3.5 V
Propagation delay		22 ns, typical
Jitter		<1 ns rms

Ordering Information

HP E1750A Broadband Distribution Amplifier
Opt AV9 Delete Operation and Programming Manual
HP E1752A Pulse Distribution Amplifier
Opt AV9 Delete Operation and Programming Manual

HP 59551A GPS Measurements Synchronization Module

The HP 59551A GPS measurements synchronization module meets the precision-timing needs of wide-area electric power transmission systems. Based on advanced Global Positioning Systems (GPS) receiver technology, the module has superior long-term timing accuracy and permits exhaustive measurement and analysis of power system performance.

The HP 59551A combines low cost and unmatched functionality, making it the timing solution of choice for a variety of applications. For monitoring existing wide-area transmission networks, the HP 59551A provides the timing synchronization and time tagging required to efficiently locate faults, analyze network disturbances, and perform detailed sequence of events analysis. The newest, state-of-the-art transmission networks benefit from the highly-accurate synchronization foundation provided by the HP 59551A.

Time Tagging

Time tagging, a standard feature of the HP 59551A, allows event marking to a quantization of 100 ns. Up to 256 tagged events per channel are stored in buffer memory, which can be downloaded to a computer for in-depth failure or sequence-of-events analysis.

Versatile I/O

The HP 59551A incorporates many input/output features and enhancements. The range of inputs and outputs allow the HP 59551A module to be integrated with external processing solutions, or used with a variety of event and fault recorders. The versatile design also integrates with the newest designs for real-time applications (state estimation, demand-side management, and energy management systems).

*This specification has a 95% probability, and is based on availability of four or more GPS satellites during three days locked operation with a fixed antenna location. The temperature must remain within a 10° C range between 10° C and 40° C.

- Tailored for power transmission networks
- Timing accuracy: 110 ns to UTC (USNO) @ 95% confidence level*
- HP SmartClock technology learns and adjusts frequency
- Time tagging (standard feature)

HP 59551A

Highlights of the I/O capabilities include:

Separate Front/Rear RS-232 Ports: The HP 59551A can be controlled locally without interfering with output signals.
Standard IRIG-B
Alarm BITE: System fault or loss of satellite lock generates an alarm signal.
Time-Tag Inputs: Conditioned TTL signals can be time-tagged to a quantization of 100 ns.
Programmable Pulse Output: An output pulse or repetitive signal can be programmed at a specific time or repetition period.

Ordering Information

HP 59551A GPS Measurements Synchronization Module (includes 129 Vdc power supply)
Opt 1CM Rack Mount 19-inch
Opt AXQ Rack Mount 23-inch
Opt AWM RPower Supply (48 Vdc)
Opt 170 90 to 132 Vac or 198 to 264 Vac, 50 to 60 Hz
See page 497 for the complete line of GPS accessories.

GPS Time and Frequency Reference Receiver

HP 58503B

- Reduce the cost for precise time and frequency
- Eliminate calibration through GPS technology
- Improve reliability through HP quartz oscillators

HP 58503B Option 001

HP 58503B GPS Time and Frequency Reference Receiver

GPS Makes Precise Time and Frequency Affordable

The HP 58503B is well-suited for a broad range of applications. Regardless of industry, it meets the needs of manufacturing, development, calibration labs and services. Through a unique combination of technology, the HP 58503B GPS Time and Frequency Reference Receiver provides a highly-reliable, low cost source of precision time and frequency.

The HP 58503B is based on Hewlett-Packard's proven quartz technology. This provides unsurpassed reliability and confidence, as well as excellent short-term stability. The core of the design is an oscillator with >500,000 hours of field-proven mean-time-between-failures (MTBF). This delivers superior performance and reliability while eliminating the need for periodic oscillator replacement as required in GPS rubidium sources.

By locking its quartz oscillator to the GPS signal, the HP 58503B provides frequency accuracy of better than 1 part in 10^{12}. This gives you the long-term performance of GPS with the superior short-term stability of a state-of-the-art quartz oscillator. Time accuracy compared to UTC (USNO MC) is better than 110 ns—even in the presence of Selective Availability (SA).

When the GPS signal is interrupted, the HP 58503B automatically enters an intelligent holdover mode using HP SmartClock technologies. This minimizes frequency drift and compensates for environmental changes, maintaining accuracy to better than 1×10^{-10} per day.

This unique combination of technology provides you superior value - lower cost, smaller size, higher performance, and excellent reliability. For a more detailed description of the technologies, see "Key Technologies", page 489.

Year 2000 Compliant

The HP 58503B has been thoroughly tested to be sure it reliably will move from the year 1999 to the year 2000. This transition was tested while locked to satellites (via simulator), in holdover mode, and when the new year requires a leap second. Further testing proved that the unit recognized that 2000 is a leap year, and that it operates through the GPS system clock rollover in August of 1999. This thorough testing is testimony to HP's uncompromising dedication to quality products - products you can count on.

Using Technology to Solve Problems

Development labs and manufacturing now have a convenient source for frequency and time—both 10 MHz and 1 pps outputs are standard. The HP 58503B is a cost-effective in-house standard. By using the HP 58503B as an external frequency reference for test equipment, time-base aging is eliminated - improving the quality of test results while eliminating the need for periodic time-base calibration.

Metrology and calibration labs find the HP 58503B essential. For smaller labs where cost is a key concern, the HP 58503B provides a low-cost alternative for precise time and frequency. For more advanced labs, the HP 58503B offers an excellent time reference.

The communications industry also benefits from the convenience of the HP 58503B. When telecom reference signals are unavailable or unreliable, a high-quality reference signal is required. Output options for the HP 58503B provide highly-accurate reference signals with signal formats consistent with all ITU-T specifications.

Abbreviated Characteristics and Specifications

GPS Receiver

- 8-channel, parallel-tracking
- HP SmartClock/HP Enhanced GPS
- DC power options available

10 MHz Output Characterizations
Frequency Accuracy (Locked): $<1 \times 10^{-12}$ for a one day average
Holdover Aging (Unlocked): $< 1 \times 10^{-10}$ per-day average frequency change in 24 hours of unlocked operation
Output Level: >1V p-p sine wave into 50 Ω load.

Phase Noise (Locked):

Offset From Signal (Hz)	SSB Phase Noise (dBc)
1	-85
10	-125
100	-135
1,000	-140
10,000	-145

Time Domain Stability (Locked):

Averaging Time (Seconds)	Root Allan Variance
0.01	1.5×10^{-10}
0.1	1.5×10^{-11}
1	5×10^{-12}
10	5×10^{-12}
100	5×10^{-11}
1,000	5×10^{-11}

1 pps Output Characteristics
Jitter on Leading Edge (Locked): <750 ps rms
Time Accuracy (Locked): <110 ns with respect to UTC (USNO MC) –95% probability when unit is properly installed and calibrated
Accumulated Time Error (Unlocked): <8.6 µs/accumulated in 24 hours after three days of locked operation with a fixed antenna location
Output Level: >2.4 V pulse into 50 Ω load
Pulse Width: 26 µs

Power Requirements
Standard (ac power)*: 90 to 132 Vac or 198 to 264 Vdc, automatically selected; 50 to 60 Hz
Option AWQ* +19 Vdc to +59Vdc (> +23 Vdc required to start)
Input Power (all power options): <35 watts nominal

*Only one power supply may be selected. The standard unit operates only from the ac line voltages described above. If either the 24V or 48V power input options are selected, the unit will operate only from that voltage. For backup power, we recommend an appropriate UPS (uninterruptable power supply). These units are inexpensive and can be selected to provide backup power for various amounts of time.

Ordering Information

HP 58503B GPS Time and Frequency Reference Receiver
Opt 001 Front-Panel Display
Opt AWQ 24/48 Vdc Power
Special Output Frequencies
Including 5MHz, telecom T1 and E1 reference signals and even second output options; contact HP for availabiltiy and price.
GPS Antenna System and Accessories
See page 497 for the complete line of GPS Accessories.

HP 58533A (shown) and HP 58540A GPS Time and Frequency Reference Receiver

HP 58533A GPS Time and Frequency Reference Receiver

The HP 58533A is a small, low-cost source of GPS time and frequency. Affordable and compact, it is a candidate for integration applications, but is suitable for bench-top use as well. The HP 58533A provides a 10 MHz output with a frequency accuracy of better than $1x10^{-11}$ for a one day average, and a 1PPS output with time accuracy within 110 ns of UTC (USNO MC) when locked to GPS. In addition, the HP 58533A features an alarm output and RS-232 interface for monitoring operation remotely, and T-RAIM satellite error detection.

Abbreviated Characteristics and Specifications

GPS Receiver
- 8-channel, parallel-tracking
- C/A code, L1 carrier

10 MHz Output Characteristics
Frequency Accuracy (locked): $<1x10^{-11}$ for a one-day average
Holdover Aging (unlocked): $<2x10^{-8}$ per day maximum
Output Level: 1 Vp-p sine wave into 50 Ω load.

Phase Noise (locked):

Offset from Signal (Hz)	SSB Phase (dBc)
10	≤–110
100	–115
1000	–120
10000	–125

Time Domain Stability(Locked): Root Allan Variance = $1x10^{-10}$ at tau = 1 second
1 pps Output Characteristics (locked):
Time Accuracy (POSITION HOLD mode): < 110 ns with respect to UTC (USNO MC) – 95% probability when unit is properly installed and calibrated.
Pulse-to-pulse Jitter of Leading Edge:
POSITION HOLD Mode: 40 ns typical
SURVEY Mode: 110 ns typical
Front-Panel Indicators (LED):
Alarm: Red LED, blinks once every two seconds when an alarm condition is present.
Remote Interface: RS-232-C DTE configuration
RS-232 Connector: 9-pin male rectangular D subminiature on front panel
Power Requirements: dc power (standard); +15 Vdc nominal, ±5%, 600 ma; +5 Vdc nominal, ±5%, 300 ma
Weight and Size: 308g, 50 mm H x 100 mm W x 125 mm L

HP 58540A GPS Time and Frequency Reference Receiver

The HP 58540A is a small, cost-effective source of GPS time and frequency. Though designed to meet the particular needs of an array of system integration applications, the HP 58540A can be used in laboratories and manufacturing facilities as an accurate frequency reference, as well.

The package of the HP 58540A is similar to the HP 58533A: the dimensions are 50 mm H x 100 mm W x 125 mm L, and the weight is approximately 300 grams. However, the HP 58540A generally provides a higher level of performance. Also, the HP 58540A can be configured through options to support the special timing requirements of Paging, GSM, CDMA, or E-911 location applications.

Standard Configuration: 10 MHz, 1PPS, and 1PP2S

In its standard configuration, this GPS-based reference receiver produces precise 10 MHz and 1 pulse per second (1PPS). Phase coherency is maintained between the outputs, supporting those applications in which the relationships of the outputs must be known. When the crystal oscillator is locked to the GPS signal, the frequency accuracy of the 10 MHz signal is better than 1×10^{-11} (one-day average), and the 1PPS signals are synchronized to UTC (USNO MC) within 110 ns.

10 MHz Output Characteristics
Frequency Accuracy (locked): $<1x10^{-11}$ for a one-day average
Holdover Aging (unlocked): $<7x10^{-10}$ per day maximum
Output Level: 1 Vp-p sine wave into 50 Ω load.

Phase Noise (locked):

Offset from Signal (Hz)	SSB Phase (dBc)
10	–120
100	–130
1000	–140
10000	–145

Time Domain Stability(Locked): Root Allan Variance = $1x10^{-10}$ at tau = 1 second
1 pps Output Characteristics (locked):
Time Accuracy (POSITION HOLD mode): < 110 ns with respect to UTC (USNO MC) – 95% probability when unit is properly installed and calibrated.
Pulse-to-pulse Jitter of Leading Edge:
POSITION HOLD Mode: 40 ns typical
SURVEY Mode: 110 ns typical
Power Requirements: +24 Vdc nominal (Range: ±18 to 32 Vdc)
Weight and Size: 308g, 50 mm H x 100 mm W x 125 mm L

Optional Configurations to Meet Needs of Paging, GSM, CDMA, and E-911 Applications

Optional configurations/OCXO's are available to cover a range of timing and frequency applications that includes Paging, GSM, CDMA, and E-911. For example, an even second output, 1 PP2s option can be ordered for CDMA. Contact the HP Call Center in your region for detailed information.

Antenna System

Hewlett Packard recommends the use of HP GPS antenna system accessories, seen on page 497, with HP GPS Time and Frequency Reference Receivers.

Ordering Information

HP 58533A GPS Time and Frequency Reference Receiver
HP 58540A GPS Time and Frequency Reference Receiver
Opt 001 Type F GPS Antenna Connector

Additional options: Consult HP Call Center

HP 58534A GPS Timing Antenna

GPS Antenna and Receiver All in One Rugged, Weatherproof Package

The HP 58534A GPS Timing Antenna is a highly reliable, user-friendly, super-low cost source of precision GPS time. An antenna, GPS receiver, interface, and power supply are all integrated into one rugged, weatherproof, easy-to-install package. A one pulse per second (1 PPS) signal synchronized to UTC within 110 ns is automatically provided when the HP 58534A is locked to GPS.

Up to 150 meter Cable Runs with Minimal Power Consumption

The HP 58534A conveniently operates on a wide range of input voltages and consumes minimal power, yet it can support long cable runs. Between +8 to + 36 volts, and less than 1.5 watts will power the unit. RS-422 drivers inside the HP 58534A allow it to easily operate 150 meters of interconnect cable. Please consult HP for installations requiring longer cable lengths.

Fast Reacquisition Time Following Power Loss

If power is lost, the RAM (Random Access Memory) which stores the navigation and satellite data continues to be powered by a super-capacitor up to 2 hours. This lets the HP 58534A reacquire satellites within 20 seconds after power is restored.

Excellent Immunity to Noise Interference

The HP 58534A is engineered for reliable operation in the toughest environments. Outstanding immunity to RF interference is imparted by three robust dielectric bandpass filters incorporated in the design. Furthermore, true 2-bit A/D conversion as opposed to 1-bit in competing products, is used to digitize the GPS signal to reduce noise interference. SAW filtering technology also results in improved interference immunity.

Corrupt satellite data is rejected and multipath is mitigated by the HP 58534A's TRAIM (Timing Receiver Autonomous Integrity Monitor) algorithm.

Mounting Hardware Kit and Extended Operating Temperature Range Available: Options AUB and 1GK

Two options available to the HP 58534A are Options AUB and 1GK. Option AUB provides a mounting hardware kit, complete with a galvanized steel mounting mast, mounting brackets, and hardware. Option 1GK provides an HP 58534A guaranteed to withstand an extended operating temperature range of –40˚ C to +80˚ C.

User-friendly Evaluation Kit with HP 58531A GPS Timing Receiver Analysis and Control Software: Option 001

Analysis and control of the HP 58534A is a simple task with the HP 58534A GPS Timing Antenna Evaluation Kit. When you order HP 58534A Option 001 you will receive the HP 58534A GPS Timing Antenna, a copy of the HP 58531A GPS Timing Receiver Analysis and Control Software, an RS-422 to RS-232 PC Interface box, a 50-meter length of interconnect cable that is terminated on both ends in order to mate with the HP 58534A and the PC Interface box, mounting hardware, and an operating manual diskette.

The HP 58531A GPS Timing Receiver Analysis and Control Software is a PC Windows-based program (for Windows NT 4.0 or Windows 98) that controls the HP 58534A, and processes and displays information received from it. The program has tools to help in analyzing the receiver data, and can log the information to a file for analysis using other tools.

The HP 58531A program includes these features:

- Convenient configuration of the software and HP 58534A
- Real-time information update
- Control and query the HP 58534A via menu-driven commands
- Generate a data log file for analysis
- Generate an error log file for analysis
- Plot instant or average position in real time
- Plot satellite history, such as PRN, C/N, elevation, DOP
- Calculate and display average or maximum C/N and associated elevation and azimuth angles
- Demo Mode capability in case a physical HP 58534A is not available

Twisted Pairs Interconnect Cables Available Through HP 58522A

The HP 58522A series of interconnect cables provides a length of cable composed of bundled twisted pairs. Each HP 58522A cable is terminated on one end to mate to the HP 58534A output connector. The remaining end is unterminated. Choose from a selection of convenient lengths.

Specifications

Electrical Specifications and Characteristics

Receiver Architecture: 8 parallel channels; L1 1575.4 MHz; C/A code (carrier aided tracking); 2-bit A/D conversion; SAW filtering
Antenna: Active micro strip patch; High jamming immunity: triple dielectric bandpass filtering
Update Rate: 1 Hz
Absolute Timing Accuracy (1 pulse per second, 1PPS), with S/A:
< 110 ns with respect to UTC (USNO) – 95% probability when unit is properly installed and locked to GPS.
Timing output valid with one satellite acquired in Position Hold mode.
Jitter: 40 ns (1s, typical) in Position Hold Mode; 110 ns (1s, typical) in Survey Mode
Position Accuracy: 25 m SEP* without S/A; *Spherical Error Probable
Acquisition Time to First Fix (TTFF): Cold Start: < 2 minutes typical
Reacquisition: < 20 seconds typical after loss of power**;
**Almanac < 1 month old and Ephemeris < 4 hours old

Power Specifications: +8 Vdc to +36 Vdc; < 1.5 Watts; Reverse Voltage Protection, <300 V; Back up power provided by super-capacitor to GPS RAM, 2 hours (typical)

Serial Communications

Interface: 9600 Baud; RS-422 Input/Output; HP proprietary protocol based on NMEA language
Extended Cable Support: RS422 differential pair capable of supporting 150 meters of cable

Mechanical Specifications and Characteristics

Dimensions: HP 58534A (without cable and connector):
16.5 cm H x 15.0 cm D; Mounting Mast (Option AUB):
457.5 mm L x 31.5 +/- .125 mm D
Mounting: Quick-fit clamp (glass-filled, high modulus nylon for secure clamp)
Weight: 684 g
Cable and Connector: 30.5 cm cable (12 conductor, 6 twisted pairs, shielded); 12 pin round, waterproof connector (Deutsch MMP 21C-2212P1)

Environmental Specifications

Operating Temperature
Standard: –35° C to +75°
Option 1GK: –40° C to +80°
Storage Temperature: –40° C to +85° C

Ordering Information

HP 58534A GPS Timing Antenna
Option 001 GPS Timing Antenna Evaluation Kit
Option AUB Mounting Hardware Kit
Option 1GK Extended Operating Temperature Range
HP 58531A GPS Timing Receiver Analysis and Control Software
HP 58522A Twisted Pairs Interconnect Cable
Option 005 5-meter Cable
Option 010 10-meter Cable
Option 050 50-meter Cable

- Complete solutions for GPS antenna systems
- High reliability GPS accessories
- Broad range of products to meet every need

HP 58517A
HP 58518A
to 58521A
HP 58518AA
to 58521AA
HP 58529A
HP 58530A
HP 58532A
HP 58535A
HP 58536A
HP 58538A
HP 58539A

HP GPS Accessories

Complete Your GPS-Based Solution with Confidence

High-quality Hewlett-Packard Global Positioning System (GPS) accessories let you configure a complete GPS antenna system with confidence and reliability. These products simplify installation while providing high signal integrity. By providing a range of GPS accessories, HP offers a complete solution—from the GPS antenna to precise time and frequency reference receivers.

HP GPS accessories include antennas, antenna assemblies, line amplifiers, lightning arresters, distribution amplifiers/splitters, bandpass filters, cables and cable kits—everything you need for your complete antenna system.

GPS L1 Reference Antenna

The HP 58532A GPS L1 Reference Antenna delivers L1 carrier frequency signals to GPS receivers. Based on a design with proven reliability in tens of thousands of installations, the HP 58532A, like its predecessors, is characterized by low noise and high gain to provide optimum signal quality. The HP 58532A also features excellent filtering, with narrow bandwidth and steep rolloff, to preserve the GPS signal while attenuating RF interference signals near the L1 carrier.

Designed for easy installation in outdoor locations, the HP 58532A features a durable, cone-shaped cover to prevent snow and debris build-up. In addition, a sturdy aluminum mounting base allows easy attachment to an optional antenna mast. With this type of mounting, the antenna/cable connector (type N) is protected from the weather. If your system requires the HP 58529A Antenna Line Amplfier with Filter or the HP 58530A L1 Bandpass Filter, then these cylinder shaped products can fit directly inside the antenna mast to be sheltered from the weather as well.

Option 001 includes an N Plug to TNC Jack adapter to accommodate TNC cable users.

Antenna Specifications
Frequency Range: 1575.42 ± 10 MHz (L1 carrier)
Total Gain: > 30 dBi (38 dB typical at elevation angle 90°)
Operating Environment: -40°C to +85°C

Lightning Arrestors

The HP 58538A Lightning Arrestor is a small, waterproof unit designed to take much of the energy out of a nearby lightning strike. This unit is typically installed where the antenna cable enters the building. The HP 58538A must be used in conjunction with the HP 58539A described below.

The HP 58539A Lightning Arrestor is a larger package which can reduce the energy from a nearby lightning strike to a level where it will not harm downstream equipment. In systems with short in-building cable lengths (less than 4 meters), a single 58539A installed where the antenna cable enters the building is sufficient. Systems that have long in-building cable lengths should have one 58539A at the entrance to the building and one relatively near the receiver to divert to ground any voltages induced in the in-building cable by electromagnetic fields generated by lightning strikes. The 58538A can replace the 58539A at the cable entrance into the building, for a more cost effective solution.

The HP 58539A, when properly installed near the antenna, will protect the antenna and nearby components such as line amplifiers from voltages and currents that can be induced in the antenna cable by lightning.

Both the HP 58538A and the HP 58539A have an integrated gas-filled surge arrestor capsule. Many competing products that use gas capsule technology do not have replaceable capsules, making periodic maintenance expensive since the whole arrestor must be exchanged. Replacement capsules to the 58538A and 39A are offered as Option 001.

Line Amplifier with Bandpass Filter

The HP 58529A GPS Line Amplifier with L1 Bandpass Filter has 20 dB of gain and also contains a bandpass filter (20 MHz wide at 1.575 GHz) to significantly reduce nearby interfering signals. The package is a small (approximately 3 cm wide) cylinder, which easily fits into the mounting mast for the antenna where it is protected from the weather. The unit is weatherproof so it can also be mounted outside if desired. Power for the HP 58529A comes from the GPS receiver via the RF cable.

Line Amplifier Specifications
HP 58529A
Amplifier Gain: >20 dB (24 dB typical)
Frequency Range: 1575.42 ± 20 MHz (L1 Carrier)
Filter Attenuation: > 7 dB at L1 ± 35 MHz > 30 dB at L1 ± 140 MHz

Bandpass Filter

The HP 58530A GPS L1 Bandpass Filter is an antenna line filter for those applications where signal amplification is not needed, but additional filtering is desired. The HP 58530A filter characteristics and package are the same as the HP 58529A, but the HP 58530A has no amplifier and does not require power.

Bandpass Filter Specifications
Frequency Range: 1575.42 ± 20 MHz (L1 Carrier)
Filter Attneuation: >7 dB at L1 ±35 MHz, >30 dB at L1 ±140 MHz
Operating Environment: –40°C to +80°C

Distribution Amplifier/Splitters NEW

The HP 58535A, 58536A and 58517A distribution amplifiers/splitters distribute the GPS signal to two, four or eight output ports, respectively. For ease of installation and configuration, these units feature built-in amplification to provide unity gain from input to each of the output ports. High isolation between output ports eliminates the risk of interaction between GPS receivers connected to the distribution amplifier.

Distribution Amplifier/Splitter Specifications
Frequency Range: 1575.42 ± 20 MHz (L1 carrier)
Gain (input to output)
HP 58535A: 0 dB ± 3 dB; **HP 58536A:** 0 dB ± 3 dB; **HP 58517A:** 0 dB ± 4 dB
Isolation (typical)
HP 58535A and HP 58536A: –50 dB; **HP 58517A:** – 35 dB
Operating Environment:
HP 58535A, HP 58536A: –35° C to +75° C; **HP 58517A:** 0°C to +55°C

Cables and Cable Kits

HP offers a complete line of antenna cables and interconnect cables for completing your antenna system. The HP 58518A and HP 58519A RG-213 cables provide increased flexibility for installation ease. The HP 58520A and HP 58521A LMR 400 cables feature low-loss and are ideal for installations requiring greater cable lengths. All cables are available in a variety of lengths ranging from 1 meter to 50 meters for RG-213 cables and 1 meter to 330 meters for LMR 400 cables.

For installations requiring greater flexibility or where cables must be pulled through conduit, cable kits are available. These kits provide the raw cable with connector kits. This allows the connectors to be installed once the cable is in place. The HP 58518AA and 58519AA are kit versions of the RG-213 cables and the HP 58520AA and 58521AA are the kit versions of the LMR 400 cables.

Cables and Cable Kits Specifications
Impedance: 50 Ω typical
Signal Loss at L1 Frequency
RG-213 Cables: 7.9 dB per 20 meters
LMR 400 Cables: 3.35 dB per 20 meters
Cable (Propagation) Delay
RG-213 Cables: 5.05 ns per meter
LMR 400 Cables: 3.93 ns per meter
Connectors or Connector Kits
HP 58518A/AA, 58520A/AA: One TNC(m) and One N(m)
HP 58519A/AA, 58521A/AA: Two N(m)

Contact the HP Call Center in your region for pricing.

HP 58000 Series

Drawing on decades of experience building the world's most accurate cesium and most reliable quartz clocks, HP designs and manufactures custom timing subsystems for network equipment manufacturers. Acting as an off-site R&D team, HP engineers are responsive to the needs of manufacturers. HP designs a custom module and then moves quickly to prototype and high-volume production. By outsourcing the timing subsystem, manufacturers can focus on other critical design issues to achieve faster time-to-market. HP's leadership in timing, decades of experience, and proven technologies remove manufacturer's risk for this increasingly-complex piece of base stations and network nodes.

State-of-the-Art Technologies

HP's areas of expertise include state-of-the-art technologies: global positioning system's (GPS) precise time and frequency, advanced quartz oscillators and breakthrough intelligent oscillator technology (see "Key Technologies," page 489). Together, these technologies revolutionize wireless base station and wireline network timing by making low-cost, highly-reliable timing available. Manufacturers can now replace the rubidium technology of the 80's with this trio of technologies for near-cesium performance when locked to GPS and near-rubidium performance during holdover. Because quartz is more reliable than rubidium (see "Oscillator Continuum", page 488), time-consuming and costly base station and transit node service is dramatically reduced. GPS further stabilizes the quartz, making recalibration that is required for rubidium or standalone quartz unnecessary. Maintenance is dramatically reduced.

The HP 58000 Series custom timing modules are designed and built for any level of accuracy and stability needed by manufacturers. HP meets and exceeds the standards for CDMA, TDMA and GSM, analog, special/private mobile radio (SMR/PMR) and paging technologies. For stratum 2, 3 and 3E transit node and local area clocks, we meet or exceed ANSI, ETSI and Bellcore standards. We match your requirements for size and form factor with a box, card or board. And we match each manufacturer's specific requirements for space, power, configuration and price.

HP 58000 Series OEM Custom Timing Modules

Important decisions that affect performance and price are:

Intelligent Oscillator: HP SmartClock Technology, which adds intelligence to the base station or local office oscillator, vastly improves the clock's performance during normal conditions as well as during holdover when the GPS antenna is down or the reference source is not available.

Holdover Capability: Lower-performance base stations can be designed without holdover capability. But for a high-performance network, rubidium or high-performance quartz oscillators will provide holdover timing when the external frequency reference source is not available. Fluctuations in temperature at the base station site and length of desired holdover are the key factors that affect initial cost. Lifetime cost is lower with quartz because it is more reliable than rubidium and, unlike rubidium, does not need to be replaced after 8 or 10 years.

Special Features: HP responds to any request. We'll provide auto-switching, a scheme that automatically switches a base station from one timing module to another without any change in output. Or you might need a special frequency—19.6608 MHz for CDMA or 13 MHz for GSM.

Frequency Reference Source: Although GPS timing combined with HP SmartClock Technology gives the best price/performance, T1 or E1 can also be used as a frequency reference source. Other levels of performance can be achieved without an external frequency reference source. The local clock—a quartz or rubidium oscillator used with or without HP SmartClock Technology—can provide the frequency for less stringent performance requirements.

Ordering Information

Contact the HP Call Center in your region for more information and design consultation for a custom solution.

Example Configurations for Different Performance Requirements

	Performance Required						HP Custom Solution	
	Frequency Outputs	Temp-erature	Holdover Requirement	Accuracy	Accuracy during holdover	Timing sync between cell sites	MTBF (hrs.)	
High-performance timing module for CDMA base station	10 MHz; 19.6608 MHz; 1 pps	0° to 50° C	24 hrs. in loss of GPS	$1x10^{-11}$ for 1 day avg. when locked	$1x10^{-10}$ for 24 hrs.	±1 µsec. locked ±7 µsec. unlocked	>100,000	Frequency Reference: GPS HP SmartClock Technology HP 10811 double-oven quartz oscillator Enhanced GPS/digital filter
Medium-performance timing module for TDMA base station (GSM or IS-54 standard)	13 MHz	0° to 50° C	1 week	$1x10^{-10}$ for 1 day avg. when locked	$1x10^{-9}$/ week	N/A	>100,000	Card-based, multi-function Frequency Reference: E1 or GPS HP SmartClock Technology HP 10811 single-oven quartz oscillator Telecom digital filter
Medium-performance timing module for paging base station	10 MHz, 32 kHz, 100 kHz; 1 pps	0° to 50° C	6 µsec./ 6 hrs.	$1x10^{-11}$ for 1 day avg. when locked	$5x10^{-10}$/ 6 hr.	<600 nsec.	>100,000	Card-based Frequency Reference: GPS HP SmartClock Technology HP 10811 single-oven quartz oscillator
Timing for SMR/PMR analog base station	10 MHz	–30° to +60° C	None	5×10^{-10}	N/A	N/A	>100,000	HP 10811 single-oven quartz oscillator Frequency Reference: None 12-channel distribution system Compact box

GPS & SmartClock Technology

HP 58503B Precise Time and Frequency Anywhere in the World
5966-3891E
5966-3892E/EUS
HP 58529A Line Amplifier
5966-3885E/EUS
HP 58530A L1 Bandpass Filter
5966-3886E/EUS
HP 58532A Reference Antenna
5966-3887E/EUS
HP 58538A/58539A Lightening Arrestor
5966-3889E/EUS
GPS and Precision Timing Applications
5965-2791E
HP SmartClock Technology
5966-0413E
HP 58518A/19A/20A/21A GPS Antenna Cables and Interconnect Cables
5964-9402E/EUS
HP GPS Antenna Systems (for use with HP 58503B, HP 55300A and HP 59551A GPS Timing Receivers)
5968-4363E
HP 59551A GPS Measurement Sychronization Module
5965-2998E

General Purpose

HP 58502A Broadband Distribution Amplifier
5966-3413E/EUS
HP 58503B Precise Time and Frequency Anywhere in the World
5966-3891E
5966-3892E/EUS
HP 5071A Sync Family Brochure
5968-2250E
HP 5071A Unsurpassed Stability in the Lab or Field
5968-1862E/EUS
The Science of Time Keeping
5965-7984E
HP E1750A/52A Distribution Amplifier
5965-6904E

Wireless OEM Timing Modules

HP 58000 Series Time and Frequency Reference Distribution Systems
5963-3504E
QUALCOMM Taps HP for CDMA Timing System
5964-9063E
HP 58533A GPS Time and Frequency Receiver
5968-4596E
HP 58534A Timing Antenna
5966-3888E/EUS
HP 58540A GPS Time and Frequency Receiver
5968-1585E
HP GPS Antenna Systems (for use with HP 58533A and HP 58540 GPS Timing Receivers)
5968-4326E

Timing Synchronization Systems and Services

Responding to the needs of customers, HP has taken a comprehensive systems approach to help audit, plan, implement, manage and support the increasingly complex synchronization network:

- HP's growing line of products improve timing and network synchronization to enable networks to operate reliably and accurately at higher speeds. Even with increasing customer loads, quality of service is improved. Products include a cesium primary reference clock (PRC), a primary reference source (PRS) based on the global position system (GPS), synchronization supply unit (SSU), building integrated timing supply (BITS), sync network management software, modulation domain analyzer technology (MDA) for sync quality management, and GPS measurements sync module for power transmission.
- A network synchronization audit uses cesium and MDA technology to quantify timing performance and identify the locations of poor timing.
- Services such as synchronization planning help network designers plan and deploy their increasingly complex timing synchronization subsystems.
- Synchronization network management software manages all GPS, BITS and SSU units in the synchronization network. A major development, HP's software is the first to provide operators a comprehensive view of the synchronization of all network offices and elements, allowing prompt identification of problem areas. The software operates on the telecom industry's defacto platform – HP OpenView – and is the final piece of HP's total network management solution that includes computers, software, and interconnectivity products.

HP 5071A Primary Reference Clock

The HP 5071A primary reference clock (PRC) delivers unsurpassed accuracy and stability for telecom applications. The unit requires no adjustments or maintenance. It will be up and running in 15 minutes, and far exceeds Stratum 1 requirements. All of these features are independent of environment.

The HP 5071A can be operated and maintained anywhere. All controls are programmable, status can be checked remotely, and no adjustments or alignments are necessary during operation.

HP 55300A GPS Primary Reference Source

The HP 55300A GPS primary reference source (PRS) provides a highly reliable, low cost source of precision timing for both wired and optical telecom digital networks. When locked to GPS, the HP 55300A delivers timing stability exceeding Stratum 1 requirements. During holdover, the HP 55300A delivers Stratum 2 performance for over 24 hours.

The unit is ideally suited for telecom service providers that are installing or upgrading existing networks with SONET/SDH equipment. These high speed technologies require highly accurate and stable network synchronization and distribution. This affordable synchronization solution can flatten hierarchical networks, providing cesium like performance at all points.

HP 55400A Synchronization Supply Unit and HP 55500A Building Integrated Timing Supply

The HP 55400A Synchronization Supply Unit (SSU) and the HP 55500A Building Integrated Timing Supply (BITS) are modular, redundant, fully manageable timing distribution units for E1 2048 kbps and T1 1544 kbps primary rate networks respectively. They are ideally suited for telecommunications networks where advanced technologies such as SONET, SDH and ATM are being deployed or expanded. They track incoming reference signals, qualify the signals against network timing standards, then filter and distribute precise timing to all network elements in the node. Incoming reference signals can come from PRCs (cesium standards), PRSs (GPS reference sources) or live traffic from higher or equal levels of the network.

HP OSMF Sync Network Management

The HP open synchronization management framework (OSMF) helps service providers isolate synchronization related problems in their networks quickly so that immediate, corrective action can be taken.

OSMF enables network operators to view synchronization network topology remotely and manage virtually every function of individual SSUs and BITS, which distribute accurate timing synchronization to equipment in telecom offices. It also lets network operators remotely manage faults (alarm and non-alarm events) for GPS PRSs on the network.

HP's synchronization management software is available on both the UNIX and Windows NT platforms. To commission SSUs and BITS and perform local troubleshooting, service providers can install the HP 55450A Local Craft Terminal for the PC on laptops running Microsoft Windows' operating systems.

HP E1725C/E1748A Network Synchronization Measurements

Network synchronization problems can lead to slips and degrading voice, fax, data, and video services. The HP E1748A network synchronization measurement software, available as Option 248 with the HP E1725C time interval analyzer (TIA), give network managers powerful tools for evaluating network synchronization and ensuring compliance with industry standards.

Jitter levels are accurately measured with the HP E1748A and the HP E1725C TIA. Its unsurpassed timing resolution of 100 ps rms, combined with the power of its Phase Power Spectral Density plot, deliver enough detail to determine which network components are improving or degrading incoming signals. The HP E1748A multiple channel network synchronization measurement software allows simultaneous recording of multiple channels. Overlay displays offer quick visual comparison of data obtained from multiple MTIE or TDEV measurements.

HP 55460A Network Sync Audit Service

The rapid growth of digital transport and integrated voice, data, and video services place stringent timing and accuracy demands on high-speed telecommunications networks. The HP 55460A network sync audit service helps network managers analyze the performance of existing networks. HP service engineers use precision timing instruments and sophisticated synchronization audit software to make measurements and assess network performance. The results present a data picture that not only shows the status of the network synchronization, but also enhances the design and management of advanced synchronization solutions.

HP 59551A GPS Measurements Synchronization Module

The HP 59551A GPS Measurements Synchronization Module meets the precision timing needs of wide-area electric power transmission systems. Based on advanced GPS receiver technology, the module has superior long-term timing accuracy and permits exhaustive measurement and analysis of power system performance.

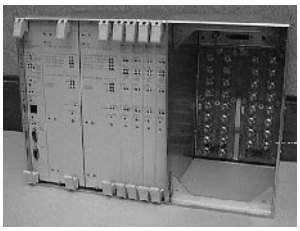
The HP 59551A combines low cost and unmatched functionality, making it the timing solution of choice for a variety of applications. For monitoring existing wide-area transmission networks, the HP 59551A provides the timing synchronization and time-tagging required to efficiently locate faults, analyze network disturbances, and perform detailed sequence of events analysis. The newest, state-of-the-art transmission networks benefit from the highly accurate synchronization foundation provided by the HP 59551A.

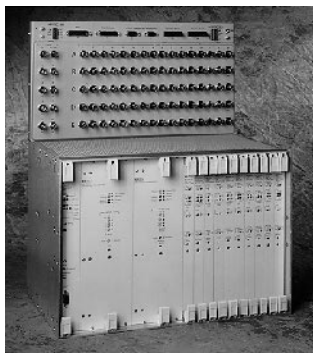
Note: The products above are described on the following pages:

HP 5071A, page 490
HP 55300A, page 505
HP 55400A, page 503
HP 55500A, page 503
HP 59551A, page 493
HP E1748A, page 128
HP OSMF, page 504
HP 55460A, p/n 5968-0407E

HP 55400A
HP 55409A
HP 55500A

- Provides precise timing synchronization signals
- Ideal wherever new technology is being deployed or expanded, such as SONET, SDH and ATM
- Minimizes SONET and SDH pointer movements
- For E1 (2048 kbps) and T1 (1544 kbps) primary rate networks
- Compliant to all national and international sync standards
- Supports Synchronization Status Messaging (SSM)
- Designed to be managed, locally or remotely
- Management software for local or remote control
- Industry standard platform allowing easy integration with other management systems
- Industry leading timing quality under stressed conditions
- Unprecedented reliability for maximum network uptime
- Oscillator MTBF > 500,000 hours
- Redundant hot swappable modules
- Downloadable firmware for easy upgrades
- Modular and expandable
- Custom systems available





Clockwise from upper left:
HP 55409A Mini SSU, HP 55400A SSU, HP 55500A BITS

HP 55400A Synchronization Supply Unit
HP 55500A Building Integrated Timing Supply

The HP 55400A Synchronization Supply Unit (SSU) and the HP 55500A Building Integrated Timing Supply (BITS) are modular, redundant, fully manageable timing distribution units for E1 2048 kbps and T1 1544 kbps primary rate networks respectively. They are ideally suited for telecommunications networks where advanced technologies such as SONET, SDH and ATM are being deployed or expanded.

They track incoming reference signals, qualify the signals against network timing standards, then filter and distribute precise timing to all network elements in the node. Incoming reference signals can come from PRCs (cesium standards), PRSs (GPS reference sources) or live traffic from higher or equal levels of the network. Both are compliant to their respective national and international synchronization standards.

A lower cost version of the HP 55400A SSU, called the HP 55409A Mini SSU, allows for distributing high quality sync even at access nodes.

Outstanding Holdover Performance

HP has developed breakthrough technology, called HP SmartClock, that delivers Stratum 2 holdover performance at less cost and higher reliability than rubidium (estimated 5x higher). HP SmartClock technology is a forward-looking correction process applied to the HP 10811 high-performance quartz oscillator; hence the lower cost and higher reliability. HP SmartClock evaluates the aging characteristics of the quartz oscillator via proprietary algorithms in conjunction with HP's high-precision counter technology. The result is outstanding holdover performance. Various levels of holdover performance can be achieved through a selection of input cards with a choice of both quartz and rubidium oscillators.

Managed Sync Elements—Key to High QoS

Having a sync network element that can be fully managed remotely and locally is key to ensuring high network QoS (Quality of Service). All functions of the HP 55400A SSU, HP 55409A Mini SSU and HP 55500A BITS are fully manageable, including faults, configuration, inventory, performance and security. Managed sync elements allow you to reduce operating costs by dispatching technicians to fix problems, not locate them. It's also possible to spot sync quality trends and fix problems proactively —before they start affecting customer QoS. Combine our sync elements with our sync network management software, OSMF, and you'll have the most powerful and robust sync network currently available. See the next page for a description of OSMF.

Key Features

See table. Additional common features:
- Power: redundant -48Vdc with dc-to-dc converters on each card
- Hot-swappable cards
- No phase hits on outputs during reference, clock or output card switchover

Ordering Information

HP 55400A E1 SSU System
HP 55409A E1 Mini SSU System
HP 55500A T1 BITS System

For detailed pricing and specific system configuration, contact your local HP sales office.

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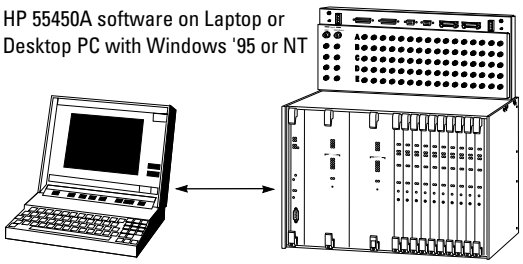
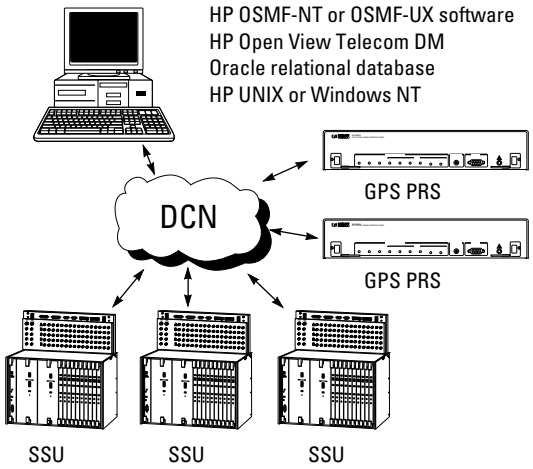
Feature	HP 55400A SSU	HP 55409A Mini SSU	HP 55500A BITS
Inputs	One 5/10 MHz from PRC/PRS Four E1 standard (ref or monitor) Four E1 optional (ref or monitor)	One 5/10 MHz from PRC/PRS Two E1 standard (ref or monitor)	One 5/10 MHz from PRC/PRS Four DS1 standard (ref or monitor) Four DS1 optional (monitor only)
Outputs	80 per subrack Up to 400 with expansion subracks 1:1 protection	32 per subrack 1:1 protection	200 per shelf Up to 1,000 with expansion shelves, unlimited with remote shelves 1:1 protection at an N:1 price
Card types	Management IMC (Alarms and local port) NIMC (Alarms, local & remote management through LAN, X.25 or TP4)	Management IMC (Alarms and local port) NIMC (Alarms, local & remote management through LAN, X.25 or TP4)	Management Alarms, local and remote management through LAN, X.25 or TP4
	ITH (Input Track and Hold) Stratum 2, transit, Stratum 3, local	ITH (Input Track and Hold) Stratum 3E	Clock Stratum 2, Stratum 3E
	Output E1 2048 kHz and kbps DS1 1.544 Mbps, CC 64/8 kHz 1/5/10 MHz	Output E1 2048 kHz and kbps Traffic re-sync	Output DS1 1.544 Mbps CC 64/8 kHz
			Monitoring. Additional inputs
Rack mount	ETSI 535 mm or EIA 19 inch	ETSI 535 mm or EIA 19 inch	NEBS, 23 inch wide, 4 units high

HP 55450A
HP OSMF-NT
HP OSMF-UX

- Makes your entire sync network visible
- Remote management from a single point
- Improves quality of service
- Reduces overall network costs
- Eases installation, configuration and commissioning of SSUs and BITS
- Allows worry-free deployment of SDH services



HP 55450A software used for local control of an HP 55400A SSU or HP 55500 BITS.



HP OSMF-NT and OSMF-UX software used for management of a network of HP 55400A SSUs, HP 55500A BITS and HP 55300A GPS PRSs interconnected by LAN.

HP Family of Synchronization Network Management Software

HP's line of sync network management software makes your entire sync network visible and remotely accessible from a single node. These products help communication service providers correct network-timing problems before they affect customer service. There are three products currently in the line:

- HP 55450A Local Craft Terminal
- HP OSMF-NT
- HP OSMF-UX

HP 55450A

The HP 55450A is primarily a tool used by crafts people to install, configure, commission and troubleshoot HP 55400A SSUs or HP 55500 BITS. The software is typically installed on a laptop PC running Windows '95 or NT. The crafts person carries the PC to a local office and connects to the SSU or BITS using an RS-232 local port interface. Users change settings, view status and monitor performance of the SSU or BITS using an extensive, user-friendly GUI instead of TL1 commands. Users configure inputs and outputs, manage fault reporting (define how events and thresholds generate alarms), monitor performance (graphs of MTIE, TDEV and other measurements vs. standards), and define security access levels of users. A TL1 command terminal window is also included for direct control.

HP OSMF-NT and HP OSMF-UX

The HP OSMF-NT and HP OSMF-UX software are full-featured TMN compliant sync network management platforms, providing complete fault, configuration, inventory, performance and security management. They give users the ability to remotely manage their sync networks and quickly isolate sync-related problems. Key functionality includes:

- Design based on the open-architecture, robust platforms of HP OpenView Telecom DM and Oracle relational database
- Easy integration with higher-level network management systems using TCP/IP or SQL*Net
- Interface with the HP 55400A SSU, HP 55500A BITS and HP 55300A GPS PRS, using TCP/IP, X.25 or TP4
- Display performance parameters for SSU or BITS input channels: TDEV, MRTIE, LMRTIE, FFOFF and SPREAD
- Report events including alarms and alarm details
- Display synchronization network connectivity
- Configurable network partitioning and management domains for operators
- Generate reports on events, performance and configuration

Differences between the HP OSMF-NT and OSMF-UX are listed below.

HP OSMF-NT

- Used to manage a moderate network of HP SSUs, HP BITS and GPS PRSs (typically up to 50 SSUs or HP BITS)
- Preferred when restraints make a PC the only platform of choice. HP OSMF-NT runs on Windows NT

HP OSMF-UX

- Used to manage a large network of HP SSUs, HP BITS and GPS PRSs (from tens to thousands of SSUs and BITS)
- Preferred when UNIX is the platform of choice
- An optional Q adapter (CMIP, OSI stack) provides connectivity to higher-level network management systems
- Optional standby management system for maximum uptime

Ordering Information

HP 55450A Software (per SSU or BITS)
HP OSMF-NT Software (per SSU or BITS)
HP OSMF-UX Software (per SSU or BITS)

For detailed pricing and specific system configuration, contact the HP Call Center in your region.

HP 55300A
HP 55310A
HP 55320A
HP 55322A

- Low-cost upgrade for office BITS clocks and SSUs
- Cesium-like timing performance
- Highly-reliable quartz oscillator with HP SmartClock technology
- Network Time Protocol to synchronize networked computers
- IRIG-B time of day fault location

HP 55300A module in the HP 553310A shelf

HP 55300A: Timing Synchronization for SONET/SDH

The HP 55300A GPS Telecom Primary Reference Source provides a highly-reliable low-cost source of precision timing for both wired and optical telecom digital networks.

The unit is ideally suited for telecom service providers that are installing or upgrading existing networks to comply with and integrate new standards such as SONET/SDH. These high-speed technologies require highly accurate and stable network synchronization and distribution. The HP 55300A exceeds the published specifications for primary reference sources. This affordable synchronization solution can flatten hierarchical networks, providing cesium-like performance at all points. Comparable in holdover performance to more expensive rubidium products, the HP source offers significantly better reliability and does not require the periodic service associated with rubidium alternatives.

Based on advanced GPS technology, the HP 55300A with enhanced GPS provides frequency accuracy of $<1 \times 10^{-12}$ using a 1-day average, even in the presence of Selective Availability. If the GPS signal is interrupted, the module enters an intelligent holdover mode ensuring that precise frequency is maintained for more than 24 hours.

The general-purpose HP GPS synchronization source can upgrade any office; the unit is not restricted to use with specific models of existing timing signal generators (TSGs), or synchronization supply units (SSUs). Modules can be configured for 1.544 Mb/s, 2.048 MHz, 2.048 Mb/s, and 10 MHz.

U.S. and International Versions

The HP 55300A consists of a plug-in card, which can be combined with a lightweight, compact rackmount frame. Configured in this manner, the unit can be hardwired into an office rack. For customers in the U.S., the HP 55300A GPS Telecom Primary Reference Source should be ordered with HP 55310A GPS NEBS/EIA Rackmount Frame. International customers can purchase the HP 55300A with the HP 55320A or HP 55322A GPS ETSI Rackmount Frame.

Integrated Time-of-Day Function

Each HP synchronization module takes advantage of the accuracy of the GPS reference to provide a time-of-day signal. The accurate time-of-day facilitates fault isolation, sequence-of-events analysis, and other emerging troubleshooting techniques that benefit service providers by improving the quality and availability of services.

Specifications Summary

Key Characteristics
Locked Accuracy: $<1 \times 10^{-12}$ using a 1-day average (when locked to GPS)
Holdover Stability: $<1 \times 10^{-10}$ per day
Outputs Available: 1.544 Mb/s, 2.048 Mb/s, and 2.048 MHz
Framing: Industry-standard formats available
Oscillator MTBF: >500,000 hours
Cold Start-up: GPS lock in < 30 minutes (assumes "normal" view of sky)

Front Panel
LEDs: Power, GPS Lock, Holdover, Critical, Major, and Minor Alarms, ACO Active
Push-buttons: Alarm Cut-Off (ACO) and ACO Reset
DS1/E1 Monitor Output: Bantam connector
Local Command Interface (Craft Interface): RS-232C, DE-9 connector, DTE configuration, TL1 command/status structure

Rear Panel (HP 55310A); Top Front (HP 55320A and HP 55322A)
GPS Antenna: "N" connector
Power: Redundant –48 V power inputs; latching plug-in connectors for 14 to 28 gauge wire
DS1/E1: Wire-wrap (HP 55310A); BNC, (HP 55320A); or DS/EI: Wire wrap (HP 55310A); BNC (HP 55320A); or DE-9S (HP 55322A)
Alarms: Wire-wrap (HP 55310A); DB-25P (HP 55320A and HP 55322A)
Remote Command I/F: RS-232C at 9.6 kbps, DB-25S connector, DTE configuration, TL1 command/status structure
Time-of-day Output: HP SCPI I/F for connection to Network Time Protocol (NTP) server
Other: 1 PPS at RS-232C level, 10 MHz sine wave, IRIG-B time-of-day

Alarm Operation
Configurable Causes: Power failure, output failure, oscillator failure, synthesizer failure, GPS signal loss (holdover)
Remote and Local: Two separate sets of connections. Local set responds to ACO pushbutton.
Multiple Alarm Priorities: Critical, major, or minor for each
Relay Connection Outputs: Common, NO, NC

Environment/Installation
Rack Configuration: 19-, 21-, and 23-inch, NEBS/EIA or ETSI-compatible
Temperature: 0 to +50°C (operating); –40 to +70° C (storage)

Antenna
Active Antenna: 30 dB (typical) active gain with dielectric filter
Temperature: –30 to +80°C (operating); –40 to +85°C (storage)

HP 55300A module in the HP 55320A shelf

Ordering Information

NEBS (US) Version
HP 55310A GPS NEBS/EIA Rackmount Shelf
HP 55300A GPS Telecom Primary Reference Source
Order Option 104 or 105
ETSI (International) Version (Unbalanced Outputs)
HP 55320A GPS ETSI Rackmount Shelf
HP 55300A GPS Telecom Primary Reference Source
Order Option 270, 271 or 272
ETSI (International) Version (Balanced Outputs)
HP 55322A GPS ETSI Rackmount Shelf
HP 55300A GPS Telecom Primary Reference Source
Order Option 220, 221 or 222
GPS Antenna Systems and Accessories
See page 497 for the complete line of GPS Accessories.

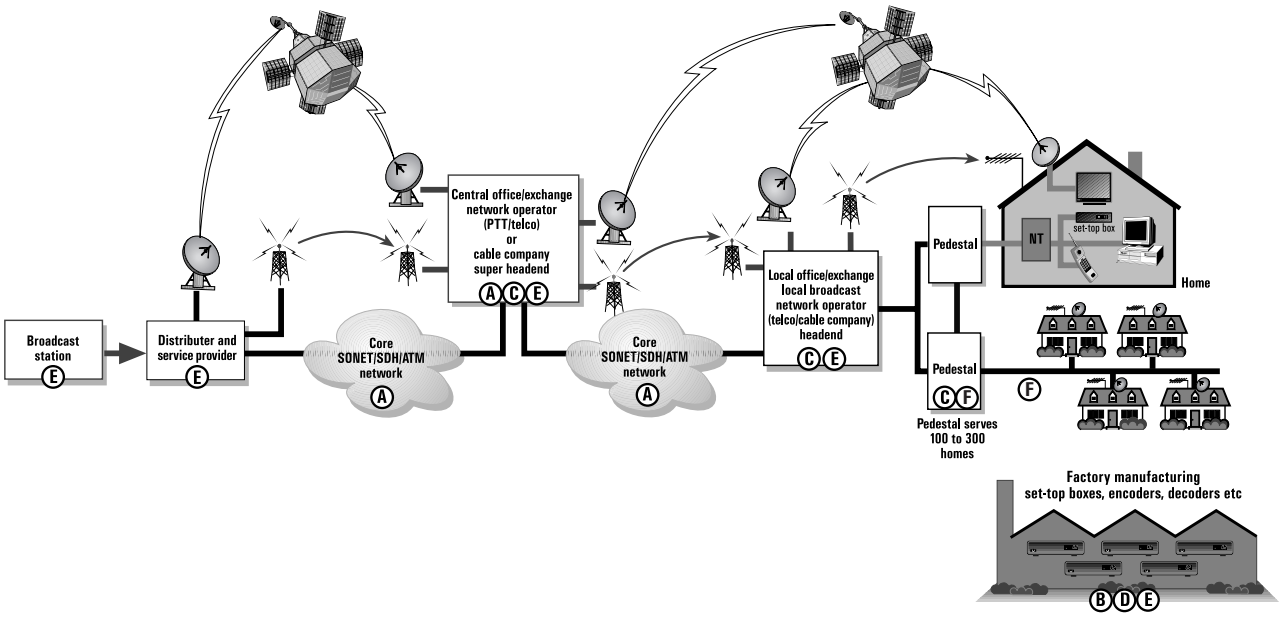
Telecom Network Synchronization

HP 55300A GPS Telecom Frequency Reference Source
5966-4170E
5965-1682E/EUS
5966-3284E
HP 5071A Sync Family Brochure
5968-2250E
HP 5071A Unsurpassed Stability in the Lab or Field
5968-1862E/EUS
HP 55400A Network Synchronization Unit
5966-0432E
HP 55452A Synchronization Management/UX
5966-1840E
HP E1748A Multiple-channel Network Synchronization Software
5965-6659E
5966-4094EUS
5966-4095E
HP Innovation for 21st Century Network Sychronization
5968-2250E

Power Measurement Synchronization

HP 59551A GPS Measurements Synchronization Module
5965-2998E
Synchronize and Analyze Power System Performance
5964-0262E/EUS
GPS Synchronization for Power Transmission Systems
5964-2459E
HP 59552A Fiber Optic Distribution Amplifier and HP 59553A Fiber Optic Receiver
5964-8927E/EUS

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00



Test Equipment for Digital Video Broadcast/Cable TV

Digital transmission is the key enabling technology that will allow cable systems to deliver a multitude of emerging services. Ensuring a high quality of service requires testing various aspects of the signal—data integrity, modulation, and RF signal quality. HP offers a wide range of instruments for testing all these aspects of digital video service development, deployment, and device manufacuring.

A
HP E6271A MPEGscope ATM
Real-time MPEG-2 tests over AAL-5, MPEG-2 transport quality of service measurements, real-time PSI table decodes. Runs on HP E4200 Broadband Series Test System. See page 512.

B
HP 89400 Digital Video Signal Analyzer
State-of-the-art modulation quality measurements for R&D and commissioning. See page 511.

C
HP 8594Q DVB-C QAM Analyzer
Comprehensive RF, modulation, and data quality measurements for cable system operators. See page 509.

D
HP ESG-D4000B Digital Signal Generator
Used to produce highly accurate IF or RF signals. See page 196.

HP E2507B Multi-Format Communications Signal Simulator
Simulate varying return link traffic levels with multiple-modulated signals. See page 189.

E
HP E6277A MPEGscope Plus
Capture, analyze, and transmit transport streams, real-time transport stream analysis, bit error rate test, TS and PES protocol, DVB, and ATSC table decodes; optional ES compression analysis software. See page 68.6.

F
HP CaLan 3010 R/H Sweep/Ingress Analyzer
Digital channel power, sweep and ingress measurements for network technicians. See page 515.

- Field testing solution for DVB-C[1] cable TV systems
- Test from the headend to the subscriber drop
- Comprehensive suite of RF, modulation, and data quality measurements
- Verify your quality of service

HP 8594Q QAM Analyzer

HP 8594Q QAM Analyzer

The HP 8594Q QAM Analyzer is a comprehensive solution for RF installation and maintenance testing of DVB-C (Digital Video Broadcast via Cable) signals on cable TV systems. It gives engineers the measurement capability required to accurately verify the quality of service delivered to the subscriber. All measurements are easy to access and the results are presented in a clear graphical displays.

Applications

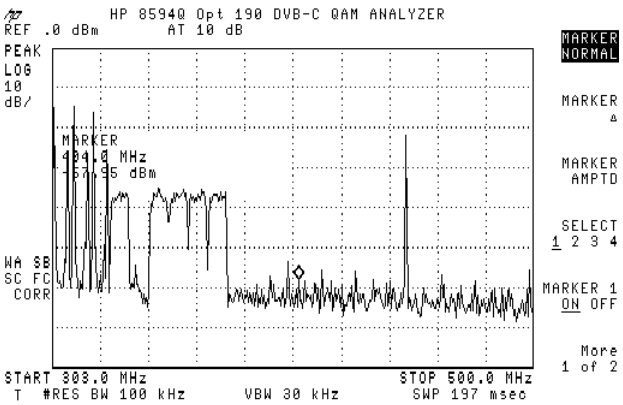
The HP 8594Q QAM Analyzer can help you during:
- Headend equipment installation and maintenance
- System verification
- Field installation and maintenance
- Modulator manufacturing or incoming inspection test
- Opt J91–Modulation measurements in 6 MHz channel bandwiths

Measurement Capability

The HP 8594Q QAM Analyzer demodulates and accurately measures the 16, 64 or 256 QAM signals carried through the DVB-C system. It provides new measurement metrics necessary to characterize these signals and troubleshoot problems. The graphical displays, clear user interface, and one-button measurement capability will help make the transition easy for analog cable TV engineers.

To accurately verify your quality of service, the HP 8594Q QAM Analyzer provides the following measurement capability:
- Average channel power—To verify the signals levels from the headend through the system to the subscriber drop
- Adjacent channel power—To make sure that transmissions are not leaking into and causing interference in adjacent channels
- Constellation display—Display the constellation points and quickly identify any modulation problems
- Error vector magnitude and modulation error ratio—To quantify the modulation quality of the signal transmitted through the system
- Equalizer response—Frequency, impulse, group delay and phase response plots can be displayed on screen to show distortions caused by the transmission channel
- Data measurements—Add Option 195 to the 8594Q QAM Analyzer to verify that the MPEG data has been correctly decoded from the DVB-C RF signal and check transport stream content. The option also proves a real-time output (both ASI and parallel), to allow access to the data stream for further analysis. The HP 8594Q option 195 includes a real-time FEC decoder. By monitoring the activity of the FEC decoder, analysis of byte and packet errors is provided.

The HP 8594Q QAM Analyzer makes all of these measurements quickly and accurately. In addition the HP 8594Q QAM Analyzer provides a fully featured 2.9 GHz spectrum analyzer.



Key Literature

Product Overview, p/n 5965-5826E
Product Note, p/n 5965-4991E

Ordering Information

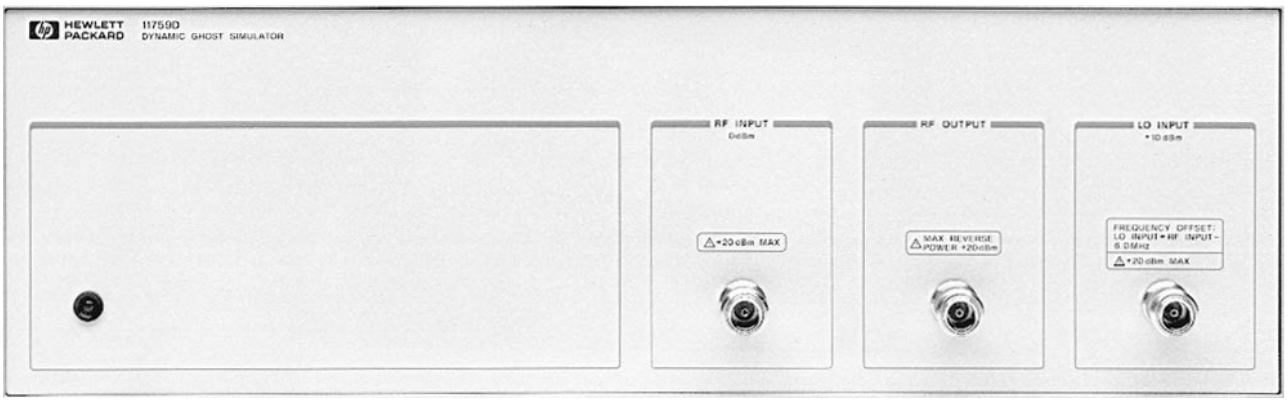
HP 8594Q QAM Analyzer
- **Opt 190**[2] DVB-C Measurement Capability
- **Opt J91**[2] Modified to operate at
- **Opt J93**[2] specific symbol rates in
- **Opt J94**[2] 6 MHz channel bandwiths[4]
- **Opt 195**[3] Data Measurements
- **Opt 016** Soft Yellow Operating/Carrying Case
- **Opt 040** Front Panel Protective Cover with Storage
- **Opt 043** RS232/Parallel Interface
- **Opt 908** Rackmount Kit without Handles
- **Opt 909** Rackmount with Handles
- **Opt 910** Additional Manual Set

[1] DVB-C is a standard defined by the European Telecommunications Standards Institute.
[2] Opt 190, J91, J93, or J94 required.
[3] Opt 195 measurements are specific to the DVB standard.
[4] Contact sales office for details.

510 Dynamic Ghost Simulator

HP 11759D

- Simulates realistic propagation models for analog and digital television
- Static and time varying ghosts
- 12-bit processing for minimum distortion
- RF input/output for full IF/VHF/UHF coverage



HP 11759D

HP 11759D Dynamic Ghost Simulator

The HP 11759D dynamic ghost simulator easily simulates the ghosting and airplane flutter that commonly degrade terrestrial TV broadcasts. With the HP 11759D, ghost canceller or digital TV designs can be tested under the real-world conditions of multiple reflections and motion. The simulation of motion is required to account for the effects of tower sway, airplane flutter, and the movement of people, vehicles, and trees. The HP 11759D is ideally suited to simulate these phenomena.

The HP 11759D consists of the applications software and the RF processing hardware and requires two user-supplied components to complete the dynamic ghost simulation system—a PC acting as a user interface and a synthesized local oscillator with a 10 MHz timebase output.

Easy to Use Manually or Remotely

Simple-to-use on-screen menus guide the user through the task of creating complex RF multipath ghost signals for testing ghost cancelling systems or digital TV receivers. These same menus are accessed remotely by installing an optional GPIB interface card in the PC.

HP 11759D Partial Specifications

(See Technical Data Sheet for complete specifications)
RF Channels: 1 of 6 paths
RF Frequency Range: 40 to 1,000 MHz (useable to 2700 MHz)
RF Bandwidth (1 dB)**:** > 6 MHz typical
RF Input Level: –10 dBm (+ 97 dBµV) nominal
Path Insertion Loss: 24 dB ± 3 dB typical
Path Delay Range: 0 to ± 186 µs, maximum delay spread, 186 µs
Path Attenuation Range: 0 to 50 dB in 0.1 dB steps
Relative Phase Between Paths: Adjustable 0 to ± 360˚, 0.1˚ steps
Simulated Doppler Range: 0 to 425 Hz, in 0.01 Hz steps
For NTSC Modulated Signals
Chrominance-to-Luminance Delay Inequality: < 10 ns typical
Chrominance-to-Luminance Gain Inequality: < 4% typical
Differential Phase Distortion: < 1 degree typical
Differential Gain Distortion: < 1% typical
General
Power: 90 to 132/190 to 264 V; 48 to 66 Hz; 325 VA maximum
Size: 425 mm W x 146 mm H x 620 mm D (16.8 in x 5.7 in x 24.4 in)
Weight: Net, 13.6 kg (30 lb); shipping, 19 kg (42 lb)

- Adaptive equalization now included in Option AYA
- Peak-to-average power measurements, including CCDF
- Constellation, eye, and error magnitude analysis for QAM, VSB, and other modulation formats (Option AYH)
- Dynamic power measurements, including: peak, average, band-integrated, and adjacent channel
- Waveform capture and analysis
- Carrier phase noise measurements to –124 dBc/Hz (typical at 10 kHz offset)
- High input sensitivity for DTV field testing

HP 89400 Option AYH Digital Video Signal Analyzer

Meeting the needs of both broadcasters and system designers, the HP 89441V and the HP 89400 series with option AYH or COFDM analysis software precisely characterize RF signals in the emerging modulation formats of the digital video industry, including COFDM, QAM and VSB. Off-the-shelf, lab-quality spectrum and waveform measurements allow designers of ATV/HDTV components, equipment and systems to deliver higher-quality video signals faster and for less cost than with custom-built test tools.

Signal Quality Measurements

HP 89400 vector signal analyzers measure signal power and waveforms in the time, frequency, and modulation domains, making them extremely versatile design and troubleshooting tools. Their advanced DSP architecture provides measurements that are not only fast, but exceptionally accurate and informative—even for complex, broadband ATV signals.

For more information about HP 89400 signal analysis capabilities, see page 250.

Digital-Modulation Analysis

The HP 89441V bundles option AYH with other necessary options for Digital Video Test in one prodect. Digital video analysis Option AYH equips HP 89400 analyzers to demodulate and characterize a wide variety of video-related signal formats. Results are shown via traditional eye and constellation displays, or as error vector magnitude and MER (Modulation Error Ratio) measurements. EVM quantifies the instantaneous difference between the actual input signal and an ideal, internally-generated reference signal containing the same data stream. It is a measurement technique now widely accepted among digital RF communications designers and international standards organizations. Expressed as a time waveform, an rms average or an error spectrum, EVM is sensitive enough to reveal the slightest degradations in signal quality, such as those which occur between the input and output of even a single amplifier stage. Use it to troubleshoot BER or other signal problems back to their root causes.

In digital demodulation mode, carrier lock, and symbol clock synchronization are automatic. This means external carrier reference or clock inputs are never required, making the HP 89400 analyzers useful even in remote or field test applications.

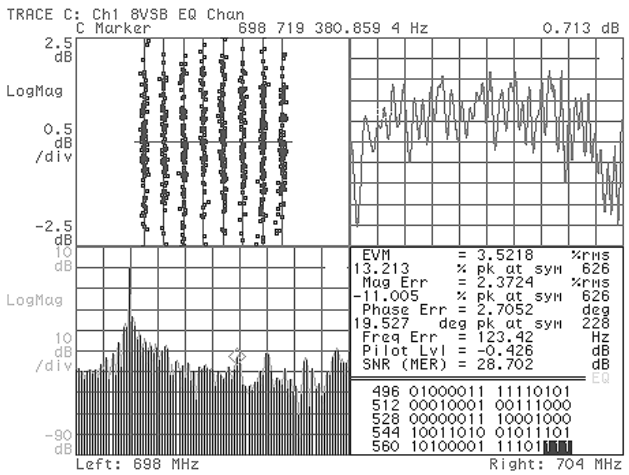
COFDM Modulation Analysis

For modulation measurements to the European DVB-T (Digital Video Broadcast - Terrestrial) standard, HP has developed software for use with the 89441A and a PC for external data analysis.

DVB-T uses a COFDM (Coded Orthogonal Frequency Division Multiplex) modulation scheme, with either a nominal 2000 ("2k") or 8000 ("8k") carriers contained within a standard 8MHz RF channel. Each carrier is modulated with low-rate 64QAM.

The analysis software is a pre-configured HP VEE application, and is supplied on CD-ROM. As well as making all the normal RF tests on the signal, the system makes the following DVB-T modulation measurements:

1. Symbol magnitude spectrum
2. Symbol phase spectrum
3. Symbol IQ constellation
4. EVM magnitude spectrum
5. EVM complex
6. Equalizer magnitude spectrum
7. Equalizer phase spectrum
8. Error statistics summary table
9. Data power from nominal relative to pilots
10. TPS Power from nominal relative to pilots
11. Modulation Error Ratio (MER)



Measurement displays include channel frequency response and impulse response of the equalization filter.

Adaptive Equalization

A new adaptive equalization capability is included and works with digital demodulation to remove linear errors, such as frequency response and reflections, from transmitted signals. Measurements more closely approximate the performance of real-world receivers and can be used to isolate linear vs. non-linear error mechanisms. Measurements include displays of channel frequency response and impulse response of the equalization filter. This equalization does not require prior knowledge of the signal such as a training sequence.

For more information, including downloading a free DTV field test IBASIC program, visit our web site: **http://www.hp.com/go/89400**

Specifications

Frequency Range and Bandwidth

Model number	Frequency range	Sensitivity	Maximum bandwidth
HP 89410A	dc to 10 MHz	–144 dBm/Hz	10 MHz
HP 89441A	dc to 2650 MHz	–160 dBm/Hz	8 MHz
HP 89441V	dc to 2650 MHz	–160 dBm/Hz	8 MHz

Symbol Rates (Symbols/Sec)
VSB Formats: 10.77 M nominal (adjustable)
QAM Formats: Rate < (Analyzer BW)/(1 + α)
Examples:

Model number	QAM α = 0.2	DVB α = 0.15
HP 89410A	< 8.33 M	< 8.70 M
HP 89441A	< 6.09 M	< 6.96 M
HP 89441V	< 6.09 M	< 6.96 M

Maximum Measurement Size
1 sample/symbol: 4096 symbols
5 samples/symbol: 819 symbols

Modulation Formats
8, 16VSB
COFDM (using external PC analysis software E9285A Opt K01)
16, 32, 64, 256QAM
16, 32, 64QAM (DVB)
(QPSK, Offset QPSK, FSK, MSK, BPSK and other formats are supported by Option AYA–not available on HP 89441V)

Residual Error (instrument contributed)
QAM Formats: Symbol rate 5 to 7 MHz, 0.15 < α < 0.2, full-scale signal ≥ –25 dBm: ≤ 1.0% EVM typ. (≤ 40 dB SNR)
VSB Formats: Symbol rate 10.762 MHz, α = 0.1152, full-scale signal ≥ –25 dBm: ≤ 1.5% EVM typ. (≤ 36 dB SNR)

Required Options for 89410A and HP 89441A
AYA (vector modulation analysis)

For complete product, literature, and ordering information, see page 250.

HP MPEGscope Test Systems–MPEG-2/DVB/ATSC

HP E6277C
HP E6300A
HP E6301A
HP E6302A

- Analyze and troubleshoot MPEG-2, DVB, and ATSC systems and services
- Record, generate and analyze MPEG-2 transport streams in real time or off-line
- Full video and audio elementary stream analysis and compliance testing

HP E6300A MPEGscope Portable and HP E6277C MPEGscope Plus

Comprehensive MPEG-2, DVB, and ATSC Testing

In today's fast-paced digital TV market, the ability to develop and test complex systems quickly and easily is critical. Open, competitive marketplaces mean standards compliance and interoperability is more important than ever. The HP MPEGscope test system is the most comprehensive tool for MPEG-2, DVB and ATSC system development and qualification. This PC-based test system offers the perfect combination of real-time and post-analysis tools for MPEG-2 testing. It is ideal for product development, quality assurance, system integration and troubleshooting. With the HP MPEGscope Test System and optional software test applications, it's quick and easy to verify and debug digital TV network systems, including encoders, multiplexers/demultiplexers, set-top boxes, video servers and much more.

With its PC-based Windows NT architecture and intuitive user interface, MPEGscope offers a familiar environment that allows you to troubleshoot your digital TV implementations quickly and effectively. Features available in the MPEGscope include:

- MPEG-2 transport stream capture and playback up to 90 Mb/s with precise timestamping
- Storage of MPEG-2 streams up to 18 GB (expandable to 36 GB)
- Real-time ETR-290 monitoring, PID bandwidth, PCR jitter and T-STD buffer model analysis with trigger-based capture of error events
- Complete MPEG-2 transport stream, PES packet and PSI table decode with protocol error analysis and compliance testing
- ATSC PSIP and DVB SI table analysis in real time and off-line
- PTS/DTS timing analysis for testing audio/video synchronization
- Private table definition capability for analyzing streams and generating streams with custom-defined tables
- Protocol-based editing of captured transport streams
- Custom multi-program MPEG-2 transport stream generation, including DVB, ATSC, and private tables and descriptors
- PCR jitter and bit-error impairment of transport streams for decoder stress testing
- Available in both high-performance HP Kayak desktop workstation or lightweight ruggedized portable platforms
- Standard DVB-SPI (parallel LVDS) interface provided, optional DVB-ASI, SMPTE 310M, DHEI, and ARIB interfaces available.

The HP MPEGscope Lite and Portable Lite models are also available for applications not requiring the full functionality of real-time analysis.

In-depth Video and Audio Elementary Stream Analysis

The Video Elementary Stream Analyzer allows you to test all aspects of MPEG video encoding. This optional MPEGscope application will decompose the video elementary stream right down to an individual macroblock. Syntax and semantic protocol testing, bit rate and VBV buffer statistics, and detailed macroblock and motion vector analysis are all provided in this high-powered package. You can even display the video for visual verification. This software finds application in bitstream verification, development and optimization of encoder compression algorithms, and troubleshooting encoder and decoder interoperability issues. All video formats used in both DVB and ATSC systems are supported, including HDTV.

The Audio Elementary Stream Analyzer provides in-depth analysis of the audio elementary stream and allows quick debugging of MPEG-1, MPEG-2 or Dolby Digital AC-3 audio encoding. It includes protocol decode, syntax and semantic error checking, and graphing of key compression parameters. The audio can also be played out through the headphones or a speaker to check for quality problems.

Complete Compliance Testing

The Compliance Verification Test Suite enhances the powerful MPEGscope test system by providing incomparable compliance testing according to MPEG, DVB and ATSC standards. Complementing the basic compliance testing that is part of every MPEGscope, this software performs more than 850 tests—the most comprehensive of any MPEG test system on the market. The automated tests quickly find errors in MPEG implementations, allowing interoperability problems to rapidly be solved and avoiding "finger-pointing" among equipment vendors. A detailed error report file is generated, referencing the error's exact location in the bitstream and the violated standard and clause.

Test Material

HP's complete MPEG testing solution also includes test material for encoders and decoders. The HP E6285A Encoder Stress Test Patterns is a video tape of synthetically produced test sequences that can be used to evaluate or optimize digital encoders. The HP E6288A MPEG Decoder Test Bit Streams is a set of MPEG streams that can be played out to a decoder chip or set-top box to verify its functionality.

Key Literature

HP MPEGscope Test Systems Colour brochure, p/n 5968-4989E
HP MPEGscope Test Systems Technical specification, p/n 5966-8194E
E6292A SMPTE 310M Interface Data sheet, p/n 5968-5375E
E6309A Audio Elementary Stream Analyzer Data sheet, p/n 5968-4990E
E6310A Video Elementary Stream Analyzer Data sheet, p/n 5965-6491E
E6311A/E6312A Compliance Verification Test Suites Data sheet, p/n 5966-0375E
E6285A Encoder Stress Test Patterns Data sheet, p/n 5965-6492E
E6288A MPEG Decoder Test Bit Streams Data sheet, p/n 5965-1508E

Ordering Information

For assistance in defining your configuration, please contact your local HP sales office.

MPEGscope Test Systems
E6277C MPEGscope Plus
E6300A MPEGscope Portable
E6301A MPEGscope Lite
E6302A MPEGscope Portable Lite

Hardware Options
E6289A ARIB (Parallel TTL) Interface
E6291A ASI and Serial ECL (DHEI) Interface
E6292A SMPTE 310M Interface
E6305A 24 GB External DAT Drive
E6306A Expand hard-disk storage to 36GB

Software Options
E6309A Audio Elementary Stream Analyzer
E6310A Video Elementary Stream Analyzer
E6311A/E6312A Compliance Verification Test Suite
E6290A PerfecTV Decode Software for MPEGscope

Test Material
E6285A Encoder Stress Test Patterns
E6288A MPEG Decoder Test Bit Streams

Accessories
E6295A Transit Case for MPEGscope Plus Monitor
E6296A Transit Case for MPEGscope Plus Chassis
E6297A Transit Case for MPEGscope Portable

HP 8591C
HP 85721A
HP 85905A
HP 85921B

- Dedicated cable TV analyzer
- Portable and easy to use
- Non-interfering RF and video measurements
- New—Digital carrier power measurements
- New—Cable TV data management software

HP 8591C

HP 8591C Cable TV Analyzer

Industry's Only Cable TV Analyzer that Keeps Pace with Changing Regulations

The HP 8591C cable TV analyzer (1 MHz to 1.8 GHz) is the first economical, portable, one-box solution for making automatic, non-interfering cable TV RF and video measurements. The analyzer features a flexible hardware and software architecture that can be upgraded easily to protect your investment as new test requirements are introduced.

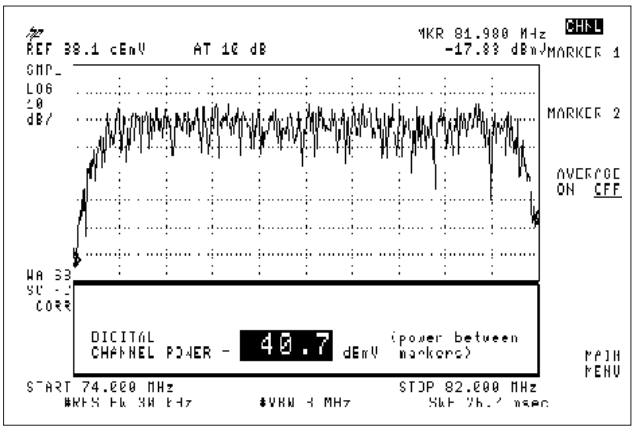
Included in the cable TV analyzer are the features you need for cable TV testing compatible with worldwide formats and standards, including all FCC proof-of-performance tests:

- HP 85721A cable TV RF/video measurements personality to simplify channel and system cable TV measurements
- 75 Ω input matches analyzer to cable TV impedance
- Built-in, internally switched preamplifier for improved carrier-to-noise measurements
- Precision frequency reference to accurately measure carrier frequency
- Fast time-domain sweeps for displaying individual TV lines
- TV trigger for selecting TV lines by number
- RS-232 and parallel interfaces for PC and printer operation, respectively
- HP 85702A 128K RAM card for storing test data
- Rugged, yellow, soft carrying case

Options add even greater measurement capability to the analyzer. These include a 75 Ω tracking generator, narrow resolution bandwidths, and non-interfering RF and video measurements.

Non-Interfering Measurements

Option 107 for the HP 8591C and the HP 8590 E-series spectrum analyzers adds the hardware needed to make non-interfering RF and video measurements. Non-interfering measurements let you perform required tests on multiple channels at multiple locations with no impact on customer programming. The video measurement capability allows you to perform required FCC color tests. Option 107 also enables simultaneous viewing of TV pictures and listening to program sound. The hardware demodulates NTSC-format television signals as well as versions of PAL and SECAM.



Digital Carrier Power Measurement on HP 8591C

Measurements for RF and Video Testing

The HP 85721A measurement personality card (included with the HP 8591C) customizes the analyzer for easy, non-interfering proof-of-performance measurements on NTSC-, PAL-, or SECAM-format signals. This software adds dedicated cable TV test functions and measurements that you can perform with the push of single keys. Measurements include the following functions and tests:

- Automatic tuning of cable TV and TV broadcast carriers
- Visual and aural carrier levels and frequencies
- Digital carrier power
- System channel survey
- Depth of modulation
- TV aural and FM broadcast carrier deviation
- Carrier-to-noise ratio (C/N)
- In-channel frequency response
- Hum/low frequency disturbances
- System frequency response
- Baseband TV line and field viewing
- TV aural and FM broadcast carrier demodulation
- Distortion (CSO/CTB)
- Crossmodulation
- Ingress and co-channel viewing

System monitor capability automates measurements, allowing the analyzer to test without assistance from the operator. It also allows you to design test plans and to turn test data into reports instantly. With Option 107 added to the cable TV analyzer, non-interfering measurements of carrier-to-noise, in-channel frequency response and distortions can be made, as well as video measurements:

- Differential gain
- Differential phase
- Chromiance-luminance delay inequality

Painless Reports and Data Archiving

Take the pain out of cable TV reports with the HP 85921B cable TV data management software. Running on IBM compatible PCs, it downloads test data from your HP 8591C, and HP CaLan 2010B, 3010, 3010B, and 3010R into a PC database for making reports and archiving data. The software compares measurement results to your specifications and displays pass/fail messages for each test. Test data can also be exported to a word processor or spreadsheet for other analysis.

You can print the results of every test run at each specified location in the cable system. The printout will list all the channels tested, as well as additional required information such as the date of the testing, the name and qualifications of the person who ran the test, and the serial number of the equipment used. Add Option 032 to automatically generate reports in a format compliant with the FCC regulations. All RF and video tests (except leakage) currently required by the FCC are included.

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Cable TV Analyzer, Accessories

HP 8591C
HP 85721A
HP 85905A
HP 85921B

Specification Summary

Specifications apply to the HP 8591C cable TV analyzer with preloaded HP 85721A measurements personality, and to the HP 8591E spectrum analyzer with Options 001, 004, and 301, and the HP 85721A personality.

General

Channel Selection: Analyzer tunes to specified channels
Input: 75Ω, BNC
Frequency Range: 5 to 1002 MHz for channel model;
54 to 896 MHz for system mode;
1 MHz to 1.8 GHz for spectrum analyzer mode
Amplitude Range: –15 to +70 dBm V for S/N > 30 dB
Displayed Average Noise Level (1 kHz RBW, 0 dB atten.)
- **Without Preamplifier:** ≤ –63 dBmV (1 to 1500 MHz)
- **With Internal Preamplifier:** ≤ –83 dBmV (1 to 1000 MHz)
- **With External Preamplifier:** ≤ –83 dBmV (1 to 1000 MHz)

Cable TV Measurements

Visual Carrier Frequency (visual carrier frequency is counted)
Precision Frequency Reference
- **Resolution:** 100 Hz
- **Accuracy:** ±(1.2 x 10^{-7} x carrier freq. +110 Hz)
- **At 55.25 MHz** (ch. 2): ±117 Hz
- **At 325.25 MHz** (ch. 41): ±149 Hz
- **At 643.25 MHz** (ch. 94): ±187 Hz

Visual-to-Aural Carrier Frequency Difference [counted frequency difference between visual (vision) and aural (sound) carriers]
- **Difference Range:** 4.1 to 4.9 MHz
- **Resolution:** 100 Hz
- **Accuracy:** ±221 Hz for precision frequency reference

Visual Carrier Peak Level (measured to an absolute standard)
- **Amplitude:** –15 to +70 dBm V
- **Resolution:** 0.1 dB
- **Absolute Accuracy:** ±2.0 dB for S/N > 30 dB
- **Relative Accuracy:** ±1.0 dB relative to adjacent channels in frequency; ±1.5 dB relative to all other channels

Visual-to-Aural Carrier Level Difference [measured difference between peak amplitudes of visual (vision) and aural (sound) carriers]
- **Difference Range:** 0 to 25 dB
- **Resolution:** 0.1 dB
- **Accuracy:** ±0.75 dB for S/N > 30 dB

Digital Carrier Power
- **Accuracy (characteristic) :** ±0.75 dB
- **Readout Resolution:** 0.1 dB

Depth of Modulation, Characteristic (percent difference from horizontal sync tip to max. video level)
- **AM Range:** 50 to 93%
- **Resolution:** 0.1%
- **Accuracy:** ±2.0% for C/N > 40 dB

FM Deviation, Characteristic (peak reading of FM deviation)
- **Range:** ±100 kHz
- **Resolution:** 100 Hz
- **Accuracy:** ±1.5 kHz

Hum/Low Frequency Disturbance (measured for power-line frequency and low-frequency disturbance)
- **AM range:** 0.5 to 10%
- **Resolution:** 0.1%
- **Accuracy:** ±0.7% for hum ≤ 5%

Visual Carrier-to-Noise Ratio, C/N (calculated from visual-carrier peak level; min. noise level normalized to 4 MHz for NTSC format)
- **Range** (input level dependent): 63 dB max. for +25 dBmV input

C/N Resolution: 0.1 dB
C/N Accuracy (input level and measured C/N dependent): < ±1 dB for 50 dB C/N and +25 dBmV input with external preselector filter
Composite Second Order and Composite Triple Beat Distortion (CSO and CTB measured relative to visual-carrier peak)
- **Range** (input level dependent): 77 dB max. for 25 dBm V input
- **Resolution:** 0.1 dB
- **Accuracy** (input-level, measured-CSO/CTB dependent): <± 1.5 dB for 60 dB CSO/CTB and +25 dBm V input

Crossmodulation Characteristic (15.7 kHz horizontal-line related AM measured on unmodulated visual carrier)
- **Range:** 60 dB, usable to 65 dB
- **Resolution:** 0.1 dB
- **Accuracy:** ±2.6 dB for xmod < 50 dB, C/N > 40 dB

System Frequency Response (system amplitude variations measured relative to a reference trace stored during the setup)
- **Frequency Response Setup:** Reference-trace storage for 50 traces including analyzer states
- **Frequency Response Test:** Trace-flatness accuracy is ± 0.1 dB per dB deviation from a flat line and ±0.75 dB maximum cumulative error

Option 107 Operation (for video and non-interfering measurements)
TV Receiver Input
- **Frequency Range:** 50 to 850 MHz
- **Amplitude Range:** 0 to 40 dBm V

Non-interfering Color Test (requires FCC composite or NTC-7 test signal for NTSC format)
- **Differential Gain Accuracy:** ≤ ±4%[1]
- **Differential Phase Accuracy:** ≤ ±3°[1]
- **Chrominance-luminance Delay Inequality Accuracy:** ≤ ±45 ns, ±32 ns typical

Non-interfering Tests with Gate ON[2]
- **C/N and CSO:** Quiet line must be selected
- **In-channel Frequency Response Accuracy:** < ±0.5 dB within channel (requires sin x/x, Philips ghost canceling reference, or FCC/NTC-7 multiburst test signal for NTSC format)

Preamplifiers

HP 85905A 75 Ω Preamplifier (external)
- **Frequency Range:** 45 to 1000 MHz
- **Gain:** 20 dB ±1.0 dB
- **Noise Figure:** 7 dB maximum at midband

HP 8591C 75 Ω Preamplifier (internal)
- **Frequency Range:** 1 to 1000 MHz
- **Gain:** ≥ 24 dB
- **Noise Figure:** ≤10 dB

Ordering Information

HP 8591C Cable TV Analyzer (includes HP 85721A)[3]
- **Opt 107**[4] TV Receiver/Video Tester (includes 75 Ω coupler and cables)
- **Opt 011** 75 Ω Tracking Generator
- **Opt 015** Change Yellow to Tan Soft Carrying Case
- **Opt 030** Cable TV Data Management Software with FCC Reports
- **Opt 040** Front-Panel Cover (used without soft carrying case)
- **Opt 041**[5] GPIB and Parallel[6] Interfaces
- **Opt 119** Noise Figure Card
- **Opt 130** Narrow Resolution Bandwidths
- **Opt 180**[7] TV Picture Display
- **Opt 701** Delete TV Trigger, AM/FM Demodulator, Fast Time-Domain Sweeps
- **Opt 704** Delete Precision Frequency Reference
- **Opt 908** Rackmount without Handles
- **Opt 909** Rackmount with Handles
- **Opt 915** Component Level Info. and Service Guide
- **Opt W30** Two Additional Years Return-to-HP Service
- **Opt W32** Two Additional Years Return-to-HP Calib.
- **Opt R07** Retrofit Kit for Option 107

Recommended Accessories
HP 85702A 128K RAM Card
HP 85721A[3] Cable TV Measurements and System Monitor Personality (for HP 8590 E-series)
HP 85901A Portable AC Power Source
HP 85905A 75 Ω Preamplifier
HP 85921B Cable TV Data Management Software
- **Opt 030** with FCC Reports

HP 24542U RS-232 Nine-Pin Cable (analyzer to PC)
HP 24542G RS-232 Nine-Pin to 25-Pin Cable (analyzer to PC)
HP C2950A Parallel Cable (analyzer to printer)
HP 10833A GPIB Cable

[1] 20° to 30° C, ≥ 20 dBm V input
[2] Gate ON synchronizes the measurement to the TV line selected
[3] NTSC format only; worldwide options available
[4] Not compatible with Option 180
[5] Replaces standard RS-232 and parallel interfaces
[6] Print and plot control only
[7] Not compatible with Option 107

- Ingress detection
- Exclusive DigiSweep technology
- Built-in digital carrier power measurement
- TDMA and Bursted Power
- Built-in reverse sweep transmitter covers 5 to 1000 MHz
- Headend unit supports up to ten field units
- Rugged and easy to use

The HP CaLan 3010R and 3010H Sweep/Ingress Analyzer

HP CaLan 2010B and 3010B

Fast, Accurate Carrier Level Analysis

The HP CaLan 2010B is a field-rugged, easy-to-use signal measurement device that maintains accuracy in all environmental conditions. The 2010B comes with a standard frequency range of 5 MHz to 1 GHz and four modes of operation: single channel, four channel, spectrum scan, and a time-saving channel scan (60 channels in less than two seconds).

Programmed unattended measurements store results to 90 internal memories. Each memory will store picture and sound information for up to 158 channels. This data can also be analyzed by the built-in FCC Pass/Fail compliance reporter. The Pass/Fail report criteria is also user definable. Comparisons of levels over time can be done with the "normalize" and "motion on screen" functions.

The HP CaLan 3010 family combines the power of the 2010B with sweep features. This solution offers a system maintenance tool coupled with powerful measurement and signal analysis in one easy-to-use lightweight package.

HP CaLan Sweep/Ingress Analyzer

The HP CaLan sweep/ingress analyzer gives you confidence that your cable system is operating reliably by helping you to eliminate ingress. Designed with ingress in mind, this new solution consists of a portable field unit (HP CaLan 3010R) and a rackmount headend unit (HP CaLan 3010H).

When ingress corrupts return-path communication, the 3010H instantly detects the problem and transmits a "picture" of the ingress through the forward data pilot. This image will be displayed on the 3010R so your technician can begin troubleshooting immediately. The 3010H can support up to ten 3010Rs simultaneously. The display will advise you which 3010Rs are currently active in the field.

With the addition of Option 052 forward dual path option, you'll be armed with a complete forward, reverse sweep and ingress analysis tool. The forward sweep is still compatable with the 1777 transmitter.

Specifications Summary

Digital Signal Power Levels
- **Formats:** QAM, QPR (DMX), QPSK, and VSB
- **Amplitude Accuracy:** ± 1.5 dB (typical)

Frequency
- **Range:** 5 MHz to 1 GHz
- **Accuracy:** ± 25 kHz
- **Resolution:** 10 kHz
- **Tuning Configuration:** Standard, Off Air VHF/UHF, HRC, IRC, SECAM, PAL, and user-defined
- **IF Bandwidth:** 230 kHz
- **Video Bandwidth:** 300 kHz, automatic 10 Hz in C/N

Level
- **Range:** –45 to + 70 dBmV
- **Accuracy**
  - **Calibrator:** ± 0.25 dB @ 113.36 MHz, ± 0.2 MHz
  - **Frequency Flatness:** ±0.5 dB
  - **Attenuator:** ± 0.5 dB
  - **Log Linearity:** ± 0.5 dB
  - **Typical Overall Accuracy:** ± 1.0 dB
- **Resolution:** 0.1 dB
- **Difference Range:** 0–25 dB
  - **Relative Accuracy:** ± 0.75 dB
- **Input Impedance:** 75 ohms
- **Input Match:** > 14 dB, 0 dB attenuation; > 20 dB, attenuation > 0 dB

Hum
- **Range:** 0.5 to 5%
- **Resolution:** 0.1%
- **Accuracy:** ± (0.2% + 30% of reading)

Carrier-to-Noise (with external preselector)
- **Range:** 50 dB typical; 55 dB typical, measured in-band with carrier off
- **Accuracy:** ± 2 dB
- **Repeatability:** ± 1 dB

General
- **Size: HP 3010H:** 483 mm W x 133 mm H x 292 mm D (19 in W x 5.25 in H x 11.5 in D)
- **HP 3010R:** 95 mm W x 317 mm H x 267 mm D (10.5 in W x 12.5 in H x 3.75 in D)
- **Weight: HP 3010H:** 4.31 kg (9.5 lb.);
- **HP 3010R:** 4.8 kg (10.7 lb.) with battery
- **Power: HP 3010H:** 90 to 264 Vac, 47 to 63 Hz, 20 VA max.;
- **HP 3010R:** + 10 to +15 Vdc @ 550 mA max.
- **Battery:** 12 V (1.9 AH) rechargable lead acid
- **Usage Time:** 4 hrs. continuous; 12 hrs. typical; battery-saving sleep mode for 3010B
- **Display Area:** 127 mm x 33.8 mm (5.00 in x 1.33 in)
  - **Resolution:** 240 x 64 pixels
  - **Type:** LCD with EL backlight
- **Temperature**
  - **Operating: HP 3010H:** 0˚ to + 55˚C; 3010R: –20˚ to + 55˚C
  - **Storage: HP 3010H and HP 3010R:** –20˚ to + 70˚ C

Fiber Power Meter Option
- **Wavelength:** 1310 and 1550 nm
- **Measurement Range:** –38 to + 20 dBm @ 1310 nm; –38 to + 18 dBm @ 1550 nm
- **Resolution:** 0.1 dB
- **Accuracy:** ± 5%
- **Display:** dB, dBm, mW, microW, nanoW
- **Connector Styles:** ST, FC, biconic, D4, SMA, or bare fiber, rotary splice, RM

Ordering Information

HP 85960B HP CaLan 2010B SLM *Plus*
- **Opt 020** Fiber Power Meter

HP 85961B HP CaLan 3010B Sweep/SLM *Plus*
- **Opt 020** Fiber Power Meter

HP 85962A HP CaLan 3010R Sweep/Ingress Analyzer
- **Opt 052** Dual Path Sweep

HP 85963A HP CaLan 3010H Sweep/Ingress Analyzer
- **Opt 030** Cable TV Data Management Software with FCC Reports
- **Opt 031** Cable TV Data Management Software
- **Opt 050** Forward Sweep Transmitter
- **Opt 052** Dual Path Sweep

Product & Order Info **See page 607**

Broadcast TV Analyzers

Spectrum Analyzer Testing

HP 85724A
HP 8590
E-Series

- RF and video tests for broadcast transmitters
- One-button, non-interfering measurements
- Wide selection of frequency coverage, options
- Easily upgraded with circuit cards and DLPs

HP 85724A and HP 8591E

Broadcast Transmitter Testing with the HP 8590 E-Series Spectrum Analyzers

The HP 85724A broadcast television measurement personality provides an HP 8590 E-series spectrum analyzer with one-button measurements that simplify the installation, maintenance, and troubleshooting of TV broadcast transmitters. You can perform nearly all RF and three key video measurements without interrupting your system, offering you convenience while keeping your customers happy.

A simple process configures the spectrum analyzer to work with your particular TV system. User-definable parameters include TV standard, default ITS lines, and noise-power bandwidths. You can tune to channels by entering the channel number and band; nonstandard TV channels or FM radio channels can be measured using the frequency tuning mode. The broadcast TV measurement personality supports PAL-I/B/G, NTSC-M, and SECAM-D/K formats.

RF and Video Measurements at the Push of a Button

The HP 85724A broadcast TV measurement personality provides the following tests:

RF Measurements

- Automatic tuning of vision, sound, and FM broadcast carriers
- Vision and sound carrier levels and frequencies (including NICAM for PAL-B/G/I)
- Vision to chrominance level
- Vision in sound (AM on FM)
- NICAM intermodulation (PAL-B/G/I)
- Intermodulation products
- Three-tone intermodulation test
- Spurious signals
- Depth of modulation (frame by frame)
- Depth of modulation (ITS line)
- Low-frequency error (hum)
- Field sync distortion
- FM deviation
- Carrier-to-noise ratio
- Simultaneous TV picture and sound[1]

Video Measurements[1,2]

- Differential gain
- Differential phase
- Chrominance-to-luminance delay inequality

Advanced Analyzer Features

The spectrum analyzer's built-in features include trace math, limit-line testing, Fast Fourier transforms, and storage for up to 50 traces and states. Adjustable markers display the amplitude and frequency of any signal; zero span markers display amplitude and time or inverse-time information. A built-in memory card reader allows you to store and load application-specific programs. Other features include local oscillator output option for compatibility with sideband adapters, optional GPIB or RS-232 programming with a parallel printer port for direct printer or plotter output.

Flexible Operation

A built-in card cage allows you to add circuit-card options at any time for increased measurement capability. There are two important circuit-card options for broadcast TV measurements. Option 301 Fast Time Domain Sweeps adds Analog+, TV line triggering, and AM/FM demodulation to the analyzer. Option 107 TV Receiver/Video Tester adds capability to display TV pictures and to perform video measurements, and it provides time gating for non-interfering carrier-to-noise testing.

Bundled Options

You can order the spectrum analyzer and options individually (see Ordering Information), or you can order one of four system bundle options for a cost savings.

	HP 8591E 9 kHz to 1.8 GHz		HP 8593/4/5/6E See Note	
System Bundle Options	**E80**	**E81**	**E85**	**E86**
Preloaded HP 85724A Broadcast Measurement Personality	•	•	•	•
AM/FM demod. plus TV line trigger	•	•	•	•
Fast time domain sweeps	•	•	•	•
Analog+ display mode	•	•	•	•
Precision frequency reference	•	•	•	•
RS-232 and parallel interfaces	•	•	•	•
Rugged carrying case	•	•	•	•
Built-in 20 dB preamplifier	•	•	—	—
TV receiver/video tester	—	•	—	•

Note:
HP 8594E, 9 kHz to 2.9 GHz
HP 8595E, 9 kHz to 6.5 GHz
HP 8596E, 9 kHz to 12.9 GHz
HP 8593E, 9 kHz to 22/26.5 GHz

Ordering Information

HP 85724A Broadcast TV Measurement Personality
(for use with HP 8590 E-series spectrum analyzers)
Spectrum Analyzer (choose one)
HP 8591E, 8593E, 8594E, or 8596E Portable Spectrum Analyzer (See page 235 for prices and additional options.)
Options
Opt 041 GPIB and Parallel Printer Interfaces
Opt 043 RS-232 and Parallel Printer Interfaces
Opt 301 Fast Time Domain Sweeps, TV Trigger and AM/FM Demod, ANALOG+ Display
Opt 107 TV Receiver/Video Tester
Opt 180[3] PAL/SECAM/NTSC Picture Display
Opt H02 LO Output (HP 8591E without Option 010)
Opt H38 LO Output (HP 8591E with Option 010)
Opt 009 LO Output (HP 8593/4/5/6E)
Recommended Accessories
HP 85702A Additional 128K RAM Card
HP 85901A Portable AC Power Source

[1] Requires Options E81, E86, or 107
[2] Requires Options E81, E86, or 107 and 301
[3] Incompatible with Option 107

For more information on compatible printers, visit:
http://www.hp.com/go/pcg

Electronic Manufacturing Test Systems 16

NEW

Intelligent Test: HP's Enterprise-Wide Solution

Test and inspection, when correctly implemented, adds value to the manufacturing process. HP has a healthy tradition of providing manufacturers with the best-in-class test and inspection systems that are the foundation of that value. This was true when HP made only one in-circuit solution and it is true today for the diversity of systems we build, from simple automated optical inspection to highly complex telecommunications functional test platforms. That diversity gives you more opportunity to find a solution that fits your particular set of challenges, including a distributed test strategy which uses more that one type of test system. Now HP is building on its tradition of good measurements to help you do more with the data you get from HP systems, make them work together more efficiently. HP AwareTest xi is the first manifestation of that.

HP AwareTest xi Software

This new software solution links in-circuit and x-ray test, enabling the ICT system to "know" what the x-ray system has already inspected. The ICT system then adjusts its test suite accordingly, eliminating redundant tests. This not only speeds overall test and inspection time, it also permits the testing of very high node count boards on the ICT test system without expensive, complex fixtures because it reduces the total number of test points required for in-circuit test. A 6,000 node board can be tested on a 3,000 node tester. This software makes the most of each system's unique strengths. The X-ray system verifies the structural integrity of solder joints; the ICT system verifies electrical integrity.

HP 3070 In-Circuit Test

This is the most popular in-circuit test system on the market today. It is available in models that range from outstanding measurements at a minimal cost to thorough fault detection at a competitive price. HP has extended the range of in-circuit test by lowering the cost and complexity of in-circuit fixturing and increasing the system's ability to perform thorough tests even with as little as 50% electrical access. The HP 3070 can be used on its own, or combined with the HP 5DX in a distributed test strategy with a link provided by HP AwareTest xi.

HP 5DX X-ray System

Without any electrical access or fixturing, the HP 5DX rapidly detects a wide range of defects, including shorts, opens, insufficient solder and inadequate solder bonds, even on the most complex boards. Its X-ray laminography technology is able to see through obstructions, enabling it to inspect obscured parts and double-sided boards in a single pass. The HP 5DX can be used on its own, or combined with the HP 3070 in a distributed test strategy with a link provided by HP AwareTest xi.

HP BV3000 Automated Optical Inspection Systems

The HP BV3000 system speeds up the manufacture of printed circuit boards by automating the visual inspection process and improving fault detection. Rapidly capturing optical images of the device under test, this system automatically analyzes the images with 95% repeatability. The HP BV3000 improves early fault detection of common manufacturing process faults such as misaligned or misplaced components and gross solder defects. This system is particularly appropriate to test the manufacture of high volume, low-to-medium complexity loaded printed circuit boards such as those found in personal computers, printers, disc drives and modems.

Functional Communications Test

HP 79000 Functional Communications Test System

The HP 79000 FCT system can dramatically decrease test development time, test time, and fault isolation time for functional testing of communications circuit boards and modules. Test development is easy even for the novice engineer thanks to HP Visual Test Advisor software. Test throughput is accelerated by HP's approach to testing up to eight channels in parallel. And HP Fault Detective software dramatically reduces fault isolation time—one of the most expensive aspects of functional test. The HP 79000 FCT has the capability to test existing as well as emerging communications technologies, including ADSL, ISDN, E1/T1, and POTS.

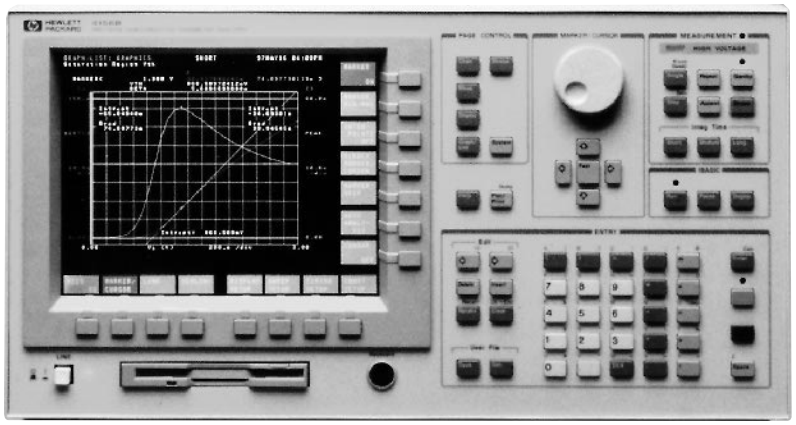
Ordering Information

Prices depend on system configuration.
Please contact the HP Call Center in your region for assistance.

HP BV3000 systems start at
HP 5DX Series II systems start at
HP 3070 Series 3 systems start at
HP 79000 FCT systems start at
HP AwareTest xi Software

HP 4155B
HP 4156B

- High-resolution/accuracy and wide range. I: 1 fA to 1 A (20 fA offset accuracy), V: 1µV to 200 V
- Fully-automated I-V sweep measurements with dc or pulse mode, expandable up to 6 SMUs
- Synchronized stress/measure function, two high-voltage pulse generator units (±40 V)
- Time-domain measurement: 60µs–variable intervals, up to 10,001 points
- Easy to use: knob-sweep similar to curve tracer, automatic analysis functions
- Automation: built-in HP Instrument BASIC, trigger I/O capability



HP 4155B

Whether you are looking for a low-cost bench-top instrument or an automated test system, HP can meet your semiconductor test needs with its Just-Enough-Test line of semiconductor measurement instruments. This instrument family provides versatile coverage of application needs in process development, device characterization, process monitoring, reliability testing, failure analysis, and incoming inspection. The low leakage switching matrix, various useful accessories, and Windows-based interactive characterization software allow the instruments to be configured flexibly from a one-box solution to an integrated, automated system.

HP 4155B Semiconductor Parameter Analyzer GPIB
HP 4156B Precision Semiconductor Parameter Analyzer

The HP 4155B and HP 4156B are the next generation in precision semiconductor parameter analyzers. You get the best digital sweep parameter analyzer plus a reliability tester, powerful failure-analysis tool, and automated incoming inspection station, all rolled into a single instrument.

This new family was explicitly designed to provide unprecedented accuracy and functionality for evaluating your sub-micron geometry devices. With one flexible instrument, you can improve your semiconductor quality starting from material evaluation and device characterization all the way through final packaged part inspection and field failure analysis.

Choose the Right Solution

The HP 4155B/56B offer four built-in source/monitor units (SMUs), two voltage source units (VSUs), and two voltage monitor units (VMUs). The HP 4155B is best suited for basic semiconductor applications with its non-kelvin connections, 10 fA/1 µV resolution, and 100 mA/100 V measurement range. For critical low-level characterization, the HP 4156B extends current resolution to 1 fA and accuracy to 20 fA. The HP 4156B utilizes full-kelvin remote sensing on each SMU.

At any time, you can add the HP 41501B SMU and Pulse Generator Expander, which is supplied with a 0 V/1.6 A Ground Unit. The expander accepts two 100 mA/100 V SMUs or one 1 A/200 V SMU, and two specially-synchronized 40 V/200 mA/1 µs pulse generators.

Setup and Measurement

HP 4155B/56B can perform staircase and pulse sweep measurement, and sampling (time-domain) measurement using many measurement units, including units in the HP 41501B, without changing connections. Moreover you can easily perform stress-measure cycling test for reliability evaluation such as hot carrier injection and flash EEPROM test.

Setup and measurement are made by setting up pages and filling in the blanks from front-panel keys, keyboard, or GPIB (SCPI commands). You can also instantly measure and find setup conditions by using knob sweep capability, which is similar to curve tracer operation.

Display and Analysis

The measurement and analysis results are displayed on the color LCD, and you can superimpose stored graphics from four graphic memories for comparison. A number of powerful graphical analysis tools make it easy to analyze and extract many parameters such as hFE and Vth.

Once you find the parameter extraction conditions, you can automatically get the parameter by using the automatic analysis function.

Output and Storage

Setup, measurement, and analysis data can be output via GPIB, parallel or network interface 10 Base-T LAN to a color plotter and printer. You can also save the data onto a disk via network or 3.5-inch disk in MS-DOS or LIF format. Graphic (HP-GL, PCL or TIF) output file allows you to transfer graphics to desktop publishing software.

Repeating and Automating Tests

The HP Instrument BASIC controller built into the HP 4155B/56B can construct an automatic measurement system using external instruments without a controller. HP 4155B/56B can be synchronized with external instruments by the versatile trigger I/O functions.

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Product	Applications								
	Basic I-V	Low Current	Ultra Low Current	High Voltage & Current	Pulsed Meas.	Time Domain Meas.	C-V & C-t	Multi-freq. Meas/	Quasi-Static C-V
HP 4155B	V	V			V	V			
HP 4156B	V	V	V		V	V			
HP 4142B	V	V		V	V				
HP 4140B	V	V							V
HP 4280A							V		
HP 4284A								V	

HP Semiconductor Measurement Instruments for Applications

HP 4142B
HP E5230B

- Flexible, modular architecture
- Wide measurement range with high resolution
  V: ±4 μV to ±1000 V, 0.05%
  I: ±20 fA to ±10 A, 0.2%
- Pulse measurement capabilities
  Pulse width 1 ms to 50 ms, 100 μs resolution
- High-speed measurement (typical)
  Sourcing or monitoring: 4 ms
  Vth, hFE extracting: 12 ms
- Internal memory
  Program memory: >2000 commands (typical)
  Data memory: 4004 measurement points

HP 4142B

HP 4142B Modular DC Source/Monitor

GPIB

Offering a wide measurement range and excellent sensitivity, the HP 4142B modular dc source/monitor is a system-use dc measurement instrument especially designed for high-throughput dc semiconductor testers. A completely user-definable system component, the HP 4142B features modular architecture that allows you to build a custom configuration to suit your measurement needs.

Eight plug-in module slots can accommodate any combination of the five presently-available modules; as new modules become available, you can upgrade your measurement capabilities with ease. Choose from two types of source/monitor units (SMUs) to force or measure up to ±200 V and ±1 A: a high-current source/monitor unit (HCU) up to ±10 A, a high voltage source/monitor unit (HVU) up to ±1000 V, a voltage source/voltage monitor unit (VS/VMU), and an analog feedback unit (AFU).The HP 4142B's instrument command and measurement data-storage capabilities, coupled with the high-speed GPIB interface, minimize computer loading, enhance throughput, and simplify systemization.

Versatile SMUs and Reliable Measurement

For general-purpose dc or pulsed measurement, use the HP 41421B source monitor unit. The equivalent of four instruments, this precision module forces voltage up to ±100 V and simultaneously measures currents down to 20 fA. It can also force currents up to ±100 mA while measuring voltage down to 40 μV.

If you test high-power components or desire a wider measurement range, use the HP 41420A source monitor unit. This versatile SMU can source ±200 V or ±1A (14 W, dc or pulsed) and still maintain a measurement resolution of 40 μV and 20 fA. Both SMUs include a compliance feature that limits output voltage, current, or power to prevent damage to your device. Each SMU (HP 41420A or HP 41421B) acts as either a voltage source/current monitor or current source/voltage monitor. These complementary operating modes let you change the stimulus on a device without modifying the physical connections. This versatility reduces test time and eliminates instabilities caused by changing connections at the DUT.

Test Power Devices to 10 A or 1000 V

The HP 41422A HCU and the HP 41423A HVU expand the measurement range of the HP 4142B to 10 A or 1000 V. They dramatically expand the HP 4142B's ability to test power devices, such as power transistors, power MOSFETs, GaAs FETs, and smart ICs. Using a combination of the two units respectively, measurements of up to 20 A or 2000 V are possible.

Using the HCU, fast pulse testing (100 μs minimum pulse width) at high current increases test reliability by minimizing the effects of thermal drift. Quasi-pulsed measurements by the HVU are effective for measuring breakdown voltage by minimizing the duration of the breakdown condition.

The HP 16087A module selector is a scanner that lets you remotely control the connection of the HP 41420A/41421B SMUs, the HP 41422A HCU, or the HP 41423A HVU to a test pin. It contributes to automatic testing for high-power devices with high-breakdown voltage. The built-in module selector can be specified as an option of the HP 16088B test fixture.

High-Speed Parameter Extraction by Analog Feedback Technique

To find important parameters that are specified at a given voltage or current, such as Vth or hFE, connect the HP 41425A AFU to two SMUs. The AFU modulates the output voltage of one SMU while monitoring the current or voltage of the other. Target currents and voltage are found with great speed (12 ms). This unique analog feedback network rapidly measures Vth, hFE, ΔL, or ΔW—parameters that would require excessive test time on other parametric testers.

You can also use the AFU to bias and test microwave devices. It can be integrated into the network analyzer system.

By using the AFU, you can eliminate the effect of device thermal drift and can hold the initial setting bias for ac measurement time.

Interactive Characterization Software (ICS)

The Windows-based HP E5230B Interactive Characterization Software together with the HP E5231B I-V Parametric Driver Library provides a uniquely-powerful instrumentation control and data analysis software package, and provides true point-and-click measurements, intuitive matrix control window, built-in database, and graphical analysis for total system solution. ICS delivers more than programming-free instrumentation control. Its spreadsheet windows and scientific plotting capability allow you to view and analyze data easily. ICS also includes valuable scientific and engineering data reduction tools necessary for interpreting test results, such as cursor assignments and curve fitting routines. ICS's resources include a robust file management system that allows you to create multiple databases without relying on external database software.

The I-V Parametric Driver Library controls the HP 4155A/B, 4156A/B, 4142B and 4145A/B. The HP E5232B C-V Driver Library and HP E5233B Switch Driver Library control the HP 4284A and HP E5250A, respectively.

HP E5250A Features:
- Unique analog bus architecture to allow configuration as a 10 x 48 cross-point matrix or as a 384-channel multiplexer
- 100 fA offset current with 10 tera-Ω channel isolation for accurate current measurement
- 100 μV offset voltage and low contact resistance for accurate voltage measurements
- Plug-in module architecture

HP 4140B Features:
- Three basic semiconductor measurements: I, I-V, and quasi-static C-V
- Two programmable voltage sources: ±100 V programmable source/function generator ±100 V programmable dc voltage source
- Basic accuracy: 0.5%
- High resolution: 1 fA
- Quasi-static C-V: 0.1 pF to 1999 pF, dc voltage ramp rate 1 mV/s to 1 V/s in 1 mV/s increments

HP 4280A Features:
- Built-in sweepable dc source and timer for C-V and C-t (capacitance-time) measurements
- High-speed C-t measurements with minimum measurement interval of 10 ms (10 μs if an external pulse generator is used)
- Basic C measurement accuracy: 0.1%

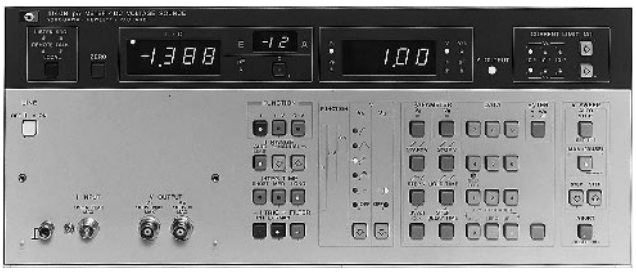
HP E5250A with HP 4155B

HP E5250A Low Leakage Switch

The HP E5250A switch mainframe has four slots for one to four 10 x 12 cross-point matrix modules or one to four 24-channel multiplexer modules. The cross-point matrix provides an automated solution for general parametric measurements while the multiplexer is ideal for long-term reliability measurements. The unique analog bus architecture ensures low noise internal interconnection of the plug-in modules without external cables. The four backside slots provide a maximum of 48 matrix outputs (one mainframe with four matrix modules installed) or 384 multiplexer outputs (four mainframes with four multiplexers installed in each mainframe).

When configured as a 10-input cross-point matrix, this configuration is ideal for general parametric measurements with six I-V triaxial inputs, low leakage (100 fA) performance, and four C-V coaxials, but can also be used for dc source/measure, and pulses up to 10 MHz.

When configured as a multiplexer, each module has 24 channels with an isolated external dc stress bias input for each set of eight channels. To safeguard other devices under stress from any surges when a device breaks down, each channel has a user-selected protection resistor to dampen the surge.



HP 4140B

HP 4140B pA Meter/DC Voltage Source

The HP 4140B pA meter/dc voltage source is part of component-measurement instrumentation. It consists of an extremely stable picoampere meter and two programmable dc voltage sources, one of which operates as a ramp and staircase generator as well as a dc source. These features make the HP 4140B ideal for making dc-characteristic measurements such as leakage current, current-voltage characteristics, and quasi-static C-V measurements, required by the semiconductor industry for new-product development and for improving production yields. It is equally useful in measuring electronic components and materials to determine leakage currents or insulation resistances.

The HP 4140B can contribute to the development, production, and quality control of semiconductor devices and to improvements in the reliability of electronic components and equipment.

HP 4280A

HP 4280A 1 MHz C Meter/C-V Plotter

The HP 4280A 1 MHz C meter/C-V plotter measures the capacitance and conductance of semiconductor devices and materials as functions of applied voltage (C-V) or time (C-t). The HP 4280A consists of a precision 1 MHz C-G meter, a programmable dc bias source that can be swept in staircase fashion, and accurate timing control.

The HP 4280's internal dc bias source has a range of 0 V to ±100 V with 1 mV resolution on the most sensitive range. Various measurement parameters for C-V and C-t measurements can be manually set from the front panel, or these parameters can be set under program control via the GPIB. Settable range for C-t measurement interval is 10 ms to 32 s with a best-case resolution of 10 μs. If an external pulse generator is used, however, measurement intervals as short as 10 μs can be set. Up to 9,999 readings can be set for a C-t measurement. These capabilities make it possible for the HP 4280A to measure the C-t characteristics of virtually any device.

The HP 4280A can measure either floating or grounded devices. Thus, it can be connected to a wafer prober and still provide stable, accurate C and G measurements.

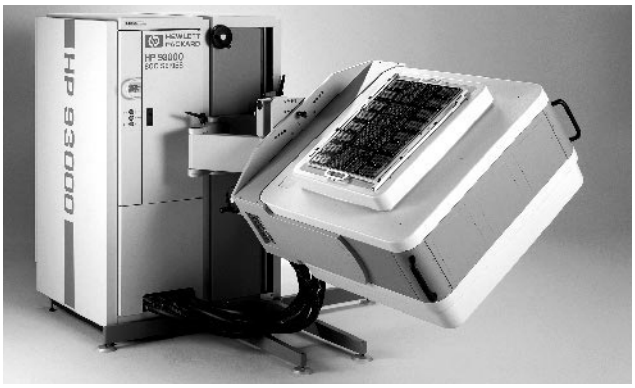
Semiconductor Test Systems

SOC, VLSI, Digital, Memory, Logic, Mixed Signal, RF, Semiconductor Parametric

HP 83000
HP 93000
HP 94000
RF 94000
HP 84000
HP 95000
HP V1300
HP V3300
HP 4072A

NEW

- Hewlett-Packard is the global leader in High-Volume Electronics Manufacturing
- Hewlett-Packard Semiconductor Test Systems keep you one STEP ahead in Speed, Technology, Experience and Price/Performance
- HP's Semiconductor Test Systems offer cost effective production test solutions for a broad range of markets
- VLSI Test Systems cover data rates from 1 Megabit per second to 1.3 Gigabits per second with up to 1024 pins and HP's Test processor-per-pin technology lets you test High Speed Processors with embedded memory. With additional Smart DSP and Waveform capability HP's VLSI test systems can address Systems-on-a-Chip, Multimedia, VLSI, PLL, and other state-of-the-art building blocks
- Mixed-Signal Test Systems offer a very low noise floor with DC to real-time DSP to RF capability along with up to 256-pin digital capability.
- HP's Memory and Logic Test Systems lead the market in Rambus, wafer level testing of Flash Memory, Non-Volatile Memory and field programmable devices.
- RFIC Test Systems, precision contactors, and wafer-probing solutions provide the ability to test wireless ICs at RF frequencies at the test site up to 3, 18, or 45 GHz
- HP's Semiconductor Parametric Test Systems offer high throughput, with links to SPECS modeling software, and maximize the instrumentation close to the wafer for maximum precision



HP 93000

HP 83000

HP 93000 SOC Series IC System-On-a-Chip Production Test Systems for state of the art ICs

NEW

Production test of Systems-on-a-Chip, microprocessors and embedded processors

- High-speed bus testing for Rambus, Cache, PC133
- High-speed serial data testing for LVDS, Gigabit Ethernet, FireWire, Fiber Channel and SONET
- Single scalable platform
- Pay-Per-Use temporary and permanent upgrades
- High Fidelity - lowest noise audio testing
- Composite video testing
- PLL and frequency jitter testing
- Embedded memory testing
- Wide Algorithmic Pattern Generator per-pin for memory testing
- Highest throughput Test Processor-per-pin Architecture
- Up to 1 Gbit/sec data rate for "At-Speed" testing
- Up to 948 Digital pins plus 4 Analog
- Timing flexibility with "Change Waveform on the Fly"
- Up to ±50 p.s. overall measurement accuracy
- High-speed DRAM and SRAM testing
- Easy and efficient docking to handlers and probers for TCI
- Multisite testing capability up to 32 sites

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**

Semiconductor Integration and Support Services

- Global Application Development Centers
- Remote Support
- Integration Services of Handlers and Wafer Probers
- Test Program Development and Conversion
- System Integration
- Scheduled and On-Site Maintenance and User Training
- Flexible Support Service Levels
- Custom Services and Support for 365 Day/24 Hour Operations
- Escalation Management
- Performance Improvement/Process Consulting
- IC Device Characterization Services
- Application Measurement Consulting
- Calibration Services

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**

HP 83000 Series VLSI IC Production Test Systems for "At-Speed" test of state-of-the-art ICs

Production test of microprocessors (CISC and RISC)/microcontrollers/VLSI/ASIC/Rambus ICs/Telecom ICs/Multimedia ICs/FSRAM/RDRAM

- Up to 660 MHz for "At-Speed" test with up to 1024 pins
- Up to ± 50 p.s. measurement accuracy
- High Speed Memory interface testing
- Algorithmic Pattern Generator per pin for memory testing
- High Speed DRAM and SRAM testing
- Multisite testing capability up to 16 sites

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**

HP 94000IP

HP 94000 Mixed Signal IC Test System for testing telecom, data management, RF and photo imaging ICs

NEW

Production test IC test solutions for wireless and wired communications, graphics controllers, high speed PMRL HDD, integrated PC audio, digital subscriber line (xDSL), ATM, A/D, DAC, and a specialized test option for Photo Imaging ICs, the HP 94000IP.

- Sourcing up to 3GHz and measuring up to 6Ghz
- Up to 256 pins at 532Mbps. digital capability
- Excellent Analog performance with low noise floor
- Full Analog/Digital synchronization
- Multisite Testing Capability
- Graphical software environment for rapid test development

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**

HP 83000
HP 93000
HP 94000
RF 94000
HP 84000
HP 95000
HP V1300
HP V3300
HP 4072A

NEW

HP 95000

HP 95000 HSM Series Production Ready, Integrated Test Cell for High Speed DRAM NEW

- Unique Test Processor-Per-Pin architecture provides maximum flexibility for developing complex protocol based test patterns.
- Per Pin Algorithmic Pattern Generator (APG) for generating at-speed patterns up to a 1GHz data rate.
- 1GHz algorithmic patterns, 1GHz logic vectors, and 1GHz error capture without pin multiplexing or pattern generator interleaving on every pin across all test sites provides true "At-Speed" testing in the production environment.
- 1M vector memory per pin for complex memory interface testing.
- Up to 32 devices tested in parallel on a single test head for high throughput production testing.

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**

Custom Support Products and Services for Semiconductor Test

- Integration Services for Handler / Prober Interface
- IC Device Characterization Services
- Test Program creation and conversion
- Custom services and support for 365 day/ 24 hour operations.

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**

HP V1300

HP Mixed Memory/Logic IC Production Test Systems for Flash and Non-volatile Memory Devices. NEW

HP V1300 Unique Features

- True 16 site system ensures the highest throughput, lowest cost production wafer sort system for non-volatile memory.

HP V1300 & HP V3300 Standard Features

- Tester-per-site architecture for high-throughput testing.
- Combined site resource mode for up to 128 I/O per site ensures test floor flexibility for high pin count devices.
- Ability to test both memory and logic addresses the complex test needs of non-volatile memory products.
- Channel Assignment Module (CAM) provides software flexibility to assign any APG address or data channel to any I/O channel; and any I/O channel to any Error Catch RAM channel.
- Standard interfaces for Electroglas TSK and TEL wafer probers.

HP V3300

HP V3300 Unique Features

- True 8 site system with 20 MHz data rates and 100ps edge placement ensures the highest throughput, lowest cost production wafer sort system for NVM where critical AC specifications for memory data patterns must be verified during wafer sort.
- AD Option facilities testing 16 devices on 8 sites for optimum throughput versus system cost.
- Handler interface available for final test applications.

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**

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Semiconductor Test Systems

SOC, VLSI, Digital, Memory, Logic, Mixed Signal, RF, Semiconductor Parametric

HP 4072A

HP 4072A High-Speed Semiconductor Parametric Test Systems for monitoring the IC fabrication process

NEW

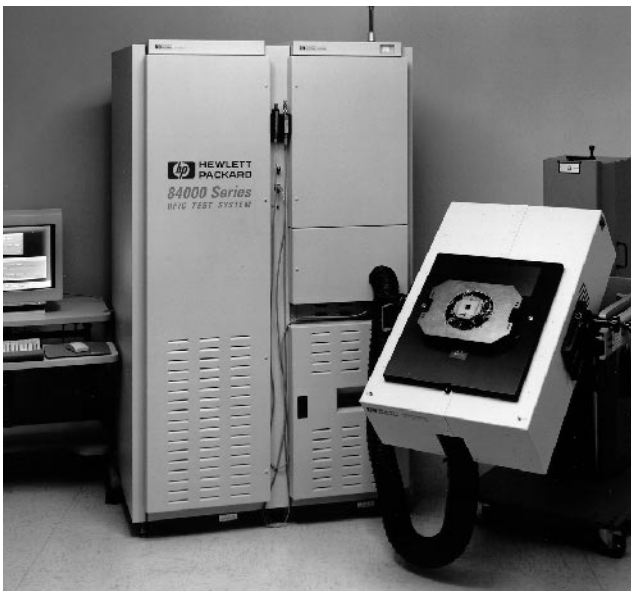
- Integrated tester-in-test head design
- High throughput for all measurements
- Higher accuracy, resolution, repeatability
- Built-in diagnostics for fewer operator assists
- Direct docking to probe card for optimum performance
- Maintains laminar air flow for clean room operation
- HP SPECS new test shell for HP 4062UX and HP 4071A

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**

Semiconductor Integration and Support Services

- Global Application Development Centers
- Remote Support
- Integration Services of Handlers and Wafer Probers
- Test Program Development and Conversion
- System Integration
- Scheduled and On-Site Maintenance and User Training
- Flexible Support Service Levels
- Custom Services and Support for 365 Day/24 Hour Operations
- Escalation Management
- Performance Improvement/Process Consulting
- IC Device Characterization Services
- Application Measurement Consulting
- Calibration Services

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**



HP 84000

HP 84000 RFIC Test Systems for testing RFIC's and MMIC's used in Wireless Systems

- Production- and R&D-testing of RF and MMICs
- Up to 3 GHz, 18 GHz or 45 GHz solutions available
- Configurations with up to 12 RF ports to test LNAs, up/down converters, power amplifiers, integrated transmitters, receivers, and complete tranceivers
- Error corrected S-parameters, noise figure, ACPR and EVM measurements
- Simplified graphical user interface for rapid test plan development
- Simplified RF calibration
- Complete packaged-DUT fixturing available to 18 GHz, including the HP YieldPro Contactor, and on-wafer solutions to 45 GHz

For more information, contact your HP sales engineer or see our web site: **http://www.hp.com/go/semiconductor**

- >600MHz System Read Channel Bandwidth
- 600Mbps(Mega bits per second) Arbitrary Data Pattern
- ±30 psec (typical) Write Current Edge Accuracy
- High Positioning Accuracy of a spinstand
- Fast Test Throughput
- Available 800Mbps Bit Error Testing (option)
- Built-in System Calibration
- Hardware and Software Open Architecture

E5022A Hard Disk Read/Write Test System

HP E5022A Hard Disk Read/Write Test System NEW

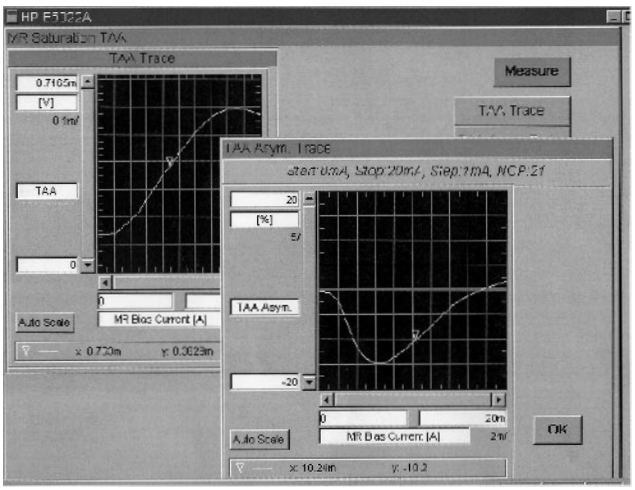
HP E5022A Hard Disk Read/Write Test System is a VXI based system and is the most advanced test system for the development and production of today's sophisticated MR and GMR heads (HGA: Head Gimbal Assembly). The combination of the measurement electronics and a high-performance spinstand enables easy use of the system without requiring any integration effort for the test system. The read channel bandwidth of the measurement electronics is greater than 600 MHz. The 600Mbps data pattern generator, accurate write edge timing, and the high positioning performance of the HP spinstand cover the measurement requirements of the most advanced GMR heads. In addition to the high quality measurements, the HP E5022A makes measurements faster than you ever imagined. This speed dramatically improves the throughput in production lines.

Wide Bandwidth Measurements

The HP E5022A system, with HP's Universal Head Amplifier (UHA) (E5029H opt 002), provides wide bandwidth (>600MHz) for evaluating advanced MR and GMR heads. The raw performance of the head or the head/media interface can be determined using the UHA. In addition, the flatness of ±0.3 dB across the pass band ensures that measurements will be accurate and will not be corrupted by the test system.

Fast Measurement in the Production Line

The measurement speed of the HP E5022A is optimized by the hardware and software. The HP E5022A uses the index pulse from the spinstand to trigger all measurements. Because each measurement module has it's own processor, processing overhead from the system controller is eliminated.



Measurement Display (TAA/TAA Asymmetry vs. MR Sense Current

High Performance Spinstand

Integrated into the HP E5022A is a high-performance spinstand. Split dual axis stage with the vacuum lock down feature and a piezo actuator on one axis ensures accurate, stable, and fast positioning capability. The dual axis air slider stages have a vacuum lock feature to maintain positioning repeatability. (0.28 µinch (7nm), sigma).

Open System Architecture

The HP E5022A's Open Architecture for both the hardware and software increases your measurement flexibility. The VXI based system hardware architecture provides the flexibility for adding a new VXI module to the existing system to meet with the new measurement requirements. In the software side, HP E5022A's proprietary tests and test sequences, data archive systems, and many other tools can be created using HP's DLLs (Dynamic Linked Libraries). The DLLs are compatible with HP VEE, Lab View, Visual Basic, C++, and many other software tools.

Bit Error Measurements (HP E5039A)

800Mbps Bit Error testing can be performed by adding the HP E5039A module into the system. Customized PRML channel chip boards are supplied as options. Variables of a PRML chip can be accessible and programmed for the chip optimization or test requirements. With the outstanding positioning performance of the HP spinstand, the system can provide accurate and reliable bit error testing, such as 747 and Bathtub tests. (Note: Please contact your local HP sales office about available PRML channel chip boards.)

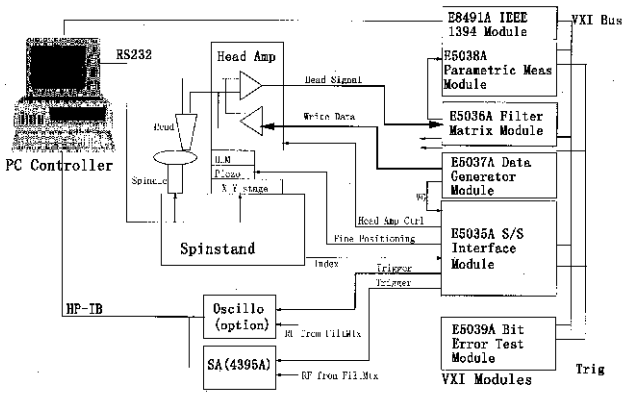
Customization

Head and head/media testing often require customized fixtures, electronics, and/or measurement functions. HP can prepare custom electronics (for example, head amplifier boards and PRML chip board using commercially available chips, etc.) and custom HGA cassettes. Please contact your HP representative for details about your customization and support needs.

HDD Head Test System

Hard Disk Read/Write Test System for MR and GMR Heads

HP E5022A



Block Diagram of the HP E5022A Test System

HP E5022A Specification Summary

Write Characteristics
Data Clock:
50Mbps - 600Mbps, 1kbps resolution
Data Pattern: HF, LF, Isolated, repetitive pattern, Pseudo Random pattern, NLTS 5'th harmonic pattern, User defined pattern (128kbits [max], repetitive)

Write Current (with HP Universal Head Amplifier)
Range: 0-90mAp-p
Accuracy: ±1% (typical)
Edge Accuracy: ±30 psec (typical)
Rising/Falling Time: 1nsec, @100nH, 10-90% (typical)

Write Pre-compensation (with HP Universal Head Amplifier)
Compensation Level: 3 levels
Pattern Selection: 3 bits (Preceding/following)
Maximum Shift: ± 1.9nsec (max, amount 1.9nsec)
Accuracy: ±30psec (typical)

Erase Current (with HP Universal Head Amplifier)
Range: 0-90mAp-p
Erase Pattern: DC+, DC-, AC

Sense Current (with HP Universal Head Amplifier)
Range: 0-50mA
Accuracy: ±1%

Read Channel Characteristics
Input Range: 200 µVp-p - 5mVp-p
Bandwidth: >600MHz, @-3dB
Filters: Four selectable filters (E5029F opt. xxx)

Measurement Accuracy:
MR DCR: ±2%
TAA: ±3% (typical) (for sinusoidal wave @ E5038A input)
Narrow Band TAA (by HP 4395A): ±2%
Pulse Width: ±5% + 150psec (typical)
Base Line: ±5% of TAAp-p (typical)
Overwrite: ±0.2dB
NLTS: ± 2%

Spinstand:
Spindle RPM: 2400 - 15000 rpm
Clamp Size: For 3.0/3.5", 2.5" disks
Spindle RPM Jitters: 0.01% @>=3000rpm
Non Repeatable Runout: <0.4µinch (<10nm), 1sigma
Coarse Stage Repeatability: 200µinch (5um), 1sigma
Skew Range: ±30 deg.
Skew Accuracy: ±1 deg.
Fine Positioning Travel: 600µinch (15um)
Travel Resolution: 0.1µinch (2.5nm)
Fine Positioning Accuracy: ±2µinch (50nm)
Fine Positioning Repeatability: ±0.28µinch (7nm), 1sigma @ ±3 µm travel

General Characteristics

Operating Temperature and Humidity: 23±5 deg. C, 15%-80% RH, Non-condensation
Voltage: 100/120/220/230/240 V ±10%
Power Frequency: 50/60 Hz
Air Supply Requirements :
Pressure and Flow: 724 - 827 kPa, 0.00048 m^3/s
Vacuum Requirements:
Pressure and Flow: -70 kPa (min), 0.00022 m^3/s
Physical Specifications:
Spinstand Size and Weight: 600mm(W) x 760mm(D) x 1020mm(H), about 300Kg
Rack Size: 600mm(W) x 905mm(D) x 1600 or 2000mm(H)
Necessary Working Space: about 2m x 1.5m

Key Literature

Hard Disk Read/Write Test System Product Overview, p/n 5968-1580E
HP E5022A Technical Specification, p/n 5968-1691E

Ordering Information

NOTE: This product cannot be sold in Europe.

HP E5022A Hard Disk Read/Write Test System includes followings :
- **VXI Modules :**
  - **HP E5035A** Spinstand Interface Module
  - **HP E5036A** Filter Matrix Module
  - **HP E5037A** Data Generator Module
  - **HP E5038A** Parametric Measurement Module
  - **HP E8491A** IEEE-1394 High Speed Interface Module
  - **HP 4395A** Spectrum Analyzer
- **PC Controller and Display**
- **Spinstand**
- **Cables and Manuals**
- **System Installation Service**
- **Opt 011** Spinstand Clamp for 3.0/3.5" Disks
- **Opt 012** Spinstand Clamp for 2.5" Disks
- **Opt 102** Add 2GS/s Oscilloscope
- **Opt 103** Add 8GS/s Oscilloscope
- **Opt 700** 2000mm Height System Rack
- **Opt 701** 1600mm Height System Rack
- **Opt 800-808** Power Option*

HP E5029F Input Filters for HP E5022A*
HP E5029C HGA Cassettes for HP E5022A*
HP E5029H Head Amplifier Board for HP E5022A*
- **Opt 002** HP Universal Head Amplifier

HP E5039A Bit Error Test Module*

*Contact the HP Call Center in your region for details, options and prices.

HP's TestSpan Series of Products & Services

(PN E6230A/TS-5430) Air Bag Systems ECU Test Platform
5965-6505E
(PN E6230A/TS-5430) Antilock Brake/ Traction Control ECU Test Platform
5965-6507E
(PN TS-5400) Family of Test Systems
5965-5226E
(PN TS-5430) HP TS-5430 Automotive Electronics Test Platform
5965-5289E

Board Test & Inspection

HP 3070 Quick Verify Platform for ICT Plus Functional Product Verification
5965-8060E
It's About Time and Cost
5966-3829E
HP 3279CT Communications Board Test System Photo Card
5965-4879E
It's About Time and Money–HP Automated Process Test Solutions
5968-1859E
HP 5DX Series II automated X-ray inspection system improves product and process-in-line, off-line, real-time
5966-3392E

(PN 3070) HP Performance Port Fixturing Product
5965-8567E
(PN 3070) RPM Invitation, Color Piece
5965-6622E

Semiconductor Test Systems

Testing Digital Series to Their Limits Data Sheet
5962-7010E
HP V1100/V2100 Test Systems
5963-6941E
HP 83000 Pay-Per-Use
5964-0094E
HP 83000 The Key to More Quality Parts at Lower Cost
5965-5033E
HP 83000 **Model F660** Can You Test Your Most Advanced Devices to Their Limits?
5962-7011E
HP 84000 Series High Throughput RFIC Test Systems
5965-5272E
HP 4062 Series HP 4062UX Semiconductor Process Control System
5091-1070E
HP 9490 Series Real Mixed-Signal Test Solutions for Production
5963-7048E
HP V1100/2100 Test Systems
5963-6941E
HP V1200 Test Systems
5965-3343E
HP 4070 Series of Semiconductor Parametric Testers – HP SPECS Semiconductor Process Evaluation Core Software
5965-2723E
HP 4072A Advanced Parametric Tester with HP SPECS
5968-4196E

(PN 4062-1) Sub-Pico Amp Measurement Using the Guarded Technique on an Automatic Wafer Prober
5090-0290
(PN 4062-2) Precision Evaluation of Flash Memory Cells
5091-6806E
(PN 4062PC-1) Effective Data Analysis Using Lotus 1-2-3– HP 4062PC Semiconductor Parametric Test System
5091-4993E
(PN) Characterizing Communications ICs with the HP 83000 Model F660
5962-9273EUS
(PN) Memory Test Software Provides Cost-Effective Solutions to Testing Advanced SRAMs (83000 F660)
5963-5078E

Semiconductor Measurement Instruments

HP E5250A Low Leakage Switch Mainframe Setup Guide
5964-4091E

(PN 4156-1) Differences from HP 4155A/4156A
59565-9846E
(PN 4156-2) Configuring an NFS and Print Server for Network Capability
5966-4184E
(PN 4156-3) Prober Connection Guide
5966-4185E
(PN 4156-4) Advantages Over the HP 4145A/4145B
5968-6681E
(PN) HP 4155A/4156A Semiconductor Parameter Analyzer—Edition 1 Programming Guide for HP 4145A/B
5963-3201E
(PN 4142B-1) DC Characterization of Semiconductor Power Devices
5091-2744E
(PN 4145B) HP 4145B Preventing SMU Oscillation
5950-2909
(PN 4140A/B) HP 4140A 4140B Measurement Hints
5950-2921

Data Storage Test Systems

HP E5022A Hard Disk Read/Write Test System Profile
5968-1580E
HP E5022A Hard Disk Read/Write Test System Technical Specifications
5968-1691E
HP E5022A Hard Disk Read/Write Test System Configuration Guide
5968-3402E

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00

Data Acquisition Systems

Overview

History and Applications

Hewlett-Packard has provided data acquisition solutions for over 25 years. The earliest systems were combinations of multiplexing scanners and digital multimeters. These early rack mounted solutions evolved into today's powerful modular data acquisition and control systems capable of providing not only analog and digital measurement capabilities but also analog and digital output for a wide variety of applications. Data acquisition and control solutions are used extensively to evaluate electromechanical product and process designs for industries supplying aerospace, automotive, consumer, industrial, medical and transportation products.

Measurements

Data can be gathered from a wide variety of sensors or may be measured directly. Voltage, resistance, temperature, strain, frequency, velocity, acceleration, noise, vibration, harshness and many other physical phenomena are measured. Sensor based data can be converted to engineering units during the measurement process. Many applications include digital parameters such as counters, timers, stepper motors, digital I/O, states, and pulses.

HP solutions can also provide a variety of control capabilities including setting alarms, stepper motor control, closed loop control with guaranteed latency, PID control, vibration control and more. Systems may also provide a stimulus to the test device. These may be analog or digital outputs for control of switches, valves, stepper motors, shakers, hydraulic rams or other devices.

HP's Data Acquisition and Control Products

HP DAC Express

If you want PC-based data acquisition but do not want to spend hours programming then HP DAC Express is the answer. A familiar spreadsheet environment makes it easy to configure, control and review your tests.

- E9800A DAC Express-Data Viewer Software. Review test data and hardware setups from files previously acquired with HP DAC Express-based systems. Graphically display data and convert files to formats readable by popular analysis and word processing packages. See page 532.
- E9801A DAC Express-Data Acquisition/Recorder Software. Controls measurement hardware with an easy to use spreadsheet, making you productive without writing programs. Log temperatures, pressures plus record sound and vibration at the same time in one system. See page 532.
- E981XA DAC Express Bundles. Complete data acquisition solutions including software and pre-configured hardware. See page 533.

Portable, small channel counts

- HP 34970A Data Acquisition Switch/Unit. For low cost data logging and system switching with precision 6-1/2 digit multimeter, temperature measurements with units conversion, up to 120 channels. Data logging software included. See page 148.
- HP 75000 Series B (E1300B/01B mainframe based) Portable/Remote Data Acquisition and Control System. VXIbus, high-speed 5-1/2 digit multimeter, temperature, strain measurements, DAC, counter/timer, digital I/O; up to 112 channels. See page 535.
- HP 35670A 2-4 channel FFT Analyzer. Versatile, rugged, portable spectrum analyzer. See page 537.

High Performance, medium channel counts:

- HP 75000 Series B (E1302A mainframe based) Portable/Remote Data Acquisition and Control System. VXIbus, high speed 5-1/2 digit multimeter with separate 16-channel multiplexers or precision 16-bit 32-channel scanning ADCs, temperature, strain measurements, DAC, counter/totalizer, digital I/O; up to 320 channels. See page 535.

High Performance, large channel counts:

- HP 75000 Series C Data Acquisition and Control System. VXIbus, high speed scanning ADC, specialized high-speed measurement module with up to 32 PID control loops, analog signal conditioning, temperature/strain measurements with units conversion, counter/totalizer, DAC, digital I/O, pulse width, PWM, stepper motor control, up to 768 channels. See page 535.
- HP 3852A Data Acquisition and Control System. 8 slot Mainframe or extender based system. 40 different measurement and control modules including high-speed ADC, scanning switches, digital I/O, DAC, counter/totalizer, stepper motor control. Up to 216 channels. See page 535.
- HP E1432A 16 Channel 51.2 kSa/sec Digitizer + DSP.
- HP E1433A 8 Channel 196 kSa/sec Digitizer + DSP. Both E1432A and E1433A include transducer signal conditioning, antialias filters, 16-bit digitizer/channel and high-speed measurement computation. Control by HP DAC Express, HP VEE, Matlab, C++ or other standard programming languages. Supports 100's of channels. See page 536.
- HP E1563/64A 800 kSa/sec 2 or 4 Channel digitizers. High speed digitizers with up to 256 V input, up to 64 MB PC-SIMM style RAM. Ideal for fast acquisition of transient events. Common mode rejection of 113 dB, selectable 1.5, 6, 25 or 100 kHz input filters. See pages 84-87.

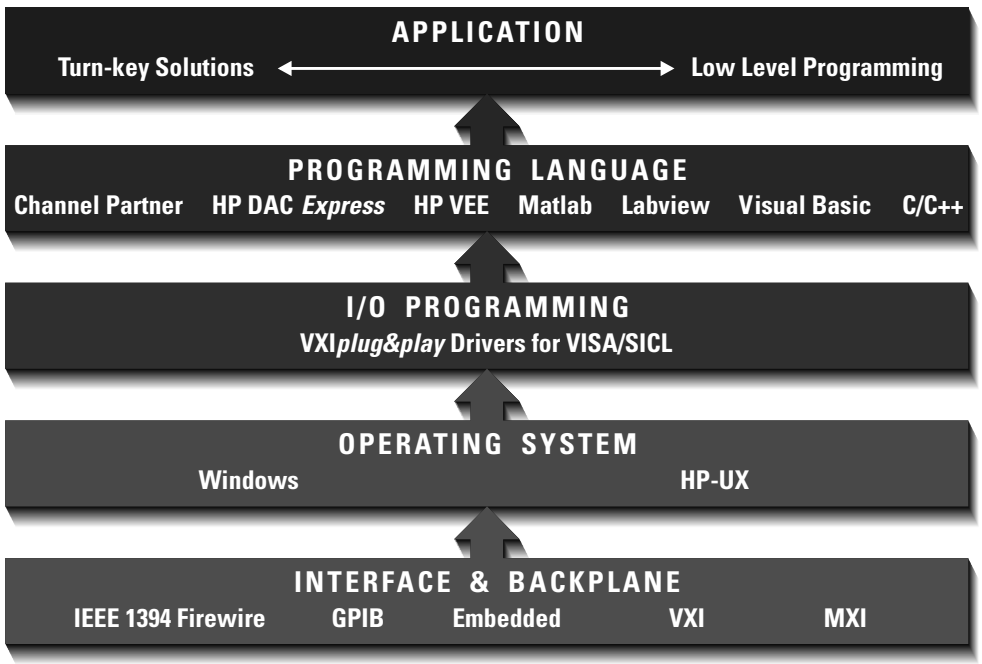
More Information

Additional information on the full line of HP VXIbus products is available in this catalog on pages 99-102. For the full line of HP VXIbus products request the HP System Builders Source Book from your regional HP Call Center or visit our web site: **www.hp.com/go/VXI**

HP Data Acquisition and Control Product information is available on-line. Please visit our web site: **www.hp.com/go/data_acq**

HP hardware is used by a large number of solution providers. These Channel Partners offer a broad variety of turn-key data acquisition solutions. See these solutions on-line: **www.hp.com/go/tmpartners**

- Broad Software Support
- HP VEE
- HP DAC *Express*
- Mathworks Matlab
- Visual C/C++
- Visual Basic
- Variety of Turn Key Solutions available from HP Channel Partners



Software is a Compelling part of VXI Hardware Story

Software is a key component to employing any hardware platform. Gone are the days that required months of programming effort to get a measurement system up and running. HP's VXI platform is a defacto standard that is used by major turn key solution providers to offer a broad range of measurement solutions. HP's Test & Measurement web site provides a growing list of HP Channel Partners that offer a wide variety of turn key measurement and data analysis solutions based upon VXI hardware.

HP VEE (Visual Engineering Environment)

HP VEE 5.0 is a popular, leading-edge graphical programming software environment that makes programming fast, easy and intuitive. With VEE's powerful icons and support for all VXI plug&play drivers, including those from other vendors, your support for VXI modules is comprehensive.

HP DAC Express

HP E9800A DAC *Express* Data Viewer Software coupled with HP E9801A DAC *Express* Data Acquisition/Recorder software provides a turn key high performance data acquisition solution, right out of the box. HP DAC *Express* makes it easy to set-up a multi-channel measurement with multiple sampling rates. Use a low sampling rate for measurements like temperature and a high sampling rate for acoustic or vibration signals. Real time data monitoring is available with displays that can be created by dragging and dropping from the display toolbar. These displays include meters, strip charts, frequency graphs, and bar graphs.

Control HP E1432A / E1433A / E1434A VXI Hardware Directly from Mathworks's Matlab

If you are one of the more than 400,000 users of Matlab and need to directly control HP's high performance multi-channel digitizers and source modules, HP is now supplying this control capability as part of its standard Plug & Play library for the HP E1432A, HP E1433A and HP E1434A VXI modules. The combination of Matlab 5.2's n-dimensional arrays, matrix math, color surface shaded 3-D graphics, user interface building tools and HP's high performance measurement hardware provide most impressive results with a minimum of programming effort. This environment is really the "measurement engineer's programming language" that quickly turns measurements into insight.

Use C / C++ or Visual Basic Software Development Environments for Unique or Demanding Applications

Work in either Microsoft Win95/WinNT software development environments using C/C++, Visual Basic or use HP-UX C/C++, to give you a great head start in developing your custom application solutions on top of standards based HP VXI hardware. The VXI plug & play software layer allows your code to be portable across platforms. The plug & play layer also allows you to support multiple hardware vendors from the various software environments

For more information

See HP's Test & Measurement Channel Partner Program web site:
http://www.hp.com.go/tmpartners

See HP's Test & Measurement Data Acquisition web site:
http://www.hp.com/go/data_acq

HP DAC Express Data Acquisition Systems

HP E9800A
HP E9801A

- Combined measurements of noise, vibration, temperature, pressure, strain, and more
- Intuitive user interface reduces system development time
- Functional replacement for analog or digital tape recorders
- On-line monitoring assures confidence in measurements
- Post-test data viewing mode helps find events of interest
- Formatted output to analysis and reporting packages saves time

HP DAC Express - Fast setup, fast recording

Hewlett-Packard's DAC Express software not only makes it easy to set up multi-channel measurements and save calibrated time data to disk, but allows you to monitor the acquisition in real time to assure that the data you are saving is valid. The HP E9801A with one or more of the various measurement modules provides complete capability for automated data acquisition.

Once you have acquired the data, it can be distributed via LAN or the Internet to other users. Anyone with a copy of HP E9800A Data Viewer Software can perform their own interpretation of the data on their PC.

System solutions ready to go

There are several starter measurement systems complete with software and hardware that are ready to connect to your PC or can be ordered with an optional Hewlett Packard PC. These systems provide up to 160 channels of noise and vibration measurement with sample rates up 192Ksa/sec/ch or up to 768 channels of temperature, pressure, strain, voltage, or other physical parameters with samples up to 1.5Ksa/sec/ch. System configurations are flexible. They can be ordered to meet your measurement mix including complete factory integration.

Replace Analog and Digital Tape Recorders

HP DAC Express systems combine the functionality of signal conditioning, digitizing, realtime data display, and recording in a solution with more flexibility of measurement type and recording speed than traditional data recorders. In addition, data playback and review is faster because there is no need to mechanically move tape past a record head. With HP DAC Express, you simply move a cursor using the PC mouse through the data file to view and select data of interest.

Wide Choice of Data Displays

The same displays that were used for on-line monitoring can be used to review the data from the saved file. Each display can be labeled with application specific titles. These displays include:

- Strip charts
- X-Y graphs
- Bar graphs
- Analog and digital meters
- Alarm indicator lights

Repeatable Data Collection

One of the often-asked questions about data files is "How was the data collected?" HP DAC Express data recordings are unique because the instrument setup parameters are stored with the data file so that you can always know what gain, filtering, or scan rate was used for each channel. This eliminates all ambiguity about trying to re-run the test and get repeatable results.

Turning Data Into Reports Is Now an Easy Job

Most test engineers know that the most tedious part of their job is converting the raw data into useful information with analysis and report generating tools. Now, with easy exporting to key software applications, this job is not a big time-consuming task. Once an analysis and word-processing process is implemented, the same process can be used quickly with new sets of data.

Key Literature

HP DAC Express Systems Product Overview, p/n 5968-6132E

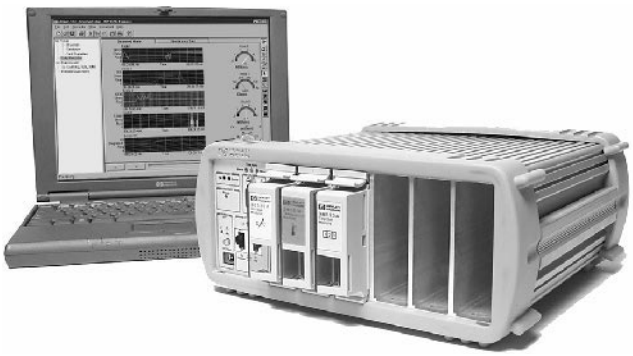
For the latest information on HP's Data Aquisition prodcuts, visit our web site:**http://www.hp.com/go/data_acq**

Ordering Information

E9800A Data Viewer Software
E9801A Data Recorder/Logger Software
HP DAC Express Data Acquisition Systems

HP 38520A
HP E9810A
HP E9811A
HP E9812A
HP E9813A
HP E9814A

Lab Capable, Field Ready
- Small, modular, low power and scaleable
- Rugged frame and broad temperature range
- Analog and digital measurements
- Connectors store sensor data and setup



HP 38520A Data Acquisition System

The HP 38520A data acquisition system is lab capable and field ready for testing of electromechanical components and systems. Manufacturers of industrial, commercial, transportation and electrical equipment can easily reduce set-up and measurement times. Tighter integration between laboratory and field testing can also yield more reliable product test information.

Portable and Versatile

Take the unit to the test. The HP 38520A—about the size of a benchtop multimeter—runs on DC power and consumes less than 20 watts, which is compatible with most gel packs and car batteries. A notebook PC running HP DAC Express software is the front panel and display through which you configure, record and analyze data. Use the Ethernet interface to link multiple HP 38520As: our time-synchronization utility ensures comparable results across systems. With Ethernet you can also configure the HP 38520A for wireless communication that is less costly than many current telemetry systems.

Phenomena-based Measurements

The HP 38520A lets you focus on measurement insight rather than system configuration. Plug-in measurement modules address specific physical phenomena and include signal conditioning. For example, the temperature input module includes thermocouple linearization and reference junction compensation. Available measurement modules include:
Temperature: Supports eight thermocouple types and 2-, 3- and 4-wire platinum RTDs with excitation (eight channels).
Sensor/Voltage: Provides 5-, 10-, 15-volt excitation and input ranges for voltage output sensors (eight channels). Resistors can be configured for current-output transducers.
Counter/Digital: Provides frequency, totalize, pulse width and duty cycle with support for multiple thresholds (eight channels; also provides 24 channels of digital I/O).
Vibration: Covers audio spectrum and provides simultaneous peak and RMS vibration levels (four channels)
Automotive Voltage: Provides 16- and 48-volt input ranges for present and future automotive requirements (eight channels).

Data Acquisition Systems with HP DAC Express

Pre-configured Data Acquisition Bundles

Get results faster with a fully configured data acquisition solution. These data acquisition systems combine pre-configured measurement hardware with flexible HP DAC Express software to increase your productivity.

Each HP DAC Express system includes the HP E9801B software, a HP E8491B IEEE-1394 interface (Firewire) and your selection of supported measurement modules installed in a VXI mainframe.

HP E9811A—Multi-Function Data Logger

Combines analog inputs and digital I/O capabilities using the versatile HP E1419A Multifunction+ module and signal conditioning plug-ons (SCPs). Optional SCPs add counter/totalizer inputs as well as other capabilities. Standard configuration includes software, interface and a 4-slot VXI mainframe. Optional inputs expand the system to over 700 channels.

HP E9812A—Analog Data Logger

Uses the HP E1413C and signal conditioning plug-ons (SCPs) to measure voltage, temperature, pressure or other sensor based analog signals. Standard configuration includes 16 analog inputs, interface and a 4-slot mainframe. Optional inputs expand the system to over 700 channels.

HP E9813A—Data Recorder

Uses the HP E1432A 51.2 kSample/second digitizer to record sound, vibration or other analog inputs. Streams simultaneous data to the host PC. Standard configuration includes 16 simultaneous inputs, interface and a 4-slot mainframe. Expandable to 32 channels.

HP E9814A—Data Recorder/Logger

Combines the HP E1413C and SCPs with the HP E1432A 51.2K sample/second digitizer. Simultaneously record sound, vibration or other analog inputs while logging voltage, temperature, pressure or other sensor based analog signals. Standard configuration includes 16 high-speed recording channels, 16 logging analog inputs, interface and a 13-slot mainframe. Optional HP E1562D/E VXI data disk available for higher speed data throughput needs.

HP E9810A—Customizable DAC System

Build a solution that is precisely what you want with our complete integration service. Includes the HP E9801A software and the HP E8491 Firewire interface (IEEE-1394). Select measurement front-ends such as the HP E1413C, HP E1432A/33B, HP E1415A, HP E1419A and HP E1422A. Specify appropriate SCPs and VXI mainframes.

HP E1529A

- Lower cost strain conditioning for large numbers of channels
- Easier connection for individual strain gages
- Versatile choice of bridge configuration and shunt calibration

HP E1529A shown with VXI Data Acquisition System

HP E1529A 32 Channel Remote Strain Conditioning Unit

The HP E1529A is specifically designed to simplify stress and fatigue testing of large mechanical structures such as airframes and rockets. Each unit provides remote conditioning for 32 channels of strain bridge measurements in a configuration that is very easy to connect and calibrate. Additional units can be added to expand the system capability at any time.

Full Measurement Capability

The HP E1529A offers the following features:

- Low cost telecom connectors and cabling for strain gages
- Connection for external excitation to banks of eight gages
- Individual buffered output for each bridge signal
- Provision for custom shunt calibration resistors
- Up to 1000 feet (330 meters) cable lengths

A Modular, Reconfigurable Architecture

The HP E1529A provides external signal conditioning and multiplexing for a VXI-based data acquisition system. Up to two HP E1529A's are supported by a new Signal Conditioning Plug-on (SCP), the HP E1539A, that is installed on an HP E1422A Remote Channel DAC Unit.

The HP E1422A includes a 16 bit, scanning A/D, high speed DSP, and a 64,000 reading buffer in a single C-size VXI slot. Each HP E1422A can house up to eight SCP's which can be a mix and match of signal conditioning for strain, temperature, resistance, voltage, digital I/O or counter functions.

For a dedicated strain measuring configuration, each HP E1422A can support up to 512 channels. As many as twelve HP E1422A's can be installed in a 13- slot C-size mainframe, thus providing a single system with 6144 channels of strain measurement.

Automated Calibration Saves Time

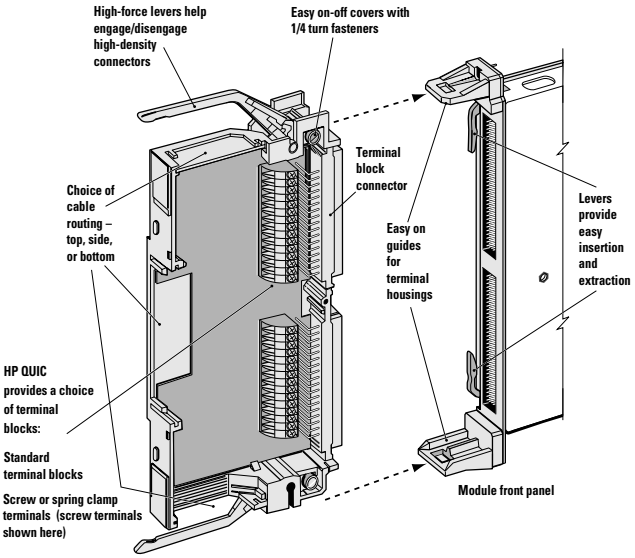
Each HP E1529A has an internal calibration source that is used to provide automatic input calibration, This automatic process takes only a few minutes for 512 channels. In addition, shunt calibration using an internal 50 kilohm or user supplied value is provided.

Key Literature

HP VXI Catalog p/n 5966-2815 EN/EUS

Flexible Wiring via Terminal Blocks

HP provides terminal blocks standard with all low-frequency multiplexer, matrix, general-purpose switch modules and scanning voltmeters. Several of the C-size modules have terminal blocks which incorporate HP's new HP QUIC (Quality Insertion and Connection). The HP QUIC terminal block provides you a convenient method of wiring to your application as shown in the accompanying illustration. A terminal block with screw or push-in spring-clamp terminals is provided as standard with HP QUIC-equipped VXI modules. HP QUIC also provides easy-in/easy-out levers and guides on the front panel to assure terminal block alignment when attaching the terminal block to the front panel of an instrument/switch module.



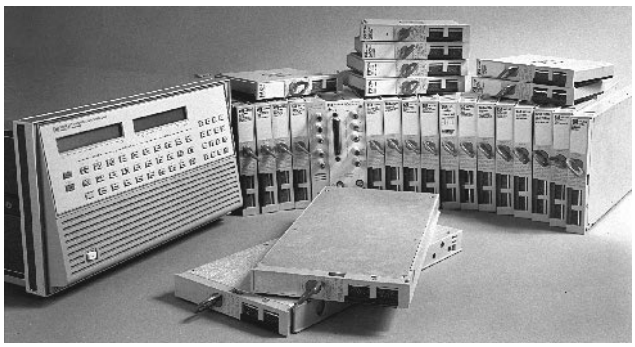
Rackmount Terminal Panel

- 96 terminals (32 3-wire channels)
- Built-in strain relief
- Includes pinouts and access to probe points
- System connections through 50-pin SCSI connectors
- Internal reference junction for 32 thermocouple channels

The HP E1586A Terminal Panel gives you maximum flexibility in configuring system wiring and interface solutions. In addition to the convenience of easy access for troubleshooting, the rackmount terminal panel gives you the flexibility you need to take advantage of money-saving wiring alternatives when system components are located at a distance from your mainframe. Within the Terminal Panel, the isothermal reference junction provides an internal reference junction for up to 32-wire thermocouple channels. The rackmount design provides easy access to the thermocouples for control and monitoring of distributed environmental temperatures, temperature control applications, and temperature control in material processing.

Optional RF filters on the terminal panel input channels filter out AC common-mode signals present in the cable connecting the terminal panel and the device under test. These filters are useful for filtering out small common mode signals below 5 Vp-p.

Connection to VXI modules with Option A3F requires either the HP E1588A six meter length cables or HP Z2220 Option 050 custom length cables.



HP 3852A Data Acquisition and Control System

You can easily configure an HP 3852A data acquisition and control system to measure physical parameters. The HP 3852A is set up to handle many different transducer inputs, including thermocouples, thermistors, RTDs, and strain gages, as well as measuring dc volts, currents, resistances, pulse counts, frequencies, and more. The HP 3852A mainframe has eight (8) slots for plug-in function modules, and has provisions for extending the mainframe (the HP3853A) for large systems requiring more plug-in cards.

High Speed and Accurate Analog in One System

Choose from three digital voltmeters to meet your measurement needs. The voltmeters can be used in the mainframe or extenders, with multiple voltmeters allowed in each mainframe.

Versatility and Expandability

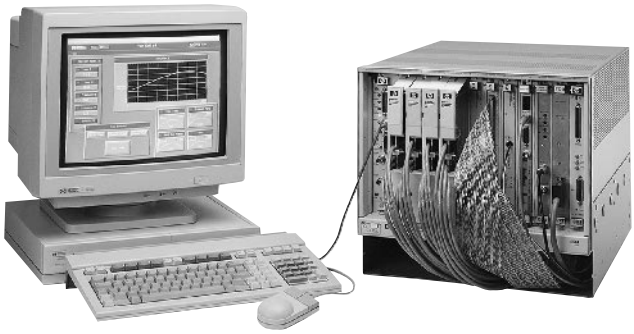
With the HP 3852A you can choose from a complete set of input and output plug-in modules providing a variety of measurement and output-controlling capabilities. Plug-in modules for the HP 3852A include a relay multiplexers, FET multiplexers, solid state relay multiplexers, analog outputs, digital inputs & outputs, a counter, and a stepper motor controller.

Front End, Computer, and Software-System

The HP 3852A has built-in, 68000-based processing to increase the speed and effectiveness of the system and to collect, analyze, and respond to data. Control decisions are handled quickly using subroutines running within the mainframe (not having to communicate via HP-IB to an external computer in every case). This intelligence can be used to return only the most significant data to the computer, increasing its efficiency with other tasks. The power of this front-end intelligence, in combination with an HP 9000 computer and data acquisition software, adapts easily to testing your product or characterizing your processes. Or, if you prefer, you may configure your system to run with a PC as the host computer, incorporating the HP-VEE graphical programming language.

Ordering Information

To order, specify an HP 3852A system with the appropriate software, controller, mainframe, extenders, function modules, racks, and extra terminal modules. The HP 3852A itself has no cost—each component of the system is priced individually. ROM revision is in brackets. Please contact The HP Call Center in your region for ROM upgrades, pricing, and information.



HP 75000 Series C VXI

HP 75000 Series C VXI Data Acquisition System: High-Performance

The HP 75000 Series C VXI data acquisition system products provide high-performance measurement, control, and computing capabilities that are well suited for solving major equipment, vehicle, and power system and many others—design problems. This data acquisition system is based on the HP E1413C high-performance scanning A/D, HP E1415A algorithmic closed-loop controller, new HP E1419A multifunction and control module, and the new HP E6237A real-time VXI computer or HP-UX controller.

All of HP's VXI scanning A/D and multifunction and control modules incorporate signal conditioning plug-ons (SCPs) for configuring the module for various measurement inputs and control outputs.

HP 75000 Series B VXI Data Acquisition System: Portable/Remote

The HP 75000 Series B DACQ is a family of portable data acquisition systems. These VXI-based solutions are suited for low to medium point-count applications where temperature, strain, pressure, flow, digital I/O, voltage, resistance, and frequency measurements are required. These systems may be used in a number of electro-mechanical applications where physical data must be collected. These include material evaluation, energy research, process characterization, facility monitoring, environmental control, or remote station monitoring and control.

The HP E1300B/E1301B mainframes with built-in controller, optional interfaces, and battery backup, can perform remote, unattended measurements and download data via long distance phone lines to your host computer.

The HP E1302A 20-slot mainframe with HP E1306A command module may be configured as a standalone PC-based data acquisition system or integrated into a general-purpose GPIB test system for switching applications. When combined with the HP E1313A scanning A/D, up to 64 channels per module may be scanned at a rate of 100 k-channels/s.

Measurement and Control VXI Modules

- HP E1413C 64-Channel Scanning A/D
- HP E1419A Multifunction Measurement and Control Module
- HP E1415A Algorithmic Closed Loop Controller

High-Speed Transient Measurement Products

- HP E1430A 10 MSa/s 23 bit, A/D with Filter/Memory
- HP E1437A 20 MSa/s Digitizer with DSP
- HP E1563A, E1564A 800 KSa/s Digitizers

Dynamic Measurement and Control Modules

- HP E1432B 51.2 kSa/s Digitizer with DSP
- HP E1433B 196 kSa/s Digitizer with DSP
- HP E1434A 65 kSa/s Arbitrary Source

VXI Embedded Controllers (C-size)

- HP E6234A 166 MHz Intel Pentium
- HP E6237A Pentium Real-Time
- HP E1497A PA-RISC, HP-UX, 64 MHz
- HP E1498A PA-RISC, HP-UX, 100 MHz

HP E1432A
HP E1433A
HP E1434A
HP E1562D/E/F
HP DAC1000

VXI Measurement Platform for Mechanical and Acoustic Test

The HP E1433A 8-channel digitizer, E1432A 16-channel digitizer, and E1434A 4-channel arbitrary source provide both system excitation and digitization for the mechanical and acoustical tests common in the automotive and aerospace industries. The HP E1433A's 196-kSa/sec sample rate and onboard digital signal processing (DSP) boost total system performance while cutting system development time. The HP E1432A 16-channel 51.2 kSa/sec digitizer provides many of the same measurements and features as the E1433A, but at a lower sample rate and decreased cost. For system excitation, the HP E1434A arbitrary source provides multi-channel stimulus.

When combined with the existing HP E1562D/E/F SCSI data disk they form a comprehensive measurement platform for mechanical, acoustical, and electrical test. Now all functions necessary for these demanding applications: digitization, excitation, and highspeed data recording are available on an industry standard VXI hardware platform.

Minimize Complexity, Maximize Performance

The HP E1432A and E1433A simplify system integration by providing signal conditioning, filtering, digitization, and measurement computation, all in a single module. Built-in measurement computations such as FFTs and averaged power spectra off load work from the host computer, keeping it from becoming a computational bottleneck. The HP E1434A arbitrary source can playback continuous arbitrary wave forms, but also provides common test signals such as sine, random and burst random noise.

Software Support

Customers can develop their own custom software solutions using VXI *plug&play* drivers and common programming languages, or they can use Mathwork's Matlab or HP's VEE graphical programming environment. For turnkey software solutions, expect wide application support from the industry's leading third-party solution providers. Applications include rotating machinery analysis, modal analysis, acoustics, vibration control, and road simulation, as well as general-purpose multi-channel data acquisition and analysis.

Key Literature

HP E1432A, HP E1433A and HP E1434A Product Overview, p/n 5966-3062E

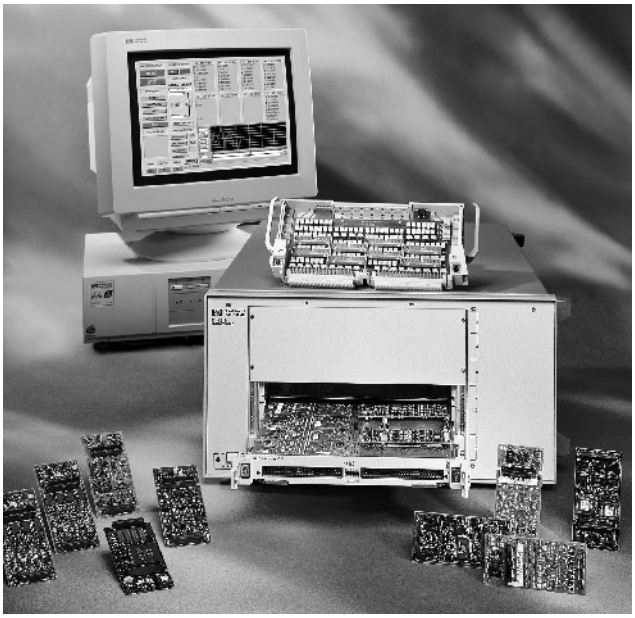
See VXI catalog for more details and additional modules.

For the latest information on HP's Data Acquisition products, see HP's web site: **http://www.hp.com/go/data_acq**

See HP's Test & Measurement Channel Partner Program web site: **http://www.hp.com/go/tmpartners**

Ordering Information

HP E1432A 16-Channel, 51.2 kSa/sec Digitizer + DSP
HP E1433B 8-Channel, 196 kSa/sec Digitizer + DSP
HP E1434A 4-Channel, 65 kSa/sec Arbitrary Source
HP E1562D VXI Data Disk, DAT and SCSI-2 Interface



HP DAC1000 System

Data Acquisition and Control System

Multifunction Measurement

The HP DAC1000 data acquisition and control system is a cost-effective solution for characterizing the designs of electromechanical products and monitoring and controlling critical manufacturing processes. This precision 16-bit scanning A/D and control unit—ideal for a variety of sensor-based and mixed-signal acquisition and control applications—is used to verify design of electromechanical assemblies and physical processes. The DAC1000 system measures temperature using thermocouples, RTDs, or thermistors and other physical parameters such as displacement and strain. It also measures dc volts, currents, resistances, pulse counts, frequencies, digital state, and more. With several output possibilities—analog voltage and current DACs, pulse generators with PWM, and digital output—the system can control switches, valves, stepper motors, and other electromechanical devices.

Powerful Flexibility

The HP DAC1000 combines the HP E1419A multifunction measurement and control module with the new HP E9801B DAC EXPRESS software and the HP E8408A 4-slot VXI mainframe, with GP-IB or Firewire interface. The HP Vee 5.0 graphical programming language can be used for applications requiring special implementations. The HP E1419A offers breakthroughs in flexibility of configuring I/O functions, ease of programming, performance and accuracy, at a surprisingly low price in VXI. It provides nearly all the functionality of separate modular cards and multiple benchtop meters including multimeters, function generators, and counters, PLUS on-board intelligent measurement analysis and control—all on a single module. The HP E1419A employs small palm-sized signal conditioning plug-ons (SCPs). These SCPs provide not only a choice of signal conditioned inputs (gain, attenuation, filtering), but a variety of input/output functions such as counter, totalizer, DAC, pulse generator, and digital input/output.

More Information

For more information, request HP DAC1000 Photo Card, HP p/n 5965-8641E, HP DAC1000 Product Note, HP p/n 5965-8642E, HP E1419A Technical Specifications, HP p/n 5965-8828E, and HP VEE Visual Programming Language Brochure, HP p/n 5965-6806EN. Additional information about HP VEE and VXI components of the HP DAC1000 may be found in the Test Software and Development Tools and the VXIbus Products sections in this catalog. For more information on-line, visit HP's data acquisition web site: **http://www.hp.com/go/data_acq**

HP 35670A

- Two or four channels (optional)
- Portable-fits under an airplane seat
- 1600 line frequency resolution
- 16-bit ADC/90 dB dynamic range (typical)
- 10 MB deep transient capture (optional)

HP 35670A Dynamic Signal Analyzer

The HP 35670A lets you make laboratory-quality measurements in the field, on an automobile test track, flying above a city, or in the narrow confines of a submarine. Small enough to fit under an airplane seat, the HP 35670A is a two, or four-channel (Option AY6), FFT-based spectrum/network analyzer. The standard instrument provides spectrum, network, time-domain, and amplitude-domain measurements from virtually dc to slightly over 100 kHz. Your ability to solve problems in the field is enhanced with the optional four-channel HP 35670A-measure noise at multiple locations inside vehicles, make triaxial vibration measurements, or gather data from several locations along a noise transmission path.

With the HP 35670A, you carry all your measurement and analysis tools in one package. Octave analysis (Option 1D1) adds real-time measurements of l/1, 1/3, or 1/12 octave spectra at frequencies up to 40 kHz. Computed order tracking (Option 1D0) allows you to view spectra as a function of orders, or to view the amplitude of multiple orders as a function of RPM. Up to 8 MB of additional memory (Option UFC) provides deep transient time capture or extra space for up to four-hundred spectra. An arbitrary source (Option 1D4) lets you test devices with real-life test signals. With HP Instrument BASIC (Option lC2), you can automate measurements or customize your instrument interface. Everything you need to troubleshoot vibration and noise problems in the field is in one instrument. (You can retrofit all options-buy only the functionality you need today and add more as your needs change.)

A deep transient time capture memory can record up to four channels of data plus a tachometer signal for playback in the narrowband FFT, octave, order, correlation, or histogram instrument modes. Pre- and post-trigger delay functions let you capture the leading edge of one-time events or eliminate transmission delay in signals.

Real-Time Octave Analysis to 40 kHz (ANSI S1.11-1986)

Octave analysis (Option 1D1) adds a real-time octave analyzer to your HP 35670A for analysis in 1/1-, 1/3-, or 1/12-octave bands. Four LEMO connectors with power for microphones are provided by the microphone adapter and power supply (Option UK4). The 1/1- and 1/3-octave band filters in the HP 35670A comply fully with ANSI S1.11-1986 (Order 3 Type 1-D), DIN 45651, and IEC 225-1966. An overall total power band and an A-weighted overall power band can be activated as needed. All three octave band modes and the overall power band can be A-weighted with an analog filter in full compliance with IEC 651-1979 Type 0. The overall power band can be redefined as a broadband impulse detector that complies with IEC 651-1979 Type 0. A fan-off mode eliminates instrument noise from measurements. A pink noise source allows you to evaluate electroacoustic devices.

View Spectra in the Order Domain (Option 1D0)

View spectra as a function of orders or track up to five orders on four channels simultaneously with computed order tracking (Option 1D0). Orders as high as 200 can be tracked. An order map can be displayed as a function of RPM or time, using the waterfall function. Waterfall markers let you view the track of any order.

Computed order tracking is ideal for troubleshooting rotating machinery. Run-up or run-down measurements can be displayed in bode or polar formats. Oscilloscope-quality orbit diagrams are another benefit. Because the data is resampled with changes in RPM, a single-loop orbit display is maintained as the shaft RPM is varied. With four channels (Option AY6), two orbits can be measured simultaneously-at both ends of a shaft, for instance. An RPM measurement readout, available in any instrument mode, aids in the interpretation of measurement data from rotating machinery.

Computed order tracking provides alias-protected measurements without expensive and cumbersome external ratio synthesizers and tracking filters. This new technique uses a digital tracking algorithm that follows rapid changes in shaft RPM without time delay and eliminates the phase noise normally associated with ratio synthesizer techniques. Accuracy is enhanced over traditional methods.

HP 35670A

Swept-Sine or Broad Measurement Range (Option 1D2)

The swept-sine instrument mode expands the network analysis range of the HP 35670A to 130 dB. Higher noise rejection and accuracy are obtained by auto-ranging the instrument during the sweep. Automatic sweep resolution reduces measurement time without sacrificing accuracy. Alternatively, sweep resolution can be set by the user.

Advanced Modeling and Analysis Cut Design Time

Prototype revisions are reduced by modeling design modifications using curve fit and synthesis functions (Option 1D3). In a typical application, a model of the test device is created by curve fitting a frequency response measurement. Up to 20 poles and 20 zeros are used to describe the device; results can be output in pole/zero, pole/residue, or polynomial formats. The designer then transfers the circuit model to the synthesis function. Using synthesis, the model is modified by adding or deleting poles and zeros. The frequency response function of the modified model is then synthesized to test the design modification.

Automation Improves Productivity

HP Instrument BASIC (Option 1C2) replaces the external computer in small test systems. Like the computer, it can be used to automate measurements, create a custom user interface, synthesize new information from raw data, or control other instruments and peripherals. An optional external keyboard plugs into the rear panel. The HP 35670A provides direct control of external disks, plotters, and printers via GPIB RS-232, or parallel interfaces, and is fully programmable via the GPIB.

Option 100 software bundle

Bundles options 1D0 through 1D4 and UFC. 35% discount over the same options sold separately.

Key Literature

HP 35670A RotoDynamics Measurement, p.n 5966-0518E
HP 35670A Technical Data Sheet, p/n 5966-3064E
HP 35670A Product Overview, p/n 5966-3063E
DSA Accessory Catalog, p/n 5966-2340E
Standard Data Format p/n 5091-2945E

For more information, visit our website:
http://www.tmo.hp.com/tmo/datasheets/English/HP 35670A.html

Ordering Information

HIP 35670A Dynamic Signal Analyzer
- **Opt AY6** Add 2 Input Channels
- **Opt 1D0** Computed Order Tracking Measurements
- **Opt 1D1** Real-Time Octave Measurements
- **Opt UK4** Microphone Adaptor and Power Supply
- **Opt 1D2** Swept-Sine Measurements
- **Opt 1D3** Curve Fit/Synthesis
- **Opt 1D4** Arbitrary Waveform Source
- **Opt 1C2** HP Instrument BASIC
- **Opt AN2** Add 4 MB Memory
- **Opt UFC** Add 8 MB RAM
- **Opt 100** Software Bundle
- **Opt UFF** Add 1 MB Nonvolatile RAM

Accessories
35250A DC Power Cable (3 m)
35251A DC Power Cable w/Cigaretter Lighter Adapter

Internet URL **www.hp.com/go/tmc00**

Product & Order Info **See page 607**

FFT Dynamic Signal Analyzers

DSA Accessory Catalog
5966-2340E
Standard Data Format Utilities
5091-2945E
HP 35639A Demo Disk Set-Up Instructions
5963-1833E
HP 35639A Data Viewer Demo Disk
5963-1834E
HP 35639A Data Viewer Product Overview
5962-9499E
HP Internet Advisor for Troubleshooting High-Speed LAN, WAN and ATM Internetworks J2300C
5968-0863E
HP E1432A Technical Specification
5965-7193E
HP E1562D/E/F Technical Specifications
5965-6938E
HP E35670A Dynamic Signal Advisor
5966-3063E

Dimensional Measurements

Introduction to Laser Systems Brochure
5091-2507E
PC Compatible Technical Data Sheet
5091-8435E
HP 5527B Technical Data Sheet
5091-2508E

(PN 5527A/B-1) Rapid Data Collection with the HP 5527A/B Laser Position Transducer System
5952-7947
(PN 5527A/B-2) Achieving Maximum Accuracy and Repeatability with the HP 5527A/B Laser Position Transducer System
5952-7973
(PN 5527A/B-3) Advanced Measurement Techniques Using the HP 5527A/B Laser Position Transducer System
5952-8020

Data Acquisition Systems

HP DAC1000 Data Acquisition and Control System
5965-8642E
HP 34790A Data Acquisition/Switch Unit, Product Overview
5965-5290EN/EUS/EE
HP 38520A Data Acquisition System, Product Overview
5968-5451E
Techincal Specifications
5968-5500E

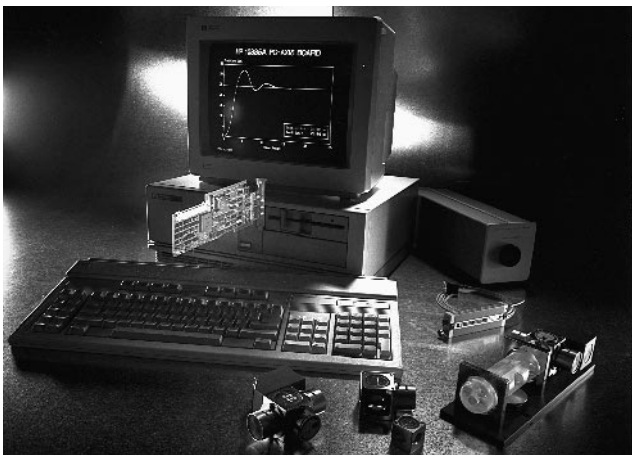
(PN E1415A) HP E1415A Algorithmic Closed Loop Controller
5965-3311E
(PN) HP E1413A/B/C, E1313A, and E1415A Recommended Wiring and Reduction Techniques
5965-1635E

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00

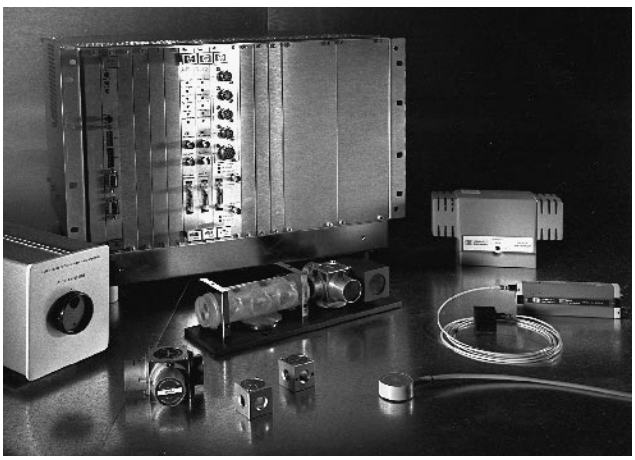
Laser Interferometers/Encoders 18

HP 5527B

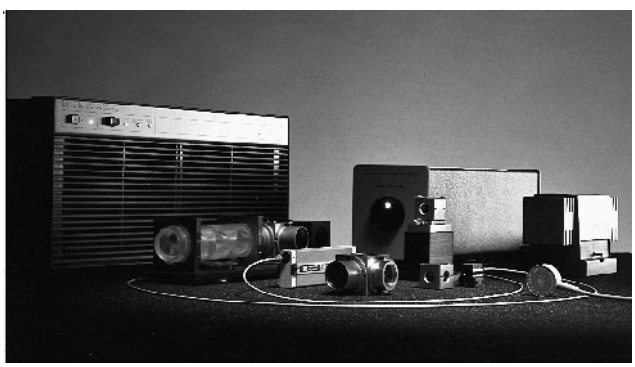
- PC-compatible and VMEbus electronics
- Resolutions to 0.3 nm, data rates to 10 MHz
- PC servo-axis board for closed-loop positioning
- Multiaxis measurements for greater control
- Wavelength-of-light compensation
- Remote sensing with fiber-optic receivers



PC-compatible laser interferometer electronics provide open- or closed-loop positioning and speed integration into the lowest-cost industry-standard backplane.



The HP 10897B High Resolution Laser Axis Board for VMEbus provides the highest position resolution available from HP and allows easy, cost-effective integration into this popular, 32-bit industry-standard backplane.



The HP 5527B Laser Interferometer Positioning System offers the greatest variety of output formats, including 32-bit position, servo-motor drive, and A-quad-B.

Precision Positioning Systems

Laser interferometer precision positioning systems—composed of electronic and optical components—provide very precise position or distance information for dimensional measurements and motion control. When built into manufacturing and inspection equipment, a laser interferometer system reports the position or controls the motion of a product platform with more accuracy than any other method.

Precision laser positioning systems improve product quality and reliability, increase manufacturing consistency for increased production yields, and allow the production of precision products that would otherwise be impossible to manufacture. Laser interferometer positioning systems are vital in many applications:

- Integrated-circuit fabrication, inspection, and repair
- Manufacture of high-capacity disk drives
- Precision machine tools
- Manufacture or calibration of other measurement scales
- Mechanical parts inspection/measurement
- Custom test and measurement
- Precise plotting
- Mechanical vibration analyis
- Antenna testing

System Components

Hewlett-Packard precision positioning systems combine Michelson interferometry with a two-frequency HeNe laser. HP's patented two-frequency design provides greater stability and reduced noise sensitivity, and extends the measurement range—up to 40 m (130 ft), or 80 m (260 ft) in certain circumstances. Three subsystems make up a laser interferometer system:

Laser: Supplies a monochromatic light source (or beam)
Optics: Directs the beam and generates the interference pattern
Electronics: Detects and counts the light and dark interference fringes, processes the data, and outputs distance information

HP offers the components needed to configure laser interferometer positioning systems for a broad range of applications and other requirements. All systems support the same laser sources, and optics, and are primarily differentiated by the receivers and electronics.

Interferometer Electronics

HP interferometer electronics offer a choice of: backplane (interfacing characteristics), output formats, and environmental compensation options. Table 1 on page 542 summarizes the HP products based on these differentiators.

The HP product line offers interferometer electronics tailored for a variety of customer needs. For interfacing to industry-standard backplanes, the VMEbus provides a high-performance alternative and PC products provide the lowest-cost solution. Both are popular industry standards and offer system configuration flexibility. The proprietary HP 5527B offers a broader choice of output formats compared with the VMEbus and PC electronics.

Each of the electronics alternatives supports the complete range of lasers and optics. In addition, the HP 10780C receiver, HP 10780F remote receiver, E1708A remote dynamic receiver, and E1709A high sensitivity dynamic receiver work with all electronics.

The HP 10737L and 10737R Compact Three-Axis Interferometers improve positioning accuracy of lower-cost equipment too compact to use the HP 10735A or 10736A.

Optics

The optics tailor each interferometer system for the physical layout and measurement requirements of each application.
HP 10702A Linear Interferometer: The basic optic for linear measurements
HP 10706A/B Plane-Mirror Interferometers: Commonly used with multi-axis stages
HP 10716A High-Resolution Interferometer: A plane-mirror interferometer with twice the resolution of the HP 10706A/B
HP 10715A Differential Interferometer: A plane-mirror interferometer for differential measurements
HP 10705A Single-Beam Interferometer: Physically smaller for confined spaces or low-mass, non-contact measurements
HP 10719A, HP 10721A One- and Two-Axis Differential Interferometers: For optimized accuracy and repeatability with IC fabrication equipment; the position of the wafer stage is directly referenced to the optics column
HP 10735A, HP 10736A Three-Axis Interferometers: Can be used in pairs to make 5 precise measurements (x, y, pitch, roll, and yaw) simultaneously for IC fabrication
HP 10737L/R Compact Three-Axis Interferometers: Multiaxis measurements for precise control of smaller, lower-cost equipment

See the table for a summary of HP reflector products and the configurations supported with HP optics.

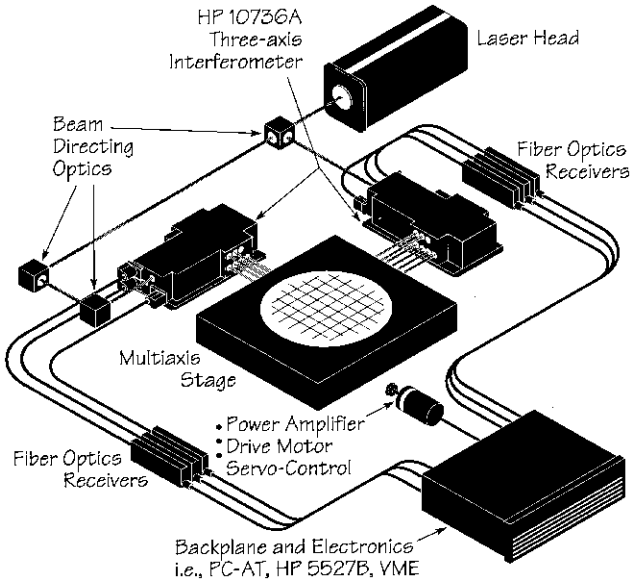
Laser Heads

Four laser heads are available for HP interferometer systems: the HP 5517A, 5517B (500-mm/second axis velocity for linear optics), 5517C (700 mm/second for linear optics), and 5517D (1000 mm/second for linear optics).

The total accuracy of an interferometer system is the sum of the errors from the laser head, the optics, and the effects of the environment. All HP laser heads have a vacuum wavelength accuracy of ±0.1 ppm. Option UK6, an NIST-traceable wavelength calibration service, is available. With this calibration, a laser's wavelength accuracy becomes ±0.02 ppm. HP laser heads over the last 25 years have a demonstrated mean time between failure of greater than 50,000 hours.

Improving Accuracy and Repeatability

Maximum accuracy and repeatability require compensation for environmental conditions. The wavelength of light in air varies with the air's refractive index, which is a function of air temperature, pressure, and composition. In addition to the wavelength-of-light effects, errors can result from thermal expansion of the workpiece. To take full advantage of Hewlett-Packard's high-wavelength stability, the HP 10717A Wavelength Tracker compensates for changes in the air's refractive index. The HP 10896B, with wavelength-of-light compensation and material temperature measurement, increases accuracy and repeatability for VMEbus systems, and the HP 10886A provides these functions for PC-compatible systems. Product Note 5527A/B-2 (p/n 5952-7973) describes in detail how to achieve maximum accuracy and repeatability.



The HP 10735A and HP 10736A Three-Axis Interferometers offer greater accuracy for microlithography and other applications that require up to five degrees of freedom.

HP Reflectors and Interferometers: Supported Combinations

	Reflectors/Mirrors			
Interferometers	**HP 10703A, 10713B**	**HP 10704A, 10713C, D**	**HP 10724A**	**Custom Mirrors**
HP 10702A	•			
HP 10705A		•		
HP 10706A/B			•	•
HP 10716A			•	•
HP 10715A			•	•
HP 10719A, HP 10721A				•
HP 10735A, HP 10736A				•
HP 10737L/R			•	•

Key Literature

To configure and order an HP laser interferometer positioning system, please request the appropriate data sheets and ordering information from the HP Call Center in your region:

Introduction to Laser Systems Brochure, p/n 5091-2507E
Laser Head and Optics Technical Data Sheet, p/n 5964-6190E
PC Compatible Technical Data Sheet, p/n 5091-8435E
VMEbus Technical Data Sheet, p/n 5965-1569E
HP 5527B Technical Data Sheet, p/n 5091-2508E
Systems Ordering Information, p/n 5964-3700E

See the next page for information on laser system electronics.

Table 1: Key Characteristics of HP Laser Interferometer Electronics

System	Backplane	Electronics	Output formats	Other differentiators
PC Compatible	ISA (PC/AT)	HP 10885A	32-bit digital (hardware output and backplane output)	Lowest-cost, most-popular, industry-standard backplane
		HP 10889B	Motor drive (in ±10 Vdc)	Servo-axis board Fast system development
		HP 10887B	32-bit digital	Part of HP 5529A calibration system
		HP 10887P	32-bit digital	Programmable version of HP 10887B
		HP 10886A	PC compensation board	Complete environmental compensation
VMEbus	VMEbus	HP 10895A	32-bit digital (hardware output and backplane output)	High-performance, robust, industry-standard 32-bit backplane
		HP 10897B	36-bit digital (hardware output and backplane output)	High resolution and data rate Fast system development
		HP 10898A	36-bit digital (hardware output and 36-bit digital (hardware output and backplane output)	Dual-axis, high resolution, slew rate and data rate
		HP 10896B	VME compensation board	Complete environmental compensation
HP 5527B	Proprietary	HP 5507B	32-bit digital, GPIO, GPIB, motor drive (in ±10 Vdc, 16-bit digital, and pulse-width modulated), A-Quad-B, up/down pulse	High-performance, complete package Servo-axis board Fully compensated A-Quad-B for high-precision machine tools Complete environmental compensation

PC-Based Laser Interferometer Positioning System

The HP 10889B PC servo-axis board is a programmable, digital servo with built-in motion control algorithms for closed-loop positioning that is compatible with the most popular PC backplane. Output is a ±10 V analog motor drive signal updated at 20 kHz. A trace function speeds and simplifies servo-loop characterization and tuning. The HP 10885A PC axis board provides a 32-bit digital, real-time position output via hardware, and position can also be read over the backplane. The HP 10886A PC compensation board increases accuracy and repeatability of systems using either the HP 10889B or HP 10885A by compensating for environmental conditions using HP environmental sensors. Combining the high performance of HP laser interferometers with the most popular, lowest-priced, industry-standard backplane speeds system development and reduces system costs.

VMEbus Laser Interferometer Positioning System

The HP 10897B and HP 10898A high-resolution laser axis boards provide high position resolution (up to 0.3 nm) at a 10 MHz rate for the most demanding applications. Position data is output in 36-bit format for very high performance closed-loop positioning systems. The HP 10895A laser axis board provides output in 32-bit format for typical applications. Both boards provide a hardware position output and also output position over the VMEbus backplane. The HP 10896B compensation board increases the accuracy and repeatability of systems using either the HP 10897B or 10895A by compensating for environmental conditions using HP or custom environmental sensors. All HP laser electronics for VMEbus are compatible with VME Rev. C.1 providing easy, cost-effective integration into VMEbus.

HP 5527B Laser Interferometer System

The HP 5527B can be configured for closed- or open-loop control, automatic compensation for environmental effects, and special prototyping abilities for custom electronics.

The HP 5507B system electronics for the HP 5527B combine superior perfomance with ease of use and full EMC compliance. The system is controlled with GPIB, GPIO, or serial (RS-232). Five outputs are available depending on the boards used:

HP 10932B Axis Board: Open-loop measurements or position data for custom closed-loop positioning. Outputs are in 32-bit digital format, and are available directly and over HP-IB.

HP 10934A A-Quad-B Board: Provides high-resolution, A-Quad-B and Up/Down pulse outputs with full environmental compensation.

HP 10936B Servo-Axis Board: Closed-loop motor drive outputs for a range of motor amplifiers. Motor-drive outputs are ±10 V analog, 16-bit digital, or pulse-width modulated for precision positioning. The HP 10936B is a programmable digital servo with built-in motion control algorithms; custom algorithms can be downloaded. A trace function speeds and simplifies servo-loop characterization and position control.

HP 10941A Prototyping Board: Capabilities for custom electronic designs.

HP 10946C Automatic Compensation Board: With HP 10717A wavelength tracker and/or HP 10751A air sensor and HP 10757A material temperature sensor, automatically compensates for wavelength-of-light and material temperature effects.

System Specifications

	PC Compatible	VMEbus	HP 5527B
Accuracy			
Vacuum	0.1 ppm	0.1 ppm	0.1 ppm
Vacuum with MIL-STD-45662A	0.02 ppm	0.02 ppm	0.02 ppm
Maximum resolution			
Linear optics	5 nm	1.2 nm	10 nm
Plane mirror optics	2.5 nm	0.6 nm	5 nm
High-res. optics	1.2 nm	0.3 nm	2.5 nm
Maximum axis velocity			
Linear optics	1000 mm/s	1000 mm/s	700 mm/s
Plane mirror optics	500 mm/s	500 mm/s	350 mm/s
High-res. optics	250 mm/s	250 mm/s	175 mm/s
Maximum optical range	40 m	40 m	40 m
Maximum hardware data output rates			
Position/position error	3.0 MHz	10.0 MHz	3.0 MHz
A-Quad-B (transition rate)	N/A	N/A	5.2 MHz
Up-down pulse	N/A	N/A	5.2 MHz
Motor-drive	20 kHz	N/A	8 kHz
Environmental compensation	Yes	Yes	Yes

HP 5529A

- Calibration of machine tools, CMMs, pick and place machines, robots, and machines with precision movement
- Comprehensive calibration
- Flexible triggering and parameter setting
- Minimum machine downtime with easy control through MS-Windows
- Graphical output provides conformance to seven international standards
- Complete localization in eight languages
- Customized compensation table enables improved performance

HP 5529A Dynamic Calibrator for Flexible, Comprehensive Calibration

The HP 5529A dynamic calibrator is a high-performance calibration tool for most equipment with precision movement. This calibrator minimizes downtime and enables conformance to international standards with its powerful measurement capability. The HP 5529A is a laser-based machine tool calibration system consisting of a laser head, optics, PC-based electronics, and Microsoft Windows-based software that operates in an IBM-PC-style (ISA bus) computer.

Comprehensive Measurements

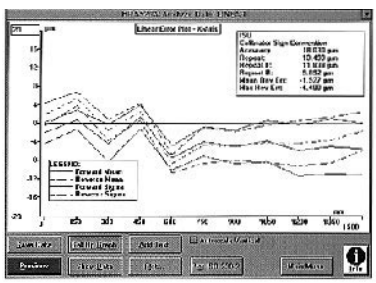
- Linear
- Angular
- Straightness
- Squareness
- Way straightness
- Parallelism
- Flatness
- Timebase
- Ballbar
- Diagonal
- Thermal drift
- 2-axis
- Rotary table

Flexible Triggering

- Manual
- Automatic
- A-Quad-B

Flexible Parameters

- Environmental compensation
- English/metric units
- 0 to 10 seconds averaging
- Measurement target lists
- Upload/Download CNC compensation tables



Linear Plot Using ISO 230-2

Conform to Seven International Standards

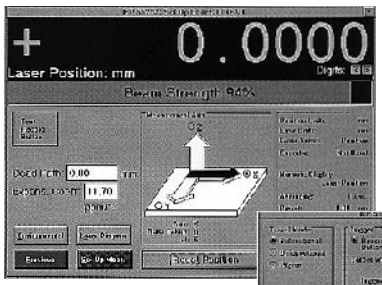
Today's world market requires many manufacturers to conform with a specific international standard. The HP 5529A provides graphical output that shows your machines' conformance with seven international standards:

- ISO 230-2
- NMTBA
- ANSI B5.54
- BSI
- VDI
- JIS
- GB 10931-89

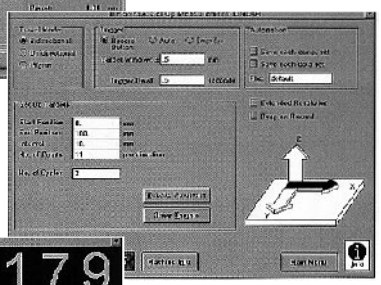
Minimize Machine Downtime

The HP 5529A is easy to control because of its simple-to-use Windows interface. Measurements are made in three steps: set up laser, set up measurement, then collect data. The standard user interface based on Windows provides in-depth help every step of the calibration, including detailed drawings showing the setup for each measurement.

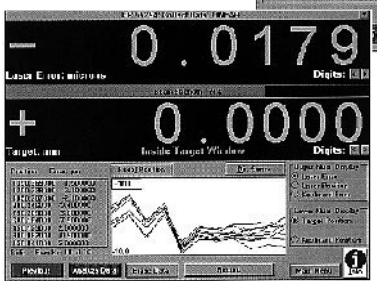
Training on the system is available at the HP factory, and HP consulting is available at your site.



Set Up Laser



Set Up Measurement



Collect Data

Available in Eight Languages

Complete documentation, control, and on-line help is available in eight languages:

- English
- French
- Spanish
- German
- Italian
- Japanese
- Chinese (PRC)
- Chinese (ROC)

Brief Specifications

Data Rate: Up to 33 kHz

Linear

Accuracy (range): ±0.02 ppm to ±3.0 ppm
Resolution: Down to 1 nm
Range: Up to 80 meters

Angular

Resolution: Down to 0.005 arc seconds
Range: ±20°

Key Literature

HP 5529A Brochure, p/n 5968-0111E
HP 5529A Price List, p/n 5966-3285EUS
HP 5529A Spec Sheet, p/n 5964-9307E

Ordering Information

HP 5529A Dynamic Calibrator

HP E1710A
HP E1720A

- Data Storage: Servo Writing, Spinstands, HGA Testers
- Dimensional metrology

Angular Encoder System (E1710A) with master arm assembly and mechanical pushpin

HP E1710A/E1720A Encoder Systems

The HP E1710A Angular and HP E1720A Linear Encoder Systems are PC-compatible sets of opto-mechanical and electronic components. They provide ultra-high resolution (16 nanoradians angular or 0.6 nm linear) measurements and servo-controlled positioning for use in dimensional metrology and motion control. They are compact, integrated solutions for precisely-controlled angular or linear positioning used in writing servotracks in the data storage industry. Individual components of the HP E1710A and HP E1720A systems are available if you wish to integrate specific HP E1710A or HP E1720A functions into systems of your own design. The HP E1710A is available with the HP E1710A Option 001 Master Arm Assembly. This combines a power amplifier, motor, arm and mechanical pushpin (HP E1710A Option 002) in an easy-to-use, integrated package.

Increase Storage Densities through Greater Track-to-Track Accuracy (10 nm)

The HP Encoder Systems are immune to turbulence created by spinning disks as well as from other changing conditions of the servotrack writing environment. This translates into superior track-to-track accuracy in measuring and controlling the drive arm.

Simplify Servo Designing Tasks with HP Electronics

Why spend valuable resources designing a custom servo capability when you can buy a cost-effective, easy-to-use electronics board from a leader in electronics for servotrack writing applications?

Lower Your System Cost

HP Encoder Systems are designed for cost efficiency. They have few components, and there is no need for alignment if you purchase an HP factory-assembled and fully-tested system, including the master arm assembly. Their rugged construction provides long-term reliable performance.

System Components

The HP E1710A and HP E1720A Encoder Systems consist of the components described below:

HP E1711A Sensor Head

The sensor head uses an infrared laser diode and interferometric technique to read the displacement of the scale relative to the sensor head. The lines on the scale are imaged onto a detector which at all times views and averages more than 10 radial markings. This results in highly linear measurements with relatively high immunity to dirt on the scale. The base of the sensor head has precisely machined holes for locating pins to facilitate accurate mounting in user-supplied hardware.

HP E1712A Scale (specify by option code)

The standard linear scale (Option 011) is 75 mm long, on a glass plate 1.5 mm thick. The standard angular scale (Option 038) is designed to be mounted so that the encoder markings are centered at a radius of 38.2 mm measured from the axis of rotation. Registration marks are provided on the angular encoder to assist in accurately positioning it at the design radius.

HP E1713A Scale Servo Axis Board

This new 8-bit PC/AT-compatible board processes the signals from the sensor head to provide a 32-bit position word at a dedicated connector and on the ISA bus. The position word can be used to control either the onboard servo or a user-provided servo. The onboard servo runs a proportional-integral-differential (PID) or infinite-impulse-response (IIR) equation for a single measurement axis, and generates a ±10-volt output signal to either the servo amplifier and Voice Coil Motor (VCM) of the HP E1714A Master Arm Assembly, or a user-provided servo-amplifier motor. The servo axis board also has a provision for adding a 16-bit value to the control loop for systems using multiple inputs. The board comes with the following software: Tune Program, Demo Program, and a library of functions (ANSI C source code). The user's manual (HP E1710A Option 101) includes the procedure for setting the PID coefficients. (The firmware and software used for servo functions are based on those used with the HP 10889B Servo Axis Board.)

HP E1714A (HP E1710A Option 001) Master Arm Assembly (applies to angular system only)

This assembly is specifically designed for servotrack writing applications. It is provided with the HP E1712A Scale attached at the proper radius on the master arm. It contains a Voice Coil Motor and servo amplifier which drive the master arm over a range of ± 20 degrees.

Non-Contact Push Pin Sensor, E1721A

HP E1721A Non-Contact Push Pin Sensor

The HP E1721A Non-contact Push Pin (NCPP) Sensor is an optical replacement for the mechanical push pin. Because no physical contact is being made with the head stack assembly (HSA), the NCPP offers the advantage of not introducing any new resonances to, or changing existing resonances in, the servtotrack writing process. Furthermore, stiction errors are eliminated.

The sensor head of the NCPP is attached to the servotrack writer's (STW's) master arm. It contains a laser diode, optics, and a detector. The laser diode's focused beam reflects off a target feature on the E-block or suspension of the HSA. The image formed by the target feature is itself imaged onto the detector. The detector signals are then electronically processed to provide an error signal which is proportional to the relative displacement between the master arm and the HSA. This signal is used to servo-control the position of the HSA to the position of the master arm with the HP E1723A DSP Servo-Axis Board or customer-supplied electronics.

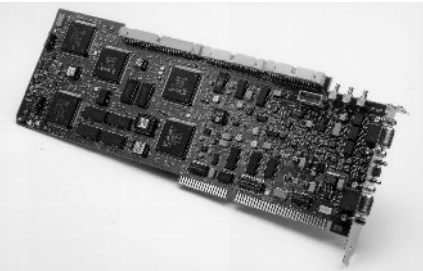
The HP E1721A is a Class II laser device with continuous power, single mode laser output, with a wavelength of 670 nm typical and an output power of 1mW max.

The following options are available with the HP E1721A Non-contact Push Pin Sensor:

HP E1721A Opt. 001: Add NCPP Cable (connects pre-amp module to HP E1723A DSP Servo-Axis Board)

HP E1721A Opt. 002: Add RS-232C cable 3m, 9M D to 9F D (connects 9F D connector to Customer-supplied electronics)

HP E1721A Opt. 101: Operating Manual (English version)



HP E1723A DSP Servo-Axis Board

The HP E1723A DSP Servo-Axis Board is a user-programmable, two-axis servo card with custom input circuitry for each axis. The board can be used with one axis controlling the HP E1710A or HP E1720A Encoder System (i.e., HP E1711A Sensor Head), and one axis controlling the HP E1721A Non-contact Push Pin (NCPP) Sensor.

You may choose to:

- Write your own low-level programming code (using program development information provided by HP and Texas Instruments) to control the DSP to implement specialized control systems, or
- Use the supplied software to download coefficients for running PID equations (with feedforward) or IIR (to 8th order) along with factors for notch and low-pass filters on each axis.

Axis #1

This axis accepts its input from the HP E1711A Encoder sensor head. In a typical system, the HP E1711A monitors the position of a linear or angular scale, and outputs an analog voltage used to control stage position.

Axis #2

This axis accepts its input from the HP E1721A Non-contact Push Pin (NCPP) sensor head. In the typical application, the NCPP sensor head monitors a target feature located on the stage to be controlled. The sensor head detects optically whether the target is to the right, left, or centered relative to the sensor head. A signal from the sensor is processed through the servo equation to produce a voltage used to control the stage carrying the target feature to keep it in a fixed position relative to the sensor head ("nulling servo").

Mechanical Dimensions

Standard full length AT-size board which supports 16-bit data bus transfers. The standard HP E1723A ships with 128k onboard memory.

The following options are available with the HP E1723A DSP Servo-Axis Board:

HP E1723A Opt. 001: Add NCPP cable
HP E1723A Opt. 002: Deep Memory (512k bytes)
HP E1723A Opt. 101: Add (English version) Operating Manual and System Software

HP E1710A/20A Encoder Systems(Sensor Head, Scale and Servo Board)

	HP E1710A[1] Angular Encoder	HP E1720A Linear Encoder
Repeatability	0.05 μrad	± 2 nm
System resolution (LSB)	16 nanoradians (8 nanoradians LSB)	0.6 nm (0.3 nm LSB)
Track-to-track accuracy	≤0.25 μrad (250 μrad span)	≤10 nm (10 μm span)
Long range accuracy	≤0.19%[3] (40 degree sweep)	±200 nm
Range	±20 degree	75 mm std.[4]
Sensor head dimensions	61 mm x 33 mm x 17 mm	61 mm x 33 mm x 17 mm
Scale dimensions	30 mm x 7 mm x 1.5 mm	75 mm x 9.2 mm x 1.5 mm[4]
Operating temperature range	15° C to 40° C	15° C to 40° C
Velocity	22.2 radians/s	850 mm/s
Power requirements[2] (via HP E1713A)	+5 Vdc @ 2 amps +12 Vdc @ 1.2 amps –12 Vdc @ 0.09 amp (with HP E1714A)	+5 Vdc @ 2 amps +12 Vdc @ 0.2 amps –12 Vdc @ 0.09 amp

[1] For angular system, scale radius =38.2 mm, other radii available
[2] Power for HP E1711A Sensor Head and HP E1713A Servo Axis Card
[3] 0.19%=0.0004% (scale tolerance) + mounting eccentricity
[4] Up to 150 mm length scale can be provided. Contact factory regarding your needs.

HP E1713A Scale Servo Axis Board

Motor Drive Output: ±10 volts with 0.3 mV resolution, updated at the sample rate. Programmable limit centered on zero volts.
Sample Rate: Up to 20 kHz (depends on equation used)
Hardware Position Output: 32-bit, updated at 400 kHz
Servo Equations: PID with feedforward or up to third order IIR
Data Age: 6.56 μsec (top connector)
Interface: Full size PC-compatible card. 8-bit ISA bus interface.

HP E1714A Master Arm Assembly

Track-to-Track Step and Settle Time:
5 msec typical for a 65 μrad step (2.5 μm step at R = 38.2 mm)
Servo Bandwidth: 200 Hz
Angular Range: ±20°
Mechanical Pushpin Radial Location Range: 15–55 mm
Operating Temperature: 0° C to 40° C
Torque: 0 –6V 0.0093 N–m/V; 6 –10V 0.056 N–m
Power Requirements: +12V @ 1 amp

Note: When ordered with the HP E1710A system, the master arm is ordered as HP E1710A Option 001.

HP E1721A Non-Contact Push Pin (NCPP) Sensor Specifications

Noise Equivalent Displacement: ≤ –1 nm rms (B/W = 3.5 kHz)
Error Slope Around Null: 0.18 mV/nm nominal
Operating Temperature Range: 15 - 40°C
NCPP Head Dimensions: 21.3 mm x 17.5 mm x 8.0 mm
Pre-amp Module Dimensions: 48 mm x 31.8 mm x 13.7 mm
Mass of Sensor Head: 6 g nominal
Standoff Distance, concave target: 14.0 mm nominal (24.75 mm +/- 0.25 mm from center of alignment holes to bottom of target feature)
Laser Output: 670 nm typical, single mode, continuous power, 1 mW max., Class II laser
First Mechanical Resonance: ≥ 4 kHz
Capture Range (before initialization): ≥ 20 μm
Target Feature: The target is a reflective, concave, cylindrical feature with radius of 0.5 mm +/- 0.1 mm
Cable and Connectors: The sensor head is connected to the remote pre-amp via a printed circuit flex cable. The remote pre-amp is terminated in a standard 9-pin D connector.
Mounting Method: Two locating holes are provided as well as tapped holes for M3 x 0.5 screws (clearance holes for M2 screws).

HP E1723A DSP Servo-Axis Board Specifications and Features

Axis #1 Resolution: 0.6 nm
Axis #2 Resolution: < 2 nm
Sample Rate: 50 kHz (both axes running, with each axis running 4 biquads to process the position error signal, and another 4 biquads that process the position error plus feed forward value)
DSP Used: Texas Instruments TMS320C32-60; DSP code customer programmable, and can be stored in flash memory
Input/Output: Auxiliary digital input port (16 bit) which can be directed to either servo; Auxiliary digital output port (16 bit) which can be directed to either servo; Auxiliary analog input and output port which can be connected to either servo; Output port (analog) for motor drive (+/- 10 V output, 0.305 mV resolution) on each axis

Ordering Information

HP E1710A Angular Encoder Sytem
(38.2 mm radius scale is standard)
HP E1711A Sensor Head (Sensor Head Cable included)
HP E1712A Scale (order with an option code)
HP E1713A Scale Servo Axis Board
HP E1714A Master Arm Assembly (with standard 38.2 mm scale included on arm)
HP E1720A Linear Encoder System
(75 mm lenth scale is standard)
HP E1721A Non-contact Push Pin (NCPP) Sensor
HP E1723A DSP Servo-Axis Board

For available options, contact your local HP Call Center.

HP 5529A/55291A Verify Machine Performance with the World Standard for Laser-based Technology
5968-0111E

HP E1710A/E1720A Encoder Systems
5966-4875E

HP E1710A/E1720A Push the Limits on Disk Drive Track Density with the Highest Available Resolution
5965-6899E

HP E 1721A Non-contact Push Pin and Pre-Amp Module
5966-1959E

HP E1723A DSP Servo-Axis Board
5966-1960E

HP 5529A Dynamic Calibrator Technical Specifications
5964-9307E

HP 10889B/85A/86A Complete PC-compatible, Closed-loop Laser Positioning
5091-8435E

HP 10895A/96A/97A High Performance Laser Interferometer Positioning Systems for VMEbus
5965-1569E

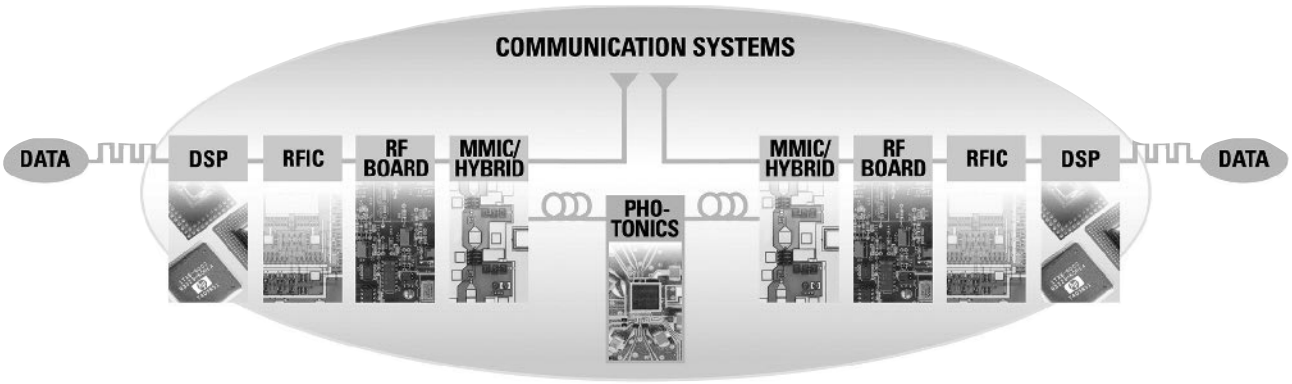
Choose from a Large Selection of Optical Components for System Design Flexibility
5964-6190E

Many of these literature pieces are available at:
http://www.hp.com/go/tmc00

EDA Infrastructure 19

For Communication Product Design 547

NEW



HP Advanced Design System—A Unified Design Environment for Communication Signal Path Design

The challenge of communications design is to shorten time to market, while making better, smaller, faster products that require less energy consumption. HP EEsof's Advanced Design System was developed specifically to simulate the entire communications signal path. This unique solution integrates proven RF, DSP, and electromagnetic simulators into a single, flexible design environment.

Combining Proven Technology with New Innovation

The HP Advanced Design System provides new DSP design and synthesis technologies and significant new design capabilities for RF, microwave, and RFIC, all integrated into one efficient, flexible design solution. The integration of RF and DSP analysis engines allows real-time co-simulation and is unique in the EDA industry. The integration of multi-discipline design tools into a single environment and database eliminates the barriers caused by separate processes and allows design teams to easily examine tradeoffs and optimize design margins. This design environment is available for both PC and UNIX platforms. The PC version can be run on a modern laptop, creating a more flexible design environment.

System Design

The HP Advanced Design System top-level design solution, HP Communication Systems Designer, offers unprecedented speed and accuracy in mixed DSP/RF system simulation.

The RF system simulation capability has been enhanced with the use of an extremely fast harmonic balance simulator that allows engineers to compute full budget simulations on any RF topology. The software includes measurements for dozens of system-level parameters such as incident power, noise figure, third-order products, signal-to-noise ratio (SNR), noise bandwidth, and more. The RF system simulation also enables designers to do detailed RF system analysis on control loops such as phase-locked loops and automatic gain control loops. These abilities allow engineers new freedom to experiment with innovative approaches to their designs.

HP Communication Systems Designer also has a new signal-processing engine that allows processing of data in both vector and matrix form and has over 300 DSP models. Bit error rate (BER) testers that have both Monte Carlo prediction and a faster variance reduction algorithm are included. Designers can use advanced post-processing capabilities such as FFT, correlation, cumulative distribution function (CDF), probability distribution function (PDF), and complex math functions.

HP Communication Systems Designer Premier comes with a Matlab interface and has a user-friendly C-code interface. An instrument server is included that lets users link to RF and communication measurement instrumentation. The design software also offers an optional library of EIA-compliant antenna and propagation models for GSM, NADC, PHP, and CDMA.

RFIC Design

Circuit simulation technology in the HP Advanced Design System features dramatic enhancements resulting from patented new technologies. The software offers a complete range of integrated RFIC simulation technologies that provide the most efficient and accurate verification of RFIC performance against modern digital wireless standards, such as adjacent channel power ratio (ACPR) and error vector magnitude (EVM) of code division multiple access (CDMA) systems.

This breakthrough software includes HP high-frequency SPICE, harmonic balance, and HP Circuit Envelope simulation technologies. Tests on the patented new harmonic balance simulation technique have shown speed enhancements from 2 to 100 times and reduction of memory usage by 8 to 15 times, enabling designers to simulate the very large RFIC circuits necessary in today's complex communications systems. HP's patented Circuit Envelope simulation technology, useful for simulation of RFICs with complex digitally-modulated signals such as CDMA, is now available for both PC and UNIX platforms.

Co-simulation of RF and DSP interactions in RFIC chipsets is possible in conjunction with HP DSP Designer, ensuring on-spec performance without costly iteration. System/DSP behavioral blocks with circuit level blocks can be simulated for optimal top-down hierarchical design.

HP EEsof provides services to integrate the HP Advanced Design System into design flows that use Cadence and Mentor products.

DSP Design and Synthesis

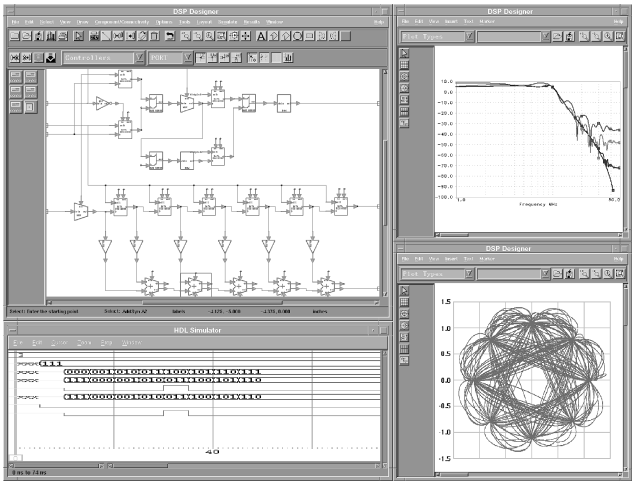
Digital signal processing is a vital part of many communication designs, and the HP Advanced Design System addresses this need with the inclusion of two new DSP tools; HP DSP Designer and HP DSP Synthesis. These two products were developed especially to help DSP design engineers create and evaluate baseband designs.

HP DSP Designer offers the most extensive environment available for communications DSP development and the largest collection of DSP, analog, RF, and digital models to ensure real-world validation. The software includes a block diagram algorithm development environment, DSP filter tool, measurement instrument links, and powerful data post-processing capability. For the first time digital parameters such as bit width can be included in a simulation with RF parameters such as power amplifier reverse isolation.

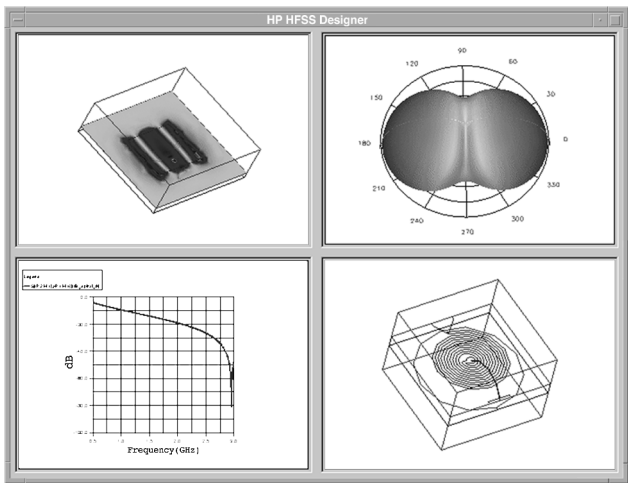
HP Ptolemy, new simulation technology from HP EEsof, is built into HP DSP Designer. The technology was developed by merging HP research and technology with the first commercialization of the University of California at Berkeley Ptolemy project, a signal-processing framework renowned for mixing multiple simulation models. This new simulation engine facilitates co-simulation of time, frequency, and data flow technologies and significantly expands the DSP development capability for mixed RF/analog/DSP communications projects. HP is the only EDA vendor to deliver RF/DSP co-simulation capability within a complete design environment.

HP DSP Synthesis offers powerful capabilities to help both DSP and integrated circuit (IC) designers move quickly from a system-level design to implementation which improves productivity and reduces development cost. DSP synthesis outputs RTL (Register-Transfer Level) and VHDL/Verilog code. The software outputs the hardware description language (HDL) in industry-standard formats for use with logic synthesis tools.

NEW



HP DSP Designer and HP DSP Synthesis are powered by HP Advanced Design System EDA software.



HP HFSS Designer models passive, arbitrary 3D structures to determine S-parameters, EM field distributions, and radiation patterns.

Microwave Circuit Design

For traditional design, the microwave circuit designer benefits from the integration of system, circuit, and electromagnetic (EM) simulation, as well as full schematic and layout, microwave hybrid and MMIC design tools, HP Microwave Circuit Designer includes a DRC with an easy-to-use rules-writing interface. A Graphical Cell Compiler allows the designer to create footprints graphically without programming and to compile them into AEL macro language. There are also layout enhancements for ground-plane management and better trace handling.

Planar and 3D EM Design Software

Electromagnetic (EM) design and simulation tools are becoming an integral part of the RF and microwave design process. Higher frequency designs, coupled with the desire for denser PCBs and chips, are driving RF and microwave engineers toward EM-based design tools to help them reach their goals through accurate characterization of the design's electrical behavior. Engineers world-wide are realizing the immense value in using EM-based design and optimization—moving away from analysis and toward design refinement automation.

HP HFSS Designer provides accurate EM modeling of arbitrarily shaped passive 3D structures. Developed especially for today's designer of high-frequency machined components and circuits, HP HFSS offers a powerful finite-element EM simulator that solves with unprecedented accuracy and speed. By combining faster solution times, efficient memory usage, an intuitive drawing environment, and powerful post-processing capabilities, HP HFSS delivers state-of-the-art solutions to highly complex 3D EM design problems. HP HFSS is a general-purpose electromagnetic modeling tool and lends itself to many design applications, such as machined-component design, antenna and feed design, microwave and RF circuit component design, model packaging effects, high-speed circuit design, and high-frequency and high-speed probe design.

HP Momentum is a planar EM simulator that allows RF and microwave designers to significantly expand the range and accuracy of their passive circuits. It accounts for coupling and parasitic effects, and helps analyze multi-layer arbitrary geometries. It works in conjunction with HP HFSS to compute the S-, Y-, and Z-parameters of general planar circuits. HP Momentum analyzes microstrip, strip-line, slot-line, coplanar waveguide, and other circuit topologies. Specialized ports are available for coplanar waveguide, ground ports, and ports on any strip surface or edge. This allows design results to be used efficiently with circuit simulators when sub-circuits or components are connected to the HP Momentum geometry.

The HP HFSS Designer bundle includes HP Empipe3D, a powerful software tool for automated EM design optimization. It allows HP HFSS users to designate geometric and/or material parameters as candidate variables for optimization. The optimizer's sophisticated set of techniques includes l1, l2, Minimax, Quasi-Newton, Simplex, Random, and Simulated-Annealing. All of these techniques have proven track records in engineering applications.

RF Board Design

Whether a cellular/PCS phone, pager or a next generation wireless product, today's communications products ultimately are built using printed circuit board (PCB) technology. When creating RF designs on a PCB, designers must take their specifications from concept to physical reality.

HP Advanced Design System's design, simulation and analysis capabilities provide complete top-down design capability from system to circuit as well as physical design all within a single integrated environment. This adds up to a complete design process solution for the RF PCB designer.

System-Level Design

- Partition designs w/ system-level models
- Budget/sweep/spur tests
- Co-simulation of system w/circuit-level designs

Circuit-Level Design

- Complete set of simulation technology
- Optimization
- Yield Analysis & Optimization
- Accurate & Extensive Parts Libraries & Models
- Co-simulation of RF with DSP designs w/ Circuit Envelope

Physical-Level Design

- Bi-directional Schematic/Layout Design Synchronization
- Integrated planar EM analysis & design
- Industry standard output for manufacturing artwork generation
- Design Flow Integration with Manufacturing Software

In addition, the RF PCB Designer can pass data to and from HP instrumentation to design, test, simulate, and generate realistic signals for next generation systems.

Libraries

Part of the power of HP Advanced Design System lies in its extensive active- and passive-device model libraries. Palettes from HP EEsof of model data for over 90,000 popular devices from numerous vendors are instantly available for placement within the design. From surface mount technology (SMT) capacitors to behaviorally modeled RFICs, the libraries contain the popular parts needed by today's designers. The new HP W-CDMA Design Library employs pre-built models, simulation systems and test benches that speed W-CDMA product development.

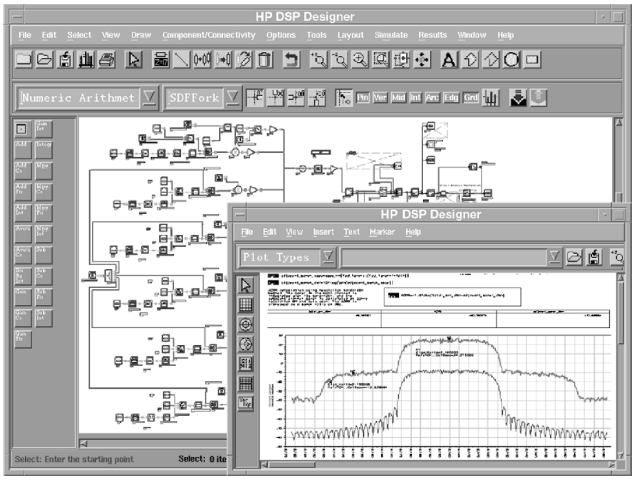
The new HP GSM Design library includes the complete set of behavioral models conforming to specifications, pre-built simulation systems, and applications examples to allow you to efficiently create GSM designs.

Getting the Most from Your Investment

With HP EEsof product support, you receive substantial software upgrades, documentation updates, and support via telephone, fax, email, and the web. Our worldwide technical support services provide assistance to new and advanced users alike.

HP 85123A
HP 85190A

NEW



Complete signal path design with the W-CDMA Design Library lets you accurately analyze adjacent channel power ratio for critical 3G applications.

The HP 85123A RF Modeling System, together with the HP 85190A IC-CAP software, are shown extracting complete nonlinear models for RF active devices.

Key Literature

HP Advanced Design System Brochure, p/n 5966-2870E
HP RF Board Designer Brochure, p/n 5966-2872E
HP RFIC Designer Brochure, p/n 5966-2871E
HP Microwave Circuit Designer, p/n 5966-0671E
HP High-Frequency Structure Simulator Brochure, p/n 5967-5846E
HP Communication Systems Designer Brochure, p/n 5966-0670E
HP DSP Designer Brochure, p/n 5966-2869E

Ordering Information

HP E8900 Advanced Design System and HP 85180A High Frequency Structure Simulator come in a number of configurations and bundles.

For more information, please call the HP Test & Measurement Call Center at 1-800-452-4844 (in North America), or refer to our web site: **http://www.hp.com/go/hpeesof**

Platforms

The products on these pages are available on popular PC and UNIX platforms.

Support

A complete line of support products, which include automatic software updates and telephone technical support, is also available. Please contact the HP Call Center in your region for more details.

Device Modeling Systems

The HP Device Modeling Systems are the first total systems specifically dedicated to active device modeling. They combine parameter extraction and test hardware (HP 85122A for microwave, HP 85123A for RF, or HP 85124A for pulsed modeling) and the HP 85190A IC-CAP modeling software. Industry-standard SPICE models as well as HP EEsof high-frequency models are available for FET, HEMT, BJT, MOS, diode, and thin-film devices.

- Use the HP 8510C or HP 8753C network analyzer for S-parameter measurements and the HP 4142B DC source/monitor for precision DC measurements and bias (custom configurations also available)
- IC-CAP software is compatible with measurement instruments and circuit simulators such as MDS
- Complete modeling solution: delivered fully configured and factory integrated
- Easy to connect and fully compatible with wafer probes from Cascade Microtech or fixtures from Inter-Continental Microwave

IC-CAP software provides the total framework environment in which standard, modified, or fully custom device models may be extracted or generated. Specific models include the HP Root FET and MOS Model Generators, as well as FET, BJT, HEMT, diode, and thin-film models.

Ordering Information

HP 85122A Precision Modeling System comes in a number of configurations and bundles.

For more information, please call the HP Test & Measurement Call Center at 1-800-452-4844 (in North America), or refer to our web site: **http://www.hp.com/go/hpeesof**

Refurbished Instruments 20

HP Refurbished Test and Measurement Product List Available on the Internet: http://www.hp.com/go/refurbished

Hewlett-Packard offers a large inventory of high-quality refurbished equipment, which is viewable on the Internet. Follow these steps to select and order this high value, HP refurbished general purpose test equipment:

- Log onto our site:
  http://www.hp.com/go/refurbished
  This url is a shortcut directly to the "HP Refurbished Equipment" page on HP's web site.
- Find the product you need. For more information (in the U.S.), contact the HP Call Center at 1-800-452-4844 (for Call Center numbers outside the U.S., see page 607). If you can't access the World Wide Web, and there is no Call Center in your area, please contact your local HP Sales Office (see page 563 for a complete listing).
- Call your local HP Sales Office to order.

www.hp.com/go/refurbished

Here is what you will find on the HP refurbished equipment site:

Overview

Learn about the benefits of purchasing refurbished equipment from Hewlett-Packard. Details about the minimum one-year warranty on all HP refurbished equipment sold by HP are included here. This section answers the questions: "What is HP refurbished equipment?" and "Why buy HP refurbished equipment from HP?"

Refurbished Products

View a current list of more than 1,200 high-quality test and measurement products that are refurbished to HP "as manufactured" standards. This list represents the largest inventory of competitively priced, highly reliable HP refurbished test equipment available. Products listed include our own demo and lease-return products. All equipment is refurbished to HP quality standards.

Details provided on the Internet include model number, options and a brief product description.

Special Offers

Periodically, there will be special clearance sales on selected models offered on this site. These models are priced to clear a temporary inventory surplus and to provide an excellent purchasing opportunity. View these special clearance sales under the "Special Offers" link on the home page. You will be directed to your geographic region for worldwide special offers plus special sales designed specifically for your market.

Service and Support
When purchasing refurbished equipment from Hewlett-Packard, our support and other services are also available. Links are provided to service notes, application information, training classes and more. If you need to find the nearest Service Center, world-wide information is available from this web site.

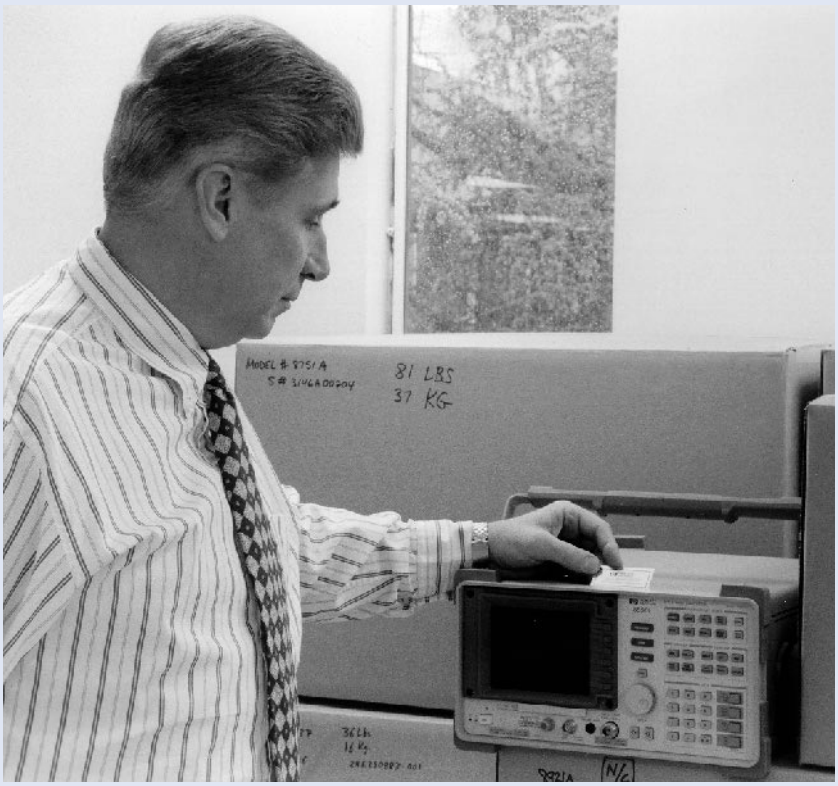
Sales Contacts
A convenient link is provided from the Refurbished Equipment site to a list of telephone numbers for Call Centers and Sales Offices around the world.

Convenient, One-stop Shopping
With Hewlett-Packard offering both new and refurbished equipment, you can save valuable time by shopping for all of your test equipment needs at HP. A single purchase order can include new and refurbished equipment, as well as training and support.

Financing
HP financing options are available for refurbished equipment. Contact your local HP Sales Representative for more details about these options.

Technical Assistance
Best of all, when you are not certain what model to purchase, you can call the HP Call Center in your area for expert assistance from a qualified engineer. We provide the same expertise for refurbished equipment that we provide for new. HP field engineers help you select the best possible equipment for your specific application using the latest information from the factory. Don't hesitate to pick up the phone and ask Hewlett-Packard's experts for advice.

Extend Your Budget with Refurbished Equipment



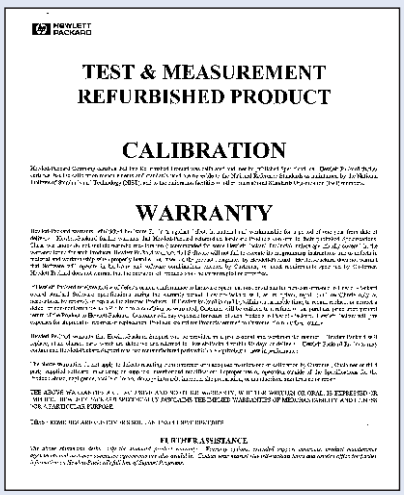
The official "Hewlett-Packard Test & Measurement Refurbished Product" seal being placed on this refurbished unit by a manufacturing manager guarantees that the product has been refurbished to HP's quality standard before it is shipped.

Easy to Purchase
Local Field Sales Engineers can help you select the appropriate product for your application, or you can call any of HP's offices to place your order directly. In the U.S., call 1-800-829-4444. For Call Center numbers outside the U.S., see page 607. You can also visit the catalog web site: **www.hp.com/go/tmc00.** If you can't access the World Wide Web, and there is no Call Center in your area, please contact your local HP Sales Office (see page 563 for a complete listing).

High-Quality, Refurbished Equipment
If your budget will not stretch far enough to purchase all of the new test and measurement equipment you need, consider adding some used instruments to your equipment pool.

Here's what you get when you buy refurbished HP equipment from HP:

- Prices lower than for new equipment.
- Low cost of ownership because of the added benefits of HP warranty and support.
- Minimum one-year warranty for all components covered when the unit was sold new. HP extended warranties are also available on most refurbished products.
- New and refurbished equipment, in addition to training and support, can be bundled on a single purchase order.
- All units are calibrated and tested to HP original manufactured standards, using HP factory specifications and test procedures. Necessary safety, reliability and Y2K upgrades identified by the factory are automatically made.
- Return policy same as for new HP products.
- Technical support, before and after the sale, is the same as for new equipment. HP field engineers help you select the best possible equipment for your application using the latest information from the factory.
- An HP Certificate of Calibration is shipped with the product, as appropriate.
- Accessories included are the same as when the product was sold new.


HEWLETT PACKARD

TEST & MEASUREMENT
REFURBISHED PRODUCT

CALIBRATION

WARRANTY

All HP refurbished equipment carries a minimum one-year warranty. HP extended warranties are also available on most refurbished products.

Adapters, Cables & Cases 21

555

HP C2950A and C2951A Printer Cables

HP C2904A SCSI Terminator

ITEL 45CHVUC Converter

IEEE 1284-Compliant Parallel Printer Cables

HP Printer Cables are IEEE-1284 compliant for the highest level of printer performance. These cables provide full access to the feature sets of today's advanced printers, allowing intelligent peripherals to "talk" and "listen" to their host, and resolving the bottlenecks that can occur when sending information from PC to printer and vice versa.

IEEE-1284 compliance is important. This industry standard defines the requirements for bi-directional parallel communication between personal computers and printers. It specifies electrical interfaces, cable construction, and interface hardware for high-performance cables, as well as three connector types: 1284-A, 1284-B, and the new 1284-C. These cables are designed for improved protection against radio frequency interference (RFI), electro-static discharge (ESD) damage, and data loss due to poor quality construction or crosstalk.

USB Cables

HP USB (universal serial bus) cables ensure optimal communications between personal computers and an array of devices.

With this technology, Microsoft Windows users are able to expand their systems with a host of USB peripherals including printers, scanners, cameras, speakers, keyboards, joysticks, modems and mice. As many as 127 devices can be connected to a single USB port.

Additionally, the USB cable's "hot plug" design allows for "plug and play" connections to other devices without having to power-down or reboot computers.

Interface Converter for GPIB Controllers

HP offers an inexpensive solution for GPIB controllers: ITEL 45 CHVUC/EC converters. These converters enable users of GPIB controllers to connect to a wide array of HP parallel printers, including the HP LaserJet and DeskJet family of printers.

These converters have been tested and approved by HP to work with GPIB controllers without additional programming. Small and simple to install, they feature switch-selectable addresses and variable resolution to automatically adjust the size of graphics for HP printers, eliminating too-small and off-the-page printouts.

GPIB Interconnection Cables

Cables for interconnecting GPIB devices are available in six lengths. The connector block at both ends of the cable has a plug on one side and a matching receptacle on the other so that several cables may be conveniently daisychained, thus simplifying system interconnection. Lock screws securely mount each connector block to an GPIB instrument or to another connector block.

HP 10833 cables feature an improved shielding design to help reduce RFI levels in systems. This series of cables has significantly lower radiated emissions than previous GPIB cables.

SCSI Cables for Hosts and Peripherals

HP SCSI cables are the critical link for transferring information from host to peripheral, between hosts, or between peripherals, and the latest generation offer impressive advancements.

The new SCSI cables feature Low Voltage Differential (LVD) operation for 80-megabytes-per-second transmission, plus VHDCI connectors to accommodate as many as four connectors on a single card. Ultra flexible jacketing allows for greater flexibility and easier routing.

Ordering Information

IEEE-Compliant Printer Cables
HP C2950A HP Printer Cable, IEEE 1284-compatible, A-B parallel 2 m (6.6 ft.)
HP C2951A HP Printer Cable, IEEE 1284-compatible, A-B parallel 3 m (9.9 ft.)
HP C2946A HP Printer Cable, IEEE 1284-compatible, A-C parallel 3 m (9.8 ft.)
HP C2947A HP Printer Cable, IEEE 1284-compatible, A-C parallel 10 m (32.8 ft.)

USB Cable
HP C6518A A-B, 2.0 m (6.6 ft.)

GPIB Cables
HP 10833A GPIB Cable, 1 m (3.3 ft)
HP 10833B GPIB Cable, 2 m (6.6 ft)
HP 10833C GPIB Cable, 4 m (13.2 ft)
HP 10833D GPIB Cable, 0.5 m (1.6 ft)
HP 10833F GPIB Cable, 6 m (18.5 ft)
HP 10833G GPIB Cable, 8 m (26 ft)
HP 10834A Adapter

Converters
ITEL 45CHVUC GPIB to Centronics Parallel Bus Converter
ITEL 45CHVEC GPIB to Centronic Parallel Bus Converter (European version)
Must order power supply separately.
Ask for one of the following part numbers:
F1011A ABG Australasia
F1011A ABU United Kingdom
F1011A ABB European
F1011A ACQ South Africa

HP SCSI 2 Cables
HP C2908A 50 HDTS m/m, 1.0 m, (3.28 ft)
HP C2956A 50 HDTS m/m, 1.5 m, (4.92 ft)*
HP C2957A 50 HDTS m/m, 2.0 m, (6.56 ft)*
HP C2961A 50 HDTS to 68 HDTS m/m, 1.0 m, (3.3 ft)*

SCSI 3 Cables
HP C2981A 68 HDTS m/m, 0.5 m, (1.64 ft)*
HP C2911A 68 HDTS m/m, 0.9 m, (2.95 ft)*
HP C2924A 68 HDTS m/m, 2.5 m, (8.2 ft)*
HP C2925A 68 HDTS m/m, 10 m, (32.8 ft)*
HP C2926A 68 HDTS m/m, 20 m, (65.6 ft)*

SCSI 3 Cables with Matched Impedance
HP C2911B 68 HDTS m/m, 0.9 m, (2.95 ft)*
HP C2924B 68 HDTS m/m, 2.5 m, (8.2 ft)*

Ultra SCSI Cables
HP C2361A 68 HDTS to 68 VHDCI m/m, 1.0 m, (3.3 ft)*
HP C2362A 68 VHDCI to 68 VHDCI m/m, 2.5 m, (8.2 ft)*
HP C2365A 68 VHDCI to 68 VHDCI m/m, 5.0 m, (16.4 ft)*
HP C2963A 68 VHDCI to 68 VHDCI m/m, 10 m, (32.8 ft)*

SCSI Terminators
HP C2904A Active 50 HDTS m
HP C2905A Differential 68 HDTS m
HP C2972A Single-ended active, 68 HDTS m*
HP C2964A Multi-mode SE/LVD, 68 HDTS m*

HP Special In-line Terminated Cable
HP C2908A 68 HDTS m/f, 0.5 m (1.6 ft)

Indicates QuickShip availability.

* = New

Ordering Information

Cable Assemblies

HP 10501A 112 cm 50 Ω Coax with One UG-88C/U BNC (m) Connector
HP 10502A 23 cm 50 Ω Coax with UG-88C/U BNC (m) Connector
HP 10503A Like HP 10502A, but 122 cm
HP 8120-1838 30 cm 50 Ω Coax with Two BNC (m) Connectors
HP 8120-1839 Like HP 8120-1838, but 61 cm
HP 8120-1840 Like HP 8120-1838, but 122 cm
HP 11000-60001 112 cm 50 Ω Coax with Dual Banana Plugs
HP 11001-60001 112 cm 50 Ω Coax, UG-88C/U BNC (m) to Dual Banana Plug
HP 11003A Test Leads: 152 cm, Probe and Alligator Clip to Dual Banana Plug
HP 18182A 152 cm WECO 310 to 2 Alligator Clips
HP 92219Z Centronics Cable 1 M
HP 92224F Female Gender Converter
HP 92224M Male Gender Converter

HP model no.	Frequency range (GHz)	Length cm (in)	Connectors	SWR	Ins. loss (dB)	Price
11500A	dc to 12.4	183 (72)	N(m) (2)	—	—	
11500B	dc to 12.4	61 (24)	N(m) (2)	—	—	
11501A	dc to 18	183 (72)	N(m)-N(f)	—	—	
11500C	dc to 18	61 (24)	Precision N(m) (2)	1.4	1.5	
11500D	dc to 18	152 (60)	Precision N(m) (2)	1.4	3.0	
11500E	dc to 26.5	61 (24)	APC-3.5 (m) (2)	1.4	2.0	
11500F	dc to 26.5	152 (60)	APC-3.5 (m) (2)	1.4	4.0	

Adapters, 2.4 mm

(See page 564 for technical description and performance)

HP 11900A 2.4 mm (m) to 2.4 (m)
HP 11900B 2.4 mm (f) to 2.4 (f)
HP 11900C 2.4 mm (m) to 2.4 (f)
HP 11901A 2.4 mm (m) to APC-3.5 (m)
HP 11901B 2.4 mm (f) to APC-3.5 (f)
HP 11901C 2.4 mm (m) to APC-3.5 (f)
HP 11901D 2.4 mm (f) to APC-3.5 (m)
HP 11902A 2.4 mm (m) to APC-7
HP 11902B 2.4 mm (f) to APC-7
HP 11903A 2.4 mm (m) to Type N (m)
HP 11903B 2.4 mm (f) to Type N (f)
HP 11903C 2.4 mm (m) to Type N (f)
HP 11903D 2.4 mm (f) to Type N (m)
HP 11904A 2.4 mm (m) to K (m) [5]
HP 11904B 2.4 mm (f) to K (f) [5]
HP 11904C 2.4 mm (m) to K (f)
HP 11904D 2.4 mm (f) to K (m)
HP 11904S 2.4 mm (f) to K adapter set

Adapters Type N, Standard 50 Ω

HP E9621A N (f) to BNC (m)
HP E9623A N (m) to BNC (m)
HP 1250-0176 N (m) to N (f) Right Angle (use < 12 GHz)
HP 1250-0559 N tee, (m)(f)(f)
HP 1250-0777 N (f) to N (f)
HP 1250-0778 N (m) to N (m)
HP E9635A N (m) to BNC (f)
HP 1250-0846 N tee (f)(f)(f)
HP 1250-1250 N (m) to SMA (f)
HP 1250-1404 N (f) to SMA (f)
HP 1250-1636 N (m) to SMA (m)
HP 1250-1741 SMA Right Angle, (f) (m)

Adapters Type N, Precision 50 Ω [1]

HP 1250-1472 N (f) to N (f)
HP 1250-1473 N (m) to BNC (m)
HP 1250-1474 N (f) to BNC (f)
HP 1250-1475 N (m) to N (m)
HP 1250-1476 N (m) to BNC (f)
HP 1250-1477 N (f) to BNC (m)

Adapters Type N, Standard 75 Ω [2]

HP 1250-0597 N (m) (50 Ω) to N (f)(75 Ω)
HP 1250-1528 N (m) to N (m)
HP 1250-1529 N (f) to N (f)
HP 1250-1533 N (m) to BNC (m)
HP 1250-1534 N (f) to BNC (m)
HP 1250-1535 N (m) to BNC (f)
HP 1250-1536 N (f) to BNC (f)

Adapters APC-3.5

HP 1250-1743 APC-3.5 (m) to N (m)
HP 1250-1744 APC-3.5 (f) to N (m)
HP 1250-1745 APC-3.5 (f) to N (f)
HP 1250-1746 APC-3.5 (m) to APC-7
HP 1250-1747 APC-3.5 (f) to APC-7
HP 1250-1748 APC-3.5 (m) to APC-3.5 (m)
HP 1250-1749 APC-3.5 (f) to APC-3.5 (f)
HP 1250-1750 APC-3.5 (m) to N (f)

Adapters Subminiature, SMA

HP 1250-1158 SMA (f) to SMA (f)
HP 1250-1249 SMA Right Angle (m) (f)
HP 1250-1397 SMA Right Angle (m) (m)
HP 1250-1462 SMA (m) to SMA (f)
HP 1250-1698 SMA tee (m) (f) (f)
HP E9631A BNC (f) to SMA (m)
HP E9632A BNC (m) to SMA (f)
HP E9633A SMA (m) to BNC (m)
HP E9634A SMA (f) to BNC (m)

Adapters APC-7

HP 11524A APC-7 to N (f)
HP 11525A APC-7 to N (m)
HP 11533A APC-7 to SMA (m)
HP 11534A APC-7 to SMA (f)

Adapters BNC, Standard 50 Ω

HP 1250-0069 BNC (m) to UHF (f)
HP E9620A Right Angle BNC (UG-306/D)
HP E9622A BNC (f) to BNC (f) (UG-914/U)
HP E9624A BNC (m) to BNC (m)
HP 1250-0591 BNC (f) to WECO Video (m)
HP 1250-0595 BNC (f) to BNC Triaxial (m)
HP E9625A BNC tee (m) (f) (f)
HP E9627A BNC (m) to Single Banana Plug
HP 10110B BNC (m) to Dual Banana Plug
HP 1250-1830 BNC (f) to BNC Triaxial (f)
HP E9637A BNC (f) to Dual Banana Plug
HP 1250-1236 BNC (f) to SMB (f)
HP 1250-1200 BNC (f) to SMA (m)
HP 1250-1899 BNC (f) to SMA (m)

Adapters BNC, Standard 75 Ω [3]

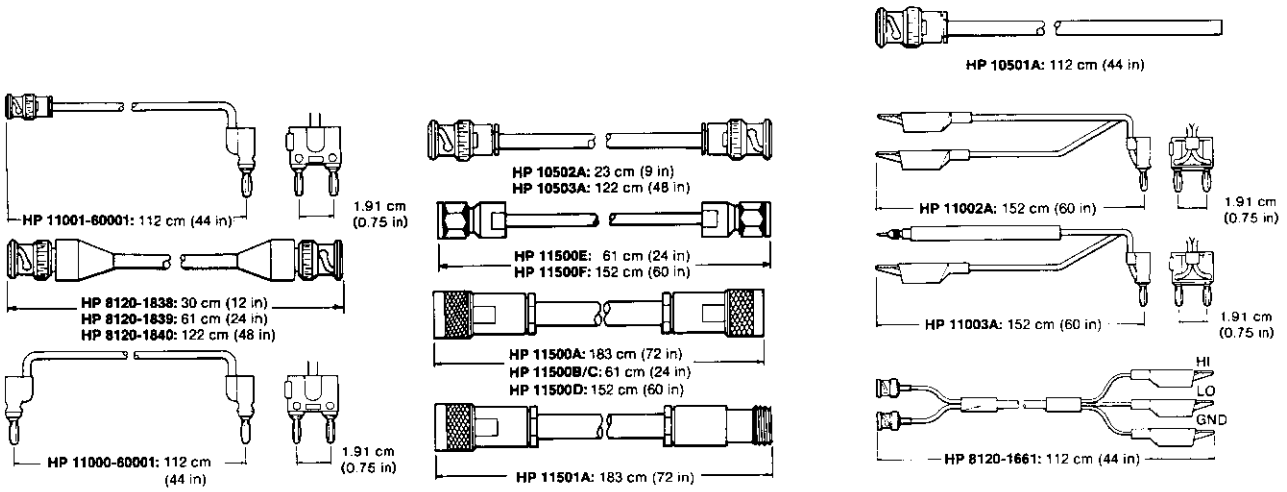
HP 1250-1286 Right Angle BNC (m)(f)
HP E9628A BNC (f) to BNC (f)
HP E9629A BNC (m) to BNC (m)

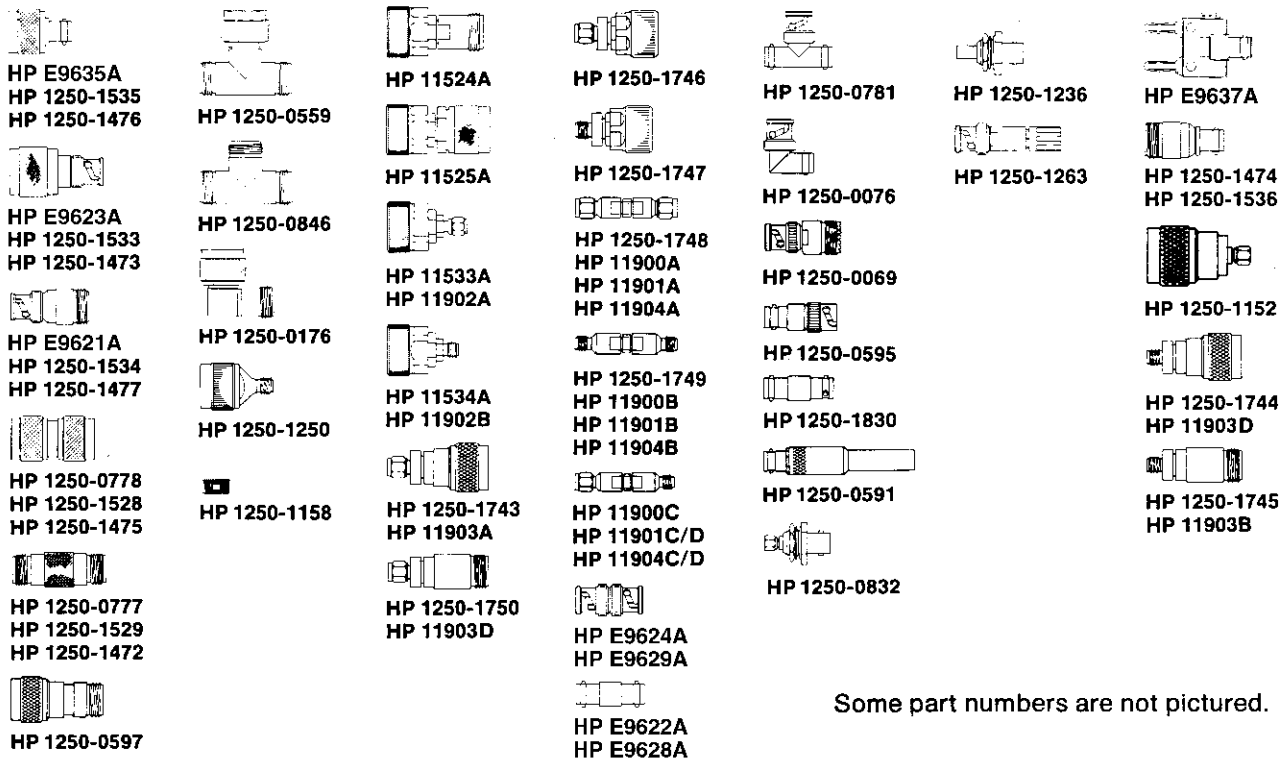
Adapters Subminiature, SMB, SMC [4]

HP 1250-0670 SMC tee (m) (m) (m)
HP 1250-0671 SMB (m) to N (m)
HP 1250-0672 SMB (f) to SMB (f)
HP 1250-0675 SMC (m) to SMA (f)
HP 1250-1023 SMC (m) to N (m)
HP 1250-1236 SMB (f) to BNC (f)
HP 1250-0674 SMB (m) to SMA (f)
HP 1250-0832 SMC (f) to BNC (f)
HP 1250-1391 SMB tee (f) (m) (m)
HP 1250-1857 SMB (f) to BNC (m)
HP 1250-1152 SMC (f) to N (m)
HP E9636A SMC (m) to BNC (f)

[1] "Precision": typically ≥36 dB return loss to 1.3 GHz
[2] Type N outer conductor; center pin sized for 75 Ω characteristic
[3] BNC outer conductor; center pin sized for 75 Ω characteristic
[4] SMB and SMC are used often inside HP instruments for intermodule RF connections. SMB is snap-on configuration; SMC is screw-on configuration.
[5] The K-connector is developed and manufactured by the Wiltron Co., Morgan Hill, California.

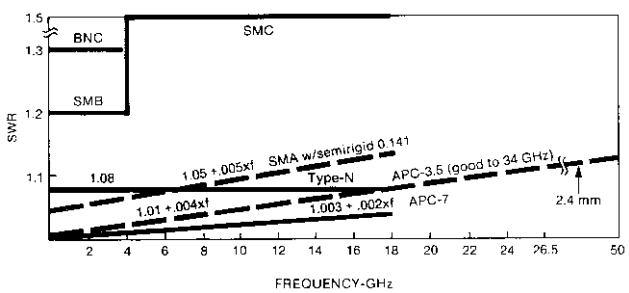
Indicates QuickShip availability.





Some part numbers are not pictured.

Coaxial Connector and Adapter Performance



Typical SWR for connector pairs

The performance curves in the graph will help you in choosing and applying HP cables, connectors, and adapters. SWR curves show design specifications for mated pairs of connectors of the type indicated. You can expect typical performance in that range.

For cross-series adapters, use the curve with the highest SWR in each case. For applications of Tee-adapters such as HP 1250-0559, 1250-0846, and 1250-0781, be sure to consider the extra shunt capacitance of the Tee.

Of course, when HP mounts various connectors onto RF and microwave products, the product specification predominates and SWR is often far superior to that shown in these utility curves. For example, the HP "precision" type-N adapters shown on these pages are for high accuracy use dc to 1.3 GHz where SWR <1.03.

For more information on history and performance of various coax connectors, see HP's *Microwave Test Accessories Catalog* (p/n 5952-2843 (D)).

Typical Series 3000 workstation-style operating case

Typical System II Valise Transit (VT) Case

Tote-style transit case

Operating Cases

Hewlett-Packard operating cases protect instruments and equipment from the hazards of transportation and the rigors of the environment. They offer sturdy protection when instruments are transported and used on-site. Operating cases are compression-molded from a glass fiber reinforced composite material (FRP) that is lighter than aluminum and provides excellent strength and durability. Tests of this molded material show tensile and compressive strength exceeding 33,000 PSI and flexural strength exceeding 46,000 PSI.

Both standard and optional heavy-duty hardware afford excellent protection from damage and the elements. Conveniently placed, surface-mounted, spring-loaded handles fold flat when not in use, or they can be designed to reside in recesses. Front and back covers seal with O-ring gaskets and clamping latches.

Interior Configuration

Operating cases come equipped with shock-mounted aluminum frames that accept any standard 19-inch rack-mounting instrument (EIA-RETMA standard). Most full-size instruments and modular combinations of instruments can be rack mounted in any one of our operating cases. The frame arrangement and the ability to remove the front and back covers allows for convenience of operation without removing the instrument.

Transit Cases

Hewlett-Packard transit cases are sturdy containers for use when instruments must be frequently transported or used away from laboratory or office conditions. HP cases protect your instruments from shock, vibration, moisture, impact, and contamination to provide a secure enclosure for shipping. Transit cases are a necessity whenever equipment is frequently transported from one operating location to another.

Product Detail

Our transit cases are compression-molded from a glass-fiber-reinforced composite material (FRP) that is lighter than aluminum and provides excellent strength and durability. Tests of this molded material show tensile and compressive strength exceeding 33,000 PSI and flexural strength exceeding 46,000 PSI. All cases seal tightly with O-ring gaskets and clamping latches. They are rainproof under the standards of MIL-STD-810. Carrying handles are conveniently placed and are spring-loaded to fold flat when not in use.

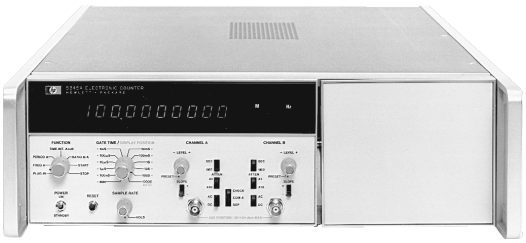
HP cases are usually provided with foam cushions designed to cradle the instrument securely. The cushion inserts are typically molded polyurethane, or are fabricated from slabs of polyurethane or polyethylene flexible foams. Each case/cushion unit is designed as its own shock and vibration damping system, protecting against damage from handling, dropping, or crushing. All transit cases are available in tote style.

How to Order

Standard transit and operating cases can be ordered from HP in the United States by calling 1-800-227-8164, or visit our web site: **www.parts.hp.com**

Operating Cases Specifications

Nominal Rack Height ISO	in	Instrument Weight Maximum kg	lbs	Minimum kg	lbs	Case Height mm	in	HP Part Number
3U	5.25	34	75	9.1	20	280.2	11.03	9211-1302
4U	7.00	34	75	9.1	20	348.7	13.73	9211-6472
5U	8.75	59	130	13.6	30	393.2	15.48	9211-1303
6U	10.50	59	130	13.6	30	438.9	17.28	9211-2635
8U	14.00	59	130	13.6	30	527.8	20.78	9211-1241
9U	15.75	59	130	13.6	30	572.3	22.53	9211-1242
10U	17.50	59	130	13.6	30	616.7	24.28	9211-1243
11U	19.25	59	130	13.6	30	661.2	26.03	9211-1244
12U	21.00	114	250	22.7	50	718.3	28.28	9211-1245
13U	22.75	114	250	22.7	50	762.8	30.03	9211-2636
14U	24.50	114	250	22.7	50	807.2	31.78	9211-1911
16U	28.00	114	250	227	50	896.1	35.28	9211-2638
17U	29.75	114	250	22.7	50	940.6	37.03	9211-2639
19U	33.25	114	250	22.7	50	1029.5	40.53	9211-1713
20U	35.00	145	320	31.8	70	1073.9	42.28	9211-6473
21U	36.75	145	320	31.8	70	1109.0	43.66	9211-6474
22U	38.50	145	320	31.8	70	1162.8	45.78	9211-6475
23U	40.25	145	320	31.8	70	1207.3	47.53	9211-6476
24U	42.00	145	320	31.8	70	1254.8	49.40	9211-6477
25U	43.75	145	320	31.8	70	1296.2	51.03	9211-6478
27U	47.25	145	320	31.8	70	1371.6	54.00	9211-2641



Typical System I full-module instrument

Typical System II full-module instrument

System I Cabinet Style Transit Cases Specifications

Full-Module Width Instruments
Instrument Width — 425.5 mm 16.75 in

Instrument Depth — 285.8 mm 11.25 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
88.9	3.50	9211-1288	9211-7800
133.4	5.25	9211-1289	9211-7527
177.8	7.00	9211-1290	9211-7528
222.3	8.75	9211-1291	9211-7501

Instrument Depth — 412.8 mm 16.25 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
133.4	5.25	9211-0839	9211-7502
177.8	7.00	9211-1293	9211-7503
222.3	8.75	9211-1294	9211-7504
311.2	12.25	9211-1313	9211-7505

Instrument Depth — 489.0 mm 19.25 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
133.4	5.25	9211-1296	9211-7507
177.8	7.00	9211-1735	9211-7508

Instrument Depth — 565.2 mm 22.25 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
311.2	12.25	9211-1297	9211-7509

Three-Quarters Module Width Instruments
Instrument Width — 3429 mm 13.5 in

Instrument Depth — 500.0 mm 19.7 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
88.9	3.5	83236-60001	9211-7530
190.5	7.5	08920-90141	9211-7529

Half-Module Width Instruments
Instrument Width — 300.4 mm 19.7 in

Instrument Depth — 279.4 mm 11.00 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
165.1	6.5	9211-1315	9211-7511

Instrument Depth — 406.4 mm 16.00 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
165.1	6.5	9211-1734	9211-7512

One-Third Module Width Instruments
Instrument Width — 130.2 mm 5.125 in

Instrument Depth — 279.4 mm 11.00 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
165.1	6.5	9211-1318	9211-7506

System II Cabinet Style Transit Cases Specifications

Full-Module Width Instruments
Instrument Width - 425.5 mm 16.75 in

Instrument Depth - 387.4 mm 15.25 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
88.9	3.50	9211-2642	9211-7514
133.4	5.25	9211-2643	9211-7515
177.8	7.00	9211-2644	9211-7516
222.3	8.75	9211-2645	9211-7517
311.2	12.25	9211-2647	9211-7518

Instrument Depth — 463.6 mm 18.25 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
88.9	3.50	9211-2648	9211-7519
133.4	5.25	9211-2649	9211-7520
177.8	7.00	9211-2650	9211-7521
222.3	8.75	9211-2651	9211-7522
266.7	10.50	9211-2652	9211-7523
311.2	12.25	9211-2653	9211-7478

Instrument Depth — 546.1 mm 21.50 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
88.9	3.50	9211-2654	9211-7479
133.4	5.25	9211-2655	9211-7480
177.8	7.00	9211-2656	9211-7481
222.3	8.75	9211-2657	9211-7482
266.7	10.50	9211-2658	9211-7483
311.2	12.25	9211-2659	9211-7484

Instrument Depth — 622.3 mm 24.50 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
88.9	3.50	9211-2660	9211-7485
133.4	5.25	9211-2661	9211-7486
177.8	7.00	9211-2662	9211-7487
222.3	8.75	9211-2663	9211-7488
266.7	10.50	9211-2664	9211-7489
311.2	12.25	9211-2665	9211-7490

Half-Module Width Instruments
Instrument Width — 215.9 mm 8.50 in

Instrument Depth — 247.7 mm 9.75 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
88.9	3.50	9211-2666	9211-7491
222.3	8.75	9211-2669	9211-7492

Instrument Depth — 323.9 mm 12.75 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
88.9	3.50	9211-2671	9211-7493
133.4	5.25	9211-2672	9211-7494
177.8	7.00	9211-2673	9211-7495
266.7	10.50	9211-2675	9211-7497

Instrument Depth — 400.1 mm 15.75 in

Inst. Height mm	in	Standard HP p/n	Tote-Style HP p/n
88.9	3.50	9211-2676	9211-7498
133.4	5.25	9211-2677	9211-7499
177.8	7.00	9211-2678	9211-7496

Communicating with HP

Product information

Your entry point to the resources of HP is through the HP Call Center at 1-800-452-4844 (for Call Center numbers outside the U.S., see pages 607-608). Our sales representatives and order support specialists are well-equipped to provide you with pre-sale assistance in product selection, as well as related business information such as current product availability and price delivered to your location.

Most HP Call Centers are tied into a sophisticated intra-company communications system. This not only means prompt transmission of orders to any HP product responsible division, it also speeds the flow of regular messages among HP sales offices and factories.

Electronic Data Interchange

HP has established Electronic Data Interchange (EDI) links with many customers to allow more timely information regarding products and orders as well as provide a more efficient flow of purchase orders and invoices.

HP Web Site

Be sure to visit the T & M Area of the Web site for comprehensive technical, application, support, training and sales contact information: **www.hp.com/go/tmc00**

Pricing and Quotations

Prices in this catalog (if any) are U.S. list prices at the time of approval for printing. HP reserves the right to change prices. The prices for an order are determined by the prices prevailing at the time the order is received. Therefore, any prices in this catalog are intended only as budgetary information. To obtain destination prices, formal quotations, pro forma invoices, or other information you need before ordering, contact the Hewlett-Packard Call Center in your region.

Inside the USA:

Call the Test & Measurement Customer Business Center, 1-800-829-4444, or write, P.O. Box 4026, Englewood, CO 80155-4026.

Outside the USA:

Request for quotations outside the USA should be placed with a HP Call Center or distributorship in the country of end use, see pages 607-608.

Placing Your Order

Because many products or configurations are changed or improved during the year, we suggest that you always contact your nearby HP sales office for current product and pricing information prior to placing your order.

HP wants to be sure the product delivered to you is exactly the one you want. Therefore, when placing your order, please specify the product model, accessory, or part number, as well as the product name. Be as complete as possible in specifying exactly what you want, including standard options.

If you want special features or capabilities, such as different color or a non-standard voltage, ask your local HP Call Center representative about availability and cost first. Then include special instructions and specification details with your order.

Terms of Sale

Inside the USA:

Hewlett-Packard's standard terms for established customers in the USA are net 30 days from invoice date. Other terms are contained in the customer's purchase agreement.

Leasing, rental and extended financing are available. However, the financing costs are not included in any product prices in this catalog. Contact your local Call Center to find out which finance options are available in your area.

Outside the USA:

Please contact your nearest Hewlett-Packard Call Center or an authorized HP subsidiary or distributor regarding terms for orders placed with them.

U.S. Government Sales

For U.S. government sales, contact the HP U.S. Government Business Center at 1-800-468-8347. Many products in this catalog are covered on GSA federal supply schedule multi-award contracts. GSA is the General Services Administration; the HP office can supply GSA contract numbers for government purchasing officers.

Product Changes

Although product information and illustrations in this catalog were current at the time it was approved for printing, HP, in a continuing effort to offer excellent products at a fair value, reserves the right to change specifications, designs, and models without notice.

Shipping

Inside the USA:

All prices include HP standard transportation and routing to any U.S. destination. If a different shipping method is needed, we will gladly ship to satisfy your requirements. Custom shipments are typically sent freight collect.

Outside the USA:

Shipments to destinations outside the USA are made by either surface or air, as requested. Contact your HP sales office for details.

Operating Environments

Hewlett-Packard provides solutions to customer needs through products that must operate in the numerous environments. To address these needs, all new hardware designs are tested and evaluated to internal HP standards on operating environments before manufacturing release. These internal HP standards are derived from HP's experience with existing environments at customer installations and from other well-known standards, such as IEC, ISO, ANSI, and MILITARY standards. These codes are not used for evaluating production units. The classification codes, used to identify expected environments where HP products or systems may be used, are as follows:

A1– Rugged Environment
A2– Outdoor Environment (Portable)
B1– Portable General-Purpose Environment
B2– General-Purpose Environment
C1– Controlled Office Environment
C2– Controlled Computer Room Environment

The classes range from the severe environments found in heavy industrial areas unsuitable for operating personnel (Class A1) to the controlled environments found in dedicated computer rooms (Class C2). Most HP hardware products are designed to meet Class B2, applying parameters commonly found in general-purpose applications of light industrial and commercial facilities.

If you are considering a specific product, ask your HP sales representative what code is applicable to the product it was designed to (A1, A2, B1, B2, C1, C2) and the limits it met for the environmental parameter of concern.

Warranty

As an expression of confidence that our products will continue to meet the high standards of reliability and performance that our customers expect, Hewlett-Packard products carry the following limited warranty:

HP products are warranted against defects in materials and workmanship. If HP receives notice of such defects during the warranty period, HP shall, at its option, either repair or replace hardware products which prove to be defective.

For more information on Agilent Technologies Test & Measurement products, applications or services, please call your local Agilent sales offices listed below. A current listing is also available:
http://www.tmo.hp.com/go/contacts00

Area Sales Offices *arranged alphabetically by region.*

Americas

Canada

Product Selection & Support
Tel: 877 894-4414

Product Purchase
Tel: 800 276-8661
Fax: 800 746-4866

Instrument Repair & Calibration
Tel: 888 447-7378
Contract Options
Tel: 800 276-8661

Training
Tel: 800 561-3276
Fax: 800 746-4866

Local Office(s)

Alberta
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Venezuela

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Equipment Service
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1995 ATM/Broadband Testing Seminar Handbook
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4 Steps for Making Better Power Measurements
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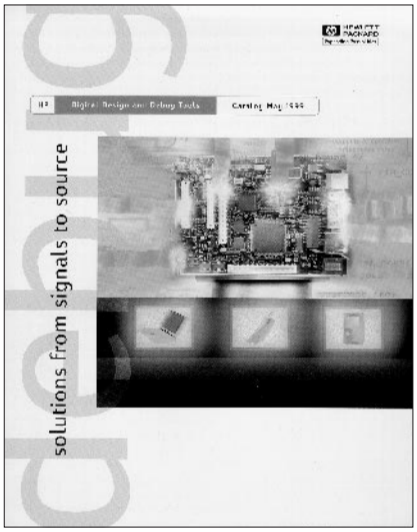

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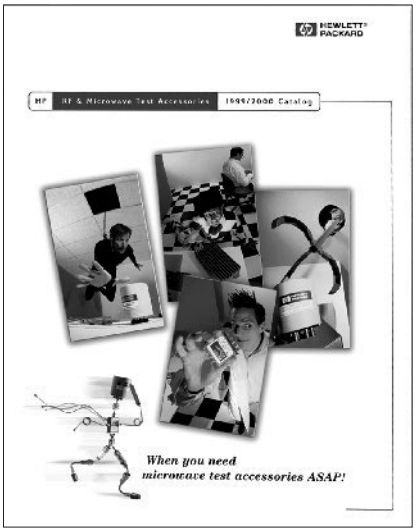
This catalog contains product information, specifications and pricing for HP's logic analysis and emulation solutions, mixed-signal and high performance oscilloscopes, data generator, PCI exerciser and pulse generators.

Digital designers may subscribe to the catalog to ensure that they are kept up-to-date on the latest digital debug solutions available from HP.

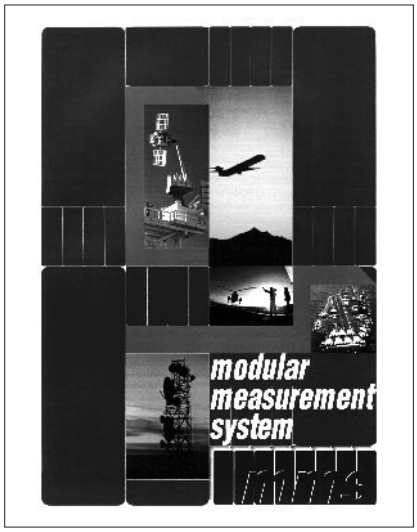


RF and Microwave Test Accessories Catalog 1999/2000
5968-4314EN

This catalog contains general purpose RF and microwave accessories for test and measurement applications. Products featured in this catalog include amplifiers, attenuators, couplers, detectors, network analyzer accessories and cal kits, sensors, switches, waveguide, and a variety of other products.

Large sections are prefaced with an applications discussion, key specification description, and product family overview. Detailed specifications, drawings, indexes, and photographs are provided for a wide array of accessories.

View the online version of the RF and Microwave Test Accessories Catalog or order a printed copy of the catalog from our web site: **http://www.hp.com/go/mtacatalog.**



Modular Measurement System: HP 70000 Family and Others
5965-2818E

This 180-page Modular Measurement System (MMS) catalog contains product information on all MMS products available from HP and other third-party vendors. Catalog highlights include an MMS over-view, configuration examples, and 100 pages of instrument information (often including specifications and ordering information). Featured are the MMS high performance spectrum analyzers including the HP 71910A/P Wide Bandwidth Receiver.

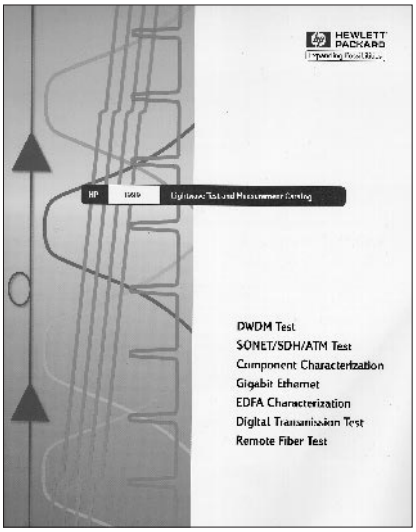
System building blocks, including mainframes, displays, tracking generators, and an external mixer interface module show you how to configure an instrument or system for unique applications using off-the-shelf modules. The catalog also includes a comprehensive discussion of service and support, with a listing of documentation available through HP Call Centers.

To order any specialty catalog or directory, complete and return the business reply card at the end of this catalog.

1999 Test System and VXI Products Catalog
5968-3698EN

The new HP Test System and VXI Products catalog covers HP's extensive line of VXI products for modular, scalable, upgradable test systems. Learn more about the latest mainframes, controllers, interfaces, power supplies, development software, and much more. A product overview helps you quickly spot products and services of interest.

The HP web site (**www.hp.com/go/vxi**) is a valuable companion resource to the VXI catalog. It contains the full details of HP VXI products as well as instrument driver software, technical articles, case studies, news items, and support information.



Lightwave Test and Measurement Catalog 1999
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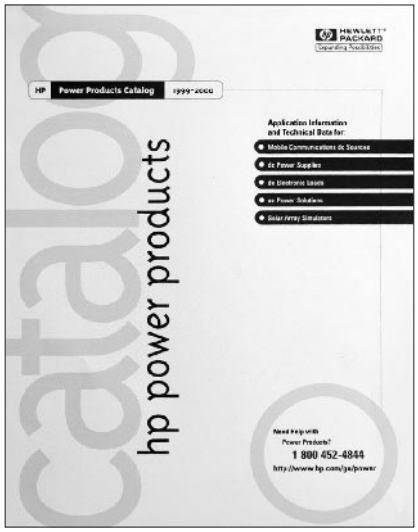
This catalog offers a new products section, which covers benchtop and portable optical spectrum analyzers, tunable lasers, multi-wavelength meter, communications performance analyzers, service advisor portable test tablet, lightwave switches, clock recovery modules, AccessFiber, photonic system designer, BenchLink lightwave software, test solution manufacturing services and Lightwave and High-Speed Digital Design Test Classes.

Chapters cover power, spectral, polarization, and return loss measurement techniques. A variety of analyzers are described, including: lightwave signal, lightwave component, time-domain, error performance, and SONET/SDH generators and analyzers. Optical accessories are also discussed.

Reference literature is provided along with tutorials on measurement applications.



1999/2000 HP Power Products Catalog
5968-2199E

HP's entire line of power supplies, electronic loads, modular power systems, ac power sources and solar array simulators are featured in this catalog. New products, such as the HP 66111A, 66309B/D, and 66311B/D mobile communications dc sources are included. Product selection and feature tables, complete product specifications, dimension drawings and application information help you make the right choice of power products for your applications.

This year's catalog is viewable and can be downloaded from our web site: **http://www.hp.com/go/power.**

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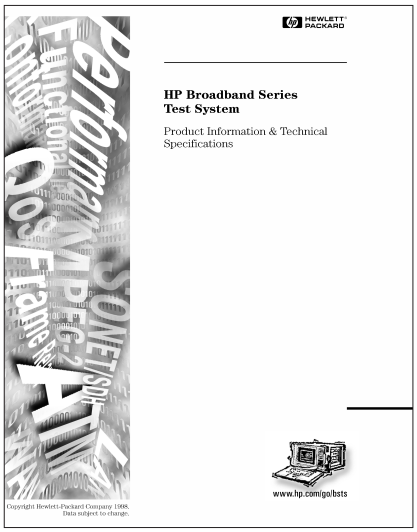
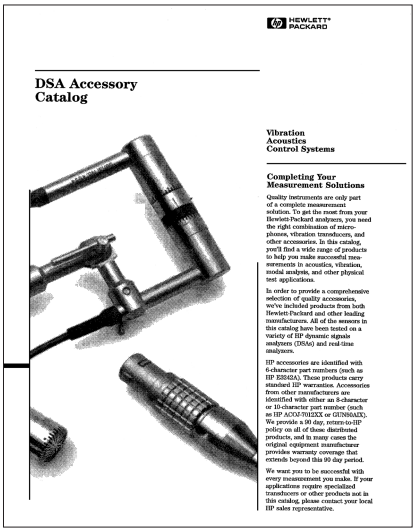


HP Broadband Series Test System Product Information & Technical Specifications
5966-0035E

This catalog clearly shows the full depth and breadth of the HP Broadband Series Test System, the industry-standard ATM/IP test system for R&D engineering, product development, field trials and QA testing. The HP BSTS is a modular system designed so that you can expand your system as your testing needs evolve.

Included in the catalog are the technical specifications and product information for each BSTS hardware and software module, as well as the Broadband Communications Map, product listings and an index of available related literature such as application and solution notes.



DSA Accessory Catalog
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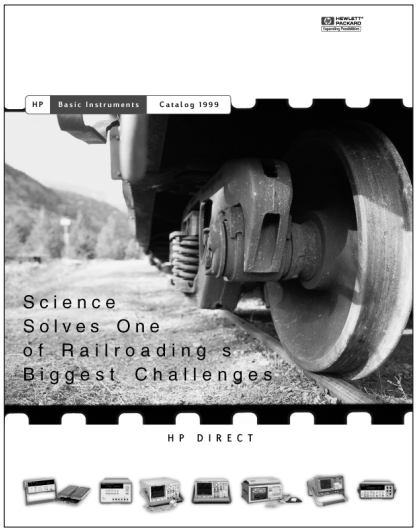
A wide variety of laboratory-quality sensors and supplies (from Hewlett-Packard and other leading manufacturers) that complement dynamic signal analyzers (DSAs) are presented in this 20-page catalog. These accessories empower you to perform accurate and successful measurements in acoustic, vibration, modal analysis, and other physical test applications.

Free field and pressure microphones, as well as microphone power supplies, preamplifiers, calibrators, adapters, and a microphone storage case are described. A new Sound Intensity Probe has been added which meets IEC 1043 Class 1 specifications.

Vibration transducers and several types of accelerometers, as well as an assortment of cables, are highlighted.



HP Basic Instruments Catalog
5968-6064EN

The HP Basic Instruments Catalog showcases HP's family of low-cost benchtop instruments. Whatever your needs for general-purpose instrumentation, it's all here:

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- Power Meters
- Logic Analyzers
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This one-stop shopping guide features key instrument specifications and photos, up-to-date ordering and pricing information—even application stories. Use the reply card at the back of this catalog to sign up for your free subscription.

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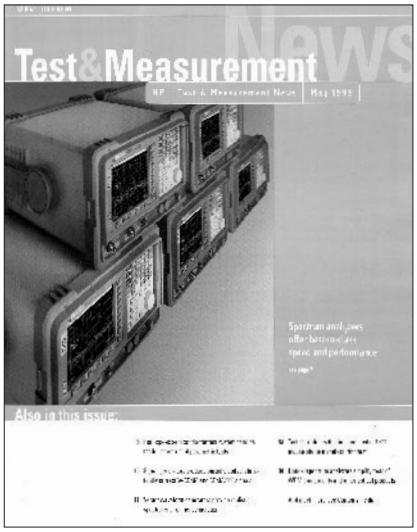

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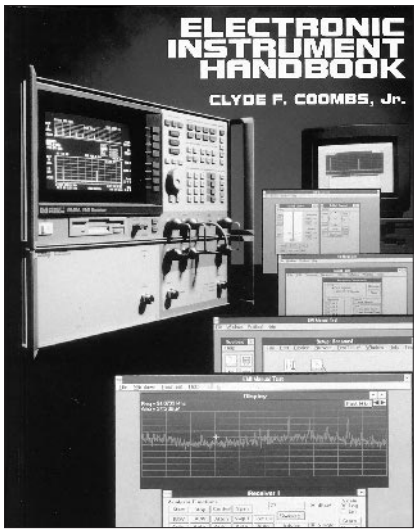


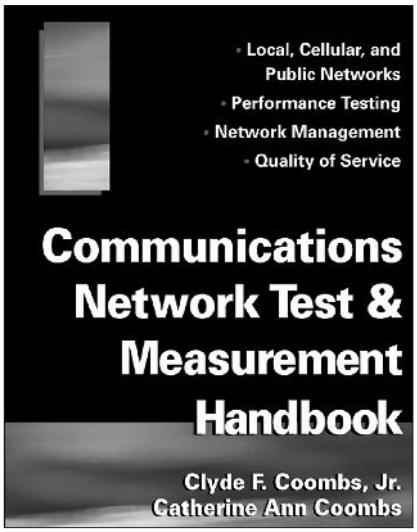
The Electronic Instrument Handbook, Third Edition
by Clyde F. Coombs, Jr.
1200 pages, Hardcover
ISBN 0-07-012616-X,
Suggested retail $125.00

Electronic Instruments—Demystified
Heavily revised, this edition includes information on how software, computer, and network technologies combine with traditional hardware to create new capabilities for electronic instruments. This is a one-volume source of information on all aspects of electronic instruments, from basic devices to distributed systems and virtual instruments.

As electronic instruments have become more capable they have become more complex. This book demystifies them. It is the only book that provides descriptions of the technology and functions of instruments and instrument systems: what they are, how they work, how to chose the right one and how to get the most from them.

It includes information on the underlying technologies of instruments such as A to D converters, microprocessors, software and languages, digital signal processors, transducers, smart transducers, lightwave, VXI, data acquisition systems, virtual instruments, and networks, including the Internet. Also included are descriptions of the common issues associated with connecting instruments.

This is a must reference for both the beginner and the experienced professional.



Communications Network Test & Measurement Handbook
by Clyde F. Coombs, Jr.
826 pages, Hardcover
ISBN 0070126178,
Suggested retail $89.50

This is a handbook on the measurements and tools required in all phases of the life cycle of a "Communications Network." It provides a comprehensive single volume reference on the technologies of communications networks and the test, measurement, and monitoring instrumentation needed to ensure effective performance and quality of service. Starting with a discussion of the Open Systems Interface (OSI) model, it describes protocols, transmission errors, and physical connection.

It also includes background information on the technologies, applications and purposes of communications networks so that the information on test and measurement instruments and processes is clear, and in context. The chapters on instrumentation describe what they are, how they work and how to get the most from them. In addition, there are descriptions on how to develop the tests that ensure that the network meets local specifications, as well as conforms to international standards.

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