About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual is the best copy we could find; it may be incomplete or contain dated information. If we find a more recent copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available. You will find any other available product information on the Agilent Test & Measurement website, www.tm.agilent.com.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. In other documentation, to reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product number/name was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

Installation and Verification Manual

HP 70301A

Tracking Generator

HEWLETT PACKARD

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Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Hewlett-Packard. Buyer shall prepay shipping charges to Hewlett-Packard and Hewlett-Packard shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Hewlett-Packard from another country.

Hewlett-Packard warrants that its software and firmware designated by Hewlett-Packard for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error-free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Assistance

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

CAUTION   The *CAUTION* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the product or the user's work. Do not proceed beyond a *CAUTION* sign until the indicated conditions are fully understood and met.

WARNING   The *WARNING* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury to the user. Do not proceed beyond a *WARNING* sign until the indicated conditions are fully understood and met.

DANGER   The *DANGER* sign denotes an imminent hazard to people. It warns the reader of a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a *DANGER* sign until the indicated conditions are fully understood and met.

General Safety Considerations

WARNING

■ The instructions in this document are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

■ The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

■ The power cord is connected to internal capacitors that may remain live for five seconds after disconnecting the plug from its power supply.

■ This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

■ For continued protection against fire hazard, replace fuse only with same type and ratings, (type nA/nV). The use of other fuses or materials is prohibited.

WARNING

■ Before this instrument is switched on, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact.

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

■ Before this instrument is switched on, make sure its primary power circuitry has been adapted to the voltage of the ac power source.

Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

Contents

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General Information

Introduction

This *HP 70301A Tracking Generator Installation and Verification Manual* tells how to install the HP 70301A in an HP 70000 Modular Measurement System. Related information about the system itself can be found in the local oscillator installation and verification manual.

Organization

Chapter 1, "General Information," describes module features and accessories.

Chapter 2, "Installation," provides steps for configuring and installing the module in an HP 70000 Modular Measurement System.

Chapter 3, "Specifications," lists system specifications for modular measurement systems that include the HP 70301A.

Chapter 4, "Verification," describes module performance-verification tests that are on Disk 3 provided with this manual.

Chapter 5, "Troubleshooting," describes LED indicators, software tools, and error codes generated by the HP 70301A.

Chapter 1 Topics

- A brief description of the HP 70301A.
- Mechanical features of the HP 70301A.
- Local oscillator firmware compatibility.
- Available options.
- Initial inspection.
- Packaging the module for shipping.
- Preventing damage by ESD (electrostatic discharge).

Safety

Before operating this instrument, read any safety markings on the instrument and the safety instructions in the manuals.

The factory manufactures and tests the HP 70301A to international safety standards. However, to ensure personal safety and to prevent instrument damage, the user must read and heed all cautions and warnings.

Refer to the summary of safety information in the front of this manual.

Description of the HP 70301A Tracking Generator

The HP 70301A microwave tracking generator module is a 3/8-width component of the HP 70000 Modular Measurement System. The HP 70301A operates as a slave to the HP 70900A/B Local Oscillator. When configured in a spectrum analyzer system, the HP 70301A provides a tracking output from 2.7 GHz to 18 GHz. It can operate in conjunction with an HP 70300A RF tracking generator to provide, from one output port, tracking-output coverage from 10 MHz to 18 GHz. A 55 dB attenuator in conjunction with the level vernier provide RF-output-level control from 0 to −66 dBm.

High-performance stimulus-response measurements are possible because of features such as exceptional dynamic range and stability, open/short averaging, and through (thru) calibration.

Notation Conventions in this Manual

The display features fourteen **softkeys** (special function keys)—seven at the the left edge of the display and seven at the right. A softkey executes a function defined by firmware or by software. The name of the function appears on the display next to the activating key.

This manual uses the following conventions:

(HARDKEY) An uppercase key-name in a keycap symbol represents a key physically located on the instrument. This key is referred to as either a **key** or a **hardkey**.

`Firmkey` A screen-font word with an uppercase first letter indicates a top-level softkey, referred to as a **firmkey**. A firmkey accesses a related sub-menu of softkeys. For example, pressing (MENU) causes firmkey labels to appear on the left side of the display and related softkey labels to appear on the right.

`softkey` A screen-font word with all lowercase letters indicates a softkey key that accesses a subset menu of softkeys.

`SOFTKEY` A screen-font word with all uppercase letters indicates a softkey that directly executes its function.

`CRT Text` Unboxed text in a monospace font indicates any text other than softkeys that appears on a CRT.

Modules Covered by This Manual

Serial Numbers

A two-part serial number appears on the Mylar label attached to the front frame of the module. The first four digits are the serial number prefix; the last five digits, the suffix. The letter designates country of the manufacturer. (See Figure 1-1.) Identical modules have the same prefix, which changes only with significant modification to the module. The suffix is different for each module. The contents of this manual apply to modules with the serial number prefix(es) listed under Serial Numbers on the title page.

Figure 1-1. Typical Serial Number Label

Manual Updating Supplement

A module manufactured after the printing of this manual may have a serial number prefix not listed on the title page, thus indicating a significant modification to the module. If so, the inclusion of a Manual Updating Supplement means the user should use supplement information to adapt this manual to the modified module. If there is no supplement, the manual requires no change.

Any supplement information that corrects errors in the manual may apply to new or existing manuals or both. You should periodically contact a Hewlett-Packard office for the latest Manual Updating Supplement. The front cover of the supplement provides applicable model number, manual print date, and manual part number. For office locations, see Table 1-4 at the end of this chapter.

Front Panel and Rear Panel Features

Figure 1-2 illustrates front- and rear-panel features.

Front-Panel Features

ERR

If the error LED lights at any time other than during self-test, there is a problem with the HP 70301A or with a system component. Chapter 5 provides LED troubleshooting suggestions.

ACT

The active LED indicates normal HP 70301A activity, not an error condition. It lights when the module is making a measurement and the master has keyboard control of the display. On a slave module, the ACT LED is only operative when there is a display in the system and the instrument is performing a measurement.

RF

The RF LED indicates that the HP 70301A Tracking Generator RF OUTPUT power is on. That is, the LED is lit when the SRC PWR ON/OFF softkey is ON.

UNLEVELED

The UNLEVELED LED indicates that the RF OUTPUT power is unleveled during the time the LED is lit. Any of the following can cause unleveled power:

- Source power (SRC PWR) is set too high.
- The EXT detector (ALC EXT) is selected with no external detector connected to the front panel EXT ALC INPUT.
- RF chain malfunctions causing low output power.

10 MHz-2.9 GHz IN

The signal applied to this SMA (f) connector is from the HP 70300A RF tracking generator. The signal is routed to the HP 70301A RF OUTPUT during low-band operation.

EXT ALC INPUT

The signal applied to this BNC (f) connector is the external leveling signal when an external detector is providing automatic level control.

RF OUTPUT

The signal available at this Type N (f) connector is the HP 70301A RF output.

Module Latch

The module latch secures the module in a mainframe. An 8 mm hex-ball driver (shipped with the mainframe) fits the module hex-nut latch. Chapter 2 provides instructions for installation and removal of a module.

Rear-Panel Features

3.6-6.6 GHz LO IN

The signal applied to this SMA (f) connector is the local oscillator signal, which comes from the RF section LO OUT. The signal passes through an isolator and a leveling amplifier to the mixer in the YTO phase-lock loop circuit.

3.6-6.6 GHz LO OUT

The signal available at this SMA (f) connector is the LO IN signal after it has passed through a leveling amplifier.

300 MHz IN

The signal applied to this SMB (m) connector is the 300 MHz reference from the local oscillator module.

300 MHz OUT

The signal available at this SMB (m) connector is the 300 MHz IN signal made available for daisy-chaining of the 300 MHz signal to another module such as an RF tracking generator.

21.4 MHz IN

The signal applied to this SMB (m) connector comes from either the modules 21.4 MHZ OUT connector or from an external signal generator.

21.4 MHz OUT

The signal available at this SMB (m) connector comes from an oscillator internal to the HP 70301A. The signal is normally cabled to the 21.4 MHz IN connector.

TUNE SPAN IN

The voltage applied to this SMB (m) connector normally comes from the local oscillator TUNE SPAN connector. The tune span voltage pretunes he YTO and drives the dynamic leveling of the HP 70301A output signal.

Mainframe/Module Interconnect

This 50-pin connector accesses the HP-MSIB communication bus and provides mainframe 40 kHz power for the module's power supply.
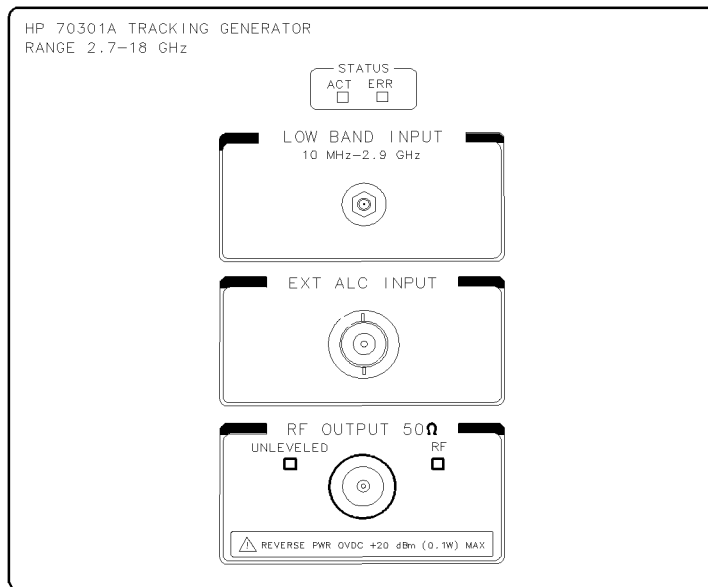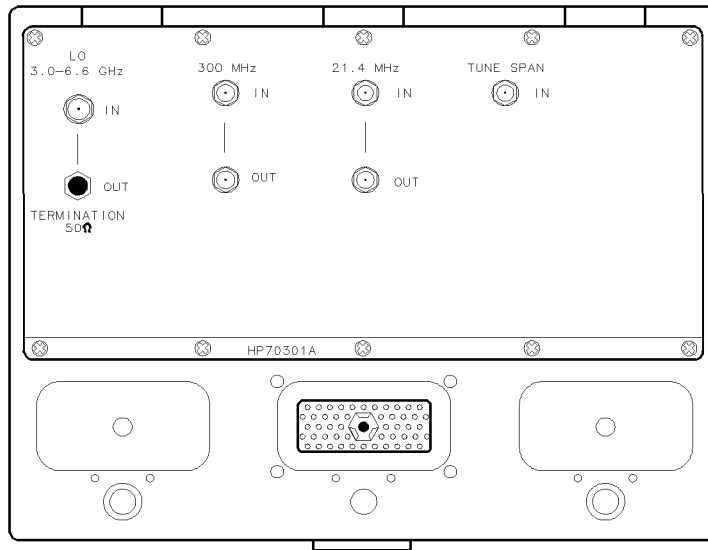
Figure 1-2. Front-Panel and Rear-Panel Features

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HP 70900 Local Oscillator Firmware

Optimal performance requires compatibility between the HP 70301A Tracking Generator and system master firmware. The HP 70301A will work with HP 70900A LO ROM versions 880901 or later. The following key sequence displays the 70900 firmware version: (MENU), `Misc`, `more`, `service`, `ROM VERSION`. The version date appears in the display's general annotation block.

Options and Accessories

Options

W30 Option	adds two years additional return to Hewlett-Packard warranty.
Option 001	Deletes 55 dB step attenuator.
Option 910	Extra copy of this manual and the *HP 70300A/70301A Operation Manual*.
Option 915	Service manual with verification software.
Option 098 or Option 099	System LO Firmware Upgrade. Contact the Marketing Department at Hewlett-Packard Signal Analysis Division, Rohnert Park, California. Order Option 098 if the current LO firmware date-code is 860203 or earlier; Option 099 if date-code is 861015 through 880314.

Accessories Provided with the HP 70301A

The HP 70301A Tracking Generator is available separately or as a component in a preconfigured system. When ordered separately, the accessories supplied allow the most common system configurations. Table 1-1 lists accessories being shipped with the HP 70301A at publication of this manual. Contact a Hewlett-Packard Sales and Service Office for a description of all accessories currently shipped with the HP 70301A. The factory ships preconfigured system with all cables in place.

Table 1-1. Accessories Shipped with the HP 70301A

Description	Qty	CD	Part Number
Cable, Semi-rigid, Type N (m) to SMA (m)	1	3	5021-9319
Cable, Flexible, SMB (f) to SMB (f)	1	4	5061-9019
Cable, Flexible, SMB (f) to SMB (f)	1	7	5061-9020
Cable, Flexible, LO I/O, SMA (m) to SMA (m)	1	7	5061-9038
Connector Adapter, SMB tee (m, m, f)	1	6	1250-1391

Service Kit

The HP 70000 System Service Kit is the general service kit for HP 70000 Series modules. This kit includes servicing tools required to repair all HP 70000 Series modules and also a modification procedure for the HP 70001A Mainframe. The modification allows access to HP 70000 Series modules during bench testing and repair.

Initial Inspection

If there is damage to the shipping container or cushioning material, inspect the contents for mechanical damage, then verify electrical operation. If these precautions reveal damage or defect, save the packing materials, file a claim with the carrier, then contact the nearest Hewlett-Packard Sales and Service Office for immediate repair or replacement.

Any future shipment of the instrument requires the original packing materials or their equivalents. For detailed packing and shipping details, refer to "Returning Instruments for Service" in this chapter.

Returning Instruments for Service

Repackaging of a module or the mainframe requires original shipping containers and materials or their equivalents. Hewlett-Packard offices can provide packaging materials identical to the original (refer to Table 1-4).

Figure 1-3 and Figure 1-4 show the packaging materials. When ordering packaging materials to ship a module, it is necessary to order the proper number of foam inserts. A 3/8-width module (for example, an HP 70301A Tracking Generator) requires no foam inserts, a 2/8-width module (for example, an HP 70900A Local Oscillator) requires one, and a 1/8-width module requires two.

Caution   Packaging materials not specified can result in instrument damage. Never use styrene pellets to package electronic instruments. The pellets do not adequately cushion the instrument, do not prevent all instrument movement, and can generate static electricity.

Use the following procedure to prepare the instrument for shipment:

1. Fill out a blue repair card (located at the end of this manual) and attach it to the instrument. Send a copy of any noted error messages or other helpful performance data. If a blue repair card is *not* available, include at least the following information:

   a. Type of service required.
   b. Description of the problem and whether it is constant or intermittent.
   c. Name and telephone number of technical contact person.
   d. Return address.
   e. Model number of returned instrument.
   f. Full serial number of returned instrument.
   g. List of any accessories returned with instrument.

2. To help prevent damage during transit, pack the instrument in the appropriate packaging materials as shown in Figure 1-3 and Figure 1-4. Original shipping materials or equivalents are best; however, the following instructions result in acceptable packaging.

   a. Wrap the instrument in anti-static plastic to reduce the possibility of electrostatic discharge (ESD) damage.
   b. For instruments that weigh less than 54 kg (120 lb), use a double-walled, corrugated cardboard carton of 159 kg (350 lb) test strength. The carton must be both large enough and strong enough to accommodate the instrument. Allow at least three to four inches on all sides of the instrument for packing material.
   c. Surround the equipment with three to four inches of packing material to protect the instrument and to prevent movement in the carton. If packing foam is not available, the best alternative is S.D.-240 Air Cap from Sealed Air Corporation, Commerce, California 90001. Air Cap is plastic sheeting filled with 1-1/4 inch air bubbles. Wrapping the instrument several times in the pink, antistatic Air Cap should provide sufficient protection and also prevent movement in the carton.

3. Seal the carton with strong nylon adhesive tape. Mark the carton FRAGILE, HANDLE WITH CARE. Retain copies of all shipping papers.
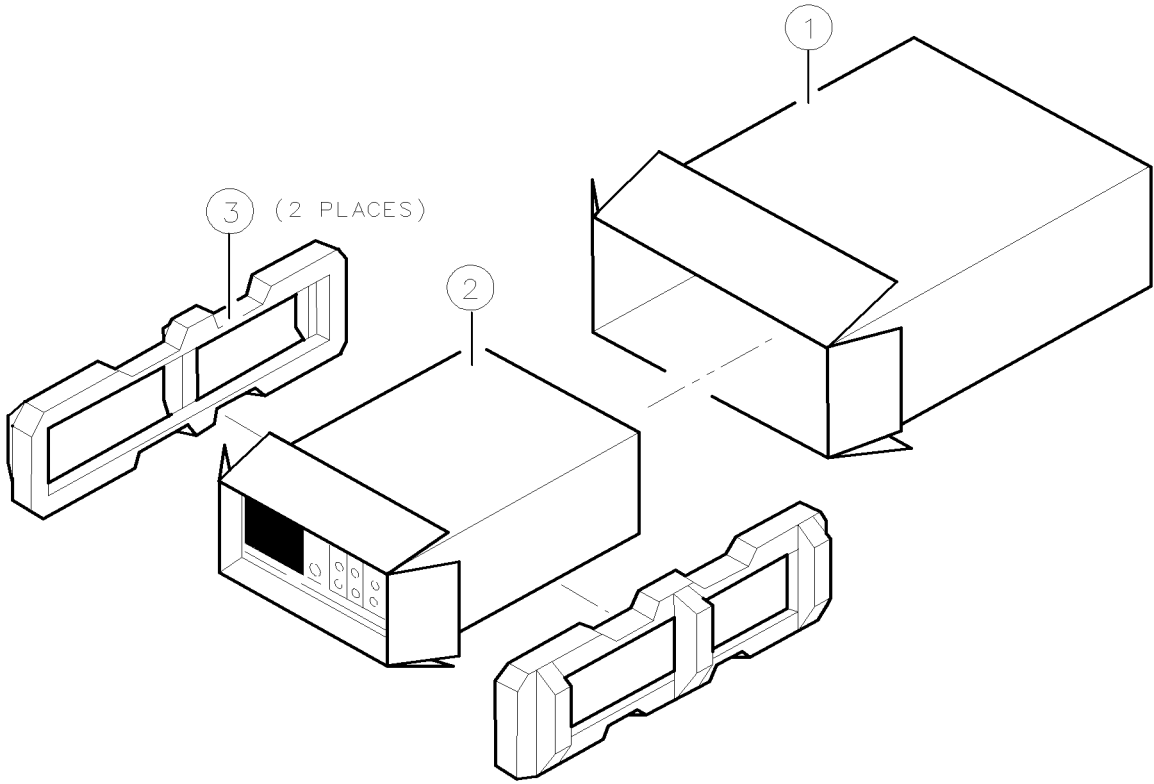
ITEM	QTY	HP PART NO.	DESCRIPTION
1	1	9211–4487	CARTON—OUTER
2	1	5180–2321	CARTON—INNER
3	2	5180–2319 OR 5180–7829	FOAM PADS (HP 70001A) FOAM PADS (HP 70206A)

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Figure 1-3. Packaging Materials for HP 70001A Mainframe
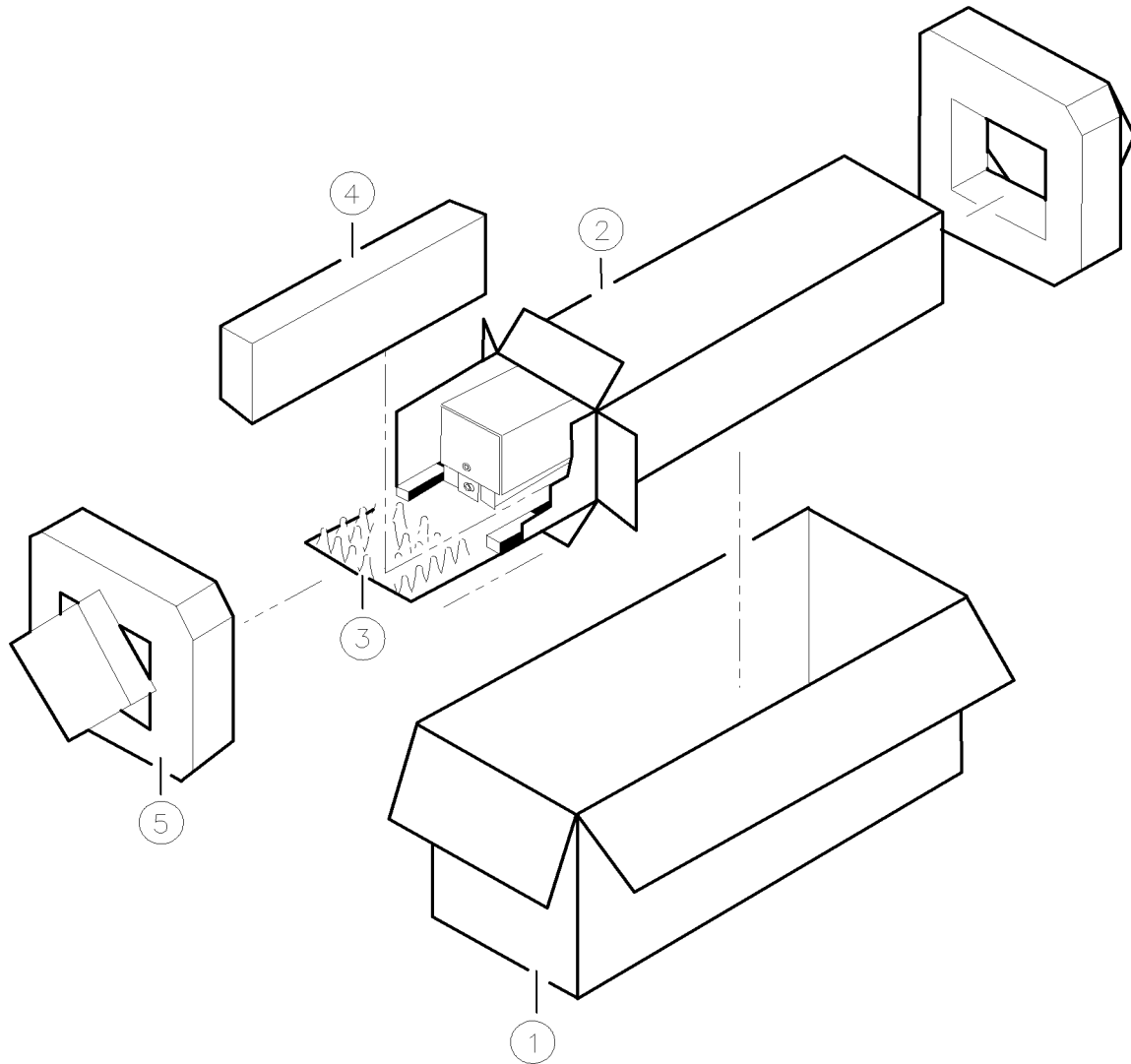
ITEM	QTY	HP PART NO.	DESCRIPTION
1	1	9211-5118	CARTON-OUTER
2	1	9211-5119	CARTON-INNER
3	1	5180-2369	CARTON-SLIDER
4	0	4208-0493	FOAM INSERT
5	2	5180-2370	FOAM PADS

dsa4a.

Figure 1-4. Packaging Materials for Modules

Electrostatic Discharge Information

Caution	ESD can damage or destroy electronic components. Work at static-safe workstations when servicing assemblies that include electronic components.

Figure 1-5 shows an example of a static-safe workstation with two combinations of ESD protection: conductive table mat with wrist strap; conductive floor mat with heel strap. Use these two combinations together. The "Static-Safe Accessories" section provides lists of accessories.
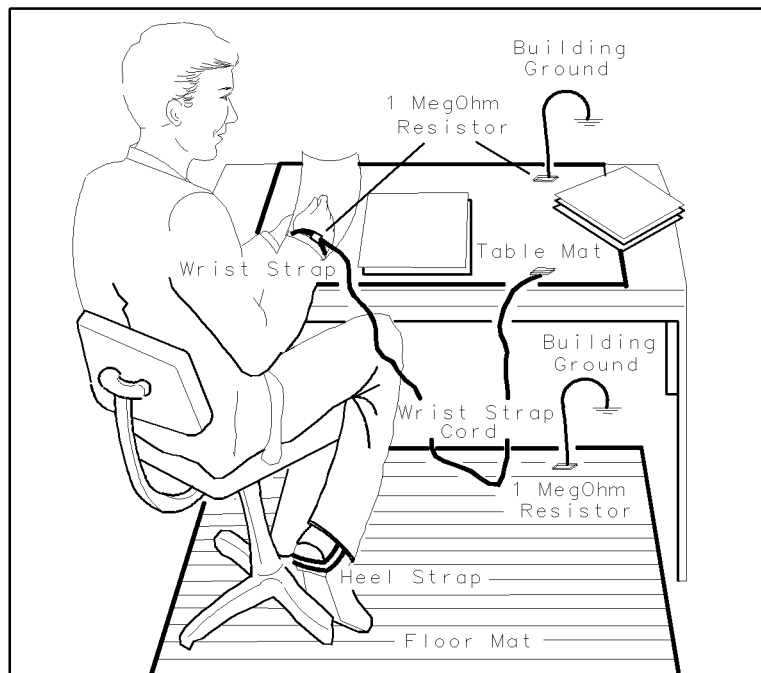
Figure 1-5. Static-Safe Workstation

Reducing ESD Damage

The following suggestions help reduce ESD damage that can occur during instrument test and service.

PC Board Assemblies and Electronic Components

- Work at a static-safe workstation.

- Store or transport in static-shielding containers.

- Do not use erasers to clean edge connector contacts. Erasers generate static electricity and remove gold plating. Clean with lint-free cloth and a solution of 80% electronics-grade isopropyl alcohol and 20% deionized water.

Test Equipment

■ Before connecting any coaxial cable to an instrument for the first time each day, momentarily short together the center and outer conductors of the cable.

■ Before touching the center pin of any connector and before removing any assembly from the instrument, ensure proper use of a grounded, resistor-isolated wrist strap.

■ To prevent buildup of static charge, ensure that all instruments are properly earth-grounded.

Static-Safe Accessories

Table 1-2 lists static-safe accessories that are available from any Hewlett-Packard office. Table 1-3 lists accessories available from the Hewlett-Packard Computer Supplies Operations.

Table 1-2. ESD Accessories Available from HP Sales and Service Offices

Description	Qty	CD	HP Part Number
3M static control mat, 0.6 m×1.2 m (2 ft×4 ft) and 4.6 m (15 ft) ground wire (The wrist strap and wrist strap cord are not included. They must be ordered separately.)	1	9	9300-0797
Wrist strap cord, 1.5 m (5 ft)	1	2	9300-0980
Adjustable wrist strap, no cord	1	7	9300-1383
ESD heel strap (reusable 6 to 12 months)	1	1	9300-1169
Shoe ground strap (one-time use only)	1	5	9300-0793

Table 1-3. ESD Accessories Available from HP Computer Supplies

Description	HP Model Number
Static control mat, black, hard surface, 1.2 m x 1.5 m (4 ft x 5 ft)	92175A
Static control mat, brown, soft-surface, 2.4 m x 1.2 m (8 ft x 4 ft)	92175B
Static control mat, black, hard-surface, 1.2 m x 0.9 m (4 ft x 3 ft)	92175C
Static control mat, tabletop, 58 cm x 76 cm (23 in. x 3 ft)	92175T
Antistatic carpet, 1.8m x 1.2m (6 ft x 4 ft) - natural	92176A
Antistatic carpet, 1.8m x 1.2m (6 ft x 4 ft) - russet	92176C
Antistatic carpet, 2.4m x 1.2m (8 ft x 4 ft) - natural	92176B
Antistatic carpet, 2.4m x 1.2m (8 ft x 4 ft) - russet	92176D

Sales and Service Offices

Hewlett-Packard Sales and Service Offices provide worldwide support for Hewlett-Packard products. To obtain servicing information or to order replacement parts, contact the nearest office listed in Table 1-4. In any correspondence, always provide essential information, which includes model numbers, serial numbers, or assembly part numbers.

Table 1-4. Hewlett-Packard Sales and Service Offices

IN THE UNITED STATES
California
Hewlett-Packard Co.
1421 South Manhattan Ave.
P.O. Box 4230
Fullerton, CA 92631
(714) 999-6700

Hewlett-Packard Co.
301 E. Evelyn
Mountain View, CA 94039
(415) 694-2000

Colorado

Hewlett-Packard Co.
24 Inverness Place, East
Englewood, CO 80112
(303) 649-5000

Georgia
Hewlett-Packard Co.
2000 South Park Place
P.O. Box 105005
Atlanta, GA 30339
(404) 955-1500

Illinois
Hewlett-Packard Co.
5201 Tollview Drive
Rolling Meadows, IL 60008
(312) 255-9800

New Jersey
Hewlett-Packard Co.
120 W. Century Road
Paramus, NJ 07653
(201) 265-5000

Texas
Hewlett-Packard Co.
930 E. Campbell Rd.
Richardson, TX 75081
(214) 231-6101

IN AUSTRALIA
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
895-2895

IN CANADA
Hewlett-Packard (Canada) Ltd.
17500 South Service Road
Trans-Canada Highway
Kirkland, Quebec H9J 2X8
(514) 697-4232

IN FRANCE

Hewlett-Packard France
F-91947 Les Ulis Cedex
Orsay
(6) 907-78-25

**IN GERMAN FEDERAL
REPUBLIC**
Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Berner Strasse 117
Postfach 560 140
D-6000 Frankfurt 56
(0611) 50-04-1

IN GREAT BRITAIN
Hewlett-Packard Ltd.
King Street Lane
Winnersh, Wokingham
Berkshire RG11 5AR
0734 784774

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COUNTRIES**
Hewlett-Packard (Schweiz) AG
Allmend 2
CH-8967 Widen (Zurich)
(0041) 57 31 21 11

IN JAPAN
Yokogawa-Hewlett-Packard Ltd.
29-21 Takaido-Higashi, 3 Chome
Suginami-ku Tokyo 168
(03) 331-6111

**IN PEOPLE'S REPUBLIC
OF CHINA**
China Hewlett-Packard, Ltd.
P.O. Box 9610, Beijing
4th Floor, 2nd Watch Factory
Main Bldg.
Shuang Yu Shu, Bei San Huan
Rd.
Beijing, PRC
256-6888

IN SINGAPORE
Hewlett-Packard Singapore
Pte. Ltd.
1150 Depot Road
Singapore 0410
273 7388
Telex HPSGSO RS34209
Fax (65) 2788990

IN TAIWAN
Hewlett-Packard Taiwan
8th Floor, Hewlett-Packard
Building
337 Fu Hsing North Road
Taipei
(02) 712-0404

IN ALL OTHER LOCATIONS
Hewlett-Packard Inter-Americas
3495 Deer Creek Rd.
Palo Alto, California 94304

2

Installation

Introduction

The HP 70301A Tracking Generator is available separately or configured in a system. The factory ships preconfigured HP 70000 Modular Measurement Systems with all system components addressed and interconnected. This chapter tells about installation of the HP 70301A in an existing system: how to install it, configure it, and address it.

System information in this manual is generalized. For more help with HP 70000 Modular Measurement System configuration, cabling, or addressing, refer to the system master installation and verification manual.

Chapter 2 Topics

■ Procedures for installation or removal of a module.

■ Example of an HP 71210C system configuration.

■ Description of HP-MSIB/HP-IB addressing.

Module Installation and Removal

Installation

1. Set the mainframe LINE switch to OFF, then swing down the front door. See Figure 2-1.

2. Verify correct module HP-MSIB addressing as explained in this chapter under "HP-MSIB/HP-IB Addressing."

3. Slide the module into the mainframe, then use the 8 mm hex-ball driver to tighten the module latch. (The HP 70301A obtains both power and interface-bus control through the module rear-panel mainframe/module interconnect.) Swing the front door up.

4. Connect rear-panel cabling. For examples, refer to "Cable Connections Examples" in this chapter and in the system master installation and verification manual.

5. Connect HP-IB cables if the system includes a remote controller.

6. Set the LINE switch to ON. Verify that the mainframe power indicator is on and that the ventilation fan(s) are working.

   During a normal power-on sequence, a self-test routine causes the various module LEDs to turn on and off. If the HP 70301A ERR LED remains on after the test, refer to Chapter 5 for troubleshooting suggestions. For help with other problems, refer to the system master installation and verification manual.

Note	If the User Screen softkeys do not appear after power-up, the display window probably is not assigned to a master. To assign it to the master with the lowest column address, press (DSP), then SELECT INSTR. To assign the display to the master with the next-highest column address, press the up-arrow key, [▲].

7. If you connect HP-IB cables after power-on, reset all instruments on the bus by cycling the power. (Most plotters and printers can be reset with the front-panel reset keys or by turning the main power off, then on.)

8. Check HP-MSIB addressing by pressing (DSP) and ADDRESS MAP. Each address consists of a row number and a column number.

9. Verify module operation using test described in Chapter 4.
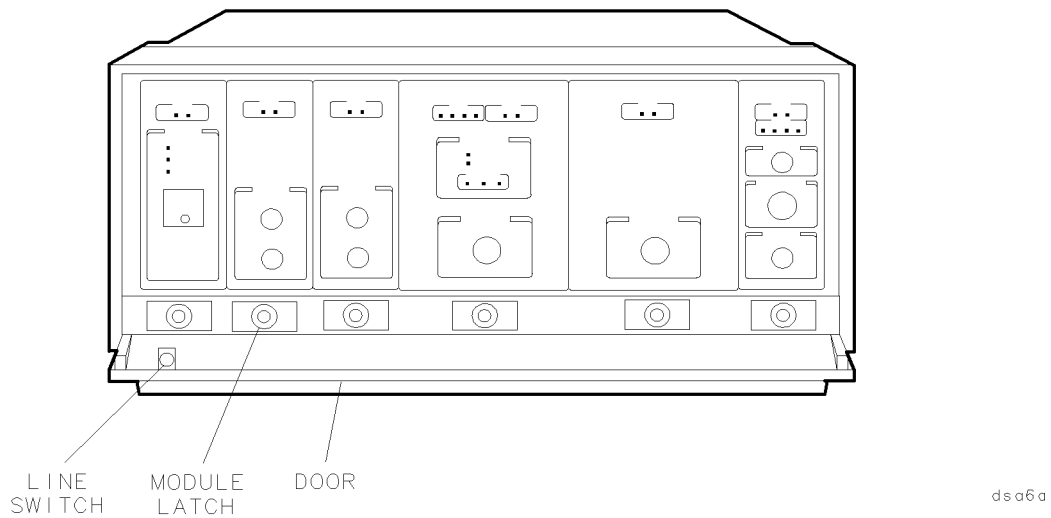
Figure 2-1. Module Removal/Replacement

Removal

1. Set the instrument LINE switch to OFF, then remove the rear-panel coaxial cables.

2. Swing down the front door, then use the 8 mm hex-ball driver to loosen the module latch.

3. Slide the module out of the mainframe.

Cable Connections Examples

The figure in this section illustrates the addressing and cable connections for a specific HP 70000 Modular Measurement System configuration. The section that follows this one, "HP-MSIB/HP-IB Addressing," provides general addressing information. Table 2-1 lists rear-panel cables available for HP 70000 system configurations. The following pages show recommended cabling for a system that includes the HP 70301A Tracking Generator.

Table 2-1. HP 70000 Modular Measurement System Rear-Panel Cables

Description	HP Part Number	CD	1/8 Spans
Semi-rigid, LO I/O	5021-5448	1	1 (L to R)
	5021-5449	2	2 (L to R)
	5021-5450	5	3 (L to R)
	5021-5451	6	4 (L to R)
	5021-5452	7	5 (L to R)
	5021-5453	8	6 (L to R)
	5021-5454	9	7 (L to R)
	5021-5491	4	1 (R to L)
	5021-5492	5	2 (R to L)
	5021-5493	6	3 (R to L)
	5021-5494	7	4 (R to L)
	5021-5495	8	5 (R to L)
	5021-5496	9	6 (R to L)
	5021-5497	0	7 (R to L)
Flexible, LO I/O	5061-9038	7	520 mm
	5061-9039	8	745 mm
Flexible, System	5061-9015	0	1 (90 mm)
	5061-9016	1	2 (140 mm)
	5061-9017	2	3 (190 mm)
	5061-9018	3	4 (240 mm)
	5061-9019	4	5 (290 mm)
	5061-9020	7	6 (340 mm)
	5061-9021	8	7 (390 mm)

In Table 2-1, L to R/R to L refers to signal flow OUT to IN as viewed from the *front* panel. For example, order a L to R cable if a given configuration, as viewed from the front, places a signal source to the left of the desitination. Bends in the semi-rigid cables makes the distinction necessary.

HP 71210C with HP 70300A and HP 70301A

An HP 71210C with HP 70300A and HP 70301A, consists of the following components:

HP 70001A Mainframe   HP 70004A Display
HP 70900B Local Oscillator   HP 70902A IF Section
HP 70903A IF Section   HP 70908A RF Section
HP 70300A Tracking Generator   HP 70301A Microwave Tracking Generator
HP 70310A Precision Frequency Reference
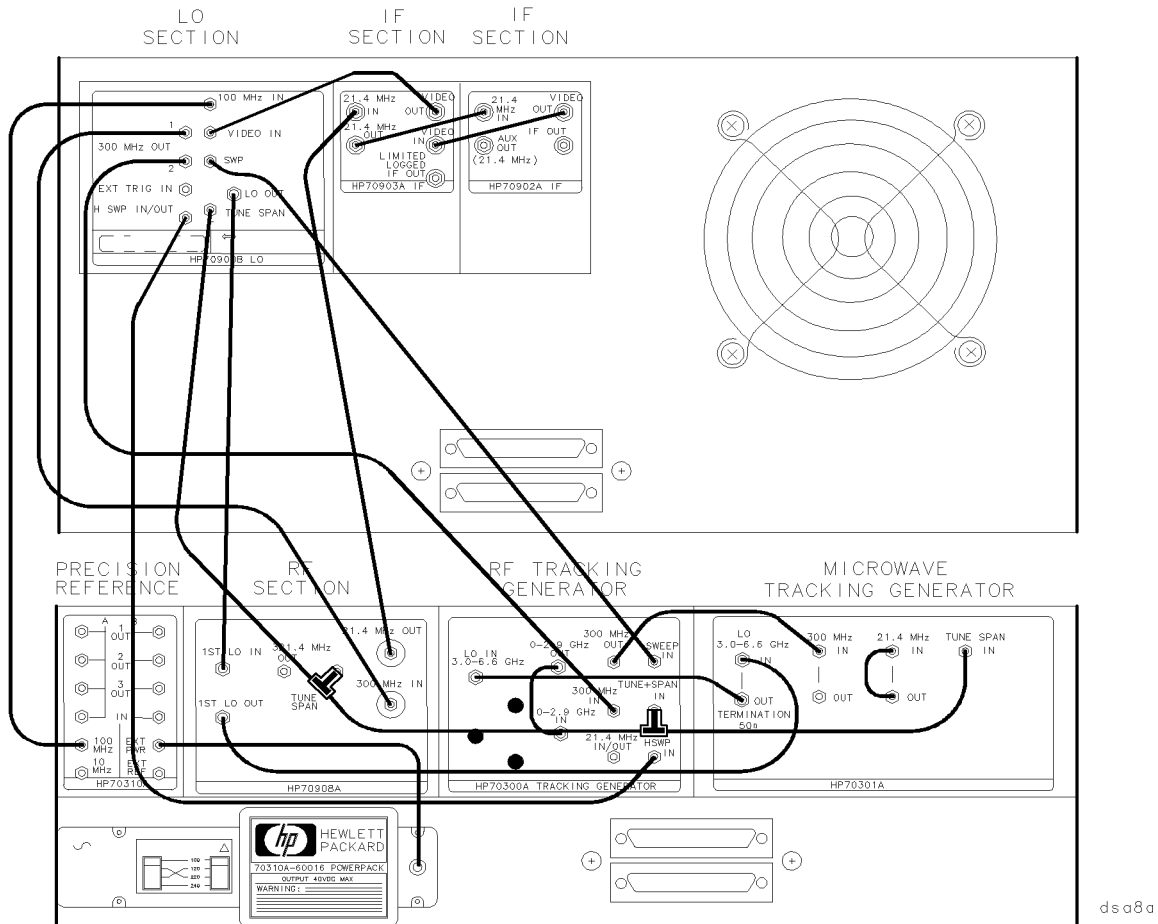
Figure 2-2. Address Map for HP 71400C with HP 70300A and HP 70301A

■ The HP 70001A mainframe does not have an HP-MSIB address.
■ The usual address for the HP 70004A display is Row 0, Column 4.
■ Refer to Chapter 1 for information about software/firmware compatibility.

CAUTION   To ensure proper electrical connection and prevent connector damage, all APC 3.5 and SMA connectors must be torqued 5 to 8 inch-pounds (finger tight). Do not exceed 8 inch-pounds.

To configure an HP 71210C with an HP 70300A and an HP 70301A, connect the rear-panel cables according to the following table. Figure 2-3 illustrates the cable connections.

Rear-Panel Cable Connections

From	To	Cable
Flexible LO I/O Cables		
HP 70900B LO OUT	HP 70908A 1st LO IN	5061-9038
HP 70301A LO OUT	HP 70300A LO IN	5021-5449
HP 70908A LO OUT	HP 70301A LO IN	5021-5494
Flexible System Cables		
HP 70900B 300 MHZ OUT 1	HP 70908A 300 MHZ IN	8120-5022 (365 mm)
HP 70900B 300 MHZ OUT 2	HP 70300A 300 MHZ IN	8120-5022 (365 mm)
HP 70900B HSWP IN/OUT	HP 70300A HSWP IN	8120-5021 (310 mm)
HP 70900B 100 MHZ IN	HP 70310A 100 MHZ	8120-5022 (365 mm)
HP 70900B VIDEO IN	HP 70903A VIDEO OUT	8120-5016 (160 mm)
HP 70900B SWEEP	HP 70300A SWEEP IN	8120-5022 (365 mm)
HP 70900B TUNE SPAN	* HP 70908A TUNE SPAN	8120-5021 (310 mm)
* HP 70908A TUNE SPAN	* HP 70300A TUNE SPAN	8120-5017 (205 mm)
* HP 70300A TUNE SPAN	HP 70301A TUNE SPAN	8120-5017 (205 mm)
HP 70908A 21.4 MHZ OUT	HP 70903A 21.4 MHZ IN	8120-5022 (365 mm)
HP 70902A VIDEO OUT	HP 70903A VIDEO IN	8120-5014 (100 mm)
HP 70902A 21.4 MHZ IN	HP 70903A 21.4 MHZ OUT	8120-5014 (100 mm)
HP 70300A 300 MHZ OUT	HP 70301A 300 MHZ IN	8120-5016 (160 mm)
HP 70301A 21.4 MHZ IN	HP 70301A 21.4 MHZ OUT	8120-5014 (100 mm)
Miscellaneous Cables		
Lower HP 70001A HP-MSIB OUT	Upper HP 70001A HP-MSIB IN	HP 70800B (1.0 m)
Upper HP 70001A HP-MSIB OUT	HP 70004A HP-MSIB IN	HP 70800B (1.0 m)
HP 70004A HP-MSIB OUT	Lower HP 70001A HP-MSIB IN	HP 70800B (1.0 m)
EXTERNAL POWER PACK	HP 70310A EXT PWR	BUILT-IN POWER PACK CABLE
* Use a T-Adapter (HP Part Number 1250-1391) on this connector		

|	ROW	17	18	19	20
7				70310A P.F.R.	
6			70908A RF SECT	70300A RFTrckG	
5				70301A uWTrckG	
4			70903A IF SECT		
3					
2			70902A IF SECT		
1					
0			70900B LO/CTLR HP-IB 18		

COLUMN

dua7a

Figure 2-3. HP 71210C with HP 70300A and HP 70301A Rear Panel Cabling

HP-MSIB/HP-IB Addressing

An **element** in an HP 70000 Modular Measurement System is a **system component** able to communicate with other modules over HP-MSIB. Element addresses must adhere to the set of rules defined in this section (HP-MSIB addressing differs from HP-IB addressing). For system addressing information, refer to the local oscillator installation and verification manual.

Correct addressing requires an understanding of basic system terminology and of the following three concepts:

Address matrix A graphic representation showing address assignments and how modules on the matrix relate to one another.

Address protocol Distinctions between master, slave and independent elements.

Address switches Techniques that set an element address.

Modular Measurement System Terminology

The following functional and structural terms are essential to understanding HP-MSIB addressing and the structural relationships among modular measurement system devices.

Functional Terms

Element Any device that communicates over the HP-MSIB. (The HP 70001A Mainframe controls all communications over HP-MSIB but does not communicate over HP-MSIB; therefore, the mainframe is *not* an element.)

Slave An element controlled by another element.

Master An element that controls other elements.

Sub-Master An element capable of functioning as both slave and master at the same time.

Independent An element that is neither a master nor a slave (for example, a display).

Instrument An element that performs an independent function. (The element can be a master, a master with slaves, or an independent.)

Structural Terms

Mainframe A housing for modules. (It supplies power, interconnection for HP-MSIB and HP-IB, and HP-MSIB communications control.)

Module A system modular measurement system component that plugs into a mainframe.

Stand-Alone Instrument An element that can perform its function independent of a mainframe (for example, the HP 70206A System Graphics Display)

Address Matrix

The address matrix, as Figure 2-4 shows, is a graphic representation of addresses on the HP-MSIB. The 8-row by 32-column matrix implies 256 available addresses; however, there are actually 255 legal addresses plus an illegal address at row 0, column 31.
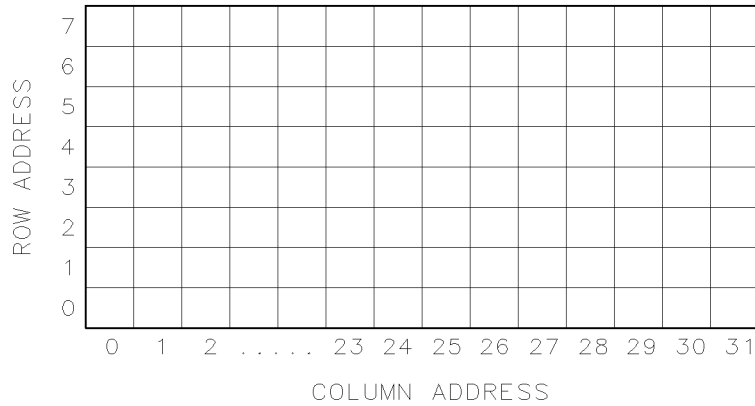
dsa12a

Figure 2-4. The Address Matrix

Each element must have a unique 8-bit binary HP-MSIB address correctly placed on the address matrix. The three most significant bits (MSB) determine the row address; the five least significant bits (LSB), the column address. This manual refers to the decimal equivalent of a binary address (see Table 2-2).

Table 2-2. Decimal Equivalent of Binary Address

	Row MSB	Column LSB
Binary	010	11000
Decimal	2	24
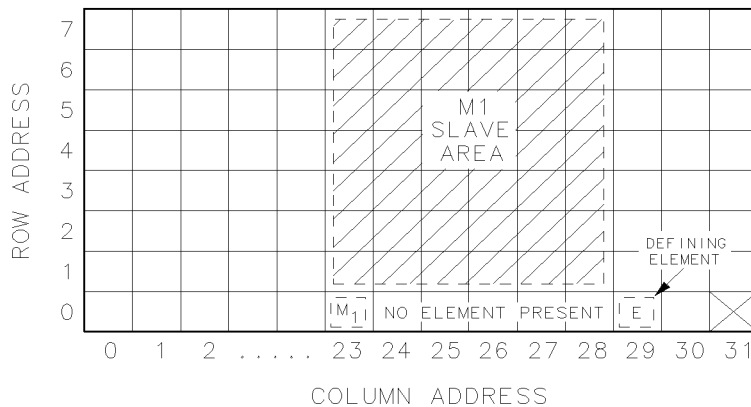
dsa13a

Figure 2-5. Master/Slave Addressing with Slave Area Defined

The master determines its slave-area boundaries by first searching upward in its own column starting in the master's row, then in each higher column starting in the master's row. The search stops at the boundary column or, if there is no defining element, after searching column 31.

The master uses the following criteria to set slave area boundaries.

1. The left boundary-column equals the master's column address.

2. If there is a defining element (see Figure 2-5), the right boundary-column equals the defining element's column address minus one.

3. If there is no defining element, the right boundary column is column 31.

4. The top boundary is row 7.

Address Switches

The address switches set an element's HP-MSIB address. If the element is a master or an independent element, the column switches also determine the default HP-IB address. (Displays do not have row address switches, so they are always set to row address 0.)

HP 70301A Address Switches

There is an eight-section address switch on top of the HP 70301A. Refer to Figure 2-6. Sections one through five set the HP-MSIB column address. The three front sections set the HP-MSIB row address. Figure 2-6 shows address row 5, column 19, the factory setting for the HP 70301A.
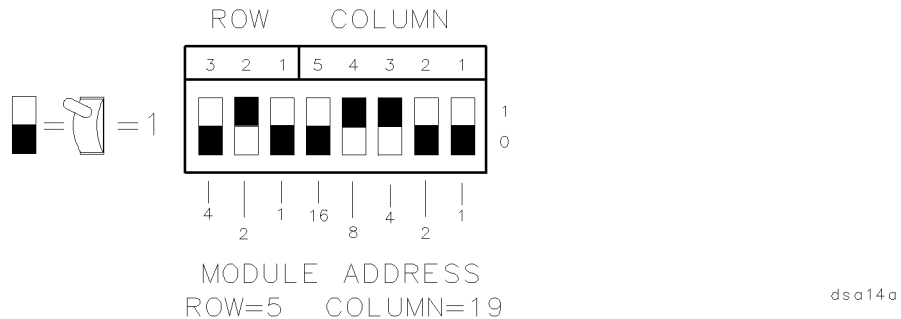
Figure 2-6. Typical Address Switch

Setting the HP-MSIB Address Switches

Note   There is no need to change the HP 70301A's factory-preset address unless other modules in the system do not have their factory-preset addresses.

A module-address change requires the following steps:

1. Locate the address switch on the top of the module. See Figure 2-6.

2. Set the row switch sections to the binary value of the module's HP-MSIB row number. For example, if the row value is 5, set the switches to binary 101, as Figure 2-6 shows.

3. Set the column switch sections to the binary value of the module's HP-MSIB column number. For example, if the column value is 19, set the switches to binary 10011, as Figure 2-6 shows.

Note	Changing HP-MSIB addresses requires an understanding of HP-MSIB addressing rules. For help with custom configuration addressing, refer to the system-master installation and verification manual.

3

Specifications

Introduction

This chapter contains characteristics and measurement-related specifications. The system specification tables list specifications and characteristics that are modified when the HP 70301A Tracking Generator operates in a HP 71000 MMS Microwave Spectrum Analyzer system.

Refer to the system data sheet for any system characteristics or electrical specifications not found in this chapter.

Tables in this chapter list specifications and characteristics together, in the same format. Table items in *italics* identify a characteristic. You should understand the distinction among terms.

Specifications   describe warranted performance over the temperature range of 0°C to +50°C after one hour of continuous operation, unless otherwise noted. Specifications apply after the system temperatures have stabilized and self-calibration routines have run. (The standard Hewlett-Packard operating temperature range is 0°C to +55°C; the HP 70301A is an exception.)

Unless otherwise noted, corrected limits are given when a specification range is improved with error-correction routines. All specifications qualified by an output power setting refer to the indicated setting.

Typical performance, where listed is *not warranted*, but indicates performance that most units will meet.

Characteristics   provide useful but non-warranted functional and performance information in the form of nominal values.

Nominal values   indicate the expected but non-warranted value of the denoted parameter.

System Specifications and Characteristics

The tables in this section list characteristics and measurement-related specifications for HP 71000 MMS Microwave Spectrum Analyzers with an HP 70301A Tracking Generator module. For more information on different system configurations please refer to the *HP 71000 MMS Spectrum Analyzer HP 70900 Installation and Verification Manual*.

Table 3-1. System Specifications and Characteristics

Parameters	Specifications	
Frequency Range	2.7 to 18 GHz	
with an HP 70301A	10 MHz-18 GHz	
Frequency Accuracy	$\pm[$(Freq. Readout $\times$ Freq. Ref. Acc.[*]) $+$ % of span $+$ 15 Hz[†]$]$	
	% of span is 1% for spans $\leq$ "Span Breakpoint" or 2% for spans > "Span Breakpoint".	
	Span Breakpoint = 10 MHz $\times$ N[‡]	
Frequency Tracking Range	± 500 Hz, 1 Hz steps	
Frequency Tracking Drift	<3 Hz/Hour after warm-up	
Frequency Offset Range	± 5 MHz with external 21.4 MHz source	
Maximum leveled output power	**20° C to 30° C**	**0° C to 50° C**
	0 dBm	-2 dBm
Amplitude Control Range	$+14.5$ to -66 dBm	
Vernier Range	$+14.5$ to -11 dBm (0.1 dB resolution)	
Amplitude Accuracy (20-30°C):		
Absolute Accuracy at 2.7 GHz	± 0.5 dB (output power set to -2 dBm)	
Amplitude Flatness rel. to 2.7 GHz	± 1.0 dB	
Vernier Accuracy	± 0.15 dB/dB, ± 0.8 dB total	
Total Abs. Accuracy (0 dB attn.)	± 2.3 dB (absolute accuracy + flatness + vernier)	
Amplitude Drift	$<\pm 0.05$ dB/°C at -2 dBm output power	
Tracking Generator Feedthrough (System Performance)	Less than -130 dBm or standard system displayed average noise level (without HP 70301A), whichever is greater, disregarding the exceptions listed below.	
	Note: Systems with preamplifiers will not meet this specification.	
Exceptions: HP 71200C opt 002/003 and HP 71201A (Preselected Mode):	< -115 dbm 2.7 - 6.2 GHz	
	< -105 dBm 6.0 - 12.7 GHz	
	< -100 dBm 12.5 - 18.0 GHz	
HP 71200A/71200C (Non-Preselected Mode):	*< -50 dBm (charateristic)*	
	(Tracking Generator Feedthrough is defined as the displayed average noise level present with the TG set to maximum leveled output power with the TG output and RF input terminated in 50Ω loads.)	

[*] Refer to Frequency Reference Accuracy for the particular system in the *HP 70900 Installation and Verification Manual.*

[†] Uncorrected, error is ± 200 Hz with tracking adjusted to 0 Hz.

[‡] N = Harmonic mixing number

Table 3-1. System Specifications and Characteristics (continued)

Parameters	Specifications		
Scalar Dynamic Range (20-30°C)	Compute using the following formula: $$SDR = \text{maximum leveled output power - TG feedthrough}$$		
Output Attenuator:			
Range	55 dB in 5 dB steps		
Repeatability	$\leq \pm 0.2$ dB for any setting		
Accuracy		**<12.8 GHz**	**12.8-18 GHz**
(referenced to 0 dB attn.)	Attn. (dB)	($\pm$dB)	($\pm$dB)
	5	0.40	0.50
	10	0.60	0.70
	15	0.85	1.00
	20	0.70	0.90
	25	0.95	1.15
	30	0.90	1.20
	35	1.25	1.60
	40	1.80	2.00
	45	2.00	2.20
	50	2.00	2.30
	55	2.20	2.50
Spectral Purity :			
(with -2 dBm output power)			
Phase Noise at 10 kHz offset	< -90 dBc/Hz $+ 20$logN[*]		
Sidebands	n[†]$\times 40$ kHz: < -70 dBc/Hz $+ 20$logN		
	(n$\times$50), (n$\times$60), and (n$\times$400 Hz): <-50 dBc		
	Display: <-60 dBc (approx. 24 kHz)		
	Others contributed by HP 70301A: <-80 dBc		
n$\times$1st LO	<-65 dBc		
Harmonic Spurious	2nd harmonic: $\quad <-7$ dBc (<-15 dBc typical)		
	3rd harmonic: $\quad <-11$ dBc (<-15 dBc typical)		
Sub-harmonic Spurious	precluded by design		
Non-harmonic Spurious	<-60 dBc		
Residuals (RF off)	<-120 dBm (tracking)		
	<-65 dBm (LO emission)		
[*] N = Harmonic mixing number [†] n = 1, 2, 3, ... ∞			

All input/output ports are 50 Ω impedance with <1.5:1 VSWR and with, unless otherwise noted, a maximum safe input/reverse level of +20 dBm ac and 20 V dc.

Table 3-2. HP 70301A Input and Output Characteristics, Front Panel

Connectors	HP 70301A Characteristics
RF OUTPUT	Type N female Max. Safe Reverse Lvl: +20 dBm (0.1 W), 0 V dc Output VSWR, ≥5 dB attn: 2.7-12.8 GHz <1.5:1 12.8-18 GHz <1.7:1 Output VSWR, 0 dB attn: <2:1
EXT ALC INPUT	BNC female, 1 MΩ Impedance −564 μV (−65 dBV) to −200 mV (−14 dBV) Max. Safe Input Level: ±15 V dc
LOW BAND INPUT	SMA female 10 MHz to 2.9 GHz Insertion Loss: <4.0 dB

Table 3-3. HP 70301A Input and Output Characteristics, Rear Panel

Connectors	HP 70301A Characteristics
LO IN	SMA female, 2:1 VSWR 3-6.6 GHz, 0.5 to 18.0 dBm required Maximum Safe Input Level: +20dBm, 5 V dc
LO OUT	SMA female, 3:1 VSWR 3-6.6 GHz, +3.0 to +15.0 dBm Maximum Safe Reverse Level: +20 dBm, ± 5 V dc
300 MHz IN	SMB male 300 ±0.03 MHz, +2 to −2 dBm
300 MHz OUT	SMB male 0 ±1 dBm <25 dBc Harmonics
21.4 MHz IN	SMB male 21.4 ±5 MHz offset allowed Minimum Required Input Level: +3 dBm ±1 dB Maximum Safe Input Level: +15 dBm, 40 V dc
21.4 MHz OUT	SMB male 21.4 MHz ±200 Hz w/ tracking adjusted to 0 Hz. Amplitude: >0 dBm Maximum Safe Reverse Level: +20 dBm, ± 5 V dc
TUNE SPAN IN	SMB male, 1 MΩ Impedance 4.5-10.2 V (1.5 V/GHz) Max. Safe Input Level; ± 15 V dc

Table 3-4. General Specifications and Characteristics

Parameters	Specifications	
Temperature	**Operation**	**Storage**
	0°C to +50°C	−40°C to +75°C
EMI (applies to systems only)	Conducted and radiated interference is in compliance with CISPR publication 11 (1975) and FTZ 1046. Radiated interference is in compliance with MIL-STD 461B, Part 7, RE02.	
HP 70301A *Weight*	6.9 kg (15.2 lb)	
HP 70301A *Dimensions*	3/8-width module	
height	127 mm (5.0 in)	
width	144 mm (5.7 in)	
length	467 mm (18.4 in)	

4

Verification

Introduction

This chapter describes module operation-verification tests that evaluate the electrical performance of an HP 70301A Tracking Generator in a spectrum analyzer system. Run these after repair or adjustment of an HP 70301A assembly.

The "Verification" chapter in the *HP 71000 Modular Spectrum Analyzer Installation and Verification Manual* for *HP 70900B Local-Oscillator-Controlled Modules* provides descriptions of operation verification tests in the HP 70900 Operation Verification software. Test Disk 3 shipped with the HP 70301A Tracking Generator essentially adds operation verification tests to that software.

You can verify the electrical performance of the HP 70301A in a spectrum analyzer system by using HP 70900A Operation Verification software and the HP 70301A Test Disk 3. (Test Disk 3 requires operation verification software Rev. B.03.00 or greater.)

Note   Tracking generator tests require modification of operation verification software Rev. B.02.00 or B.02.01. The UPDATE program on HP 70301A Test Disk 3 provides these changes.

Explanation of Test Descriptions

The next section describes verification tests provided on Disk 3. The following list explains the information found under the test descriptions:

- **Tested Specification** is the name of the specification as found in the "Specifications" chapter of this *HP 70301A Installation and Verification Manual*.

- **Equipment** lists all external test equipment required by the particular test. Accessories are not listed. The test will not run if required test equipment is missing.

- **Equipment Setup** describes equipment interconnections. A User Interface Setup Screen will also provide instruction. This screen does not appear if the current setup is complete and correct. The screen presents `ABORT` and `PROCEED` softkeys. `ABORT` displays the Test Menu. Pressing `PROCEED` three times when the setup is wrong will display the Test Menu.

- **Description** provides a brief description of the test.

Test Descriptions

The HP 70900B installation and verification manual includes all needed information about equipment requirements and HP 70900 Operation Verification software operation. Table 4-1 lists tracking generator tests described in this section and included on the HP 70301A Test Disk 3. Table 4-1 is an extension to a similar table in the HP 70900B installation and verification manual.

Table 4-1. Tracking Generator Operation Verification Tests

Operation Verification Test	Page
Absolute Amplitude Accuracy	4-3
Vernier Accuracy	4-4
Frequency Response	4-5
Feedthru	4-6

TG Absolute Amplitude Accuracy (HP 70301A)

Tested Specification

AMPLITUDE ACCURACY: Absolute Accuracy

Equipment

Power Meter
MW Power Sensor

Equipment Setup

With the MW power sensor connected to the power meter, connect the MW power sensor to the RF OUTPUT of the tracking generator.

Description

This test measures the absolute RF output amplitude accuracy of the tracking generator at its maximum specified leveled output power. The tracking generator frequency is set at 2.7 GHz, and the output amplitude is set to -2 dBm. Then the output power is measured.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

■ Tracking Generator.

TG Vernier Accuracy (HP 70301A)

Tested Specification

AMPLITUDE ACCURACY: Vernier Accuracy

Equipment

Power Meter
MW Power Sensor

Equipment Setup

With the MW power sensor connected to the power meter, connect the MW power sensor to the RF OUTPUT of the tracking generator.

Description

This test measures the incremental RF output amplitude accuracy of the tracking generator over -11 dBm to 0 dBm, the range of the automatic level control (ALC).

The tracking generator frequency is set to 2.7 GHz, and the tracking generator's attenuator (if present) is set to 0 dB. The tracking generator output power is then set to 0 dBm, and a reference reading is taken with the power meter. The output power is then stepped in 1 dB increments over the -11 dBm to -1 dBm range. The absolute error between the programmed amplitude (what was expected) and the power meter reading (what was measured) is stored. The differences in the absolute errors are checked to see if they meet incremental specifications.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

■ Tracking Generator.

TG Frequency Response (HP 70301A)

Tested Specification

AMPLITUDE ACCURACY: Amplitude Flatness rel. to 2.7 GHz

Equipment

Power Meter
MW Power Sensor

Equipment Setup

With the MW power sensor connected to the power meter, connect the MW power sensor to the RF OUTPUT of the tracking generator.

Description

This test measures the RF output amplitude variations of the tracking generator over its complete frequency range.

The tracking generator is set to a frequency of 2.7 GHz, then a power meter is used to set the tracking generator output amplitude to -2 dBm ± 0.15 dB. This establishes the reference amplitude. The tracking generator is then incremented in frequency, the output power is read by the power meter, and the variation from the reference amplitude is stored. Frequency response is measured at a total of 201 points.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

■ Tracking Generator.

TG Feedthru (HP 70301A)

(using HP 70902A or HP 70903A)

Tested Specification

Tracking Generator Feedthrough

Equipment

Power Meter
RF Power Sensor
50 Ohm Termination (HP 909D only)

Note	The type of 50Ω termination used can greatly affect the feedthrough level. BNC or Type N terminations have too much leakage, and should not be used. The leakage of the HP 909D termination is low enough not to affect the measurement.

Equipment Setup

Setup A: Connect the RF OUTPUT of the tracking generator to the RF INPUT of the spectrum-analyzer system.

Setup B: With the RF power-sensor output connected to the power meter, connect the input of the RF power sensor to the RF OUTPUT of the tracking generator. Connect the 50 ohm termination to the RF INPUT of the spectrum analyzer.

Description

The equipment is connected using setup A. The spectrum analyzer system containing the tracking generator is placed in Stimulus Response mode and set to the minimum IF resolution bandwidth (10 Hz, HP 70902A; 100 kHz, HP 70903A). Source track peaking is then performed to make sure that the source frequency is centered in the IF resolution bandwidth.

The equipment is connected using setup B. The tracking generator feedthrough level is then measured in each band of the spectrum analyzer using the following procedure:

1. The tracking generator is set for an RF output of −10 dBm.

2. The spectrum analyzer is set as follows:

    Reference level:
        HP 70902A: −65 dBm (−75 dBm when HP 70908A is RF section).
        HP 70903A: −25 dBm (−35 dBm when HP 70908A is RF section).
    Resolution bandwidth:
        HP 70902A: 10 Hz.
        HP 70903A: 100 kHz.
    Attenuator setting of 0 dB.
    Sample detection.
    Stop and start frequencies are set for the band of interest.

3. A sweep is taken.

4. The tracking generator frequency is set to the frequency of the peak response, and a power meter is used to set the output amplitude to -10 dBm ±0.05 dB.

5. The spectrum analyzer settings are changed as follows:

Span is set to 0 Hz.
Video bandwidth is set to 3 Hz.
Sweep time is set to a value which assures that the trace data elements are uncorrelated.

6. A sweep is taken.

The tracking generator feedthrough level is equal to the average of the trace elements. This procedure is repeated for each band of the spectrum analyzer.

In Case of Failure

If this test fails, the following modules may need repair or adjustment:

- Tracking Generator.
- RF Section.
- Preselector.

5

Troubleshooting

Introduction

Review Chapter 2 of this manual to ensure that the module addressing switches are properly set, cabling is correct, and that the module is securely seated in the mainframe.

This module-level troubleshooting chapter provides information on the front-panel status lights, indicator lights, and those error messages produced by the HP 70301A Tracking Generator module. (For component-level troubleshooting information, refer to the HP 70301A service manuals.)

If the problem persists, you can find system-level help in the system-master installation and verification manual.

Troubleshooting Features

This section assumes an understanding of the terminology listed in Chapter 2 under "Modular Measurement System Terminology."

The modular spectrum analyzer has the following troubleshooting features:

1. Indicator lights.
2. Status Indicators.
3. Programs.
   a. Power-On Self Test.
   b. System Diagnostics.
   c. Module Verification.
   d. System Performance Programs.
   e. System Analyzer Operation Verification.
4. Error message reports.

1. Indicator Lights

UNLEVELED   This LED indicates that the RF OUTPUT power is unleveled during the time the indicator is lit. Any of the following can cause unleveled power:

- The source power (SRC PWR) is set too high.
- The EXT detector (ALC EXT) is selected with no external detector connected to the front panel EXT ALC INPUT.
- The RF chain malfunctions thus causing low output power.

RF   This LED indicates that the HP 70301A Tracking Generator RF OUTPUT power is turned on (the `SRC PWR ON/OFF` softkey function is set to ON).

2. Status Indicators

The mainframe and all elements have two types of status indicators. The ERR (error) indicator indicates a fault of some kind. The ACT (active) indicator shows that an element is **active** (that it is being controlled or accessed). The status indicators for a display are the letters E and A in the lower right corner of the display in the display status block. All other elements have ERR and ACT indicators on the front panel.

The HP 70206A System Graphics Display has an I/O error indicator that lights when only *one* HP-MSIB cable is connected to the HP 70206A. The indicator is off if both cables are either connected or disconnected.

Status Error Indicator

A slave error causes the ERR indicators to light on both the slave and the master. The ERR indicators go out when the fault condition is cleared and is reported. "Error Message Reporting" in the system-master installation and verification manual provides a full description of error reporting.

- The status ERR indicator LED flashes at a 1-Hz rate when a communication over HP-MSIB is not satisfactorily completed.

- If the error-indicator LED of more than one of the spectrum analyzer's modules simultaneously flash at a 1-Hz rate, refer to the installation and verification manual of the system master.

- Some errors may only be present when the spectrum analyzer is sweeping. These errors cause the error indicator to flash at the sweep rate.

Note   It is possible that the error indicator may not be flashing on a module that has disrupted all HP-MSIB communication.

You can isolate status-indicator problems by substituting master, modules, or mainframe. Since there are no operator adjustments or repairs, you should refer broken-assembly problems to qualified technical personnel.

Active Indicator

The following conditions turn on the ACT LED:

- The module is performing a function directed by manual control of the display keyboard.

- The module is making a measurement and its master has keyboard control of the display.

- The instrument is in self-test mode.

Refer to the system-master installation and verification manual for additional detail related to the ACT LED.

When the address map cursor is at the address of an element, the element's ACT indicator lights. It is thus possible to determine an element's address by scrolling through the map.

3. Programs

The following software and firmware aids help evaluate :

    a. Power-On Self-Test.
    b. System Diagnostics.
    c. Module Verification.
    d. System Performance Programs.
    e. System Analyzer Operation Verification.

a. Power-On Self-Test:

Switching line power on causes execution of a module self-test of each module in an HP 70000 Modular Measurement System. The test verifies the ability of the module to communicate with the system controller on the system bus (HP-MSIB). During self-test the ACT (active) and ERR (error) status indicator LEDs will blink on, then off, as the analyzer checks the operation of each module. If the LEDs stay on or continue to blink, refer to Chapter 5, "Troubleshooting." You can determine the results of this test by examining the front-panel indicator LEDs. After completion of the self-test, systems LO firmware will display any errors encountered.

To turn the tracking generator on, press `MENU`, `State`, `tracking gen`, `SRC POWER`.

b. System Diagnostics:

A **downloadable program** (DLP) is a software routine written with an external computer and **downloaded** (stored) into the instrument's non-volatile RAM. Once downloaded, the DLP can be executed, at the press of a softkey, without an external computer.

System Diagnostics is a DLP downloaded into each standard HP 70000 Series system (not HP 70000XL Series) shipped to a customer. The primary purpose of System Diagnostics is to detect **catastrophic failure** in the spectrum analyzer and to determine the nature of the failure. A catastrophic failure is a failure which renders the instrument unusable.

A secondary purpose of System Diagnostics is to determine if any *soft* failures have occurred and to diagnose, to the module level, where the soft failure occurred. A soft failure is defined as a failure which renders some circuitry of the instrument unusable or beyond its proper operating limit.

The HP 70301A Tracking Generator tests are part of System Diagnostics and will execute automatically if a tracking generator is a component in the spectrum analyzer. System Diagnostics are available on disks for down-loading into HP 70000 Series modular spectrum analyzers. Contact the nearest HP Sales and Service Office to obtain these disks.

System Diagnostics requires an RF INPUT signal of 300 MHz, −10 dBm, nominally taken from the LO's CALIBRATOR OUTPUT. Pressing the `System diag` softkey presents a menu with the message `Select Desired System to Test`. After you connect the calibrator and select the system, diagnostics runs without user interaction. System Diagnostics will run then exit with one of the following messages:

■ `Test Completed`

■ `Addressing Error`

■ `Test Aborted Early`

The display will show messages for any errors. Depending on which failure occurs, System Diagnostics may not run to completion. Refer to Chapter 5, "Troubleshooting," in this

manual for a list of error messages produced by the HP 70301A Tracking Generator module. For error messages generated by other modules, refer to the system-master installation and verification manual. Refer to the troubleshooting chapter in the system-master installation and verification manual for more details about test results.

Note	The HP 70000XL configuration precludes the use of other DLPs because most of the available memory is used for the HP 70000XL Personality software.

CAUTION	As programs are down-loaded, previously stored DLPs may be disposed. It is imperative that you maintain backup copies of all DLPs—including System Diagnostics and the scalar analysis personality.

The factory ships the HP 70000XL systems with the scalar analysis personality software downloaded and all other systems with System Diagnostics. Disks containing the various programs accompany instrument shipments. To operate System Diagnostics or other DLPs on an HP 70000XL system, you must download the DLP from a disk. This, however, will dispose the HP 70000XL operating software, since it occupies most of the available memory. You have to reload the scalar analysis personality software after completion of diagnostics.

c. **Module Verification:**

There is specific module verification software for the HP 70301A Tracking Generator. This HP 70301A Module Verification software includes both adjustments and verification tests to ensure performance. Contact the nearest HP Sales and Service Office for details.

d. **System Performance:**

It is possible to check the calibration and overall performance of the HP 70301A Tracking Generator Module by using HP 11990A System Performance Tests. These programs are available from the nearest HP Sales and Service Office.

To test an HP 70301A in a specific system, order the following:

User interface	11990A OPT 001 B.03.00 or greater
System test package	OPT 100, OPT 200, etc., B.03.00 or greater
Accessory test	11990A OPT 033 B.03.00 or greater

To update an earlier version of the 11990A software, order the appropriate 11990A update.

e. **Spectrum Analyzer Operation Verification:**

It is possible to verify the electrical performance of the HP 70301A in a spectrum analyzer system by using HP 70900A Operation Verification software and Test Disk 3 supplied with this manual. (Test Disk 3 requires Operation Verification software version B.03.00 or greater.) Refer to the system-master installation and verification manual for information about HP 70900A Operation Verification programs.

4. Error Messages

CAUTIONS   The HP 70301A Tracking Generator module contains components and assemblies that electrostatic discharge (ESD) can damage. Service the module only at a static-safe work station. Refer to Chapter 1 for lists of precautions and static-safe accessories and for a work-station description.

The HP 70301A Tracking Generator module contains both metric and inch hardware. Refer to Chapter 7 for identification of hardware type.

To assure proper electrical connection and no connector damage, all APC 3.5 and SMA connectors must be torqued five to eight inch-pounds. Do not exceed eight inch-pounds.

This section lists spectrum-analyzer error messages generated by an HP 70301A. The messages are in functional categories, each with its own number series. Interaction and dependencies can result in a single problem causing multiple errors. You should investigate errors in their order of reporting. Refer to the system-master installation and verification manual for a complete list of all system error messages.

Table 5-1. Error Message Grouping

Type	Numbers
User Application	0001 to 0999
Usage/Operating	2000 to 2999
Hardware Warning	6000 to 6999
Hardware Broken	7000 to 7999
Computation	8000 to 8999
Factory Use Only	9000 to 9999
Display Disruptive	not numbered

System Diagnostic messages use numbers in the 0001 to 0999 range. All but the first and last two categories report the element number and HP-MSIB address along with the error message. The first and last three categories are discussed in the *HP 71000 Modular Spectrum Analyzer Installation and Verification Manual* for the system master.

Hardware warning and hardware broken errors are for information only. The HP 70301A Tracking Generator has no operator repairs or adjustments. Refer repairs to qualified technical personnel.

CAUTION   Some error message descriptions in this section suggest corrections that involve removing instrument covers and assemblies. These suggestions are directed at qualified repair personnel only. Other users and operators must not attempt these repairs.

A detailed explanation of the causes and troubleshooting steps necessary to repair these error conditions is available in the *HP 70301A Tracking Generator Service Manual*.

Operating Errors (2000-2999)

Operating errors result from incorrect use of the analyzer, usually during remote operation. The operation and programming manuals explain manual and remote analyzer operation.

2001 `Illegal cmd` (Illegal command) — User-generated system protocol error. This error occurs when the module encounters a command it does not recognize. This can be caused by the master element's sending such a command, a problem internal to the module, or an open cable between the master and module. The problem can be isolated by substituting master, mainframe, or modules.

2002 `Illegal parameter` — Description of error 2001 applicable to error 2002.

2006 `Parm out of range` — Description of error 2001 applicable to error 2006.

2008 `Output unleveled` — Setting the output power above the specified maximum leveled output power (0 dBm for 20-30° C) may cause error 2008. This error will also occur if EXT detector (ALC EXT) is selected with no external detector connected to the front panel EXT ALC INPUT.

The source power from the HP 70301A Tracking Generator is unleveled (outside the range of the ALC circuit). The selected output power may be set above 0 dBm for 20-30°C.

If the power setting is within range, suspect the following assemblies:

- A7 ALC/Bias PC Board.
- A8A3 ALC Microcircuit.
- A8A3A1W1 Internal detector coaxial cable.
- W6 EXT ALC INPUT coaxial cable, if error 2008 occurs with ALC EXT selected.

2009 `Protocol error` — Description of error 2001 applicable to error 2002.

Hardware Warning Errors (6000-6999)

These error codes report the status of the HP 70301A hardware. An error indicates that some of the hardware is not functioning properly. Measurement accuracy may be impaired.

6000 `EAROM unprotected` — The EAROM write protect/enable switch on the controller PC board is in the enable position.

Hardware Broken Errors (7000-7999)

These error codes are generated by hardware or firmware failures within the module and are usually catastrophic to operation of the module.

7000 `ROM Check error` — The programmed checksum of the lower two kilobytes of EAROM does not agree with the computed checksum. First suspect the A3U4 EAROM then the A3 Controller Board Assembly.

7002 `First LO unleveled` — The Local Oscillator signal from the local oscillator module is missing or not correct. Verify that rear-panel cabling is correct.

If the cables are correct, the following assemblies are most suspect:

- A8A7 LO leveling amp
- A7 ALC/Bias Board Assembly
- A8A5 Isolator
- W3 LO input coaxial cable

■ A8W4 Coax cable

7005 `321.4 MHz error` — The 321.4 MHz signal is not correct at A6J1, the output of the 321.4 MHz amplifier (A6U1) on the 321.4 MHz Reference Board Assembly. Verify that the correct cables are connected at the rear-panel 300 MHz IN and 21.4 MHz IN connectors. If the internal oscillator is selected, there must be a cable connecting the 21.4 MHz OUT and 21.4 MHz IN rear-panel connectors. Instrument preset defaults to the internal oscillator.

If the cabling is correct, the following assemblies are suspect:

■ 21.4 MHz IN/OUT jumper cable
■ A6 321.4 MHz Reference Board Assembly
■ A5 21.4 MHz Oscillator Board Assembly

7009 `ROM #2 check error` — The programmed checksum of the upper two kilobytes of EAROM does not agree with the computed checksum. First suspect the A3U4 EAROM then the A3 Controller Board Assembly.

7078 `Tune+Span error` — The Tune Span voltage is missing or not correct. Verify that the correct cable is connected to the rear-panel TUNE SPAN IN connector. Verify that there is a cable connecting TUNE SPAN IN to A4J1 on the A4 Phase Lock Loop Board Assembly. If the cables are correct, suspect the A4 board assembly.

7079 `Loop unlocked` — The A8A2 YIG Oscillator is not phase-locked to the Local Oscillator. Verify that the correct cable is connected to the rear-panel LO IN. If error 7005 or 7078 is also present, refer to the corresponding error description. Verify that cable A8W8 is connected to A4J2 on the phase lock loop board assembly. If other checks do not reveal the fault, suspect the A4 Phase Lock Loop Board or the A8 RF Assembly.

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