HP 8657A SYNTHESIZED SIGNAL GENERATOR

(Including Options 001 and 002)

Operation and Calibration Manual

SERIAL NUMBERS

This manual provides complete information for instruments with serial-number prefixes:

2746U and above

For additional important information about serial numbers, refer to "INSTRUMENTS COVERED BY THIS MANUAL" in Section 1.

NOTE

Use this manual only with instruments that have a "U" in their serial-number prefix.

First Edition

Operation and Calibration Manual HP Part 08657-90003

Other Documents Available:
Service Manual HP Part 08657-90004
Microfiche Operation and Calibration Manual HP Part 08657-90023
Microfiche Service Manual HP Part 08657-90024

Printed in U.K. : February 1988

HEWLETT
PACKARD

CERTIFICATION

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 Bureau of Standards, to the extent allowed by the Bureau'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 HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to the Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP 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. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

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SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

SAFETY SYMBOLS


Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (refer to Table of Contents.)


Indicates hazardous voltages.


Indicates earth (ground) terminal.

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

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

WARNING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could resulting personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection).

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

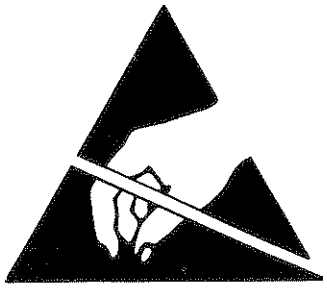
If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

Servicing instructions are for use by service trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at may points may, if contacted, result in personal injury.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source os supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.) Do not use repaired fuses or short circuited fuseholders.



ATTENTION
Static Sensitive
Devices

This instrument was constructed in an ESD (electro-static discharge) protected environment. This is because most of the semi-conductor devices used in this instrument are susceptible to damage by static discharge.

Depending on the magnitude of the charge, device substrates can be punctured or destroyed by contact or mere proximity of a static charge. The results can cause degradation of device performance, early failure, or immediate destruction.

These charges are generated in numerous ways such as simple contact, separation of materials, and normal motions of persons working with static sensitive devices.

When handling or servicing equipment containing static sensitive devices, adequate precautions must be taken to prevent device damage or destruction.

Only those who are thoroughly familiar with industry accepted techniques for handling static sensitive devices should attempt to service circuitry with these devices.

In all instances, measures must be taken to prevent static charge build-up on work surfaces and persons handling the devices.

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Section 1–General Information

Section 2–Installation

Section 3–Operation

Section4–Performance Tests

Section 5–Adjustments

Section 1
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, and adjust the Hewlett-Packard Model 8657A Signal Generator. The Model 8657A will generally be referred to as the Signal Generator throughout this manual. This manual also documents Signal Generators supplied with the high stability time base, Option 001, and rear-panel connectors, Option 002.

Operation and Calibration Manual

Section 1 General Information, describes the instruments documented by this manual, it covers instrument description, options, accessories, specifications, and other basic information.

Section 2 Installation, provides information about initial inspection, preparation for use (including time base selection, and HP-IB address selection for remote operation), and storage and shipment.

Section 3 Operation, provides information about panel features and includes operator's checks, operating instructions for both local and remote operation, and operator's maintenance information.

Section 4 Performance Tests, provides the information required to check performance of the instrument against the critical specifications listed in Table 1-1.

Section 5 Adjustments, provides the information required to properly adjust the instrument.

Service Manual

Section 6 Replaceable Parts, provides ordering information for all replaceable parts and assemblies.

Section 7 Instrument Changes, provides instrument modification recommendations and procedures.

Section 8 Service, provides the information required to repair the instrument.

One copy of the operating information is supplied with the Signal Generator. Operating information is found in Section 3 of the Operation and Calibration Manual. A copy of the Operation and Calibration Manual may be ordered separately through your nearest Hewlett-Packard office. Its part number is listed on the title page of this manual.

Also listed on the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 100 × 150 millimeter (4- × 6-inch) microfilm transparencies of this manual. Each microfiche contains up to 96 photo-duplicates of the manual's pages. The microfiche package also includes the latest MANUAL CHANGES supplement, as well as all pertinent Service Notes.

1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested. Supplemental characteristics are also listed in Table 1-1. Supplemental characteristics are not warranted specifications, but are typical characteristics included as additional information for the user.

1-3. SAFETY CONSIDERATIONS

This product is a Safety Class I instrument, that is, one provided with a protective earth terminal. The Signal Generator and all related documentation must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information pertinent to the task at hand, that is, installation, operation, performance testing, adjustment, is found throughout this manual. Safety information pertinent to servicing this product is found in the Service Manual.

1-4. INSTRUMENTS COVERED BY THIS MANUAL

This instrument has a two-part serial number in the form 0000U00000 which is stamped on the serial number plate attached to the rear of the instrument. The first four digits and the letter constitute the serial number prefix, and the last five digits form the suffix. The prefix is the same for all identical instruments. It changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those documented in this manual. The manual for this newer instrument is accompanied by a yellow MANUAL CHANGES supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current as possible, Hewlett-Packard recommends that you periodically request the latest MANUAL CHANGES supplement. The supplement for this manual is identified with the manual print date and part number, both printed on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

For information concerning a serial number prefix that is not listed to the title page or in the MANUAL CHANGES supplement, contact your nearest Hewlett-Packard Office.

1-5. DESCRIPTION

The Hewlett-Packard Model 8657A is a synthesized signal generator with a carrier frequency range of 100 kHz to 1040 MHz. Its output amplitude is leveled and calibrated from +13 to −127 dBm. AM and/or FM functions can be individually selected. The carrier frequency, output amplitude, and modulation functions can be remotely programmed via the Hewlett-Packard Interface Bus. The unique modular design and incorporated service features permit rapid and easy calibration and service.

Carrier Frequency

The Signal Generator covers a carrier frequency range of 100 kHz to 1040 MHz (10 kHz to 1040 MHz with underrange) which can be extended to 2080 MHz with an external doubler. Frequency resolution is 10 Hz. An 8-digit LED display of the carrier frequency in MHz is provided. Pushbutton keys permit coarse tuning, fine tuning, and incrementing of the carrier frequency.

Frequency accuracy and stability are dependent on the reference source being used, either the internal 50 MHz reference oscillator or an external source that operates at 1, 5, or 10 MHz. An optional 10 MHz crystal reference is available for increased accuracy and stability (Option 001).

Output Amplitude

The Signal Generator has precise power levels from +13 to −143.5 dBm (+1.00V to +0.015 nV) with overrange at decreased accuracy. The output amplitude from +7 to −127 dBm is accurate to less than or equal to ±1.0 dB from 100 kHz to 1040 MHz. Level flatness is less than or equal to ±0.5 dB with an output amplitude setting of 0.0 dBm. Output amplitude resolution is 0.1 dB. A $3\frac{1}{2}$-digit LED display of output amplitude is provided with 7 LED annunciators used to display unit information. Easy conversion of units between dBm, +V, EMF, and so forth is possible.

Modulation Capabilities

The Signal Generator features a versatile internal and external modulation capability for AM and FM. This includes internal 400 Hz or 1 kHz tones; mixed modulation, such as AM/FM, AM/AM, or FM/FM; and the capability to accept low frequency digital unsquelching signals. A 2-digit display of AM depth or FM peak deviation is provided with 11 LED annunciators used to display internal or external modulation source information. Simple keyboard entries of AM depth up to 99% with a resolution of 1%, and FM peak deviation up to 99 kHz with resolutions of 100 Hz (for deviations less than 10 kHz) or 1 kHz (for deviations greater than or equal to 10 kHz) are possible.

1-6. OPTIONS

The following options are available and may have been ordered and received with the Signal Generator. If they were not received with the original shipment and are now desired, they may be ordered from your nearest Hewlett-Packard office using the part number included in each of the following paragraphs.

Electrical Options

High Stability Timebase Option 001. A 10 MHz crystal reference for increased frequency accuracy and stability is installed. Order HP part number 08656-60079.

Mechanical Options

Rear-Panel Inputs and Outputs Option 002 . RF Output and Modulation Input/Output Connectors are located on the rear-panel. HP part number 08657-61037.

Front Handle Kit Option 907. Ease of handling is increased with the front-panel handles. Order HP part number 5061-9689.

Rack Flange Kit Option 908. This kit contains all necessary hardware and installation instructions for mounting the Signal Generator in a rack with 482.5 millimeter (standard 19-inch) spacing. Order HP part number 5061-9677.

Rack Flange and Front Handle Combination Kit Option 909. This kit is not simply a front handle kit and rack flange kit packaged together. The combination is made up of unique parts which include both functions. Order HP part number 5061-9683.

Documentation Options

Extra Manual Set Option 910. Provides an additional copy of the Operation and Calibration Manual and two copies of the Service Manual.

Add Service Manual Option 915. Use for ordering a copy of the Service Manual to enable a qualified service person to troubleshoot and repair the HP 8657A.

1-7. HEWLETT-PACKARD INTERFACE BUS

Compatibility

The Signal Generator has an HP-IB Interface Bus (HP-IB) and can be used with any HP-IB computing controller or computer for automatic system applications. The Signal Generator is fully programmable via the HP Interface Bus. The Signal Generator's complete compatibility with HP-IB is defined by the following list of interface functions: SH0, E1, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0. The Signal Generator interfaces with the bus via open collector TTL circuitry. An explanation of the compatibility codes can be found in the IEEE Standard 488 and the identical ANSI Standard MC1.1.

For more detailed information relating to programmable control of the Signal Generator, refer to Remote Operation, Hewlett-Packard Interface Bus in Section 3 of this manual.

Selecting the HP-IB Address

Five miniature HP-IB address switches are located inside the Signal Generator. These switches represent a five-bit binary number (00 through 31 in decimal). HP-IB addresses greater than 30 (decimal) are invalid. When the instrument is shipped from the factory, the HP-IB address is preset to 07 (decimal). To determine the Signal Generator's HP-IB address, refer to HP-IB Address Display in Section 3 of this manual. To change the HP-IB address, refer to paragraph 2-7, HP-IB Address Selection.

1-8. ACCESSORIES SUPPLIED

The power cable and fuse supplied for the Signal Generator are selected at the factory according to the Mains voltage available in the country of destination. For the part numbers of the power cables and Mains plugs available, refer to paragraph 2-5, Power Cables. For the part numbers and ratings of the fuses available, refer to paragraph 2-4, Line Voltage and Fuse Selection. If the Signal Generator is equipped with Option 001, a coaxial time base cable is supplied. This cable must be connected between the rear-panel TIME BASE HIGH STABILITY OUTPUT connector and the TIME BASE INPUT connector.

1-9. RECOMMENDED TEST EQUIPMENT

Table 1-2 lists the test equipment required for testing, adjusting, and servicing the Signal Generator. The Critical Specifications column describes the essential requirements for each piece of test equipment. Other equipment can be substituted if it meets or exceeds these critical specifications.

Table 1-4 lists alternate test equipment that can be used. Alternate models may be suggested for additional features that would make them a better choice in some applications. For example, some reasons for recommending an alternate model might be:

- HP-IB programmability,
- Multi-function capability (that is, one model can replace two or more single purpose models).

Table 1-1. Specifications (1 of 2)

Frequency

Range (8-digit LED display): 100 kHz to 1040 MHz.
Resolution: 10 Hz.
Display Resolution:
10 Hz for frequencies < 1000 MHz.
100 Hz for ≥ 1000 MHz.
Switching Speed (to be within 100 Hz of final frequency): <130 milliseconds.
Accuracy and Stability: Same as time base used.

Supplemental Characteristics

Frequency Underrange: *To 10 kHz with uncalibrated output and modulation.*

Phase Offset: *Output signal phase is adjustable in 1° nominal increments.*

Timebase Characteristics:

	Standard	*Option 001*
Aging rate	*±2 ppm/year*	*1×10^{-9}/day*
Temperature (0–55°C)	*±10 ppm*	*7×10^{-9}*
Line Voltage	—	*2×10^{-9} (+5%, −10%)*
Frequency	*50 MHz*	*10 MHz*
Timebase Reference Signal (Rear Panel)	*Available at a level of >0.15 V_{rms} into 50Ω (Output of 10, 5 or 1 MHz is selectable via internal jumper). If external reference is used, output will be the same frequency.*	
External Reference Input (Rear Panel)	*Accepts any 10, 5 or 1 MHz (±0.002%) frequency standard at a level >0.15 V_{rms} into 50Ω.*	

Spectral Purity

Spurious Signals (≤+7 dBm output levels):
Harmonic: <−30 dBc.
Sub-harmonic: None.
Non-harmonic (CW mode):

Frequency Range	Offset From Carrier	
	5 kHz to 2 MHz	>2 MHz
0.1– 130 MHz	−60 dBc	<−60 dBc
130– 260 MHz	−72 dBc	
260– 520 MHz	−66 dBc	
520–1040 MHz	−60 dBc	

Residual FM (in CW mode):

Frequency Range	Post Detection BW (rms detector)	
	300 Hz to 3 kHz	50 Hz to 15 kHz
0.1– 130 MHz	4 Hz	6 Hz
130– 260 MHz	1 Hz	1.5 Hz
260– 520 MHz	2 Hz	3 Hz
520–1040 MHz	4 Hz	6 Hz

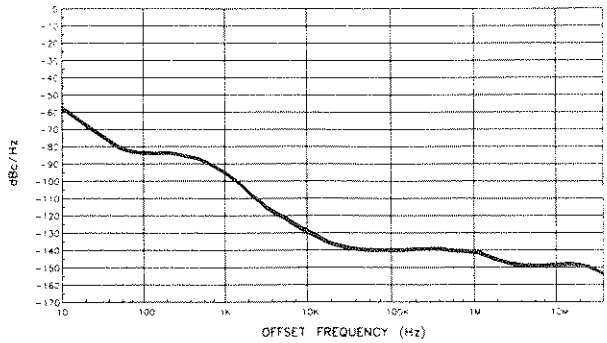
Residual AM (50 Hz to 15 kHz post-detection noise bandwidth, in CW mode): <0.04% AM.

SSB Phase Noise (in CW Mode):

Carrier Frequency	SSB Ø-Noise 20 kHz Offset
0.1 to 130 MHz	<−124 dBc/Hz
130 to 260 MHz	<−136 dBc/Hz
260 to 520 MHz	<−130 dBc/Hz
520 to 1040 MHz	<−124 dBc/Hz

Supplemental Characteristics

Typical SSB Phase Noise at 500 MHz



Output

Level Range (3½-digit LED display): +13 dBm to −143.5 dBm into 50Ω, +10 dBm to −143.5 dBm for frequencies from 100 kHz to 1 MHz.
Resolution: 0.1 dB.
Absolute Level Accuracy[1]: <±1.0 dB, +7 to −127 dBm; <±1.5 dB, >+7 dBm.
Level Flatness (100 kHz to 1040 MHz): <±0.5 dB, output level setting of 0 dBm.
SWR (f_c ≥ 400 kHz): <1.5 for levels <−3.5 dBm.
<2.0 for levels ≤+13 dBm.
Reverse-Power Protection: Protects the signal generator from applications of up to 50 watts of RF power (from a 50Ω source) to 1040 MHz into generator output; DC voltage cannot exceed 50V.

Supplemental Characteristics

Impedance: *50Ω Nominal.*
Output Level Overrange: *To +17 dBm.*
Absolute Level Accuracy:
<±1.5 dB, output levels <−127 dBm.
<±0.5 dB, 25°C ± 10°C, +7 to −127 dBm.

TYPICAL MAXIMUM POWER VS. FREQUENCY
(OUTPUT SET TP +17 dBm)

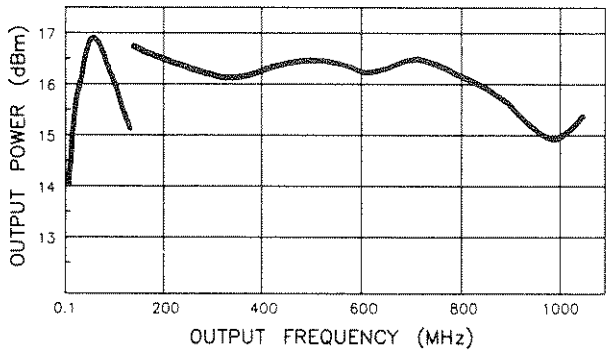


Table 1-1. Specifications (2 of 2)

Amplitude Modulation

AM Depth (2-digit LED display)[2]:
0 to 99%, level ≤+7 dBm, $f_c \geq 400$ kHz[3].
0 to 30%, level ≤+10 dBm, $f_c \geq 400$ kHz[3].
Resolution: 1%.
AM Rate, Internal: 400 Hz and 1 kHz, ±2%.
External: 20 Hz to 40 kHz (1 dB bandwidth, AC coupled).
AM Distortion (at internal rates):
0 to 30% AM <1.5% THD plus noise.
31 to 70% AM <3.0% THD plus noise.
71 to 90% AM <4.0% THD plus noise.
Indicator Accuracy (for depths <90% and internal rates and levels <+7 dBm): <±(2% +6% of setting).
Incidental Phase Modulation (at 30% AM depth, internal rates): <0.3 radians peak.

Frequency Modulation

Maximum FM Peak Deviation (2-digit LED display)[2]:

Center Frequency	Maximum Peak Deviation	
	AC Mode (the lessor of)	DC Mode
0.1 to 130 MHz	99 kHz or 4000 × rate (Hz)	99 kHz
130 to 260 MHz	50 kHz or 1000 × rate (Hz)	50 kHz
260 to 520 MHz	99 kHz or 2000 × rate (Hz)	99 kHz
520 to 1040 MHz	99 kHz or 4000 × rate (Hz)	99 kHz
FM not specified for $f_c - (\Delta f_{pk})$ <100 kHz		

Resolution: 100 Hz for deviations less than 10 kHz; 1 kHz for deviations ≥10 kHz.
FM Rate:
Internal: 400 Hz and 1 kHz, ±2%.
External: AC Coupled: 5 Hz to 100 kHz, 3 dB BW, 1 kHz reference.
20 Hz to 50 kHz, 1 dB BW, 1 kHz reference.
DC Coupled: DC to 100 kHz, 3 dB BW, 1 kHz reference.
DC to 50 kHz, 1 dB BW, 1 kHz reference.

Center Frequency Accuracy in DC Mode:

Carrier Frequency	Center Frequency Accuracy
0.1 to 130 MHz	±500 Hz
130 to 260 MHz	±125 Hz
260 to 520 MHz	±250 Hz
520 to 1040 MHz	±500 Hz

Center Frequency Stability in DC Mode: <10 Hz per hour.
FM Distortion (at internal rates and ≥3 kHz peak deviations)[4]: <0.5% THD plus noise.
Indicator Accuracy (internal rates): <± 5% of setting.
Incidental AM (peak deviations <20 kHz, internal rates and f_c ≥500 kHz): <0.1% AM.

Supplemental Characteristics

External Sensitivity: *1 volt peak for indicated accuracy (1 volt DC when in DC-FM mode).*
External Modulation Input: *Front panel BNC, 600Ω DC-coupled; front panel annunciators indicate application of 1V peak signal, ±5%.*
Modulating Signal Output: *Internal modulating signal is provided at the front panel BNC connector at nominally 1 volt peak into a 600Ω resistive load.*
Simultaneous Modulation:
Internal/External: AM/FM, FM/AM, AM/AM, FM/FM
Internal/Internal, External/External: AM/FM

Remote Programming

Interface: HP-IB (Hewlett-Packard's implementation of IEEE Standard 488).
Interface Functions Implemented: SHØ, AH1, TØ, L2, SRØ, RL1, PPØ, DC1, DTØ, CØ, E1.

General

Operating Temperature Range: 0 to +55°C.
Storage Temperature Range: −55 to +75°C.
Leakage: Conducted and radiated interference is within the requirements of RE02 of MIL STD 461B, and FTZ 1046. Furthermore, RF leakage of <1 μV is induced in a two-turn loop, 2.5 cm in diameter, held 2.5 cm away from the front surface.
Save/Recall/Sequence Storage Registers: 100 non-volatile registers are available that save front panel settings.
Power Requirements: 100 or 120 or 220 or 240 volts (+5%, −10%) from 48 to 440 Hz; 175 VA maximum.
Weight: Net 18.2 kg (40 lb); shipping 23.6 kg (52 lb).
Dimensions: 133H × 425W × 520D mm (5.25 × 16.75 × 20.5 inches).
HP System II module size: 5¼H × 1MW × 17D.

Table 1-2. *Recommended Test Equipment (1 of 3)*

Instrument Type	Critical Specifications	Recommended Model	Use[1]
AM/FM Test Source (required for Measuring Receiver verification)	Range: 10 MHz Residual AM[2] FM Flatness: ±1% (dc to 250 kHz Peak Deviation: to 100 kHz	HP 11715A	P
Audio Source	Level: 0.0 to 1 Vpk into 50 and 600 ohms Frequency: 25 Hz to 40 kHz	HP 8903B	P, A, T
Controller, HP-IB	HP-IB compatibility as defined as IEEE Standard 488 and the identical ANSI Standard MC1.I: SHO, E1, AH1, T4, TEO, LO, LEO, SRO, RLO, PPO, DCO, DTO, and C1, 2, 3, 28.	Use any HP controller and HP-IB interface to implement HP-IB functional checks	T
DC Power Supply	Output: 0-1 V Current: 500 mA	HP 6214A	A
Digital Multimeter	Accuracy: 4 1/2 digit, ±0.05% of reading ±3 Ranges: 20 mV to 30 Vdc and 2 Vac Sensitivity: 100 μV	HP 3466A or HP 3455A (see Table 1-3)	P, A, T
Distortion Analyzer	Distortion Range: <0.1% Range: 25 Hz to 25 kHz	HP 8903A	P,T
Frequency Counter	Range: 10 MHz Resolution: 1 Hz	HP 5328B	A
Frequency Counter	Range: 1040 MHz Resolution: 10 Hz	HP 5328B Option 031	T
Function Generator	Frequency Range: 500 Hz Function: Square wave Output Level: 1 Vp into 600 ohms	HP 3312A	T
Loop Antenna	To ensure measurement accuracy, no substitution is possible. Fabrication depends upon machining and assembling to close tolerances.	HP 08640-60501	P
Measuring Receiver and Sensor Module	Frequency Range: 150 kHz to 990 MHz Input Level: −127 to +13 dBm RF Power: 0.2 dB Tuned RF Level: 0.36 dB RSS Referenced to −10 dBm input	HP 8902A and 11722A (option 003 required for Residual FM Optional Performance Test)	P, A, T

[1] A = Adjustments; P = Performance Tests; T = Troubleshooting.

[2] The residual AM specification of both the HP 8902A Measuring Receiver and HP 11715A AM/FM Test Source are stated in a 50 Hz to 3 kHz bandwidth. In order to assure the validity of the residual AM measurement in the bandwidths stated for the HP 8657A Signal Generator (namely, 50 Hz to 15 kHz) the combined performance of both the HP 8902A and HP 11715A must be verified to be better than 0.022% rms for the 50 Hz to 15 kHz bandwidth.

Table 1-2. *Recommended Test Equipment (2 of 3)*

Instrument Type	Critical Specifications	Recommended Model	Use[3]
Measuring Receiver and Sensor Module (Cont'd)	Amplitude Modulation: Rates[4]: 25 Hz to 25 kHz Depth: to 99% Accuracy: Flatness: ±0.5% Demodulated Output Distortion:0.3% for 50% depth; <0.6% for 90% depth Incidental ΩM: <0.05 radians for 50% depth at 1 kHz rate (50 Hz to 3 kHz bandwidth) Residual AM[5] Frequency Modulation: Rates: 25 Hz to 25 kHz Deviation to 99 kHz Accuracy ±2% at 1 kHz Demodulated Output Distortion: <0.3% Incidental AM[5] Residual FM: <8 Hz rms at 1300 decreasing linearly with frequency to <1 Hz rms for 1000 MHz and below (50 Hz to 3 kHz bandwidth) Audio Distortion: Frequencies: 400 Hz and 1 kHz, ±5% Display Range: < 0.1% Accuracy: ±1 dB of reading	HP 8902A and 17722A ±2% at 1 kHz	P, A, T
Oscilloscope and Probes	Vertical Sensitivity: 100 mV/div (with 54001A 1 GHz Active Probe 54003A 1MΩ input and 10:1 probe 54003-61617 Bandwidth: 50 MHz Time Base: .05 μsec Input: Dual Channel	HP 54100A[6]	A, T
Phase Noise Measurement System	Frequency Range: 0.1to 1040 MHz Offset: 20 kHz Accuracy: ±2 dB Noise Floor: −145 dB	HP 3048A	P

[3] A = Adjustments; P = Performance Tests; T = Troubleshooting.

[4] The incidental AM specification for the Signal Generator is not equivalent to the published specification of the HP 8902A Measuring Receiver. In order to assure the validity of the Incidental AM measurement, the incidental AM of the modulation analyzer must be verified to be less than 0.002% for the 300 Hz to 20 kHz peak deviation at internal rates.

[5] The residual AM specification of both the HP 8902A Measuring Receiver and HP 11715A AM/FM Test Source are stated in a 50 Hz to 3 kHz bandwidth. In order to assure the validity of the residual AM measurement in the bandwidths stated for the HP 8657A Signal Generator (namely, 50 Hz to 15 kHz) the combined performance of both the HP 8902A and HP 11715A must be verified to be better than 0.022% rms for the 50 Hz to 15 kHz bandwidth.

[6] See Table 1-4 for an alternate analog oscilloscope listing.

Table 1–2. *Recommended Test Equipment (3 of 3)*

Instrument Type	Critical Specifications	Recommended Model	Use[7]
Reference Source	Frequency: 0.1 to 1040 MHz Level: +13 dBm SSB Phase Noise (20 kHz offset): < −124 dBc/Hz, 0.1 to 130 MHz < −136 dBc/Hz, 130 to 260 MHz < −130 dBc/Hz, 260 tp 520 MHz < −124 dBc/Hz, 520 to 1040 MHz	HP 8657A or HP 8662A	P
Signal Source (optional)	Residual SSB phase noise in 1 Hz Bw (320 MHz $\leq f_c$ <640 MHz) with an offset from the carrier of: −100 dBc at 10 Hz, −121 dBc at 1 kHz, and −131 dBc at 10 kHz	HP 8662A (for Optional Residual FM Test)	P
Signature Analyzer	Provides preferred method for troubleshooting digital circuitry	HP 5005A	T
Spectrum Analyzer, RF	Frequency Range: 0.1 to 1040 MHz Resolution Bandwidth: <1 kHz to 3 kHz	HP 8568B or HP 8558B/P/853A (see Table 1–4)	P, A, T
SWR Bridge	Frequency Range: 5 MHz to 1040 MHz Impedance: 50 ohms Directivity: >40 dB Test Connector: Type N male	Wiltron 60N50	P
Wideband Amplifier	Gain: 20 or greater Frequency Range: 10 MHz to 1040 MHz Impedance: 50 ohms Connector: Type N	HP 8447D Option 010	P
Termination	Frequency Range: 0.1 to 1040 MHz Termination: 50ohms SWR: <1.05	HP 908A	P

[7] A = Adjustments; P = Performance Tests; T = Troubleshooting.

Table 1–3. *Recommended Accessories*

Adapter	Quantity	Type	Recommended Model	Use[1]
Coaxial	1	BNC(f) to BNC(f)	HP 1250-0080	A, T
Coaxial	1	N(f) to BNC(m)	HP 1250-0077	A
Coaxial	3	N(m) to BNC(f)	HP 1250-0780	P, A, T
Probe	2	SMC(f) to RF Test Point	HP 1250-1598	A, T
RF	2	BNC(f) to SMC(f)	HP 08662-60075	P
RF	1	Connector: UG-21D/U Type N(m)	HP 11500A	P, A, T
RF	2	Connector: UG-21D/U Type N(m)	HP 11500B	P, A, T

[1] A = Adjustments; P = Performance Tests; T = Troubleshooting.

Table 1–4. *Alternate Test Equipment*

Instrument	Recommended Model	Suggested Alternative	Advantages of Alternative
Digital Voltmeter (DVM)	HP 3466A	HP 3455A	HP-IB* Compatible
Frequency Counter	HP 5328B Option 031	HP 5328A Options 001 and 031	HP-IB* Compatible
Oscilloscope	HP 54100A	HP 1740A	Availability
Spectrum Analyzer, RF	HP 8658B	HP 8558B/P/853A or HP 8554B/8552B/141T	Satisfies the requirements for testing the Signal Generator.

* HP-IB is Hewlett-Packard's implementation of IEEE Standard 488 and the identical ANSI Standard MC1.1

Section 2
INSTALLATION

2-1. INTRODUCTION

This section provides the information needed to install the Signal Generator. Included is information pertinent to initial inspection, power requirements, line voltage and fuse selection, power cables, time base selection, HP-IB address selection, interconnection, mating connectors, operating environment, instrument mounting, storage, and shipment.

2-2. INITIAL INSPECTION

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are any signs of shipping damage to any portion of the outer enclosure (covers and panels).

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. Procedures for checking electrical performance are given in Section 4. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

2-3. PREPARATION FOR USE

The Signal Generator requires a power source of 100, 120, 220, or 240 Vac from 48 to 440 Hz. Power consumption is 175 VA maximum.

WARNING

This is a Safety Class I product (i.e., provided with a protective earth terminal). An uninterruptible safety earth ground must be provided from the Mains power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an external autotransformer for voltage reduction, make sure that the common terminal is connected to the earthed pole of the power source.

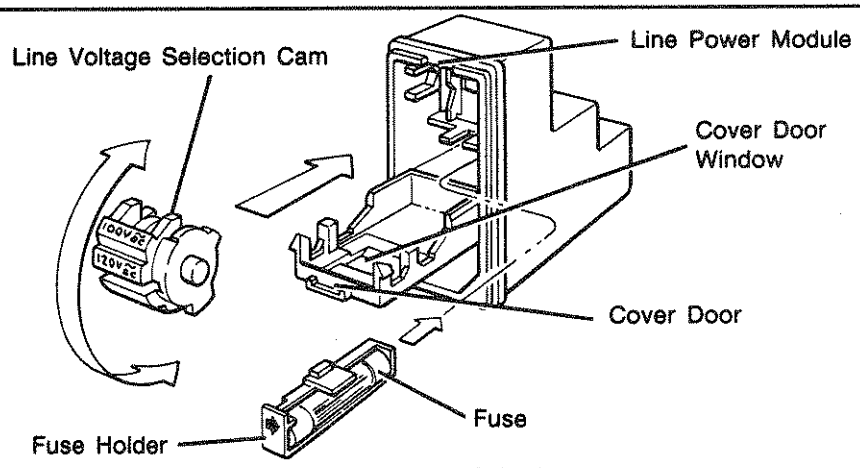
2-4. LINE VOLTAGE SELECTION AND FUSE REPLACEMENT

CAUTION

BEFORE PLUGGING THIS INSTRUMENT into the Mains (line) voltage, be sure the correct voltage has been selected.

A rear-panel, line power module permits operation from 100, 120, 220, or 240 Vac. The number visible in the window (located on the module) indicates the nominal line voltage to which the instrument must be connected. Verify that the Line Voltage Selection Cam is matched to the power source. See Figure 2-1, Line Voltage Selection and Fuse Replacement. Table 2-1 lists the ratings and the HP part number for the replaceable fuse.

The fuse is installed in the instrument at the time of shipment. The rating of the line voltage selection card is selected according to the line voltage specified by the customer. If the voltage is not specified, the rating of the installed cam will be selected according to the country of destination.



Line Voltage Selection

1. Open the Cover Door by placing a small standard screwdriver between the Cover Door and the Line Power Module, and pry open.
2. Remove the Line Voltage Selection Cam with fingers. Rotate cam so that the desired line voltage appears at the Cover Door Window when the cam is re-inserted.
3. Close the Cover Door by pressing it firmly.

Fuse Replacement

1. Open the Cover Door as described in step 1 for Line Voltage Selection.
2. Remove Fuse Holder with fingers. Replace Fuse in Fuse Holder and re-insert into the Line Power Module.
3. Close the Cover Door by pressing it firmly.

Figure 2-1. *Line Voltage Selection and Fuse Replacement*

WARNING

For protection against fire hazard, the line fuse should only be a 250V fuse with the correct current rating.

Table 2–1. *Line Fuse Rating and HP Part Number*

Line Voltage	Rating	Part Number
100, 120 Vac	2A, 250V	2110-0002
220, 240 Vac	1.5A, 250V	2110-0043

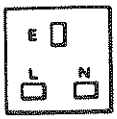
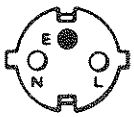
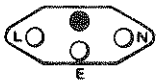
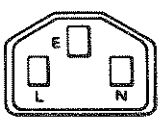
2–5. POWER CABLES

WARNING

BEFORE CONNECTING THIS INSTRUMENT, the protective earth terminal of the instrument must be connected to the protective conductor of the (Mains) power cord. The Mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of Mains plug shipped with each instrument depends on the country of destination. Refer to Table 2–2 for the part numbers of the power cables and Mains plugs available.

Table 2–2. Power Cable and Mains Plug Part Numbers

Plug Type	Cable HP Part Number	CD	Plug Description	Cable Length (inches)	Cable Color	For Use in Country
250V 	8120-1351 8120-1703	0 4	90°/STR BS1363A* 90°/90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Rhodesia, Singapore
250V 	8120-1369 8120-0696	0 4	STR/STR NZSS198/ASC112* STR/90°	79 80	Gray Gray	Austrailia, New Zealand
250V 	8120-1689 8120-1692	7 2	STR/STR* STR/90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, (unpolarized in many nations)
125V 	8120-1378 8120-1521 8120-1751	1 6 1	STR/STR NEMA5-15P* STR/90° STR/STR	80 80 90	Jade Gray Jade Gray Jade Gray	United States, Canada, Mexico, Phillipines, Taiwan U.S./Canada
100V (Same plug as above)	8120-4753 8120-4754	2 3	STR/STR STR/90°	90 90	Dark Gray Dark Gray	Japan only Japan only
250V 	8120-2104 8120-2296 8120-3997	3 4 4	STR/STR SEV1011 1959-24507 Type 12 STR/90° STR/90°	79 79 177	Gray Gray Gray	Switzerland
250V 	8120-0698	6	STR/STR NEMA6-15P	90	Black	United States, Canada
250V 	8120-2956 8120-2957 8120-3997	3 4 4	90°/STR 90°/90° STR/STR	79	Gray	Denmark
250V 	8120-4211 8120-4600	7 8	STR/STR*IEC83-B1 STR/90°	79 79	Black Gray	South Africa, India
250V 	8120-1860 8120-1575 8120-2191 8120-4379	6 0 8 8	STR/STR*CEE22-V1 (Systems Cabinet Use) STR/STR STR/90° 90°/90°	59 31 59 80	Jade Gray Jade Gray Jade Gray Jade Gray	

* Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug. E = Earth Ground; L = Line; N = Neutral; STR = Straight

2-6. TIME BASE SELECTION

One of three time base output signals (1, 5, or 10 MHz at a level greater than 0.15 Vrms into 50 ohms) is accessible at the rear-panel TIME BASE OUTPUT connector. This output signal is derived from the internal reference oscillator frequency and is jumper selectable through a resistor located inside the Signal Generator on the Low Frequency Loop Assembly — A3. When the instrument is shipped from the factory, the resistive jumper is hard-wired to provide a 10 MHz time base output signal. If the Option 001 or another external 10 MHz reference is applied to the rear-panel TIME BASE INPUT connector, only that reference frequency will be available as an output signal.

If either a 1 or 5 MHz output signal is desired, the internal resistive jumper will have to be repositioned. Similarly, if an external 1 or 5 MHz reference input is to be applied to the rear-panel TIME BASE INPUT connector, the resistive jumper will have to be repositioned to the position that corresponds to the frequency of the external reference input. The top cover of the Signal Generator, and the top cover of the Low Frequency Loop 50 MHz Reference Oscillator will have to be removed to gain access to the time base jumper. The following procedure describes how to change the location of the resistive jumper.

a. Switch the HP 8657A to Standby, and then remove it's top cover by removing the two screws used to secure the strap handle and handle caps to each side of the instrument. Then lift the top cover away from the frame.
b. Remove the top cover of the Low Frequency Loop 50 MHz Reference Oscillator by removing eight screws on the top cover's four sides. The 50 MHz Reference Oscillator's top cover is located on the Low Frequency Loop Assembly — A3 to the rear of the Signal Generator. The top cover lifts off exposing the time base jumper (see Figure 2-2).
c. Unsolder one end of the resistive jumper and resolder it in the position that corresponds to the desired time base output or to the external reference input.
d. Reassemble the instrument by reversing the procedure given in step b and then in step a.

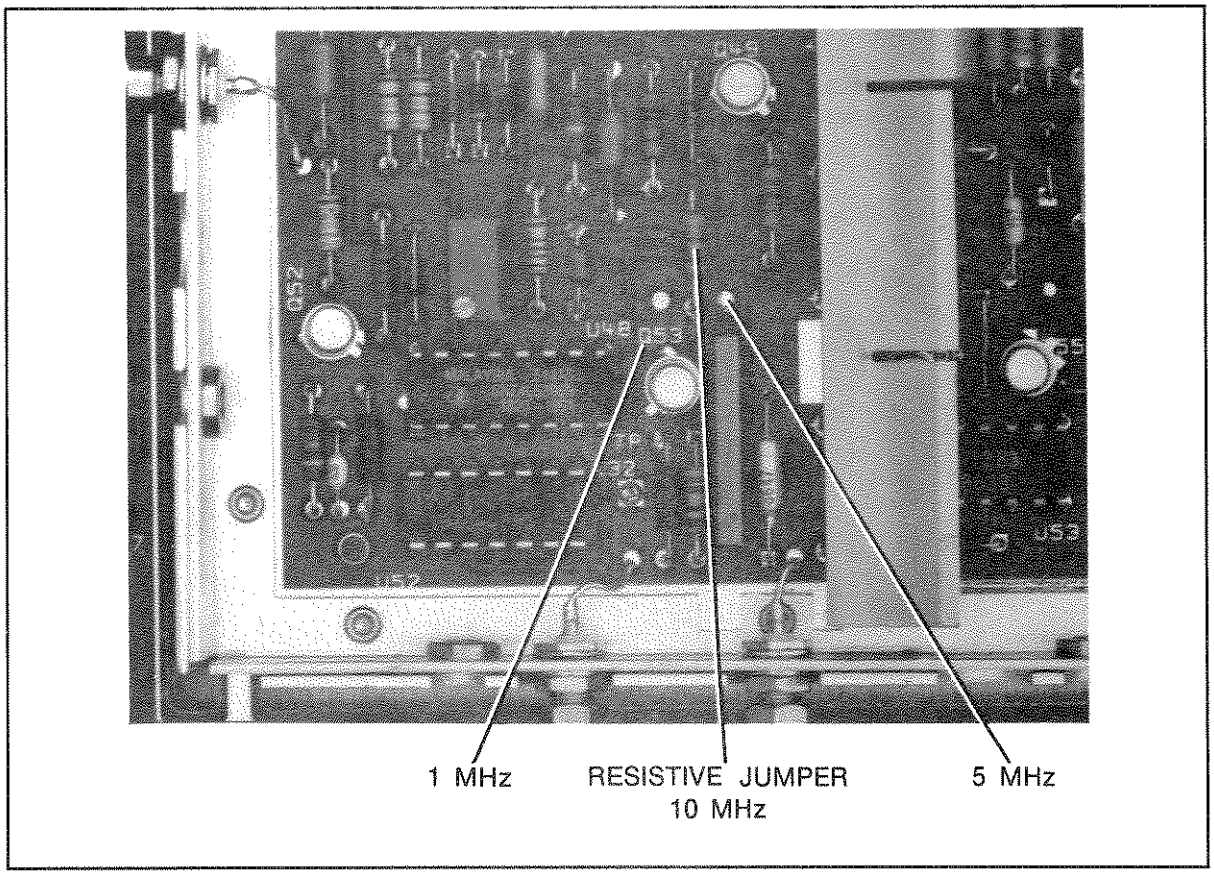


Figure 2-2. Time Base Jumper Location

2-7. HP-IB ADDRESS SELECTION

The Signal Generator is strictly a listener, never a talker, and therefore only its HP-IB (listen) address can be selected. This HP-IB address is switch-selectable through five miniature rocker-switches located inside the Signal Generator on the Microprocessor/Memory/HP-IB Assembly — A11. These switches provide the means to select one of 31 valid HP-IB addresses (00 through 30). HP-IB addresses greater than 30 (decimal) are invalid. Refer to Table 2-3 for the allowable HP-IB address codes. Listed are the valid address switch settings and the equivalent ASCII character and decimal value. When the instrument is shipped from the factory, the HP-IB address is preset to 07 (decimal). (In binary, this is 00111; the ASCII equivalent character is an apostrophe.) This preset address is shaded in Table 2-3. The bottom cover of the Signal Generator will have to be removed to gain access to the HP-IB switches. The following procedure describes how to change the settings of the HP-IB address switches.

NOTE

The HP-IB address stored in memory only changes after the switch settings have changed and the instrument is switched from standby to on. Otherwise, the stored HP-IB address remains unchanged.

a. Unplug the Signal Generator.
b. Remove the bottom cover from the Signal Generator by first removing the two screws used to secure the strap handle and handle caps to each side of the instrument. Lift the bottom cover away from the frame.
c. Locate the HP-IB address switches S2 and S3 on the Microprocessor/Memory/HP-IB Assembly — A11 (see Figure 2-3).
d. Use a pointed object (such as a pencil) to set the switches to the desired HP-IB address in binary (see Figure 2-3). The five switches are labeled A1 through A5, where A1 is the least significant address bit and A5 is the most significant address bit. Pressing the right-hand side of the switch (as viewed from the front of the instrument) "sets" the corresponding address bit (bit = 1), while pressing the left-hand side "clears"the bit (bit = 0). Setting all of the address bits to "1" will result in an invalid HP-IB address (31 decimal). In this case, an HP-IB address of 30 (decimal) is stored in memory once the instrument is powered up.
e. Replace the bottom cover by reversing the procedure given in step b.
f. Plug in the Signal Generator.
g. To confirm the HP-IB address, simply press the SHIFT key, and hold the LOCAL key. The internally-set, decimal HP-IB address is displayed in the MODULATION Display as long as the LOCAL key remains pressed.

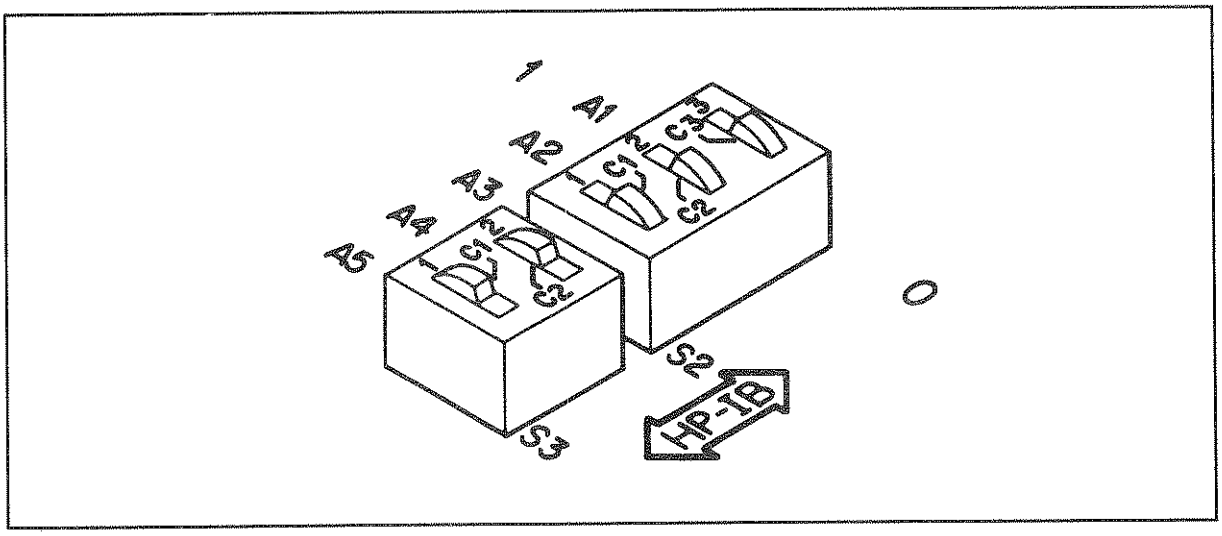


Figure 2-3. HP-IB Address Switch Location and Settings

Table 2–3. *Allowable HP-IB Address Codes*

Address Switch					Equivalent ASCII Character (LISTEN)	Equivalent Decimal Value (LISTEN)
A5	A4	A3	A2	A1		
0	0	0	0	0	SP	00
0	0	0	0	1	!	01
0	0	0	1	0	"	02
0	0	0	1	1	#	03
0	0	1	0	0	$	04
0	0	1	0	1	%	05
0	0	1	1	0	&	06
0	0	1	1	1	'	07
0	1	0	0	0	(	08
0	1	0	0	1	)	09
0	1	0	1	0	*	10
0	1	0	1	1	C	11
0	1	1	0	0	,	12
0	1	1	0	1	–	13
0	1	1	1	0	.	14
0	1	1	1	1	/	15
1	0	0	0	0	0	16
1	0	0	0	1	1	17
1	0	0	1	0	2	18
1	0	0	1	1	3	19
1	0	1	0	0	4	20
1	0	1	0	1	5	21
1	0	1	1	0	6	22
1	0	1	1	1	7	23
1	1	0	0	0	8	24
1	1	0	0	1	9	25
1	1	0	1	0	:	26
1	1	0	1	1	;	27
1	1	1	0	0	J	28
1	1	1	0	1	G	29
1	1	1	1	0	K	30

2-8. INTERCONNECTION

Interconnection data for the Hewlett-Packard Interface Bus is provided in Figure 2-4.

Mating Connectors

Coaxial Connectors. Coaxial mating connectors used with the Signal Generator should be either 50-ohm BNC male connectors or 50-ohm Type N male connectors that are compatible with those specified in US MIL-C-39012.

Interface Connector. The HP-IB mating connector is shown in Figure 2-4. Note that the two securing screws are metric.

2-9. OPERATING ENVIRONMENT

The operating environment should be within the following limitations:

Temperature ..... 0° C to + 55° C
Humidity ..... < 95% relative at 40° C
Altitude ..... < 4570 meters (15,000 feet)

2-10. BENCH OPERATION

The instrument cabinet has plastic feet and foldaway tilt stands for convenience in bench operation. (The plastic feet are shaped to ensure self-alignment of instruments when they are stacked.) The tilt stands raise the front of the Signal Generator for easier viewing of the front-panel.

2-11. RACK MOUNTING

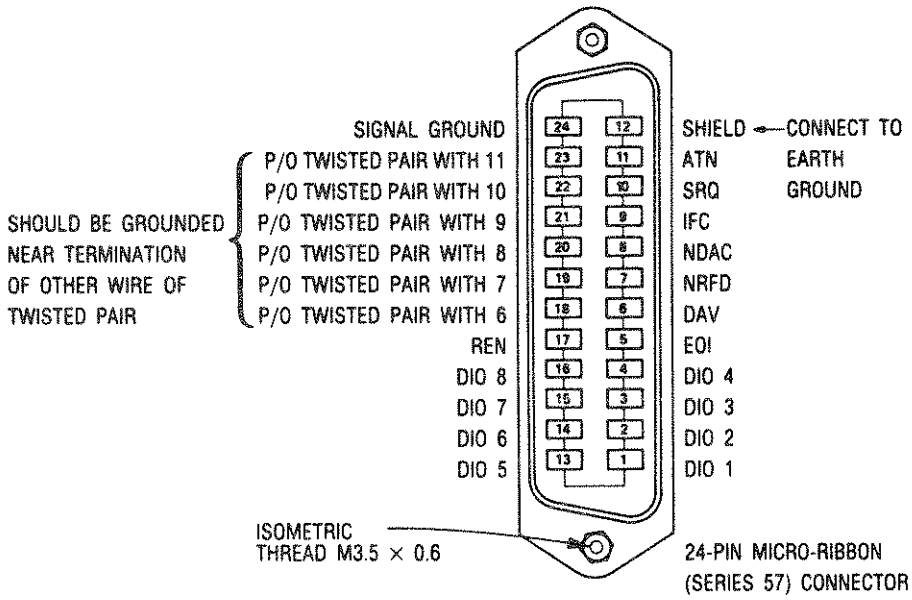
NOTE

The Signal Generator weighs 18.2 kg (40 lb); therefore, care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting.

Rack mounting information is provided with the rack mounting kits. If a kit was not ordered with the Signal Generator as an option, it may be ordered through the nearest Hewlett-Packard office. Slide rack mount kits are discussed in the following paragraphs; refer to paragraph 1-11, Mechanical Options, in Section 1 for information and part numbers pertaining to other rack mount kits.

Slide rack mount kits allow the convenience of rack mounting with the flexibility of easy access. The slide kits for the Signal Generator are listed below.

Standard Slide Kit for HP rack enclosures ..... HP 1494-0060
Special Tilt Slide Kit for HP rack enclosures ..... HP 08656-82001
Slide Adapter Bracket Kit for Standard Slides (for non HP rack enclosures) .... HP 1494-0061



Logic Levels

The Hewlett-Packard Interface Bus logic levels are TTL compatible, i.e., the true (1) state is 0.0 Vdc to +0.4 Vdc and the false (0) state is 2.5 Vdc to +5 Vdc.

Programming and Output Data Format

Refer to Section III, "Operation".

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

HP 10833A, 1 metre (3.3 ft.), HP 10833B, 2 metres (6.6 ft.)
HP 10833C, 4 metres (13.2 ft.), HP 10833D, 0.5 metres (1.6 ft.)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus system may contain no more than 2 metres (6.6 ft.) of connecting cable per instrument.
2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus system is 20 metres (65.6 ft.).

Figure 2–4. Hewlett-Packard Interface Bus Connections

2-12. STORAGE AND SHIPMENT

Environment

The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment.

Temperature	−55° C to + 75° C
Humidity	< 95% relative
Altitude	15,300 meters (50,000 feet)

Packaging

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

Other Packaging. The following general instructions should be used for repackaging with commercially available materials.

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)
b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.
c. Use enough shock-absorbing material (75 to 100 millimeter layer; 3 to 4 inches) around all sides of the instrument to provide a firm cushion and to prevent movement in the container. Protect the front-panel with cardboard.
d. Seal the shipping container securely.
e. Mark the shipping container FRAGILE to assure careful handling.

Section 3
OPERATION

3-1. INTRODUCTION

This section provides complete operating information for the Signal Generator. Included are both general and detailed operating instructions; detailed descriptions of each front and rear panel key, connector, switch and display; information on remote operation; operator's checks; and operator's maintenance procedures.

3-2. OPERATING CHARACTERISTICS

Table 3-1 briefly summarizes the major operating characteristics of the Signal Generator. This table is not intended to be an in-depth listing of all characteristics. For more detailed information on the Signal Generator's characteristics, refer to Table 1-1, Specifications. For information on the instrument's HP-IB capabilities, refer to the summary contained in Table 3-9, HP-IB Message Reference Table.

3-3. LOCAL OPERATION

Information covering front-panel operation of the Signal generator is presented in four areas of this section, namely General Operating Instructions, Simplified Front-Panel Features and Operation, Basic Functional Checks, and Detailed Operating Instructions.

General Operating Instructions (Refer to paragraph 3-6). Instructions relating to the Signal Generator's power-on procedure, power-on sequence, various keystroke sequences, and time-base selection are presented to acquaint the user with general operation of the instrument.

Front-Panel Features and Simplified Operation (Refer to paragraph 3-7). Figure 3-1 illustrates the front-panel of the Signal Generator and provides simplified descriptions of each key, connector, switch, and display. The instructions on operation also provide a quick introduction to front-panel operation of the Signal Generator. These instructions are designed to rapidly acquaint the novice user with the basic operation of the instrument. Included are instructions for setting carrier functions, setting modulation functions, and changing parameter values. This is a good starting point for the first-time user.

Basic Functional Checks (Refer to paragraph 3-9). This procedure provides assurance that most of the front-panel controlled functions are being properly executed by the Signal Generator. A frequency counter, spectrum analyzer, and interconnecting cables and adapters are required.

Detailed Operating Instructions (Refer to paragraph 3-12). The detailed operating instructions present the most comprehensive information about all of the Signal Generator's functions. Table 3-10 provides an index (in functional order) to the detailed operating instructions. This index is intended to direct the user to the more complete operating instructions which are arranged alphabetically at the end of this section.

Table 3–1. Operating Characteristics

<table>
<tr><td>Frequency</td><td>Range: 100 kHz to 1040 MHz
Resolution: 10 Hz</td></tr>
<tr><td>Amplitude</td><td>Range: −143.5 dBm to +13 dBm (+1.00V to +0.100 μV)
Resolution: 0.1 dB
Absolute Level Accuracy: ≤ ±1.0 dB; −127 dBm to +7 dBm</td></tr>
<tr><td>Modulation</td><td>AM
Depth: 0% to 99%, levels ≤ +7 dBm
0% to 30%, levels >+7 dBm to +10 dBm
Resolution: 1%
FM
Peak Deviation:
<table>
<tr><th rowspan="2">Carrier Frequency (MHz)</th><th colspan="3">Maximum Peak Deviation</th></tr>
<tr><th colspan="2">AC Mode</th><th rowspan="2">DC Mode</th></tr>
<tr><th>Rates ≥ 50 Hz</th><th>Rates < 50 Hz</th></tr>
<tr><td>0.1 to 129.99999</td><td>99 kHz</td><td>4000 × rate Hz</td><td>99 kHz</td></tr>
<tr><td>130 to 259.99999</td><td>50 kHz</td><td>1000 × rate Hz</td><td>50 kHz</td></tr>
<tr><td>260 to 519.99999</td><td>99 kHz</td><td>2000 × rate Hz</td><td>99 kHz</td></tr>
<tr><td>520 to 1040</td><td>99 kHz</td><td>4000 × rate Hz</td><td>99 kHz</td></tr>
</table>
Resolution: 0.1 kHz (deviations < 10 kHz)
1 kHz (deviations ≥ 10 kHz)
Rates: Internal: 400 Hz or 1 kHz ±2%,
External:
Ac Coupled: 5 Hz to 100 kHz, ±3 dB
20 Hz to 50 kHz, ± 1 dB
Dc Coupled: Dc to 100 kHz, ±3 dB
Dc to 50 kHz, ±1 dB
External Modulation Source: 600 ohms nominal, ac coupled
Mixed Modulation: Internal/Internal: AM/FM
Internal/External: AM/FM, FM/AM, AM/AM, and FM/FM</td></tr>
</table>

3–4. TIME BASE SELECTION

The Signal Generator is shipped from the factory with a resistive jumper hard-wired to provide a 10 MHz time base output signal at the rear-panel TIME BASE OUTPUT connector. If either a 1 or 5 MHz output signal is desired, this internal resistive jumper will have to be repositioned. Also, if an external 1 or 5 MHz reference input is to be applied at the rear-panel TIME BASE INPUT connector, this internal resistive jumper will have to be repositioned. In either case, this internal resistive jumper has to be installed in the position that corresponds to the frequency of the time base input or output signal being used. Refer to paragraph 2-6 for the time base selection procedure.

3-5. REMOTE OPERATION (HP-IB)

The Signal Generator is capable of remote operation via the Hewlett-Packard Interface Bus. Knowledge of local operation is essential for HP-IB programming since most of the data messages contain the same keystroke-like sequences. HP-IB information is presented in the following areas of this section:

a. General HP-IB information begins with paragraph 3-10.

b. A summary of HP-IB capabilities is provided in Table 3-9.

c. A summary of program codes is provided in Tables 3-6 and 3-7.

d. HP-IB Functional Checks begin with paragraph 3-11. This series of procedures requires an HP-IB compatible computing controller, and an HP-IB interface with its interconnecting cable. These procedures assume that front-panel operation has been previously verified, that is, that the basic functional checks have been previously performed. The procedures check all of the applicable bus messages summarized in Table 3-9.

e. Detailed information relating to the Signal Generator's HP-IB programmable features together with tables and examples of associated program codes are presented in the detailed operating instructions which are arranged alphabetically at the end of this section.

3-6. GENERAL OPERATING INSTRUCTIONS

WARNING

Before the Signal Generator is switched on, all protective earth terminals, extension cords, autotransformers, and devices connected to it should be connected to a protective earth grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

For continued protection against fire hazard, replace the line fuse with only a 250V fuse of the same rating. Do not use repaired fuses or short circuited fuseholders.

CAUTION

Before the Signal Generator is switched on, it must be set to the same line voltage as the power source or damage to the instrument may result.

The Signal Generator is protected against reverse power applications up to 50 watts; however, for greatest protection of expensive internal components be careful not to apply any reverse power to the RF OUTPUT connector.

Operator's Maintenance

The only maintenance the operator should normally perform is replacement of the primary power fuse. For instructions on how to change the fuse, see Figure 2-1, steps 1-3. Fuses may be ordered under HP Part Number 2110-0002 (2A, 250V) for 100/120 Vac, or under HP Part Number 2110-0043 (1.5A, 250V) for 220/240 Vac operation.

All other maintenance should be referred to qualified service personnel.

Power-On Procedure

The Signal Generator has a "STANDBY" state and and "ON" state. Whenever the instrument is connected to the AC line voltage and is in standby, all regulated power supply voltages are off. If the instrument is equipped with an optional high stability reference (Option 001), the timebase oven will be energized to keep the reference oscillator stable. If the Signal Generator is already plugged in, set the POWER switch to ON. If the power cable is not plugged in, follow these instructions:

1. Check that the line voltage setting matches the power source. Refer to paragraph 2-4.
2. Check that the fuse rating is appropriate for the line voltage being used. Refer to paragraph 2-4.
3. Plug in the power cable.
4. Set the POWER switch to ON.

Power-On Sequence

When the POWER switch is set to ON, an internal memory check is initiated. This check tests for a failure in ROM (read-only memory) and in RAM (read-write memory). During this check, all front-panel indicators will light for approximately 1.5 seconds to provide a quick visual inspection of each front-panel annunciator and display segment. If a memory failure is detected, a RAM or ROM error code will be displayed in the frequency display window. A 2-digit numeral is displayed and all other displays and LEDs will be off. Table 3-2 lists the codes and respective faults for the power-on check-tests. The error code remains displayed until any front-panel key is pressed.

Table 3-2. *Power-On Error Codes.*

Error Code	Fault	Address
10	RAM Error	0000-07FF
20	ROM Error	8000-FFFF
30	RAM and ROM Error	

The Signal Generator is equipped with a battery backup for its internal RAM memory. Current instrument settings and contents of the 100 storage registers are kept active by the battery backup whenever the instrument is in standby or whenever the AC line voltage is removed. After a successful internal memory check, the instrument settings and contents of the storage registers are the same as when the instrument was last ON. If, when the instrument was last ON, RF OFF had been selected, the instrument will power up with RF ON.

Power STBY Sequence

When the instrument is turned to STBY after being ON, all instrument settings and contents of the storage registers are saved in RAM. When the instrument is turned back ON, all instrument functions and storage registers return to their previous settings, except for the sequence counter, which is reset to zero, and RF OFF. Output amplitude will be the same as when RF OFF had been selected.

3-7. FRONT-PANEL FEATURES AND SIMPLIFIED OPERATION

The Signal Generator is designed to be simple and easy to operate. The front-panel primarily consists of 48 pushbutton keys, 3 digital displays, and 20 LED annunciators. Each key has a single purpose and only one key should ever be pressed at any given time. In most cases, keys are pressed, then released, with the action occurring as the key is pressed. In some cases, a key must be pressed and held for the action to occur. The four main functions of the Signal Generator are selected by four dark gray colored keys labeled FREQ, AMPTD, AM and FM. The only other dark gray colored key (located in the upper left-hand corner of the front-panel) selects local operation when in the remote mode. The 28 medium gray colored keys control the modulation source, enter numeric data, select the unit(s) which terminates data entry, and turn RF off and on. The 14 light gray colored keys set an increment value for each of the four main functions, change main function parameters by the set increment values, and store up to 100 (00-99) complete front-panel settings (exclusive of increment values) for either selectable or sequential recall at a later time. The light blue colored key, SHIFT, changes the capabilities of some keys to their blue labeled function. The SHIFT key allows the user to access DC FM, phase-up, phase-down, instrument-preset, to display the contents of the sequence counter, to display the internally set decimal HP-IB address, and to enter the diagnostics mode.

The 3 digital displays show frequency of the carrier in megahertz, output amplitude of the carrier in one of 14 possible units, and percentage of AM depth or frequency of FM peak deviation used to modulate the carrier. In addition, the FREQUENCY Display can show the value of the carrier frequency increment, and is used to display an error code if a memory failure occurs; the AMPLITUDE Display can show the value of the output amplitude increment or current contents of the sequence counter; and the MODULATION Display can show the value of the modulation increment or internally set, decimal HP-IB address. All 3 digital displays are used when the keyboard-invoked tests are run.

The 20 LED annunciators are used to indicate remote operation status, internal or external modulation source and unit information, and amplitude unit information.

Keystroke Sequences

The Signal Generator's functions can be selected in any order; however, each function selection requires a prescribed sequence of keystrokes. A keystroke sequence might contain only a single keystroke, such as SEQuence, RF OFF, or return to local operation. More often though the sequence contains several keystrokes which must be entered in a specific order. This is true whenever one of the four main functions (Frequency, Amplitude, AM, or FM) is selected. Once one of these functions is selected, the instrument remains in that function until one of the following events occurs:

a. One of the three remaining functions is selected.

b. One of the SAVE, RECALL, SEQuence keys or Display (SHIFT, DSPL) is pressed.

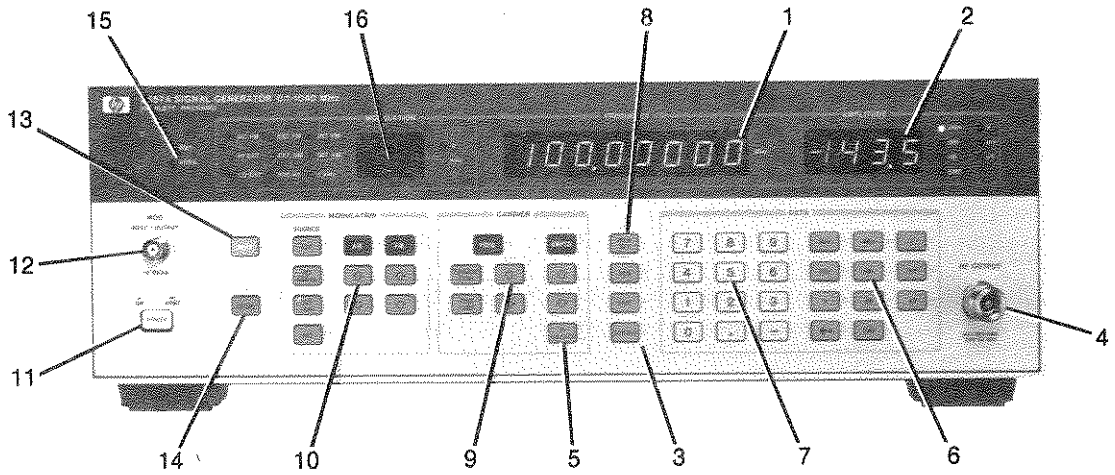
c. The instrument is preset, unplugged or switched to standby.

As long as a function remains in effect, it is not necessary to re-select that function before entering new data. The following paragraphs discuss multiple-entry keystroke sequences.

Carrier Keystroke Sequence. The parameter used to set the carrier's frequency and amplitude are entered in a Function-Data-Units format. Data entered following a function selection is interpreted for that function. Data previously entered remains unaffected until the new data entry is terminated by pressing a valid unit key. If any other function key is pressed before the data entry is terminated, that entry is rejected, the last valid display is restored so that it agrees with the actual output of the Signal Generator, and the last function selected is in effect.

Modulation Keystroke Sequence. Internal, external or mixed AM or FM functions can be selected. Modulation parameters are selected in a Source-Function-Data-Units format. The modulation source, either one of the two internal modulation signals (400 Hz or 1 kHz) and/or a signal or dc level from an external modulation source (coupled through the front-panel connector), may be selected before or after the AM depth or FM peak deviation parameters are selected. The internal 400 Hz or 1 kHz modulation source will be common to both AM and FM functions whenever they are simultaneously selected.

Save-Recall-Display Keystroke Sequency. Up to 100 complete front-panel settings (exclusive of increment values) can be saved for either selectable or sequential recall at a later time. Saved front-panel settings can also be displayed without actually changing the output signal. A 4-keystroke sequence is necessary to store or recall front-panel settings. First, the desired function is entered and then a numeric entry (00–99). A 4-keystroke sequence is necessary to display front-panel settings. First, the SHIFT key is pressed followed by DSPL (the blue labeled function of SEQuence key) and then a numeric entry (00–99). The numeric entry represents the location of the storage register.



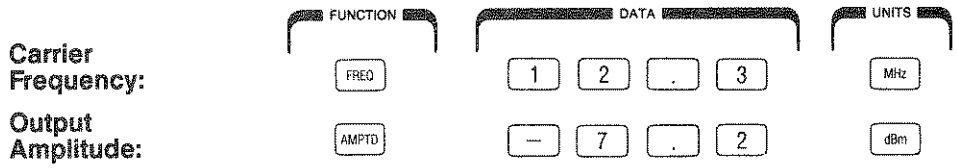
1. **FREQUENCY Display.** An 8-digit display of frequency or frequency increment in megahertz. Also used to display power-on error codes and keyboard-invoked tests.
2. **AMPLITUDE Display.** A 3-digit display of RF output level or amplitude increment. Unit information is displayed by seven LED annunciators. Also used to display current contents of the sequence counter, to display keyboard-invoked tests and to indicate that a reverse-power condition has been detected.
3. **SAVE, RECALL AND SEQuence Keys.** Stores up to 100 front-panel settings for selectable recall or display at a later time. The SEQ key permits a sequential recall of stored front-panel settings or a display of the sequence counter contents when it is used in conjunction with the SHIFT key and DSPL (Display).
4. **RF OUTPUT Connector.** Female, type-N connector provides an AC-coupled, reverse-power protected (up to 50W and 25 Vdc) RF output signal with a frequency range of 100 kHz to 1040 MHz and a leveled output of +13 dBm to −143.5 dBm (+1.00V to +0.10 μV). Nominal impedance is 50 ohms.
5. **RF OFF/ON Key.** Two-position push-button key which turns the RF signal to the RF OUTPUT off and on.
6. **Units Entry Key.** Terminates a data entry for any one of the four main functions. The backspace key (⇐) clears the last digit or decimal point visible in a display to permit the entry to be corrected.
7. **DATA Entry Keys.** Ten numeric entry keys, a decimal point key, and a minus sign key are used for frequency, amplitude, AM, FM, or increment value data entry. Numeric entry keys are also used in conjunction with the SAVE, RECALL and SEQ keys to select one of the 100 storage registers. The "0" key has a shift function which presets the instrument.

Figure 3–1. Front Panel Features and Simplified Operation (1 of 3)

8. **INCR SET Key.** Selects the value of the frequency, amplitude, AM, or FM increment. Also used to display the stored increment value for each of the four main functions and to access the diagnostics mode.
9. **CARRIER Keys.** Selects and permits tuning of the basic carrier functions including phase-up and phase-down.
10. **MODULATION Keys.** Selects either internal, external, or mixed AM, FM or DC FM functions.
11. **POWER Switch.** Two-position push-button switch used to control the operating-state of the instrument. The optional reference oscillator crystal oven remains energized as long as the ac line is connected to the instrument.
12. **MOD INPUT/OUTPUT Connector.** Female, BNC connector accepts either an external modulation signal (1 Vpk) or a dc level (1 Vdc). In addition, it provides access to the 400 Hz or 1 kHz modulating signal from the internal audio oscillator. Nominal impedance is 600 ohms.
13. **SHIFT Key.** Changes the capabilities of some keys to their blue labeled function.
14. **LOCAL Key.** Returns the Signal Generator to local operation (full front-panel control), provided that it is not in local lockout.
15. **Remote Annunciators.** Remote operation status is indicated by two LED annunciators. The RMT annunciator lights when the instrument is in remote operation. The ADRS annunciator lights when the instrument has been addressed to listen via the bus (regardless of whether or not the instrument is in remote operation).
16. **MODULATION Display.** A 2-digit display of AM depth, FM peak deviation, or modulation increment. Internal and external modulation source information is displayed by 11 LED annunciators. It is also used to display the internally set, decimal HP-IB address and used to display the keyboard-invoked tests.

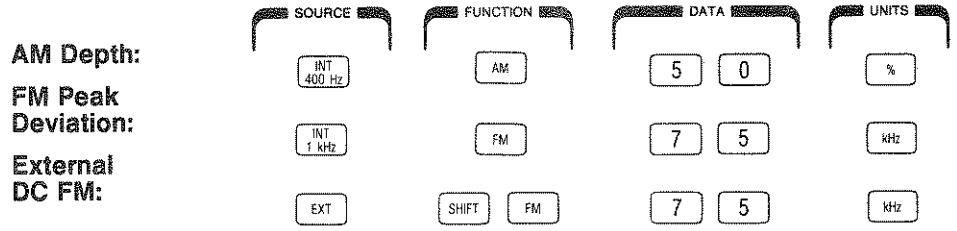
SETTING CARRIER FUNCTIONS
SETTING MODULATION FUNCTIONS
CHANGING PARAMETER VALUES
SAVE/RECALL/DISPlay/SEQuence

SETTING CARRIER FUNCTIONS



Both of the Signal Generator's carrier functions have value-selectable parameters. These parameters are selected in the Function-Data-Units format as shown in the examples above.

SETTING MODULATION FUNCTIONS



Internal,external or mixed AM or FM functions can be selected. Modulation parameters are selected in the Source-Function-Data-Units format as shown in the examples above. One of the internal modulation sources (400 Hz or 1 kHz) and/or a signal or dc level from an external modulation source coupled through the front-panel connector may be used to modulate the carrier.

Figure 3–1. Front Panel Features and Simplified Operation (2 of 3)

CHANGING PARAMETERS VALUES

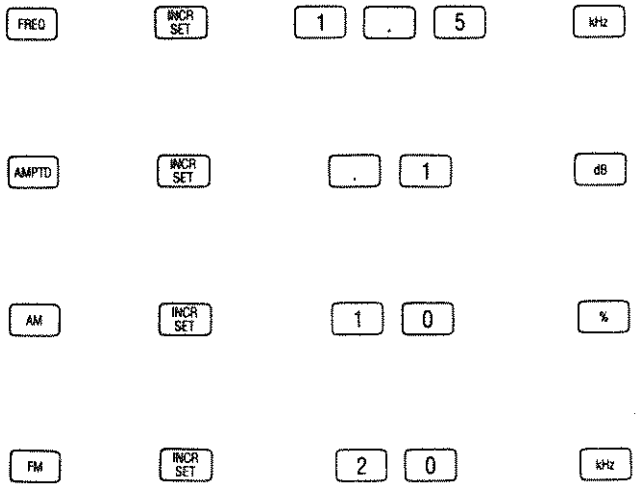
Value-selectable parameters can be changed by making new Function-Data-Units entries, or by using the step up or step down keys associated with each of the four main functions. These keys are used in conjunction with the INCR SET key.

The step up and down keys are always enabled to change the value of the associated main function. The initialized value of each increment is listed as follows:

Carrier Frequency: 10 MHz
Output Amplitude: 10 dB
AM Depth: 1%
FM Peak Deviation: 1 kHz

The value of each increment can be displayed or modified by using the INCR SET key. The stored increment value is displayed as long as the INCR SET key remains pressed.

The increment value for the four main functions can be modified as follows:



The maximum allowable increment value for each of the four main functions is as follows:
Carrier Frequency: $\leq$ 999.99999 MHz
Output Amplitude: $\leq$ 160.5 dB
AM Depth: $\leq$ 99%
FM Peak Deviation Frequency: $\leq$ 99 kHz

NOTE

The carrier Frequency increment is rejected if it is not a multiple of 10 Hz.

In addition, value-selectable carrier frequency parameters can be changed using the COARSE TUNE or FINE TUNE keys in conjunction with the step up or down keys associated with the carrier frequency function. The COARSE TUNE key causes the carrier frequency tuning value to be increased by a factor of 10 each time it it pressed, while the FINE TUNE key causes the carrier frequency tuning value to be decreased by a factor of 10. Pressing the INCR SET key disables the effect of these keys and enables the original carrier frequency increment value.

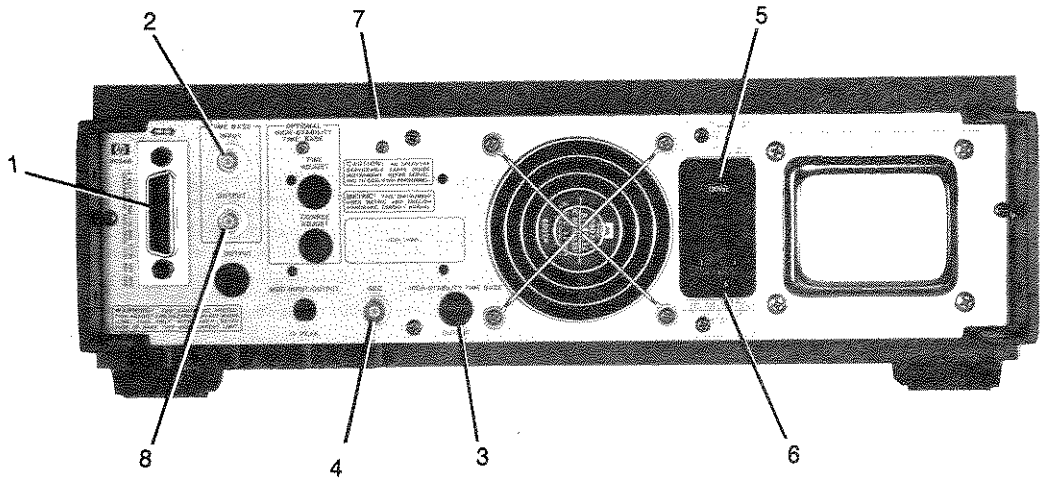
SAVE-RECALL-DISPLAY-SEQUENCE

Up to 100 complete front-panel settings (exclusive of increment values) can be saved for either selectable or sequential recall at a later time. The output of the Signal Generator is changed so that it agrees with the recalled parameter values. Saved front-panel settings can also be displayed without actually changing the output signal.

Figure 3–1. *Front Panel Features and Simplified Operation (3 of 3)*

3-8. REAR PANEL FEATURES

Figure 3-2, Rear Panel Features provides a description of the HP-IB connector, Time Base Input, Time Base High Stability Option, Sequencer, Fuse Line Power Module, Serial Number Plate and Time Base Output.



NOTE

For Option 002 instruments, the RF OUTPUT and MOD INPUT/OUTPUT connectors are located on the rear-panel.

1. **HP-IB Connector.** A 24-pin female connector is used to connect the Signal Generator to the Hewlett-Packard Interface Bus for remote operation. Connection information is presented in Section 2, Installation.
2. **TIME BASE INPUT.** Female BNC connector (J3) accepts an external 1, 5, or 10 MHz (±0.005%) time base reference input at a level of 0.2 to 0.4 Vrms into 50 ohms. An internal jumper must be installed in the position that corresponds to the external time base reference input used (refer to Section 2, Installation).
3. **TIME BASE HIGH STABILITY OPTION.** Female BNC connector (A16J1) provides access to the optional 10 MHz time base reference output. With Option 001 installed and its output connected to the TIME BASE INPUT connector through the supplied cable (not shown), the frequency accuracy and stability of the Signal Generator is increased. The optional reference oscillator is kept at operating temperature in the STBY (Standby) mode as long as the Signal Generator remains connected to Mains power.
4. **SEQ.** Female BNC connector (J5) accepts external contact closure (from foot pedal, pushbutton switch, etc.) which causes the Signal Generator to sequentially recall the stored contents (exclusive of increment settings) from each of its 100 storage registers.
5. **Fuse.** Fuse selection and ordering information is presented in Section 2, Installation.
6. **Line Power Module.** Permits operation from 100, 120, 220, or 240 Vac. The number visible in the window indicates nominal line voltage to which the instrument must be connected (see Figure 2-1). Center conductor is safety earth ground.
7. **Serial Number Plate.** First four digits and letter constitute the serial prefix which defines the instrument configuration. The last five digits form a sequential suffix that is unique to each instrument. The plate also indicates any options supplied with the instrument.
8. **TIME BASE OUTPUT.** Female BNC connector (J4) provides access to an internal 10 MHz time base reference output at a level greater than 0.2 Vrms into 50 ohms which is derived from the internal reference oscillator. An internal jumper may be repositioned to select either a 1 or 5 MHz reference output (refer to paragraph 2-6).

Figure 3-2. *Rear Panel Features*

3-9. BASIC FUNCTIONAL CHECKS

Description

This procedure requires a frequency counter, a spectrum analyzer, a power supply, and the interconnecting cables and adapters. It provides assurance that most of the front-panel controlled functions are being executed by the Signal Generator.

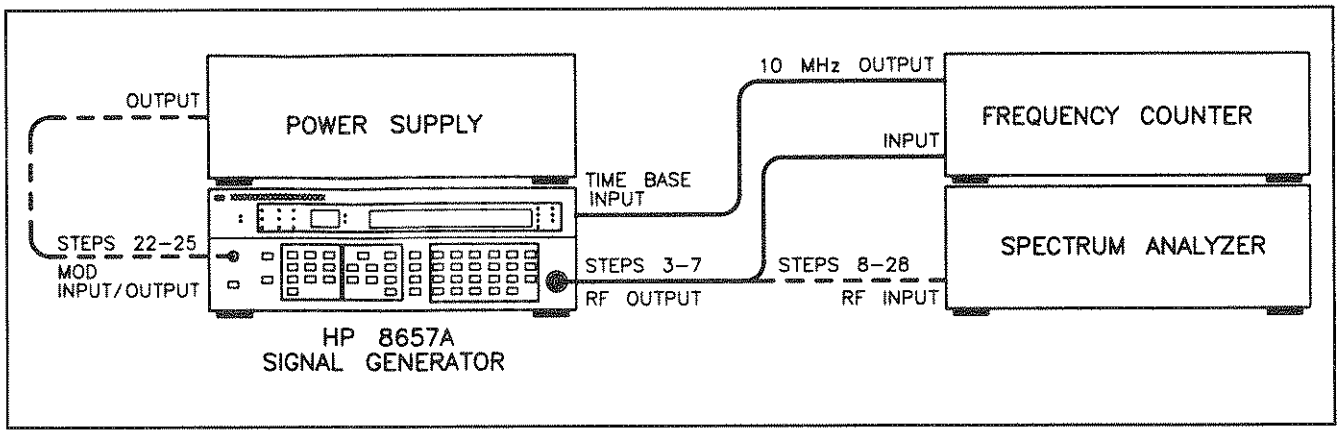


Figure 3-3. Test Setup for Basic Functional Checks

Equipment

Frequency Counter ..... HP 5328A Option 031
Spectrum Analyzer ..... HP 8668B/182T
Power Supply ..... HP 6235A

Procedure

1. Ensure that the power cable is plugged into a suitable source of Mains power (refer to paragraph 2-4).
2. Press the POWER switch to ON.

   An internal memory check is initiated to test for a failure in ROM (read-only-memory). All front-panel indicators light for approximately 1.5 seconds to provide a quick visual inspection of each front-panel annunciator and display segment.

   If a memory failure is detected, a RAM or ROM error code is displayed in the FREQUENCY Display window (refer to Table 3-2 Power-On Error Codes). The error code remains displayed until any front-panel key is pressed. If the memory check was successful, the instrument will return to its previous setting when last ON.
3. Connect the RF OUTPUT of the Signal Generator to the input of the frequency counter, and the 10 MHz reference output from the frequency counter to the TIME BASE INPUT located at the rear of the Signal Generator as shown in Figure 3-3.

   Connecting the 10 MHz reference output of the frequency counter to the TIME BASE INPUT of the Signal Generator phase locks the two instruments to the same time base reference.

NOTE

If the Signal Generator is equipped with the high stability time base (Option 001), disconnect its cable from the TIME BASE INPUT before performing this step.

Frequency Check

4. Set the output amplitude of the Signal Generator to −10.0 dBm and the carrier frequency to the values listed in the following table:

Carrier Frequency (MHz)
100.00000
140.00000
200.00000
300.00000
400.00000
600.00000
800.00000
990.00000
1040.00000

Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter (except for the resolution of the frequency counter being used).

5. Set the carrier frequency of the Signal Generator to 111.11111 MHz and the frequency increment value to 111.11111 MHz. Leave the output amplitude set at − 10.0 dBm.

   Verify that the FREQUENCY display on the Signal Generator agrees with the frequency displayed on the frequency counter.

6. Quickly press and release the frequency step-up key to increase the carrier frequency.

   Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter.

   Continue to increase the carrier frequency to the maximum value listed in the following table:

Carrier Frequency (MHz)
111.11111
222.22222
333.33333
444.44444
555.55555
666.66666
777.77777
888.88888
999.99999

Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter each time the carrier frequency is increased.

7. Quickly press and release the frequency step-down key to decrease the carrier frequency.

   Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter.

   Continue to decrease the carrier frequency to the minimum value listed in the previous table.

   Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter each time the carrier frequency is decreased.

Output Level Checks

8. Connect the RF OUTPUT of the Signal Generator to the input of the spectrum analyzer as shown in Figure 3-3.
9. Set the output amplitude of the Signal Generator to 0.0 dBm, carrier frequency to 0.1 MHz, and frequency increment value to 10 MHz.
10. Set the amplitude scale of the spectrum analyzer to display 1 dB/division, and make the necessary adjustments to properly display the output signal from the Signal Generator.

NOTE

This check only verifies level flatness, it does not verify absolute level accuracy.

11. Slowly increase the carrier frequency through its entire calibrated frequency range (0.1 to 1040.00000 MHz) and observe the level displayed on the spectrum analyzer. The level should not vary more than a total of 3 dBm (±1.5 dB from 0.0 dBm).
12. Set the carrier frequency of the Signal Generator to 600 MHz, output amplitude to +13 dBm, and output amplitude increment value to 1.0 dB.
13. Adjust the spectrum analyzer as necessary to display the output signal from the Signal Generator. The displayed carrier should be positioned in the center of the graticule with its maximum level positioned near the top of the graticule.
14. Slowly decrease the output amplitude down to −4.0 dBm and observe the level displayed on the spectrum analyzer. The level should decrease in relatively uniform 1 dB steps.
15. Set the output amplitude of the Signal Generator to −10.0 dBm and the output amplitude increment value to 5 dB. Leave the carrier frequency set to 600 MHz.
16. Set the amplitude scale of the spectrum analyzer to display 10 dB/division and make the necessary adjustments to properly display the output signal from the Signal Generator. The displayed carrier should be positioned in the center of the graticule with its maximum level positioned near the top of the graticule.
17. Slowly decrease the output amplitude down to −80 dBm and observe the level displayed on the spectrum analyzer. The level should decrease in relatively uniform 5 dB steps.

FM Check

18. Set the output amplitude of the Signal Generator to 0.0 dBm. Leave the carrier frequency set to 600 MHz. Select FM with a peak deviation of 99 kHz using the internal 1 kHz source. Set the FM peak deviation increment value to 1 kHz.
19. Set the spectrum analyzer for a 50 kHz frequency span/division, a resolution bandwidth of 3 kHz, and a reference level of 0 dBm. The waveform displayed should be similar to that shown in Figure 3-4.

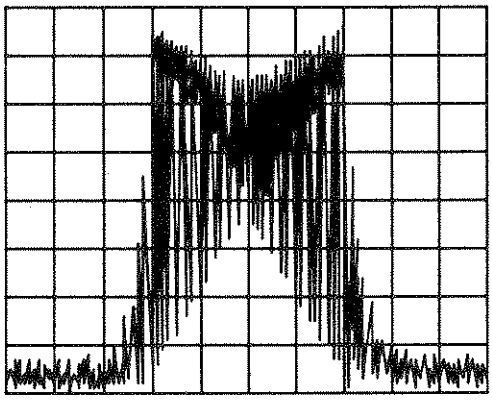


Figure 3-4. FM Functional Check Waveform

20. Slowly decrease the FM peak deviation to zero. The deviation displayed on the spectrum analyzer should decrease in relatively uniform steps.
21. Press FM, then OFF to turn off the FM function.

DC FM Check

22. Leave the output amplitude of the Signal Generator set to 0.0 dBm, and the carrier frequency set to 600 MHz. Select external DC FM with a peak deviation of 60 kHz.
23. Set the spectrum analyzer for a 200 kHz frequency span/division and a reference level of 0 dBm. Adjust the spectrum analyzer as necessary to display the output signal from the Signal Generator in the center of the display.
24. Connect a power supply to the MODulation INPUT/OUTPUT Connector of the Signal Generator as shown in Figure 3-3. Set the power supply for a +1 Vdc output and switch the voltage line on. Notice the LO EXT annunciator will remain on. The carrier frequency displayed on the Spectrum Analyzer should move three divisions to the right. The carrier frequency is offset by 60 kHz.
25. Press FM, then OFF to turn off the DC FM function.

AM Check

26. Leave the carrier frequency set to 600 MHz, and the output amplitude set to 0.0 dBm. Select AM with a depth of 50% using the internal 400 Hz source.
27. Set the spectrum analyzer to the linear amplitude mode. Set a frequency span/division of zero. Increase the resolution bandwidth, then fine tune for the maximum level of the demodulated signal. The displayed demodulated signal should be a sine wave with a period of 2.5 ms (400 Hz).
28. Press the INT 1 kHz key to change the frequency of the internal modulation source from 400 Hz to 1 kHz. The displayed demodulated signal should be a sine wave with a period of 1 ms (1 kHz).

3-10. REMOTE OPERATION, HEWLETT-PACKARD INTERFACE BUS

The Signal Generator can be operated through the Hewlett-Packard Interface Bus (HP-IB). Bus compatibility, programming, and data formats are described in the following paragraphs.

All front-panel functions (except for DSPL, DSPL in conjunction with SEQ, display Amplitude Offset, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS) are programmable through HP-IB.

A quick check of the Signal Generator's HP-IB input/output capability is described in paragraph 3-11, HP-IB Functional Checks. These checks are used to verify that the Signal Generator can respond to each of the applicable HP-IB messages described in Table 3-9.

HP-IB Compatibility

The Signal Generator has an open-collector, TTL, HP-IB interface which can be used with any HP-IB computing controller or computer for automatic system applications. The Signal Generator is fully programmable via the HP Interface Bus. Its programming capability is described by the 13 HP-IB messages listed in Table 3-9. Foremost among these messages is the Data message. Data messages contain the program codes that control the Signal Generator's output signal. The Signal Generator's complete compatibility with HP-IB is further defined by the following list of interface functions: SH0, E1, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0. A more detailed explanation of these compatibility codes can be found in the IEEE Standard 488 (and the identical ANSI Standard MC1.1). For more information about HP-IB, refer to the Hewlett-Packard Electronic Instruments and Systems catalog and the booklet titled "Improving Measurements in Engineering and Manufacturing" (HP part number 5952-0058).

Remote Operation

Remote Capability. In remote operation, the front-panel keys are disabled (except for the POWER switch and the LOCAL key). The Signal Generator can only be addressed to listen. When addressed to listen, the Signal Generator responds to the following messages: Data, Clear, Remote, Local, Local Lockout, Clear Lockout/Set Local, and Abort. Each is discussed in detail further on in this section.

Local-to-Remote Change. The Signal Generator switches to remote operation upon receipt of the Remote message. The Remote message is comprised of two parts. They are:

- Remote Enable bus control line (REN) set true.
- Device listen address received once (while REN is true).

The Signal Generator's RMT and ADRS annunciators will both light, and its output signal and all preselected functions remain unchanged when the local-to-remote transition occurs.

Local Operation

Local Capability. In local operation, the Signal Generator's front-panel is fully operational, and the instrument will respond to the Remote message. Whether addressed or not, the Signal Generator also responds to the Clear, Local Lockout, Clear Lockout/Set Local, and Abort messages. It will not, however, respond to the Data message unless it has been previously addressed.

Remote-to-Local Change. The Signal Generator returns to local operation upon receipt of the Local message (GTL) or Clear Lockout/Set Local message. The Clear Lockout/Set Local message sets the Remote Enable bus control line (REN) false. The instrument can always be set to local operation by pressing the front-panel LOCAL key, provided that local lockout is not in effect. The output signal remains unchanged, and all preselected functions remain unchanged when the remote-to-local transition occurs.

Local Lockout. When a data transmission is interrupted, which can happen by returning the Signal Generator to local operation with the LOCAL key, the data could be lost. This would leave the Signal Generator in an unknown state. To prevent this, a local lockout is recommended. Local lockout disables the LOCAL key and allows return-to-local only under program control.

NOTE

Return-to-local can also be accomplished by setting the POWER switch to STBY, and then back to ON. This technique, however, has some potential disadvantages.

It defeats the purpose and advantage of local lockout, that is, the system controller will lose control of the Signal Generator.

Some HP-IB conditions are reset to their default state during turn on.

Addressing

The Signal Generator interprets the byte of information on its eight data input/output bus lines as either an address or a bus command. Whenever the bus is in the command entry mode, the Attention bus control line (ATN) is true and the Interface Clear bus control line (IFC) is false. Whenever the Signal Generator is being addressed (whether in local or remote operation), the front-panel ADRS annunciator will light.

The Signal Generator's listen address is established by five miniature rocker switches located inside the instrument. The address selection procedure is described in Section 2, Installation. The decimal equivalent of the listen address can be displayed in the MODULATION Display by pressing the SHIFT key first and then the Local key. Refer to Table 3-3 for a list of the valid decimal (listen address) values and their equivalent ASCII characters.

Table 3-3. *Valid Decimal Values vs. Equivalent ASCII Characters*

Equivalent Decimal Value (Listen)	Equivalent ASCII Character (Listen)	Equivalent Decimal Value (Listen)	Equivalent ASCII Character (Listen)
00	SP	16	0
01	!	17	1
02	"	18	2
03	#	19	3
04	$	20	4
05	%	21	5
06	&	22	6
07	'	23	7
08	(	24	8
09	)	25	9
10	*	26	:
11	+	27	;
12	,	28	<
13	—	29	=
14	.	30	>
15	/		

Indicates factory-set address.

Data Messages

The Signal Generator communicates on the interface bus with Data messages. Each Data message consists of one or more bytes of information sent over the Signal Generator's eight data input/output bus lines DIO1 through DIO8 during the data entry mode. The data entry mode is established when the Attention bus control line (ATN) is false. Data messages include the program codes listed in Tables 3-6 and 3-7. These program codes contain the necessary information to program virtually all of the instrument functions available in local operation. The only exceptions are DSPL, DSPL in conjunction with SEQ, display Amplitude Offset, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS.

Receiving the Data Message

The Signal Generator must be in remote operation and addressed to listen before it can respond to Data messages. The instrument remains addressed to listen until it receives an Abort message or a universal unlisten command from the controller.

The paragraph entitled Switching Characteristics, 3-38, shows how the Signal Generator responds to Data Messages. Timing considerations and other characteristics pertinent to operation are included.

Data Message Input Format. Data messages contain the controller's talk address, the Signal Generator's listen address, a string of program codes, and an End of String message (EOS). The string of program codes follows the same protocol as a front-panel keystroke sequence in local operation. The EOS message can be a Line Feed (LF), a bus END message (EOI and ATN bus control lines both set true), or an internally produced EOS.

The following paragraphs explain other key elements of the program code strings. Figure 3-5 provides some examples of Data messages.

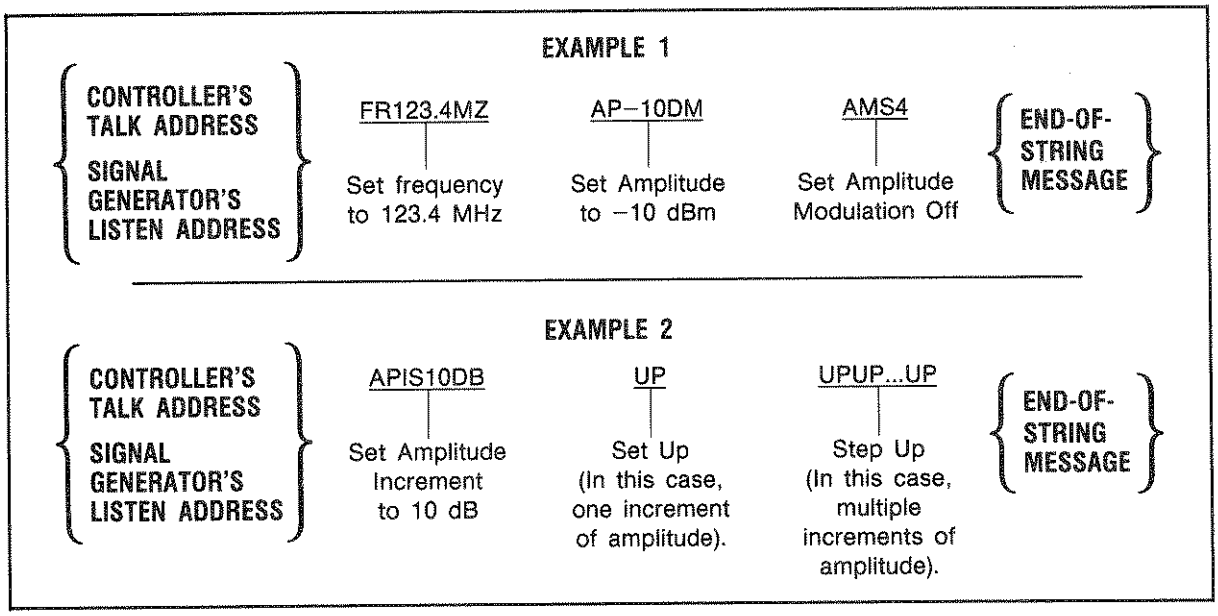


Figure 3–5. *Data Message Example.*

NOTE

After any function terminator (UNITS entry) is sent to the Signal Generator, the instrument is unable to respond to the interface bus until the microprocessor has completed execution of the particular task. Any attempt to send data to the Signal Generator delays bus operation until the execution is complete. The normal terminators carriage-return, and line-feed are considered further data. Data cannot be sent on the bus until the Signal Generator has processed the carriage-return, and line-feed. The bus is free, however, for communication between controller and other equipment. It is recommended that the carriage-return, and line-feed be omitted from data messages sent to the Signal Generator by using a semicolon after the function terminator.

Keyboard-to-Program Code Correlation. There is a program code that corresponds to nearly every front-panel key. The exceptions are DSPL, DSPL in conjunction with SEQ, display Amplitude Offset, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS. In addition, the program code HZ is available for carrier frequency entries, RP is available to reset the reverse power protection circuitry after the source of reverse power has been removed, and R0 and R1 are available to programmatically place the instrument in the STBY and ON states, respectively.

Value-Selectable Parameters. Carrier parameters are set using a Function-Data-Units sequence of program codes, while modulation parameters are set using a Source-Function-Data-Units sequence of program codes. Single-value parameters; such as, INT 400 Hz, INT 1 kHz, and so forth, are set with a single program code sequence.

Data. The term "Data" in each program sequence refers to the numeric value and not to the entire Data message. Data can be any number of arbitrary length in fixed point notation. Digits that exceed the maximum data length for the particular function will be truncated. This maximum limit includes any embedded decimal points. In the case of the Amplitude function, this maximum limit also includes the minus sign. The minus sign is only applicable during Amplitude Data entries. Table 3-6 summarizes these input data restrictions. A complete list of ASCII characters with conversions to binary, octal, decimal, and hexadecimal is provided in Table 3-8.

Table 3-4. Input Data Restrictions

Function	Maximum Data Length	Decimal Point Allowed	Minus Sign Allowed
Frequency	9 Digits	Yes	No
Amplitude	9 Digits (1)	Yes	Yes
AM	2 Digits	Yes	No
FM	2 Digits	Yes	No
Increment Set	Same as for selected function	Yes	No

NOTES:

1. In the Amplitude function, leading zeros are not counted.
2. Unused or unidentifiable characters are ignored.
3. Either upper or lower case letters can be used in Data messages.
4. Only the following ASCII characters are recognized by the Signal Generator:

   A-Z a-z 0-9 LF — . %

All other characters, including spaces, are ignored.

Sending the Data Message

The Signal Generator does not have the capability to talk; therefore, it cannot send Data messages.

Receiving the Trigger Message

The Signal Generator does not have the capability to respond to the trigger message.

Receiving the Clear Message

The Signal Generator responds to a Clear message by setting each function parameter to the value listed in Table 3-5. The Signal Generator responds equally to the Selected Device Clear (SDC) bus command when addressed to listen, and to the Device Clear (DCL) bus command whether addressed or not.

Table 3-5. *Response to Clear Message.*

Parameter	Value
Carrier Frequency	100.00000 MHz
Output Amplitude	−143.5 dBm
AM Depth	0%
FM Peak Deviation	0.0 kHz
Carrier Frequency Increment	10.00000 MHz
Output Amplitude Increment	10.0 dB
AM Depth Increment	1%
FM Peak Deviation Increment	1.0 kHz
Coarse and Fine Tune Pointer	10.00000 MHz
Sequence Counter	0
All 100 Storage Registers	Remain unchanged

Receiving the Remote Message

The Remote message is comprised of two parts. First, the Remote Enable bus control line (REN) is held true, then the device listen address is sent by the controller. These two actions combine to place the Signal Generator into remote operation. Therefore, the instrument is enabled to go into remote operation when the controller begins the Remote message, but it does not actually make the transition until it is addressed to listen for the first time. All instrument settings remain unchanged when the transition from local-to-remote operation occurs. The front-panel RMT and ADRS annunciators will both light once the Signal Generator has received the Remote message and is addressed to listen.

Receiving the Local Message

The Local message is the means by which the controller sends the Go to Local (GTL) bus command. If addressed to listen, the Signal Generator returns to local operation (full front-panel control) when it receives the Local message. If the instrument is in local lockout when the Local message is received, full front-panel control is returned, but local lockout remains in effect. Unless the Signal Generator receives the Clear Lockout/Set Local message, it returns to local lockout the next time it receives a Remote message. All instrument settings remain unchanged when the transition from remote-to-local operation occurs.

The front-panel RMT annunciator turns off when the Signal Generator switches to local operation. However, the front-panel ADRS annunciator remains lit if the Signal Generator is still being addressed to listen (whether in remote or local operation).

The front-panel LOCAL key can also be used to return the Signal Generator to local operation. However, pressing the LOCAL key (when the instrument is not in local lockout) might interrupt a Data message being sent to the Signal Generator. This would leave the Signal Generator in a state unknown to the controller. This situation is undesirable and can be avoided by sending the Local Lockout message to disable the LOCAL key.

Receiving the Local Lockout Message

The Local Lockout message is the means by which the controller sends the Local Lockout (LLO) bus command. If the Signal Generator is in remote operation, it responds to the Local Lockout message by disabling the front-panel LOCAL key. Local lockout prevents the loss of data or system control due to someone accidentally pressing any of the front-panel keys. If the Signal Generator is in local operation when it is enabled to remote operation (that is, REN is set true) and it receives the Local Lockout message, it switches to remote with local lockout operation the first time it is addressed to listen. Once in local lockout, the Signal Generator can only be returned to local operation by the controller or by unplugging or switching the instrument to STBY and then back to ON.

Receiving the Clear Lockout/Set Local Message

The Clear Lockout/Set Local message is the means by which the controller sets the Remote Enable bus control line (REN) false. The Signal Generator returns to local operation (full front-panel control) when it receives the Clear Lockout/Set Local message. All instrument settings remain unchanged when the transition from remote with lockout to local operation occurs.

The front-panel RMT annunciator is turned off when the Signal Generator switches to local operation.

Receiving the Pass Control Message

The Signal Generator does not respond to the Pass Control message because it cannot act as a controller.

Sending the Require Service Message

The Signal Generator does not have the capability to require service by setting the Service Request bus control line (SRQ) true.

Sending the Status Byte Message

The Signal Generator does not have the capability to respond to a Serial Poll Enable (SPE) bus command; therefore, it cannot send the Status Byte message.

Sending the Status Bit Message

The Signal Generator does not have the capability to respond to a Parallel Poll Enable (PPE) bus command; therefore, it cannot send the Status Bit message.

Receiving the Abort Message

The Abort message is the means by which the controller sets the Interface Clear bus control line (IFC) true. When the Abort message is received, the Signal Generator becomes unaddressed and stops listening.

Table 3–6. *HP-IB Program Codes (Alphabetical Order)*

Program Code[1]	Parameter	Comments
AM	Amplitude Modulation	Function Entry
AO	Amplitude Offset	Function Entry
AP	Amplitude (carrier)	Function Entry
DB	dB	Units Entry
DF	dBf	Units Entry
DM	dBm	Units Entry
DN	Step Down (l)	Function Feature
EM	EMF	Units Entry
FM	Frequency Modulation	Function Entry
FR	Frequency (carrier)	Function Entry
HZ	Hz	Units Entry
IS	Increment Set	Function Qualifier
KZ	kHz	Units Entry
MV	mV	Units Entry
MZ	MHz	Units Entry
PC	Percent [2]	Units Entry
PD	Phase Decrement	Function Feature
PI	Phase Increment	Function Feature
RC	Recall	Feature
RP	Reverse Power Protection Reset [3]	Feature
R0	Standby [4]	Feature
R1	On[4]	Feature
R2	RF OFF	Function Feature
R3	RF ON	Function Feature
SQ	Sequence	Feature
SV	Save	Feature
S1	External Modulation Source	Source Qualifier
S2	Internal 400 Hz Modulation Source	Source Qualifier
S3	Internal 1 kHz Modulation Source	Source Qualifier
S4	Modulation Source Off	Source Qualifier
S5	DC FM	Function Entry
UP	Step Up (k)	Function Feature
UV	lV	Units Entry
VL	Volts	Units Entry
0-9	Numerals 0-9	Data Entries
F	Minus Sign	Data Entry
.	Decimal Point	Data Entry
%	Percent[2]	Units Entry

[1] Program codes can be either upper or lower case.
[2] Either PC or % can be used.
[3] The source of reverse power must be removed.
[4] The POWER switch must be set to the ON position.

Table 3–7. HP-IB Program Codes (Functional Order)

Parameter	Program Code[1]		Parameter	Program Code[1]
Frequency			Units (Cont'd)	
Frequency (carrier)	FR		EMF	EM
			Volts	VL
Amplitude			mV	MV
Amplitude (carrier)	AP		μV	UV
Amplitude Offset	AO		Hz	HZ
			kHz	KZ
Modulation			MHz	MZ
Amplitude Modulation	AM		Percent[2]	PC
Frequency Modulation	FM		Percent[2]	%
External Modulation Source	S1			
Internal 400 Hz Modulation Source	S2		**Other**	
Internal 1 kHz Modulation Source	S3		Step Up (⇧)	UP
Modulation Source Off	S4		Step Down (⇩)	DN
DC FM	S5		Increment Set	IS
			Standby[3]	R0
Data			On[3]	R1
Numerals 0-9	0-9		RF OFF	R2
Minus Sign	–		RF ON	R3
Decimal Point	.		Save	SV
			Recall	RC
Units			Sequence	SQ
dB	DB		Reverse Power Protection Reset[4]	RP
dBf	DF		Phase Increment	PI
dBm	DM		Phase Decrement	PD

[1] Program codes can be either upper or lower case.
[2] Either PC or % can be used.
[3] The POWER switch must be in the ON position.
[4] The source of reverse power must be removed.

Table 3–8. Commonly Used Code Conversions

ASCII	Binary	Octal	Decimal	Hexadecimal
NUL	00 000 000	000	0	00
SOH	00 000 001	001	1	01
STX	00 000 010	002	2	02
ETX	00 000 011	003	3	03
EOT	00 000 100	004	4	04
ENQ	00 000 101	005	5	05
ACK	00 000 110	006	6	06
BEL	00 000 111	007	7	07
BS	00 001 000	010	8	08
HT	00 001 001	011	9	09
LF	00 001 010	012	10	0A
VT	00 001 011	013	11	0B
FF	00 001 100	014	12	0C
CR	00 001 101	015	13	0D
SO	00 001 110	016	14	0E
SI	00 001 111	017	15	0F
DLE	00 010 000	020	16	10
DC1	00 010 001	021	17	11
DC2	00 010 010	022	18	12
DC3	00 010 011	023	19	13
DC4	00 010 100	024	20	14
NAK	00 010 101	025	21	15
SYN	00 010 110	026	22	16
ETB	00 010 111	027	23	17
CAN	00 011 000	030	24	18
EM	00 011 001	031	25	19
SUB	00 011 010	032	26	1A
ESC	00 011 011	033	27	1B
FS	00 011 100	034	28	1C
GS	00 011 101	035	29	1D
RS	00 011 110	036	30	1E
US	00 011 111	037	31	1F
SP	00 100 000	040	32	20
!	00 100 001	041	33	21
"	00 100 010	042	34	22
#	00 100 011	043	35	23
$	00 100 100	044	36	24
%	00 100 101	045	37	25
&	00 100 110	046	38	26
'	00 100 111	047	39	27
(	00 101 000	050	40	28
)	00 101 001	051	41	29
*	00 101 010	052	42	2A
+	00 101 011	053	43	2B
,	00 101 100	054	44	2C
–	00 101 101	055	45	2D
.	00 101 110	056	46	2E
/	00 101 111	057	47	2F
0	00 110 000	060	48	30
1	00 110 001	061	49	31
2	00 110 010	062	50	32
3	00 110 011	063	51	33
4	00 110 100	064	52	34
5	00 110 101	065	53	35
6	00 110 110	066	54	36
7	00 110 111	067	55	37
8	00 111 000	070	56	38
9	00 111 001	071	57	39
:	00 111 010	072	58	3A
;	00 111 011	073	59	3B
<	00 111 100	074	60	3C
=	00 111 101	075	61	3D
>	00 111 110	076	62	3E
?	00 111 111	077	63	3F

ASCII	Binary	Octal	Decimal	Hexadecimal
@	01 000 000	100	64	40
A	01 000 001	101	65	41
B	01 000 010	102	66	42
C	01 000 011	103	67	43
D	01 000 100	104	68	44
E	01 000 101	105	69	45
F	01 000 110	106	70	46
G	01 000 111	107	71	47
H	01 001 000	110	72	48
I	01 001 001	111	73	49
J	01 001 010	112	74	4A
K	01 001 011	113	75	4B
L	01 001 100	114	76	4C
M	01 001 101	115	77	4D
N	01 001 110	116	78	4E
O	01 001 111	117	79	4F
P	01 010 000	120	80	50
Q	01 010 001	121	81	51
R	01 010 010	122	82	52
S	01 010 011	123	83	53
T	01 010 100	124	84	54
U	01 010 101	125	85	55
V	01 010 110	126	86	56
W	01 010 111	127	87	57
X	01 011 000	130	88	58
Y	01 011 001	131	89	59
Z	01 011 010	132	90	5A
[	01 011 011	133	91	5B
\	01 011 100	134	92	5C
]	01 011 101	135	93	5D
^	01 011 110	136	94	5E
_	01 011 111	137	95	5F
`	01 100 000	140	96	60
a	01 100 001	141	97	61
b	01 100 010	142	98	62
c	01 100 011	143	99	63
d	01 100 100	144	100	64
e	01 100 101	145	101	65
f	01 100 110	146	102	66
g	01 100 111	147	103	67
h	01 101 000	150	104	68
i	01 101 001	151	105	69
j	01 101 010	152	106	6A
k	01 101 011	153	107	6B
l	01 101 100	154	108	6C
m	01 101 101	155	109	6D
n	01 101 110	156	110	6E
o	01 101 111	157	111	6F
p	01 110 000	160	112	70
q	01 110 001	161	113	71
r	01 110 010	162	114	72
s	01 110 011	163	115	73
t	01 110 100	164	116	74
u	01 110 101	165	117	75
v	01 110 110	166	118	76
w	01 110 111	167	119	77
x	01 111 000	170	120	78
y	01 111 001	171	121	79
z	01 111 010	172	122	7A
{	01 111 011	173	123	7B
|	01 111 100	174	124	7C
}	01 111 101	175	125	7D
~	01 111 110	176	126	7E
DEL	01 111 111	177	127	7F

3-11. HP-IB FUNCTIONAL CHECKS

Description

The following procedures check the Signal Generator's ability to recognize its own HP-IB (listen) address, properly make remote/local transitions, and process all the applicable HP-IB messages described in Table 3-9. During the process, all of the Signal Generator's HP-IB data input/output bus, control, and handshake lines are checked, except for DIO8 (the most significant data input/output bus line which is not used by the Signal Generator). Only the Signal Generator, a bus controller, and an HP-IB interface with appropriate cabling are required to perform these procedures. The checks are intended to be as independent of one another as possible, since each begins with the instrument being reset to its initialized condition. Nevertheless, it is suggested that the first four checks be performed in order before any other check. Any special initialization steps or requirements for a given check are provided at the beginning of the check.

The validity of these checks is based on the following assumptions:

- The Signal Generator performs properly when operated via the front-panel keys (that is, in local operation). This can be verified by performing the basic functional checks as outlined in paragraph 3-9.
- The bus controller properly executes HP-IB operations.
- The bus controller's HP-IB interface properly transfers the controller's instructions.
- The select code of the bus controller's interface is set to 7.
- The HP-IB address of the Signal Generator is set to 07 (the factory-set address).
- The select code address combination (that is, 707) is not necessary for these checks to be valid, however, the program lines presented in the following procedures would have to be modified for any other combination.

If the Signal Generator appears to fail any of the remote functional checks, the validity of the preceding assumptions should be confirmed before attempting to service the instrument.

If all of these checks are performed successfully, the Signal Generator's HP-IB capability can be considered to be operating properly. These procedures do not check whether or not all of the Signal Generator's program codes are being properly interpreted and executed by the instrument, however, if the front-panel operation is confirmed to be working properly and its HP-IB capability operates correctly, then there is a high probability that the Signal Generator will respond properly to all of its program codes.

Initial Setup

The test setup is the same for all of the checks. That is, the Signal Generator is connected to the bus controller through the bus controller's HP-IB interface via the appropriate cable.

Equipment

Use any HP Controller and HP-IB Interface to implement HP-IB functional checks.

Procedure

Address Recognition

This check determines whether or not the Signal Generator recognizes when it is being addressed and when it is not. It is assumed that the Signal Generator is in local operation and that it can properly handshake on the bus. Before beginning this check, verify that the instrument is in local operation and unaddressed by the controller.

Description	BASIC
Set the Remote Enable (REN) bus control line false.	LOCAL 7
Send the listen address to the Signal Generator.	OUTPUT 707

1. Verify that the Signal Generator's RMT annunciator remains off, and that its ADRS annunciator lights.

Description	BASIC
Unaddress the Signal Generator by sending a different address.	OUTPUT 715

2. Verify that the Signal Generator's RMT and ADRS annunciators are both off.

Remote and Local Messages and the LOCAL Key

This check determines whether the Signal Generator properly switches from local to remote operation, switches from remote to local operation, and whether the LOCAL key can return the instrument to local operation. It is assumed that the Signal Generator is able to both handshake and recognize its own address. Before beginning this check verify that the instrument is in local operation and unaddressed by the controller.

Description	BASIC
Send the Remote message which sets the Remote Enable (REN) bus control line true and addresses the Signal Generator to listen.	REMOTE 707

1. Verify that the Signal Generator's RMT and ADRS annunciators both light.

Description	BASIC
Send the Local message to the Signal Generator.	LOCAL 707

2. Verify that the Signal Generator's RMT annunciator turns off, and that its ADRS annunciator remains on.

Description	BASIC
Send the Local message to the Signal Generator.	REMOTE 707

3. Verify that the Signal Generator's RMT and ADRS annunciators are both on. Press the LOCAL key on the front-panel of the Signal Generator and verify that the RMT annunciator turns off, and that the ADRS annunciator remains on.

Data Message

This check determines whether or not the Signal Generator properly receives Data messages. Because the Signal Generator is only a listener, it can only receive Data messages, but never send them. It is assumed that the Signal Generator is able to handshake, recognize its own address, and properly make remote/local transitions. The Data message that is sent will cause the 7 least significant HP-IB data lines to be placed in both their true and false states. Before beginning this check, verify that the instrument is in local operation and unaddressed by the controller.

Description	BASIC
Send the the first part of the Remote message (which enables the Signal Generator's remote operating mode).	REMOTE 707
Address the Signal Generator to listen (which completes the Remote message) and send the Data message (which tunes the Signal Generator to 1040 MHz).	OUTPUT 707; "FR1040MZ"

1. Verify that the Signal Generator's RMT and ADRS annunciators both light, and that the FREQUENCY Display shows a carrier frequency of 1040.0000 MHz.

Local Lockout and Clear Lockout/Set Local Messages

This check determines whether or not the Signal Generator properly receives the Local Lockout message which disables all of the front-panel keys. In addition, this check determines whether or not the Clear Lockout/Set Local message is properly received and executed by the Signal Generator. It is assumed that the Signal Generator is able to handshake, recognize its own address, and properly make remote/local transitions. Before beginning this check, verify that the instrument is in local operation and unaddressed by the controller.

Description	BASIC
Send the first part of the Remote message (which enables the Signal Generator's remote operating mode).	REMOTE 707
Send the Local Lockout message.	LOCAL LOCKOUT 7
Address the Signal Generator to listen (which completes the Remote message).	OUTPUT 707

1. Verify that the Signal Generator's RMT and ADRS annunciators both light. Press the LOCAL key on the front-panel of the Signal Generator, and verify that its RMT and ADRS annunciators both remain on.

Description	BASIC
Send the Clear Lockout/Set Local Message.	LOCAL 7

2. Verify that the Signal Generator's RMT annunciator is turned off, and that its ADRS annunciator remains on.

Clear Message

This check determines whether or not the Signal Generator properly responds to the Clear message. It is assumed that the Signal Generator is able to handshake, recognize its own address, properly make remote/local transitions, and receive Data messages. Before beginning this check, verify that the instrument is in local operation, and unaddressed by the controller.

Description	BASIC
Send the first part of the Remote message (which enables the Signal Generator's remote operating mode).	REMOTE 707
Address the Signal Generator to listen (which completes the Remote message) and send the Data message (which sets the output amplitude of the Signal Generator to 3.0 dB mV).	OUTPUT 707; "APD3DBMV"

1. Verify that the Signal Generator's RMT, ADRS, dB, and mV annunciators all light, and that the AMPLITUDE Display shows an output amplitude of 3.0 dBmV.

Description	BASIC
Send the Clear message.	CLEAR 707

2. Verify that the Signal Generator's RMT and ADRS annunciators remain on, and that the AMPLITUDE Display now shows frequency as 100 MHz and amplitude as −143.5 dBm. The dB and mV annunciators will now be off and the dBm annunciator will be on.

Abort Message

This check determines whether or not the Signal Generator becomes unaddressed when it receives the Abort message. It is assumed that the Signal Generator is able to handshake, recognize its own address, and properly make remote/local transitions. Before beginning this check, verify that the instrument is in local operation and unaddressed by the controller.

Description	BASIC
Send the complete Remote message.	REMOTE 707

1. Verify that the Signal Generator's RMT and ADRS annunciators both light.

Description	BASIC
Send the Abort message (which unaddresses the Signal Generator to listen.)	ABORTIO 7

2. Verify that the ADRS and RMT annunciators turn off.

Table 3–9. *HP-IB Message Reference Table*

HP-IB Capability	Applicable	Response	Related Commands and Controls*	Interface Functions*
Data	Yes	All Front-Panel functions, except for DSPL, DSPL in conjunction with SEQ, display Amplitude Offset, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS are programmable. The front panel ADRS annunciator lights when the Signal Generator is addressed to listen.		T0, L2, AH1, SH0
Trigger	No	The Signal Generator does not have a device trigger (DT0) capability.	GET	DT0
Clear	Yes	Resets the Signal Generator to a carrier frequency of 100 MHz, an output amplitude of −143.5 dBm, and no modulation. Responds equally to Device Clear (DCL) and Selected Device Clear (SDC) bus commands.	DCL, SDC	DC1
Remote	Yes	Remote operation is entered when the Remote Enable (REN) bus control line is true and the Signal Generator is first addressed to listen. The front-panel RMT and ADRS annunciators both light when remote operation is entered, all front-panel keys are disabled (except for the LOCAL key and the POWER switch), and the output signal remains unchanged.	REN	RL1
Local	Yes	The Signal Generator returns to local operation (full front-panel control) when either the Go to Local (GTL) bus command is received or the front-panel LOCAL key is pressed. The output signal remains unchanged.	GTL	RL1
Local Lockout	Yes	Disables the front-panel LOCAL key so that only the controller can return the Signal Generator to local operation.	LLO	RL1
Clear Lockout/Set Local	Yes	The Signal Generator returns to local operation and local lockout is cleared when the REN bus control line goes false.	REN	RL1
Pass Control/Take Control	No	The Signal Generator has no control capability.		C0
Require Service	No	The Signal Generator does not have the capability to request service.		SR0
Status Byte	No	The Signal Generator does not have the capability to respond to a serial poll.		T0
Status Bit	No	The Signal Generator does not have the capability to respond to a parallel poll enable.		PP0
Abort	Yes	The Signal Generator stops listening.	IFC	T0, L2
Driver Electronics	Yes	The Signal Generator has an open-collector, TTL, interface.		E1

* Commands, Control lines and Interface Functions are defined in IEEE Std 488 (and the identical ANSI Standard MC1.1). Knowledge of these might not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left column. Complete HP-IB capability as defined in IEEE Std 488 (and the identical ANSI Standard MC1.1) is: SH0, E1, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0.

Switching Characteristics

The Signal Generator's switching characteristics are an important consideration in applications involving a computer controller. If the timing requirements are not taken into account in the controller's program, it will be impossible in many situations to make meaningful measurements on a device driven by the Signal Generator.

Switching times for frequency, modulation, and amplitude have several characteristics in common. In each case a finite amount of time passes from the command (manual or computer generated) until the required output occurs. Software execution time is required for the microprocessor and related digital circuits to process the data. This begins with a valid final terminator (keystroke or data entry) and ends with the execution in the hardware. The software time may vary considerably depending on the function. Examples are internal instructions to more than one hardware location, (may be serial, parallel or both) and differing amounts of control data and calculations.

Hardware execution time will also vary considerably. This depends on the number of circuits affected, the length of time each takes to change, and whether the changes occur one at a time or concurrently.

Frequency Switching. The Signal Generator will typically be within 100 Hz of the final frequency within 120 ms after receiving the valid units data (terminator). Figure 3-6 shows the sequence of events and the typical error frequency relative to time. Area I shows the software execution time. Areas II through IV make up the hardware execution time.

At times, certain events in the frequency switching cycle may be bypassed. For example, small frequency changes will often eliminate event II, the loop settling time or event III, the FM calibration mode. However, the frequency change that allows these events to be bypassed depends on an involved algorithm that is a function of frequency. Therefore, it is best to assume that the entire sequence of events shown in Figure 3-6 occurs every time a frequency change is made.

During an FM calibration cycle as a result of a frequency change, all modulation is disabled if the FM mode has been enabled. This applies to FM only or mixed modulation such as FM from two sources or simultaneous AM and FM. After the frequency change and FM calibration is completed, the modulation is turned on.

Amplitude Switching. During an RF amplitude change, the final level is always approached from a lower level. This means that a critical amplitude level is never exceeded in the course of normal Signal Generator operation.

Software correction of amplitude with respect to frequency may cause the amplitude to be uncalibrated while a frequency change occurs.

The basic unit for amplitude in the Signal Generator is dBm. An input in other units requires calculations. This tends to increase the software execution time considerably. For example, an input in dBm generally will take about 40 ms from the terminator to the end of software execution. Examples of a change with calculations involved are: a preset level in mV with a change in dB, 80 ms; a level and change in mV, 220 ms; a level in dBm and a change in mV, 340 ms.

A 10 dB change without modulation (narrowband Automatic Level Control — ALC) may take up to 110 ms in the vernier hardware circuits. With modulation (wideband ALC) the switching time is typically 1 to 25 ms. The step attenuator switching time is on the order of 12 ms.

Total time requirements for simple amplitude inputs or changes, that is, minimal software and hardware execution time is 150 ms. A more complex change may take up to 250 ms.

Modulation Switching. There are applications where it is necessary to turn modulation on or off or to change to another modulation level. It takes about 400 ms for the modulation accuracy (AM or FM) to be within tolerance from the time the modulation (audio oscillator) is initially turned on. An FM deviation change typically occurs 60 ms after the final terminator (Units key) triggers the change. Turning the FM off takes about 20 ms. Amplitude modulation normally takes about 120 ms to turn off or to change to a new depth. Software execution time in the modulation mode is insignificant.

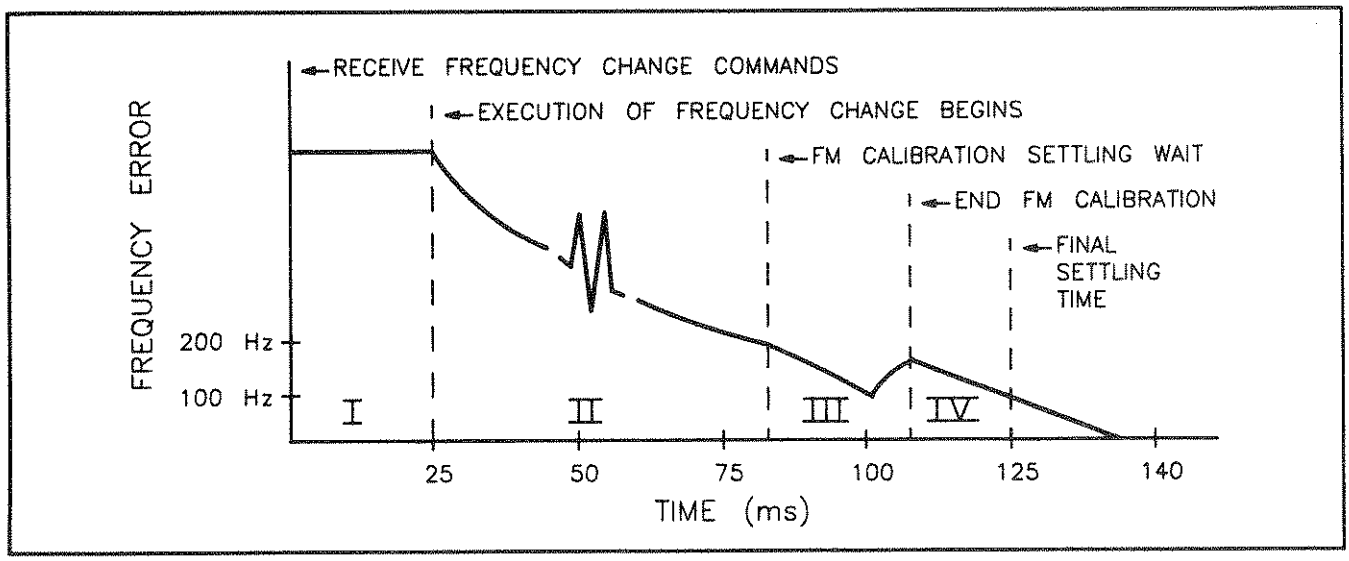


Figure 3-6. *Typical Frequency Switching Characteristics.*

3-12. DETAILED OPERATING INSTRUCTIONS

The Detailed Operating Instructions describe most of the features and functions that can be accessed by the user.

Title: Lists the main feature or function to be discussed.

Description: Describes the feature or function.

Keystroke Sequence: Enables the user to perform the feature or function that is explained in the "Description."

Example: Describes the necessary steps required to accomplish one or more of the features or functions discussed in the "Keystroke Sequence."

Keys and Program Codes: Lists a table with the associated keys and HP-IB program codes for controller execution of that feature or function.

Indications: Describes the expected response of the instrument when the keystroke sequence is performed; which annunciators will light, and which displays are used.

Comments: Describes any miscellaneous information, any discrepancies in the instrument's performance or statements to clarify the feature or function capabilities.

Related Instructions: Lists other features or functions which are similar in operation.

Table 3-10. Index of Detailed Operating Instructions

The actual detailed operating instructions are arranged in alphabetical order starting on the next page.

Amplitude

Description

This instruction details how to set the output amplitude.

Operating Characteristics

Range: +13 dBm to −143.5 dBm (+1.00V to +0.016 μV)

Resolution: 0.1 dB

Keystroke Sequence

Press the AMPTD Function key, the desired Data keys, and a valid Units key or combination of valid Units keys.

Examples

Set the output amplitude to −12.3 dBm.

	FUNCTION	DATA	UNITS
LOCAL (keys)	AMPTD	(−) 1 2 . 3	dBm
HP-IB (program codes)	AP −12.3 DM		

Set the output amplitude to −2.0 dB EMF μV.

	FUNCTION	DATA	UNITS
LOCAL (keys)	AMPTD	(−) 2 . 0	dB EMF μV
HP-IB (program codes)	AP −2.0 DB EM UV		

Keys and Program Codes

Keys	Codes
AMPTD	AP
dBm	DM
dBf	DF
dB	DB
EMF	EM
V	VL
mV	MV
μV	UV

Indications

The selected output amplitude (with sign and units) will be displayed in the AMPLITUDE Display.

Comments

Digits selected beyond the specified resolution of the AMPLITUDE Display are truncated.

Leading zeros are blanked.

Calibrated level is from −127 dBm to +13 dBm with underrange to −143.5 dBm and overrange to maximum power of the instrument.

Minus sign may be entered at any time before the final terminator.

Amplitude Data entries that would cause the peak envelope power of the instrument to exceed +17 dBm are rejected.

Amplitude function remains selected until:

a. One of the three remaining functions is selected (AM, FM, or FREQuency).

b. One of the SAVE, RECALL, SEQuence keys or Display (SHIFT, DSPL) is pressed.

c. The instrument is preset, unplugged, or switched to standby.

Fourteen valid units entries are possible which will cause one or more AMPLITUDE annunciators to light. They are as follows:

dBm	dB μV	V EMF	mV
dBf	dB EMF V	mV	EMF μV
dBV	dB EMF mV	μV	
dBmV	dB EMF μV	EMF V	

Whenever a reverse power condition is detected, all segments and all seven LED annunciators associated with the AMPLITUDE Display flash until the source of reverse power is removed and the AMPTD key is pressed.

Related Instructions

Amplitude Conversion
Amplitude, Up/Down

Amplitude Conversion

Description

This instruction details how to change the AMPLITUDE Display from power units in dBm to any one of 13 other valid unit configurations. This feature does not affect the actual output amplitude of the Signal Generator.

Keystroke Sequence

Press any valid Units key or combination of valid Units keys with the amplitude function selected.

Example

The AMPLITUDE display shows 10.0 dBm. Change the display to units of dB μV. (The resulting display will be 117.0 dB μV.)

	PREFIX TERMINATOR	FINAL TERMINATOR
LOCAL (keys)	dB	μV
HP-IB (program codes)	DB UV	

Keys and Program Codes

Keys	Codes
dBm[1]	DM[1]
dBf[1]	DF[1]
dB[2,3]	DB[2,3]
EMF[2]	EM[2]
V[1]	VL[1]
mV[1]	MV[1]
μV[1]	UV[1]

[1] Final Terminator.

[2] Prefix Terminator.

[3] Final Terminator for Increment Set Mode.

Indications

The AMPLITUDE Display changes to reflect the newly selected units, and the corresponding annunciator(s) will light.

Comments

The Amplitude function must be selected before the conversion entry or entries are made.

Logarithmic Data entries (dBm or dBf) will be displayed in the AMPLITUDE Display with 0.1 dB resolution.

The dBm or dBf Units terminator overrides a dB or EMF terminator.

If a dB or EMF Units terminator is selected, the AMPLITUDE Display is blanked, the corresponding annunciator lights, and the Signal Generator waits for a final terminator to be entered.

Linear Data entries (V, mV, or μ V) are displayed in the three most significant digits of the AMPLITUDE Display, and the linear terminator is autoranged (or adjusted) to comply with this condition.

Conversion formulas used are as follows:

$$
\begin{aligned}
dBm &= dBm \\
dBf &= dBm + 120.0 \\
dBV &= dBm - 13.0 \\
dBmV &= dBm + 47.0 \\
dB\ \mu V &= dBm + 107.0 \\
dB\ EMF\ V &= dBm - 7.0 \\
dB\ EMF\ mV &= dBm + 53.0 \\
dB\ EMF\ \mu V &= dBm + 113.0 \\
V &= 10^{(dBm-13.0)/20} \\
mV &= 10^{(dBm+47.0)/20} \\
uV &= 10^{(dBm+107.0)/20} \\
EMF\ V &= 10^{(dBm-7.0)/20} \\
EMF\ mV &= 10^{(dBm+53.0)/20} \\
EMF\ \mu V &= 10^{(dBm+113.0)/20}
\end{aligned}
$$

Related Instructions

Amplitude
Amplitude, Up/Down

Amplitude Offset

Description

This instruction details how to change the RF output amplitude by the value stored in the Amplitude Offset storage register.

Keystroke Sequence

Press the SHIFT key, the AMPTD key, then enter the Amplitude Offset in dB.

Example

Add Amplitude Offset of +2 dB to the RF OUTPUT.

	SPECIAL FEATURE	DATA	UNITS
LOCAL (keys)	SHIFT AMPTD	2	dB
HP-IB (program codes)	AO 2 DB		

Keys and Program Codes

Keys	Codes
SHIFT AMPTD dB	 AO* DB
*NOTE: Not to be confused with A0 (zero).	

Indications

The actual RF OUTPUT amplitude is increased by 2 dB over the displayed value.

Comments

The Amplitude Offset value is shown in the AMPLITUDE display until a valid UNITS terminator is pressed.

A change in RF OUTPUT amplitude that would make the sum of the amplitude and offset to be above or below the legal limits of the instrument, will cause the instrument to output only a maximum or minimum output limit.

The Amplitude Offset storage register initializes to a value of 0 dB whenever an instrument preset is done, and whenever the instrument is switched from STBY to ON.

Performing this feature:

- Clears any previously selected function.
- Does not affect the original AMPLITUDE display setting.

Related Instructions

Display Amplitude Offset

Amplitude, Up/Down

Description

This instruction details how to change the output amplitude by the value stored in the output amplitude increment register.

Keystroke Sequence

Press the step-up or step-down keys associated with the output amplitude function.

Keys and Program Codes

Keys	Codes
AMPTD	AP
⬆	UP
⬇	DN

NOTE

During remote operation, repeated UP or DN codes can be sent over the bus once the amplitude function is selected.

Indications

The output amplitude shown in the AMPLITUDE Display, and the output of the Signal Generator changes by the value stored in the output amplitude increment register.

Comments

Step-up and step-down keys, associated with the output amplitude function, are used to change the output amplitude by the value stored in the output amplitude increment register.

If the output amplitude increment is set to a value that would cause the instrument to exceed a range of +17 dBm to −143.5 dBm, the step-up and step-down keys become inoperative. A correct decrease in the increment setting re-enables the step-up and step-down keys.

Performing this feature:

- Places the instrument in the Amplitude Data entry mode, and clears any previously selected function.
- Continues to change the output amplitude by the value stored in the output amplitude increment register if either key remains pressed.

Increment entries are checked against maximum and minimum allowable increment limits. If a limit is exceeded, the increment entry is either truncated or rejected.

Initialized value and limits of the output amplitude increment are as follows:

Initialized Value	Minimum Value	Maximum Value
10.0 dB	0.1 dB 0.001 μV 0.001 EMF μV	≤144.0 dB ≤1.57V ≤3.15 EMF V

Related Instructions

Amplitude
Amplitude Conversion
Increment Value Change
Increment Value Display

Display Amplitude Offset

DESCRIPTION

This instruction details how to display the stored contents of the Amplitude Offset register.

Keystroke Sequence

Press the SHIFT key, then press and hold the AMPTD key.

Example

Display contents of the Amplitude Offset register.

LOCAL (keys)	SHIFT	AMPTD
HP-IB (program codes)	This feature is not accessible via HP-IB.	

Indications

The Amplitude Offset value is shown in the AMPLITUDE display as long as the AMPTD key remains pressed.

Comments

The Amplitude Offset storage register initializes to a value of 0 dB whenever an instrument preset is done, and whenever the instrument is switched from STBY to ON.

If the RF OFF/ON control is switched to OFF, the AMPLITUDE display can still be used to display the Amplitude Offset value.

Performing this feature:

- Clears any previously selected function.
- Does not affect the original AMPLITUDE display setting.
- Keeps the instrument in the Amplitude Offset mode until another mode key is pressed.

Related Instructions

Amplitude Offset
Display
Display Sequence
HP-IB Address Display
Increment Value Display

Display

Description

This instruction details how to selectively display the stored contents of a storage register.

Keystroke Sequence

Press the SHIFT key, press DSPL, press the first Data key, then press and hold the second Data key.

Example

Display the stored contents from register 02.

LOCAL (keys)	SHIFT	DSPL SEQ	0	2
HP-IB (program codes)	This feature is not accessible via HP-IB.			

Indications

The stored contents from the selected register are displayed as long as the last Data key remains pressed.

Comments

One hundred storage registers are available (00 - 99) Each is capable of storing complete front-panel setups (exclusive of increment settings).

Performing this feature:

- Does not affect the actual output of the Signal Generator.
- Does not change the contents of the sequence counter.
- Does not affect the current increment settings.
- Clears any previously selected function.

All displays are restored to reflect the actual Signal Generator output when the Data key is released.

Related Instructions

Display Amplitude Offset
Display Sequence
Recall
Sequence
Store

Display Sequence

Description

This instruction details how to display the contents of the sequence counter.

Keystroke Sequence

Press the SHIFT key, press DSPL, and then press and hold the SEQ key.

Example

Display the contents of the sequence counter.

LOCAL (keys)	SHIFT	DSPL SEQ	SEQ
HP-IB (program codes)	This feature is not accessible via HP-IB.		

Indications

The stored contents from the sequence counter are displayed in the least significant digit of the AMPLITUDE Display as long as the SEQ key remains pressed.

Comments

One hundred storage register numbers can be displayed (00 - 99), a different register number each time the sequence feature is performed.

Performing this feature:

- Clears any previously selected function.
- Does not affect the current increment settings.
- Does not change the contents of the sequence counter.
- Does not affect the actual output of the Signal Generator.

The AMPLITUDE Display is restored to reflect the actual Signal Generator output when the SEQ key is released.

Related Instructions

Display
Display Amplitude Offset
Sequence

Frequency

Description

This instruction details how to set the carrier frequency.

Operating Characteristics:

Range: 100 kHz to 1040 MHz (1040.0000 MHz)
Resolution: 10 Hz

Keystroke Sequence

Press the FREQuency Function key, the desired Data keys, and a valid Units key.

Example

Set the carrier frequency to 123.45 MHz.

	FUNCTION	DATA	UNITS
LOCAL (keys)	FREQ	1 2 3 . 4 5	MHz
HP-IB (program codes)	FR 123.45 MZ		

Keys and Program Codes

Keys	Codes
FREQ	FR
MHz	MZ
kHz	KZ
No key	HZ

Indications

The selected carrier frequency is displayed in megahertz in the FREQUENCY Display.

Comments

Digits selected beyond the specified resolution of the FREQUENCY Display are truncated.

Leading zeros are blanked.

Carrier frequencies below 100 kHz will result in an uncalibrated output amplitude.

The MODULATION Display flashes if a change in carrier frequency causes the FM peak deviation allowed for that frequency band to be exceeded. Entering a carrier frequency that sets the instrument in the correct band for the selected deviation frequency clears the error condition, or pressing one of the following keys automatically adjusts the FM peak deviation to the maximum frequency possible for that frequency band.

Band	Carrier Frequency (MHz)
1	0.1–129.99999
2	130–259.99999
3	260–519.99999
4	520–1040

Frequency function remains selected until:

a. One of the three remaining functions is selected (AM, FM, or AMPTD).

b. One of the SAVE, RECALL, SEQuence keys or Display (SHIFT, DSPL) is pressed.

c. The instrument is preset, unplugged, or switched to standby.

Related Instructions

Frequency, Coarse and Fine Tune
Frequency, Up/Down

Frequency, Coarse and Fine Tune

Description

This instruction details how to quickly tune the carrier frequency in decade steps using the step-up and step-down keys associated with the carrier frequency function.

Keystroke Sequence

This feature is enabled by pressing either the COARSE TUNE or FINE TUNE key.

Pressing either key will increase (COARSE TUNE) or decrease (FINE TUNE) the carrier frequency timing value by a factor of 10.

Pressing the step-up key increases the carrier frequency by the newly selected carrier frequency timing value, while pressing the step-down key decreases the carrier frequency.

This feature is disabled and the original carrier frequency increment value is enabled by pressing the INCR SET key (with the frequency function selected).

Example

Enable a carrier frequency tuning value of 10 kHz (assuming a starting value of 10 MHz).

LOCAL (keys)	FINE TUNE (÷10)	FINE TUNE (÷10)	FINE TUNE (÷10)
HP-IB (program codes)	This feature is not accessible via HP-IB.		

Indications

Whenever the COARSE TUNE or FINE TUNE key is pressed and held, the frequency digit that corresponds to the carrier frequency tuning value will flash.

When the COARSE TUNE key is pressed again, the next digit to the left will flash to indicate the new tuning value.

When the FINE TUNE key is pressed again, the next digit to the right will flash to indicate the new tuning value.

Comments

This feature only applies to the carrier frequency function.

COARSE TUNE and FINE TUNE keys are always available to change the carrier frequency timing value by a factor of 10.

Performing this feature:

- Places the instrument into the frequency Data entry mode, and clears any previously selected function, once either the step-up or step-down key is pressed.
- Enables the last valid carrier frequency increment value when the INCR SET key is pressed.

Related Instructions

Frequency
Frequency, Up/Down
Increment Value Change

Frequency, Phase Up/Down

Description

This instruction details how to change the carrier frequency phase in one-degree increments or decrements.

Keystroke Sequence

Press the SHIFT key, then press the step-up or step-down keys associated with the carrier frequency function.

Example

Change the carrier frequency phase to lead one degree.

LOCAL (keys)	SHIFT	Φ↑
HP-IB **(program codes)**	PI	

Keys and Program Codes

Keys	Codes
Φ↑	PI
Φ↓	PD

NOTE

During remote operation, repeated PI or PD codes can be sent over the bus.

Indications

The carrier frequency phase at the RF OUTPUT of the Signal Generator changes in one-degree steps each time the keystroke sequence is followed.

Comments

Step-up and step-down keys, associated with the carrier frequency function, are used to change the carrier frequency phase by one-degree increments or decrements.

Performing this feature:

- Continues to change the carrier frequency phase in one-degree increments or decrements if either step-up or step-down key remains pressed.
- Does not affect any previously selected function.

Related Instructions

None

Frequency, Up/Down

Description

This instruction details how to change the carrier frequency by the value stored in the carrier frequency increment register.

Keystroke Sequence

Press the step-up or step-down keys associated with the carrier frequency function.

Keys and Program Codes

Keys	Codes
FREQ	FR
⇧	UP
⇩	DN

NOTE

During remote operation, repeated UP or DN codes can be sent over the bus once the frequency function is selected.

Indications

The carrier frequency shown in the FREQUENCY Display, and the output of the Signal Generator changes by the value stored in the carrier frequency increment register.

Comments

Step-up and step-down keys associated with the carrier frequency function are used to change the carrier frequency by the value stored in the carrier frequency increment register.

Performing this feature:

- Places the instrument in the Frequency Data entry mode, and clears any previously selected function.
- Continues to change the carrier frequency by the value stored in the carrier frequency increment register if either key remains pressed.

Increment entries are checked against maximum and minimum allowable increment limits. If a limit is exceeded, the increment entry is either truncated or rejected.

If the carrier frequency increment is set to a value that would cause the instrument to exceed its frequency range, the step-up and step-down keys become inoperative. A correct decrease in the increment setting re-enables the step-up and step-down keys.

The MODULATION Display flashes if a change in carrier frequency causes the FM peak deviation allowed for that frequency band to be exceeded. Entering a carrier frequency that sets the instrument in the correct band for the selected deviation frequency clears the error condition, or pressing one of the following keys automatically adjusts the FM peak deviation to the maximum frequency possible for that frequency band.

Band	Carrier Frequency (MHz)
1	0.1–129.99999
2	130–259.99999
3	260–519.99999
4	520–1040

Initialized value and limits of the carrier frequency increment are as follows:

Initialized Value	Minimum Value	Maximum Value
10.00000 MHz	0.01 kHz	≤ 999.99999 MHz

Related Instructions

Frequency
Frequency, Coarse and Fine Tune
Increment Value Change
Increment Value Display

HP-IB Address Display

Description

This instruction details how to display the internally set, decimal HP-IB address.

Keystroke Sequence

Press the SHIFT key, then press and hold ADRS.

Example

Display the internally-set, decimal HP-IB address.

LOCAL (keys)	SHIFT	ADRS LOCAL
HP-IB **(program codes)**	This feature is not accessible via HP-IB.	

Indications

The internally set, decimal HP-IB address is displayed in the MODULATION Display as long as ADRS remains pressed.

Comments

HP-IB addresses greater than 30 (decimal) are interpreted as 30.

HP-IB address is factory-set to 07 decimal. (In binary, this is 00111, the equivalent ASCII character is an apostrophe).

The HP-IB address is updated only when the instrument is powered up.

To change the HP-IB address, refer to paragraph 2-7, HP-IB Address Selection.

The MODULATION Display is restored to reflect the actual Signal Generator output when ADRS is released.

Allowable HP-IB Address Codes

Address Switch					Equivalent ASCII Character (Listen)	Equivalent Decimal Value (Listen)
A5	A4	A3	A2	A1		
0	0	0	0	0	SP	00
0	0	0	0	1	!	01
0	0	0	1	0	"	02
0	0	0	1	1	#	03
0	0	1	0	0	$	04
0	0	1	0	1	%	05
0	0	1	1	0	&	06
0	0	1	1	1	'	07
0	1	0	0	0	(	08
0	1	0	0	1	)	09
0	1	0	1	0	*	10
0	1	0	1	1	+	11
0	1	1	0	0	,	12
0	1	1	0	1	−	13
0	1	1	1	0	.	14
0	1	1	1	1	/	15
1	0	0	0	0	0	16
1	0	0	0	1	1	17
1	0	0	1	0	2	18
1	0	0	1	1	3	19
1	0	1	0	0	4	20
1	0	1	0	1	5	21
1	0	1	1	0	6	22
1	0	1	1	1	7	23
1	1	0	0	0	8	24
1	1	0	0	1	9	25
1	1	0	1	0	:	26
1	1	0	1	1	;	27
1	1	1	0	0	<	28
1	1	1	0	1	=	29
1	1	1	1	0	>	30

Indicates factory-set address.

Related Instructions

Display Amplitude Offset

Increment Value Change

Description

This instruction details how to change the value of the stored increments which are controlled by the step-up and step-down keys associated with each of the four main functions. Increment values for the carrier frequency, output amplitude, AM depth, and FM peak deviation can be stored. The initialized value of each stored increment is listed as follows:

Function	Initialized Value
Carrier Frequency	100.00000 MHz
Output Amplitude	10.0 dB
AM Depth	1%
FM Peak Deviation	1.0 kHz

Keystroke Sequence

Press a Function key, the INCR SET key, the desired Data keys, and a valid Units Key.

Example

Set a carrier frequency increment of 1 MHz.

	FUNCTION	INCREMENT SET	DATA	UNITS
LOCAL (keys)	FREQ	INCR SET	1	MHz
HP-IB (program codes)	FR IS 1 MZ			

Keys and Program Codes

Keys	Codes
INCR SET	IS
FREQUENCY	FR
AMPTD	AP
AM	AM
FM	FM
MHz	MZ
kHz	KZ
No Key	HZ

Keys	Codes
%	PC or %
dBm	DM
dBf	DF
dB	DB
EMF	EM
V	VL
mV	MV
μV	UV

Indications

The value of the increment appears in the display associated with the selected function as the data is entered.

Comments

FM peak deviation increments are selected in units of kHz only. AM depth is selected without fractional digits. All fractional digits are truncated.

If the increment value change is set to a value that would cause the instrument to exceed a minimum or maximum range, the step-up and step-down key associated with that function become inoperative. A correct decrease in the increment setting re-enables the step-up and step-down keys.

Increment entries are checked against maximum and minimum allowable increment limits. If a limit is exceeded the increment entry is either truncated or rejected.

Minimum and maximum allowable increment values for each of the four main functions are listed as follows:

Function	Minimum Value	Maximum Value
Carrier Frequency	0.01 kHz	$\leq$ 999.99999 MHz
Output Amplitude	0.1 dB	$\leq$ 160.5 dB
	0.001 μV	$\leq$ 1.57 V
	0.001 EMF μV	$\leq$ 3.15 EMF V
AM Depth	1%	$\leq$ 99%
FM Peak Deviation	0.1 kHz	$\leq$ 99 kHz

All displays are restored to reflect the actual Signal Generator output as soon as a valid increment terminator is selected.

Related Instructions

Amplitude, Up/Down
Frequency, Coarse and Fine Tune
Frequency, Up/Down
Increment Value Display Modulation, AM Up/Down
Modulation, DC FM
Modulation, FM Up/Down

Increment Value Display

Description

This instruction details how to display the stored value of the increments which are controlled by the step-up and step-down keys associated with each of the four main functions. Increment values for the carrier frequency, output amplitude, AM depth, and FM peak deviation can be displayed.

Keystroke Sequence

Press a function key, then press and hold the INCR SET key.

Example

Display the stored carrier frequency increment.

	FUNCTION	INCREMENT SET
LOCAL (keys)	FREQ	INCR SET
HP-IB (program codes)	FR IS	

Keys and Program Codes

Keys	Codes
INCR SET	IS
FREQUENCY	FR
AMPTD	AP
AM	AM
FM	FM

Indications

The stored value of the increment is displayed in the display associated with the selected function as long as the INCR SET key remains pressed.

Comments

The initialized value of each stored increment is listed as follows:

Function	Initialized Value
Carrier Frequency	100.00000 MHz
Output Amplitude	10.0 dB
AM Depth	1%
FM Peak Deviation	1.0 kHz

The display is restored to reflect the actual Signal Generator output when the INCR SET key is released.

Related Instructions

Amplitude Up/Down
Display Amplitude Offset
Frequency, Up/Down
Increment Value Change
Modulation, AM Up/Down
Modulation, DC FM
Modulation, FM Up/Down

Instrument Preset

Description

This instruction details how to perform an instrument preset.

Keystroke Sequence

Press the SHIFT key, and then the 0 units key.

Example

Preset the instrument.

LOCAL (keys)	SHIFT	0 PRESET
HP-IB (program codes)	This feature is not accessible via HP-IB.	

NOTE

Sending the Clear message via HP-IB is equivalent to performing an instrument preset.

Indications

An instrument preset clears any previously selected function. The front-panel indicators will display a carrier frequency of 100.00000 MHz, an output amplitude of −143.5 dBm, and no modulation.

Comments

Performing this feature:

- Does not affect storage register memory.
- Clears sequence counter to zero, and current increment setting of each function to their initialized values.

Related Instructions

None

Modulation, AM

Description

This instruction details how to select amplitude modulation using the internal modulation source.

Operating Characteristics:

Depth: 0 - 99% +7 dBm
0 - 30% +10 dBm
Resolution: 1%
Rate (internal): 400 Hz and 1 kHz, ±2%

Keystroke Sequence

Press an Internal Source key, the AM function key, the desired Data keys, and a valid Units key.

Example

Select AM with a depth of 75% using the internal 400 Hz source.

	SOURCE	FUNCTION	DATA	UNITS
LOCAL (keys)	INT 400 Hz	AM	7 5	%
HP-IB (program codes)	S2 AM 75 PC or %			

Keys and Program Codes

Keys	Codes
INT 400 Hz	S2
INT 1 kHz	S3
AM	AM
%	PC or %

Indications

Selected AM depth is displayed in the MODULATION Display, and the source annunciators (INT AM, 400 Hz, and %) will light.

Comments

Digits selected beyond the specified resolution for AM depth are truncated.

Leading zeros are blanked.

AM depth Data entries that would cause the peak envelope power of the instrument to exceed +17 dBm are rejected.

The External Source key may be selected in place of the Internal Source key.

AM function remains selected until:

a. One of the three remaining functions is selected (AMPTD, FM, or FREQuency).

b. One of the SAVE, RECALL, SEQuence keys or Display (SHIFT, DSPL) is pressed.

c. The instrument is preset, unplugged, or switched to standby.

A one key sequence acts as a select between the two internal modulation sources.

Only one internal modulation source can be selected at any time either 400 Hz or 1 kHz.

Related Instructions

Modulation, AM Up/Down
Modulation, External Source
Modulation, Mixed
Modulation, Off

Modulation, AM Up/Down

Description

This instruction details how to change the percentage of AM depth by the value stored in the AM depth increment register.

Keystroke Sequence

Press the step-up or step-down keys associated with the amplitude modulation function.

Keys and Program Codes

Keys	Codes
AM ▲ ▼	AM UP DN

NOTE

In remote operation, repeated UP or DN codes can be sent over the bus once the AM function is selected.

Indications

The percentage of AM depth shown in the MODULATION Display, and the output of the Signal Generator changes by the value stored in the AM depth increment register.

Comments

Step-up and step-down keys associated with the amplitude modulation function are used to change the percentage of AM depth by the value stored in the AM depth increment register.

Performing this feature:

- Places the instrument in the AM Data entry mode, and clears any previously selected function.
- Selects default modulation source (internal 1 kHz) if no other source is selected.
- Will automatically stop incrementing when the maximum percentage of AM depth permitted for a selected output amplitude is reached.
- Continues to change the percentage of AM depth by the value stored in the AM depth increment register if either key remains pressed.

If the AM depth increment is set to a value that would cause the instrument to exceed a modulation depth of 1 to 99% the step-up and step-down keys become inoperative. A correct decrease in the increment setting re-enables the step-up and step-down keys.

Increment entries are checked against maximum and minimum allowable increment limits. If an AM depth increment limit is exceeded the entry is truncated.

Initialized value and limits of the AM depth increment are as follows:

Initialized Value	Minimum Value	Maximum Value
1%	1%	≤99%

Related Instructions

Increment Value Change
Increment Value Display
Modulation, AM
Modulation, Off
Modulation, DC FM Up/Down
Modulation, FM Up/Down

Modulation, DC FM

Description

This instructions details how to select dc coupled frequency modulation using an external power source.

Operating Characteristics:

Band	Carrier Frequency (MHz)	Maximum Peak Deviation DC Mode (kHz)
1	0.1–129.99999	99
2	130–259.99999	50
3	260–519.99999	99
4	520–1040	99

Resolution: 0.1 kHz for peak deviations < 10 kHz
1 kHz for peak deviations ≥ 10 kHz
DC calibrated input level: ±1 Vdc

CAUTION

Maximum allowable input level is ±15 Vdc. Exceeding this limit may cause damage to the instrument.

Keystroke Sequence

Press the SHIFT key, the FM function key, the desired Data Keys and a valid Units key.

Example

Select DC FM with a peak deviation of 50 kHz.

	FUNCTION	DATA	UNITS
LOCAL (keys)	SHIFT FM	5 0	kHz
HP-IB (program codes)	S5 50 KZ		

Keys and Program Codes

Keys	Codes
DC FM kHz	S5 KZ

Indications

Selected DC FM peak deviation are displayed in the MODULATION Display, and the Modulation annunciators (DC FM, EXT FM, and LO EXT) will light.

Comments

Selecting DC FM automatically enables the front-panel MOD INPUT/OUTPUT connector for an external modulation source.

The LO EXT Modulation annunciator remains on regardless of the dc input level applied to the MOD INPUT/OUTPUT connector.

The LO EXT Modulation annunciator turns off if external AM or FM is selected along with DC FM, and the external source has been adjusted to 1 Vpk (0.707 Vrms ±5%).

Digits selected beyond the specified resolution for DC FM peak deviation are truncated.

Leading zeros are blanked.

The instrument is placed in the DC FM Data entry mode, any previously selected function is cleared.

DC FM peak deviation Data entries that would be out-of-range for the selected carrier frequency are rejected.

The MODULATION Display flashes if a change in carrier frequency causes the FM peak deviation allowed for that frequency band to be exceeded. Entering a carrier frequency that sets the instrument in the correct band for the selected deviation frequency clears the error condition, or pressing one of the following keys automatically adjusts the FM peak deviation to the maximum deviation possible for that frequency band.

Band	Carrier Frequency (MHz)
1	0.1–129.99999
2	130–259.99999
3	260–519.99999
4	520–1040

DC FM function remains selected until:

a. One of the three remaining functions is selected (AM, AMPTD, or FREQuency).

b. One of the SAVE, RECALL, SEQuence keys or Display (SHIFT, DSPL) is pressed.

c. The instrument is preset, unplugged, or switched to standby.

Related Instructions

Modulation, DC FM Up/Down
Modulation, External Source
Modulation, Mixed
Modulation, Off

Modulation, DC FM Up/Down

Description

This instruction details how to change the DC FM peak deviation by the value stored in the FM peak deviation increment register.

Keystroke Sequence

Press the step-up or step-down keys associated with the frequency modulation function.

Keys and Program Codes

Keys	Codes
DC FM ⬆ ⬇	S5 UP DN

NOTE

During remote operation, repeated UP or DN codes can be sent over the bus once the DC FM function is selected.

Indications

The DC FM peak deviation shown in the MODULATION Display, and the output of the Signal Generator changes by the value stored in the FM peak deviation increment register.

Comments

Step-up and step-down keys associated with the DC FM function are used to change the DC FM peak deviation by the value stored in the FM peak deviation increment register.

Performing this feature:

- Continues to change the DC FM peak deviation by the value stored in the FM peak deviation increment register if either key remains pressed.
- Will automatically stop incrementing when the maximum FM peak deviation permit ted for a selected carrier frequency is reached.

If an out-of-range condition exists (MODULATION Display flashing) pressing either the step-up or the step-down (or FM) key automatically selects the maximum FM peak deviation permitted for the currently selected carrier frequency.

Initialized value and limits of the FM peak deviation increment are as follows:

Initialized Value	Minimum Value	Maximum Value
1 kHz	0.1 kHz	≤99 kHz

Related Instructions

Increment Value Change
Increment Value Display
Modulation, AM Up/Down
Modulation, DC FM
Modulation, FM Up/Down
Modulation, Off

Modulation, External Source

Description

This instruction details how to apply an external modulation signal via the front-panel MOD INPUT/OUTPUT connector.

Operating Characteristics:

Rate: (AM) 20 Hz to 40 kHz; 1 dB bandwidth, ac coupled
(FM) dc to 50 kHz; ±1 dB 20 Hz to 50 kHz, ac coupled
dc to 100 kHz; ±3 dB
Input Impedance: 600 ohms (resistive)
Input Level: 1 Vpk (0.707 Vrms)

Keystroke Sequence

Press the EXT key to enable the front-panel MOD INPUT/OUTPUT connector, then set the signal level of the external modulation source to 1 Vpk (0.707 Vrms) for calibrated internal control of the AM depth or FM peak deviation.

Keys and Program Codes

Keys	Codes
EXT	S1
AM	AM
%	PC or %
FM	FM
kHz	KZ

Indications

The HI EXT annunciator lights if the external modulation signal is greater than 1.02 Vpk (0.721 Vrms), and the LO EXT annunciator lights if the signal is less than 0.98 Vpk (0.693 Vrms). Both annunciators are off when the input level is 1.00 ±0.02 Vpk (0.707 Vrms), except when exclusively in the DC FM Mode in which case the LO EXT annunciator remains on.

NOTE

If greater accuracy is required, use a calibrated voltmeter to measure the external modulation signal.

Comments

In addition to being able to accept an external modulation signal, the MOD INPUT/ OUTPUT connector provides access to the internally generated 400 Hz or 1 kHz signal whenever either is selected, and the external modulation source is not selected. Its signal level is 1 Vpk (0.707 Vrms), and it can not be adjusted by the operator.

For AM or FM the front-panel MOD INPUT/OUTPUT connector is ac coupled. For DC FM the front-panel MOD INPUT/OUTPUT connector is dc coupled.

Related Instructions

Modulation, AM
Modulation, DC FM
Modulation, FM
Modulation, Mixed
Modulation, Off

Modulation, FM

Description

This instruction details how to select frequency modulation using the internal modulation source.

Operating Characteristics:

Band	Carrier Frequency (MHz)	Maximum Peak Deviation	
		Rates ≥ 50 Hz	Rates < 50 Hz
1	0.1–129.99999	99 kHz	4000 × Rate
2	130–259.99999	50 kHz	2000 × Rate
3	260–519.99999	99 kHz	4000 × Rate
4	520–1040	99 kHz	4000 × Rate

Resolution: 0.1 kHz for peak deviations < 10 kHz
1 kHz for peak deviations ≥ 10 kHz
Rate (internal): 400 Hz or 1 kHz, ±2%

Keystroke Sequence

Press an internal Source key, the FM Function key, the desired Data keys, and a valid Units key.

Example

Select FM with a peak deviation of 25 kHz using the internal 400 Hz source.

	SOURCE	FUNCTION	DATA	UNITS
LOCAL (keys)	INT 400 Hz	FM	2 5	kHz
HP-IB (program codes)	S2 FM 25 KZ			

Keys and Program Codes

Keys	Codes
INT 400 Hz	S2
INT 1 kHz	S3
FM	FM
kHz	KZ

Indications

Selected FM peak deviation are displayed in the MODULATION Display, and the source annunciators (INT FM, 400 Hz, and 1 kHz) will light.

Comments

Digits selected beyond the specified resolution for FM peak deviation are truncated.

Leading zeros are blanked.

A one-key sequence acts as a select between the two internal modulation sources.

The External Source key may be selected in place of the Internal Source key.

Only one internal modulation source can be selected at any time, either 400 Hz or 1 kHz.

FM peak deviation Data entries are rejected if they would cause the selected carrier frequency to be out-of-range.

The MODULATION Display flashes if a change in carrier frequency causes the FM peak deviation allowed for that frequency band to be exceeded. Entering a carrier frequency that sets the instrument in the correct band for the selected deviation frequency clears the error condition, or pressing one of the following keys automatically adjusts the FM peak deviation to the maximum frequency possible for that frequency band.

Band	Carrier Frequency (MHz)
1	0.1–129.99999
2	130–259.99999
3	260–519.99999
4	520–1040

FM function remains selected until:

a. One of the three remaining functions is selected (AM, AMPTD, or FREQuency).

b. One of the SAVE, RECALL, SEQuence keys or Display (SHIFT, DSPL) is pressed.

c. The instrument is preset, unplugged, or switched to standby.

Related Instructions

Modulation, FM Up/Down
Modulation, External Source
Modulation, Mixed
Modulation, Off

Modulation, FM Up/Down

Description

This instruction details how to change the FM peak deviation by the value stored in the FM peak deviation increment register.

Keystroke Sequence

Press the step-up or step-down keys associated with the frequency modulation function.

Keys and Program Codes

Keys	Codes
FM	FM
⬆	UP
⬇	DN

NOTE

In remote operation, repeated UP or DN codes can be sent over the bus once the FM function is selected.

Indications

The FM peak deviation shown in the MODULATION Display, and the output of the Signal Generator changes by the value stored in the FM peak deviation increment register.

Comments

Step-up and step-down keys associated with the frequency modulation function are used to change the FM peak deviation by the value stored in the FM peak deviation increment register.

If the FM peak deviation increment is set to a value that would cause the instrument to exceed its peak deviation range, the step-up and step-down keys become inoperative. A correct decrease in the increment setting re-enables the step-up and step-down keys.

Performing this feature:

- Places the instrument in the FM Data entry mode, and clears any previously selected function.
- Selects default modulation source (internal 1 kHz) if no other source is selected.
- Continues to change the FM peak deviation by the value stored in the FM peak deviation increment register if either key remains pressed.
- Will automatically stop incrementing when the maximum FM peak deviation permitted for a selected carrier frequency is reached.

If an out-of-range condition exists (MODULATION Display flashing), pressing either the step-up or step-down (or FM) key automatically selects the maximum FM peak deviation permitted for the currently selected carrier frequency.

Increment entries are checked against maximum and minimum allowable increment limits. If a limit is exceeded, the increment entry is either truncated or rejected.

Initialized value and limits of the FM peak deviation increment are as follows:

Initialized Value	Minimum Value	Maximum Value
1.0 kHz	0.1 kHz	≤99 kHz

Related Instructions

Increment Value Change
Increment Value Display
Modulation, AM Up/Down
Modulation, FM
Modulation, DC FM Up/Down
Modulation, Off

Modulation, Mixed

Description

These instructions detail the selection of mixed modulation. Modulation is selected in one of five ways.

1. Simultaneous AM and FM is selected using common or separate modulation sources (rate).
2. Simultaneous AM or FM at two rates is selected by using internal and external modulation sources. Only one AM depth or one FM deviation can be selected.
3. Three simultaneous modulation signals, AM and FM using a common source (rate) and either AM or FM from a separate source, may be selected.
4. Four simultaneous modulation signals, two AM and two FM, may be selected. Each AM/FM pair must have a common modulation source (rate). Only one AM depth and one FM deviation can be selected.
5. DC FM may be selected and entered along with any of the four ways mentioned in statements 1–4.

Keystroke Sequence 1

To select simultaneous AM and FM, press the Source key to provide the desired AM rate, the AM Function key, the desired Data keys, and the % Units key. Then press the Source key to provide the desired FM rate, the FM Function key, the desired Data keys, and the kHz Units key. (The Source key need not be pressed for FM if the AM and FM rate is the same. Only one internal rate can be used at a time.)

Example 1

Simultaneously select AM with a depth of 70% and FM with a peak deviation of 3 kHz using the internal 400 Hz source, and an external 1 kHz source respectively.

	SOURCE	FUNCTION	DATA	UNITS
LOCAL (keys)	INT 400 Hz	AM	7 0	%
	EXT	FM	3	kHz
HP-IB (program codes)	S2 AM 70 PC or % S1 FM 3 KZ			

Keystroke Sequence 2

To select simultaneous AM or FM, press the desired Source key, the desired Function key, the desired Data keys, and a valid Units key. Then press the other Source key, and the same Function key that was selected previously.

Example 2

Select FM with a peak deviation of 5 kHz using both an internal 1 kHz modulation source and an external 150 Hz modulation source.

	SOURCE	FUNCTION	DATA	UNITS
LOCAL (keys)	INT 1 kHz EXT	FM FM	5	kHz
HP-IB (program codes)	S3 FM 5 KZ S1 FM			

Keystroke Sequence 3

To select three simultaneous modulation signals, AM and FM using a common source (rate) and AM or FM from a separate source, press the Source key to provide the common AM and FM rate. Then press a Function key, the desired Data keys, and the valid Units key. Press the other Function key, the desired Data keys, and the valid Units key. Press the other Source key, the appropriate Function key, the desired Data keys, and the valid Units key.

Example 3

Simultaneously select AM with a depth of 90% and FM with a peak deviation of 25 kHz using the internal 400 Hz source, and AM with a depth of 90% using an external 6 kHz modulation source.

	SOURCE	FUNCTION	DATA	UNITS
LOCAL (keys)	INT 400 Hz EXT	AM FM AM	9 0 2 5	% kHz
HP-IB (program codes)	S2 AM 90 PC or % FM 25 KZ S1 AM			

Keystroke Sequence 4

To select four simultaneous modulation signals, press the appropriate Source key, a Function key, the desired Data keys, and the valid Units key. Press the other Function key, the desired Data keys and valid Units key. Press the other Source key, and then both Function keys.

Example 4

Simultaneously select AM with a depth of 10% and FM with a peak deviation of 50 kHz using the internal 1 kHz modulation source. AM and FM with the same depth and deviation as selected previously are also selected using an external 5 kHz source.

	SOURCE	FUNCTION	DATA	UNITS
LOCAL (keys)	INT 1 kHz EXT EXT	AM FM AM FM	1 0 5 0	% kHz
HP-IB (program codes)	S3 AM 10 PC or % FM 50 KZ S1 AM S1 FM			

Keys and Program Codes

Keys	Codes
AM	AM
FM	FM
DC FM	S5
EXT	S1
INT 400 Hz	S2
INT 1 kHz	S3

Indications

The last selected AM depth or FM peak deviation is displayed in the MODULATION Display, and the source annunciators will light. In the case where an external modulation source is used, the HI EXT and LO EXT annunciators will also light until the signal level of the external source is adjusted to 1 Vpk (0.707 Vrms) ±5%.

Comments

Digits selected beyond the specified resolution for AM depth or FM peak deviation are truncated.

Leading zeros are blanked.

AM depth Data entries that would cause the peak envelope power of the instrument to exceed +17 dBm are rejected.

FM peak deviation Data entries that are out-of-range for the selected carrier frequency are rejected.

The MODULATION Display flashes if a change in carrier frequency causes the FM peak deviation allowed for that frequency band to be exceeded. Entering a carrier frequency that sets the instrument in the correct band for the selected deviation clears the error condition, or pressing one of the following keys automatically adjusts the the FM peak deviation to the maximum frequency possible for that frequency band.

Band	Carrier Frequency (MHz)
1	0.1–129.99999
2	130–259.99999
3	260–519.99999
4	520–1040

AM or FM function remains selected until:

a. One of the three remaining functions is selected.

b. One of the SAVE, RECALL, SEQuence keys or Display (SHIFT, DSPL) is pressed.

c. The instrument is preset, unplugged, or switched to standby.

Setting the level of the external modulation source is described under Modulation, External Source.

Related Instructions

Modulation, AM
Modulation, DC FM
Modulation, External Source
Modulation, FM
Modulation, OFF

Modulation, Off

Description

This instruction details how to selectively turn off DC FM, and the AM or FM function. In addition, it details how to selectively turn off a modulation source.

Keystroke Sequences

To turn off a modulation function (AM or FM), press the Function key, then the OFF key.

To turn off a modulation source (internal 400 Hz, internal 1 kHz, or external), press the associated Function key, Source key, then the OFF key.

Examples

Selectively turn off DC FM.

	FUNCTION	SOURCE
LOCAL (keys)	FM	EXT OFF
HP-IB (program codes)	FM S1 S4	

Selectively turn off AM modulation function with only one modulation source in use.

	FUNCTION	SOURCE
LOCAL (keys)	AM	OFF
HP-IB (program codes)	AM S4	

Selectively turn off internal 400 Hz source.

	FUNCTION	SOURCE
LOCAL (keys)	AM	INT 400 Hz OFF
HP-IB (program codes)	AM S2 S4	

Keys and Program Codes

Keys	Codes
AM	AM
FM	FM
EXT	S1
INT 400 Hz	S2
INT 1 kHz	S3
OFF	S4
DC FM	S5

Indications

The current MODULATION Display is blanked or the modulation source (including its annunciator) is turned off when the OFF key is pressed.

Comments

The currently selected modulation function (AM or M) is turned off when the OFF key is pressed, provided only one source (internal 400 Hz or 1 kHz, or external) is selected for use.

If more than one source is selected, then a Source key (INT 400 Hz, INT 1 kHz, or EXT) has to be pressed before the OFF key is pressed. In this case, the currently selected modulation function remains selected, and only the chosen source (including its annunciator) is turned off.

If both modulation functions are simultaneously selected and share the same source, then; only the currently selected modulation function is turned off when the OFF key is pressed, and the MODULATION Display is restored to show the modulation parameters of the remaining function.

Related Instructions

Modulation, AM
Modulation, AM Up/Down
Modulation, DC FM
Modulation, DC FM Up/Down
Modulation, FM
Modulation, FM Up/Down
Modulation, External Source
Modulation, Mixed

Recall

Description

This instruction details how to selectively recall the stored contents from a storage register.

Keystroke Sequence

Press the RECALL key, and then two Data keys sequentially.

Example

Recall the stored contents from register 02.

LOCAL (keys)	RECALL	0	2
HP-IB (program codes)	RC 02		

Keys and Program Codes

Keys	Codes
RECALL	RC

Indications

The stored contents from the selected register is recalled, and the output of the Signal Generator is changed so that it agrees with the recalled parameter values.

Comments

One hundred storage registers are available (00–99). Each is capable of storing complete front-panel setups (exclusive of increment settings).

Performing this feature:

- Clears any previously selected function.
- Updates contents of the sequence counter, so that it agrees with the numerical location of the recalled register.
- Does not affect current increment settings.

Related Instructions

Display
Store
Sequence

RF OFF/ON

Description

This instruction details how to turn OFF and ON the carrier frequency at the RF OUTPUT of the Signal Generator.

Keystroke Sequence

Press the RF OFF/ON key.

Keys and Program Codes

Keys	Codes
RF OFF	R2
RF ON	R3

Indications

The AMPLITUDE Display, and Amplitude annunciators are blanked when RF OFF/ON is off. Pressing RF OFF/ON again turns on the RF and restores the AMPLITUDE Display and annunciators.

Comments

The RF OFF/ON key turns off the carrier frequency to the output without affecting the attenuators.

Performing this feature:

- Does not affect the currently selected function.
- Does not change the contents of the sequence counter.

Related Instructions

None

Save

Description

This instruction details how to save complete front-panel setups (exclusive of increment settings) for either selectable or sequential recall or display at a later time.

Keystroke Sequence

Press the SAVE key, then two Data keys sequentially.

Example

Save the current front-panel settings in register 02.

LOCAL (keys)	SAVE	0	2
HP-IB (program codes)	SV 02		

Keys and Program Codes

Keys	Code
Save	SV

Indications

No visible front-panel change.

Comments

One hundred storage registers are available (00–99). Each is capable of storing complete front-panel setups (exclusive of increment settings).

Performing this feature:

- Clears any previously selected function.

Related Instructions

Display
Recall
Sequence

Sequence

Description

This instruction details how to sequentially recall the stored contents from each of the storage registers.

Keystroke Sequence

Press the SEQ key.

Example

Sequentially recall the stored contents from each of the storage registers.

LOCAL (keys)	SEQ
HP-IB (program codes)	SQ

Keys and Program Codes

Keys	Codes
SEQ	SQ

Indications

Each time the SEQ key is pressed, the stored contents from each storage register is recalled, and the output of the Signal Generator is changed so that it agrees with the recalled parameter values.

Comments

One hundred storage registers are available (00–99). Each is capable of storing complete front-panel setups (exclusive of increment settings).

Performing this feature:

- Clears any previously selected function.
- Updates contents of the sequence counter, so that it agrees with the numerical location of the recalled register.
- Clears any previously selected Modulation, frequency, and Amplitude setting which has not been stored in one of the storage registers.
- Does not affect current increment settings.

Remote sequence operation is permitted through an external switch closure connected at the rear-panel SEQ connector J5.

Related Instructions

Display
Display Sequence
Recall
Store

Section 4
PERFORMANCE TESTS

4-1. INTRODUCTION

The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section 3 under Operator's Checks.

NOTE

If the performance tests are to be considered valid, the following conditions must be met:

a. *The Signal Generator must have a 30-minute warmup.*

b. *The line voltage must be 100, 120, 220, or 240 Vac (+5%, −10%) from 48 to 440 Hz. The Voltage Selector Cam must be in the proper position. Refer to Figure 2-1.*

c. *The ambient temperature must be 0 to 55° C for the Level Accuracy and Flatness Test.*

4-2. EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in Table 1-2, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-3. PERFORMANCE TEST RECORD

Results of the performance tests may be tabulated on Table 4-2 which is the Performance Test Record. The Performance Test Record located at the end of this section lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

4-4. CALIBRATION CYCLE

This instrument requires periodic verification of performance. Depending on the use and environmental conditions, the instrument should be checked using the following performance tests at least once each year.

4-5. ABBREVIATED PERFORMANCE TESTING

In most cases, it is not necessary to perform all of the tests in this section. Table 4-1 shows which tests are recommended for various situations. The Operator's Checks in Section 3 should be the first step in all testing situations.

4-6. TEST PROCEDURES

It is assumed that the person performing the following tests understands how to operate the specified test equipment. Equipment settings, other than those for the Signal Generator, are stated in general terms. For example, a test might require that a spectrum analyzer's resolution bandwidth be set to 100 Hz; however, the time per division setting would not be specified and the operator would set that control so that the analyzer operates correctly.

It is also assumed that the person performing the tests will supply whatever cables, connectors, and adapters are necessary.

Table 4-1. Abbreviated Performance Tests

Testing Situations		Section 3 Functional Checks		Performance Test Number and Name				
				1	2	3	4	5
		Basic	HP-IB	Spectral Purity	Output Level Accuracy And Flatness	Modulation	Output Leakage	SWR
Incoming Inspection or Overall Performance Verification		X	X	X	X	X	X	X
After Complete Adjustment		X		X	X	X	X	X
After Repairs to Assembly:	Reference Service Sheet No.							
A1	21	X						
A2	21-24	X						
A3A1	9	X		X		FM		
A3	9	X						
A3	10	X		X		FM		
A3	11	X		X				
A3	12	X		X				
A3	13	X		X		FM		
A3	14	X		X		FM		
A3	15	X		X		FM		
A3	16	X		X				
A4	1	X		X				
A4	2	X		X				
A6	4	X		X	X	AM		
A6	5	X		X	X			
A6	8	X						
A7	9	X		X				
A8	3	X		X				
A9	8	X		X	X		X	X
A10	6	X						
A10	7	X			X	X		
A10	8	X						
A11	17-20	X	X		X	X		
A15	25	X						
A16	25	X						
FL1	3	X		X				

Performance Test 1

SPECTRAL PURITY TESTS

- **Spurious Signals**
- **Residual AM**
- **Residual FM**
- **SSB Phase Noise (1 Hz Bandwidth)**

Specifications

Electrical Characteristics	Performance Limits	Conditions
Spurious Signals:		
Harmonics	< −30 dBc	≤ +7 dBm output levels
Non-harmonics	< −60 dBc	≥ 2 MHz from carrier in CW mode
		> 5 kHz to 2 MHz from carrier in CW mode
	< −60 dBc	0.1 to 130 MHz
	< −72 dBc	130 to 260 MHz
	< −66 dBc	260 to 520 MHz
	< −60 dBC	520 to 1040 MHz
Sub-harmonics	None	
Residual Modulation CW Mode:		
AM	< 0.04%	0.1 to 1040 MHz
(0.5 to 15 kHz Post Detection Noise Bandwidth)		
FM	< 4 Hz rms	0.1 to 130 MHz
(0.3 to 3 kHz Post Detection Noise Bandwidth)	< 1 Hz rms	130 to 260 MHz
	< 2 Hz rms	260 to 520 MHz
	< 4 Hz rms	520 to 1040 MHz
FM	< 6 Hz rms	0.1 to 130 MHz
(0.05 to 15 kHz Post Detection Noise Bandwidth)	< 1.5 Hz rms	130 to 260 MHz
	< 3 Hz rms	260 to 520 MHz
	< 6 Hz rms	520 to 1040 MHz
SSB Phase Noise		20 kHz offset from carrier
	< −124 dBc/Hz	0.1 to 130 MHz
	< −136 dBc/Hz	130 to 260 MHz
	< −130 dBc/Hz	260 to 520 MHz
	< −124 dBc/Hz	520 to 1040 MHz

Description

Spurious signals are checked using a spectrum analyzer. Residual AM and FM Modulation are checked using a measuring receiver. SSB phase noise is measured using a phase noise measurement system.

Equipment

Spectrum Analyzer ..... HP 8568B or HP 8558A/853A (Harmonics/Spurious Tests)
Measuring Receiver ..... HP 8902A (Option 003 for Optional Residual FM Tests)
Sensor Module ..... HP 11722A
Digital Multimeter ..... HP 3466A
AM/FM Test Source ..... HP 11715A
Cable (UG-21D/U type N connectors) ..... HP 11500B
Cable (UG-88C/U BNC and dual banana plug connectors) ..... HP 11001-60001
Synthesized Signal Generator/(LO for Optional Residual FM Test) ..... HP 8662A
Phase Noise Measurement System ..... HP 3048A

Procedure

Spurious Signals Test

1. Set the spectrum analyzer as follows:

   Center Frequency ..... 100 kHz
   Frequency Span ..... 30 kHz
   Resolution Bandwidth ..... 300 Hz
   Reference Level ..... +7 dBm

2. Set the Signal Generator as follows:

   Frequency ..... 100 kHz
   Frequency Increment ..... 100 kHz
   Amplitude ..... +7 dBm
   Modulation ..... Off

3. Connect the RF OUTPUT of the Signal Generator to the input of the spectrum analyzer as shown in Figure 4-1. Verify that all harmonics are < −30 dBc, all non-harmonics 2 MHz from the carrier are < −60 dBc, all non-harmonics 5 KHz to 2 MHz from carrier are < −72 dBc, < −66 dBc, < −60 dBc for each frequency band shown in the table, and that there are no sub harmonics as the frequency is incremented from 100 kHz to 1040 MHz.

Spurious Signals	Results	
	Actual	Max.
Harmonics	_____	< −30 dBc
Non-Harmonics (≥ 2 MHz from carrier)	_____	< −60 dBc
5 kHz to 2 MHz from carrier	_____	< − 60 dBc, 0.1 tp 130 MHz
	_____	< −72 dBc, 130 to 260 MHz
	_____	< −66 dBc, 260 to 520 MHz
	_____	< − 60 dBc, 520 to 1040 MHz
Sub-Harmonics	_____	None

NOTE

Adjust the Center Frequency, Frequency Span, and Resolution Bandwidth controls as required.

Change the frequency increment from 100 kHz to 10 MHz at 10 MHz, if desired.

4. Verify the residual AM of the measuring receiver as follows:

   a. Connect the modulation output of the measuring receiver to the input of the digital multimeter and the AM output of the AM/FM test source to the input of the measuring receiver as shown in Figure 4-2. Nothing should be connected to the audio input of the AM/FM test source.

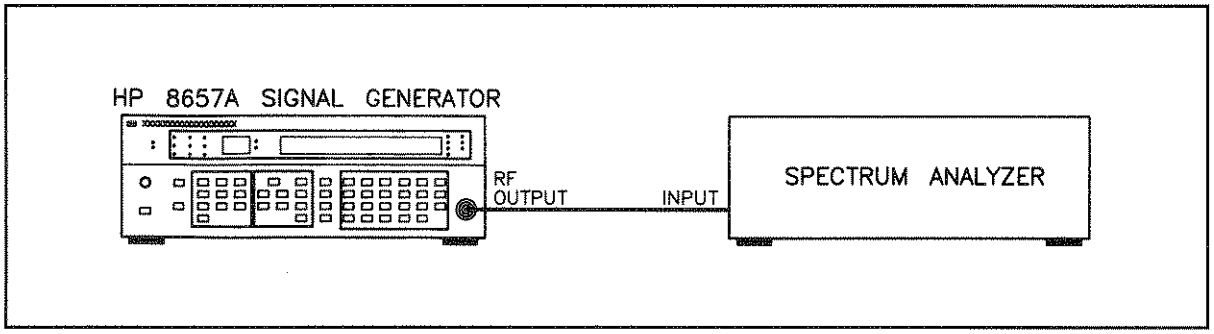


Figure 4-1. *Spurious Signals Test Setup*

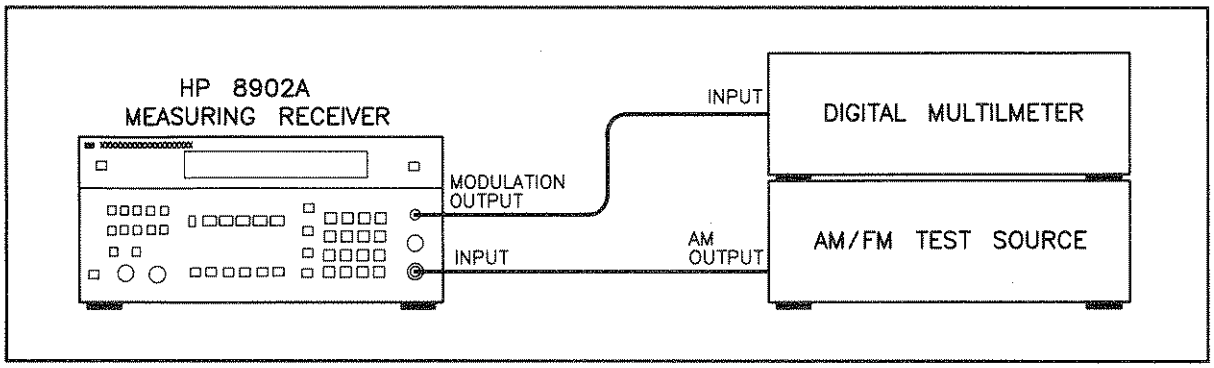


Figure 4-2. *Measuring Receiver Residual AM Verification Test Setup*

Residual AM

NOTE

The residual AM specification of the Signal Generator is not equivalent to the published specification of the HP 8902A Measuring Receiver. To make a valid residual AM measurement, the residual AM of the measuring receiver should be at least 3 dB better than the specification being tested. In order to verify that the residual AM of the measuring receiver is adequate to measure the Signal Generator's residual AM specification, the residual AM of the measuring receiver must be verified to ensure the validity of the measurement. If the Signal Generator's residual AM is measured frequently, it is not necessary to verify the residual AM of the measuring receiver each time; however, it is recommended that it be verified monthly to ensure an accurate measurement.

b. Set the measuring receiver as follows:

Measurement ..... Frequency

c. Set the AM/FM test source as follows:

Test Mode ..... FM

d. Tune the carrier frequency on the AM/FM test source for a measuring receiver reading of 12.5 ±0.1 MHz.

e. Set the digital multimeter as follows:

Function ..... Vac
Range ..... 200 mV

f. Set the measuring receiver as follows:

Measurement ..... AM
HP Filter ..... 50 Hz
LP Filter ..... 15 kHz

g. The digital multimeter should indicate 3.28 mV or less.

NOTE

To make a valid residual AM measurement, the residual AM of the measuring receiver should be at least 3 dB better than the specification being tested or 0.028%. With an output sensitivity of 10%/V, the corresponding output level is 2.80 mV.

5. Set the measuring receiver as follows:

   Measurement ..... AM
   Detector ..... Peak+
   HP Filter ..... 50 Hz
   LP Filter ..... 15 kHz
   FM De-Emphasis ..... Off

6. Set the Signal Generator as follows:

   Frequency ..... Any
   Amplitude ..... 0.0 dBm
   Modulation ..... Off

7. Set the digital multimeter as follows:

   Function ..... Vac
   Range ..... 200 mV

8. Connect the RF OUTPUT of the Signal Generator to the input of the measuring receiver and the modulation output of the measuring receiver to the input of the digital multimeter as shown in Figure 4–3.

9. The digital multimeter should indicate <4.00 mVrms.

Actual	Maximum
_____	< 4.00 mVrms

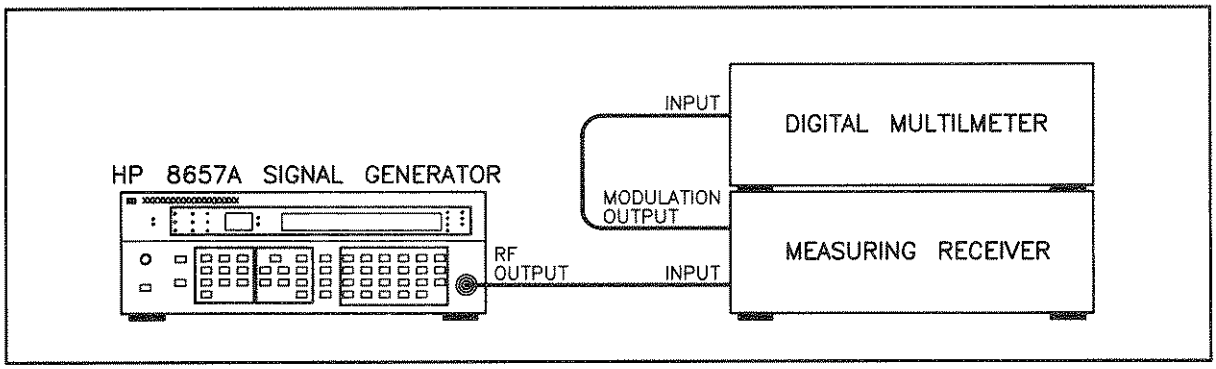


Figure 4–3. *Residual AM Test Setup*

Residual FM

NOTE

A standard HP 8902A can be used to verify the residual FM specifications in the heterodyne band of frequencies. Tests performed at these frequencies will verify that in all probability, the instrument meets its specifications. If the HP 8657A has been repaired or the heterodyne band of frequencies do not pass, the Optional Residual FM Test (steps 10a-13a) should be performed.

10. Set the measuring receiver as follows:

    Measurement ..... FM
    Detector ..... RMS
    FM De-Emphasis ..... Off
    Automatic Operation ..... Selected

11. Set the Signal Generator under test as follows:

    Frequency ..... Any From Chart
    Amplitude ..... 0.0 dBm
    Modulation ..... Off

12. Connect the RF OUTPUT of the Signal Generator under test to the input of the measuring receiver as shown in Figure 4-4.

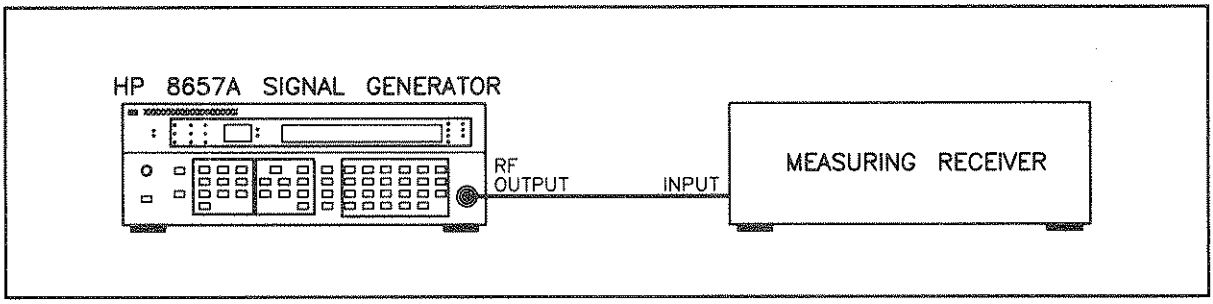


Figure 4-4. *Residual FM Test Setup*

13. Set the Signal Generator frequency and select the measuring receiver high-pass and low-pass filters as indicated in the following table. Verify that the measured results do not exceed the limits specified.

Signal Generator Frequency (MHz)	Modulation Analyzer Filter		Results (Hz rms)	
	High Pass (Hz)	Low Pass (Hz)	Actual	Max.
0.15 to 129.99999	300	3	_____	< 4
0.15 to 129.99999	50	15	_____	< 6

Optional Residual FM Test

The Residual FM Test gives confidence that the HP 8657A is passing all its Residual FM specifications. The Residual FM of the HP 8657A can be checked at all frequencies with an HP 8902A Option 003 and an external local oscillator (LO). The residual FM of the external LO must be less than the internal LO of the HP 8902A and the residual FM of the HP 8657A.

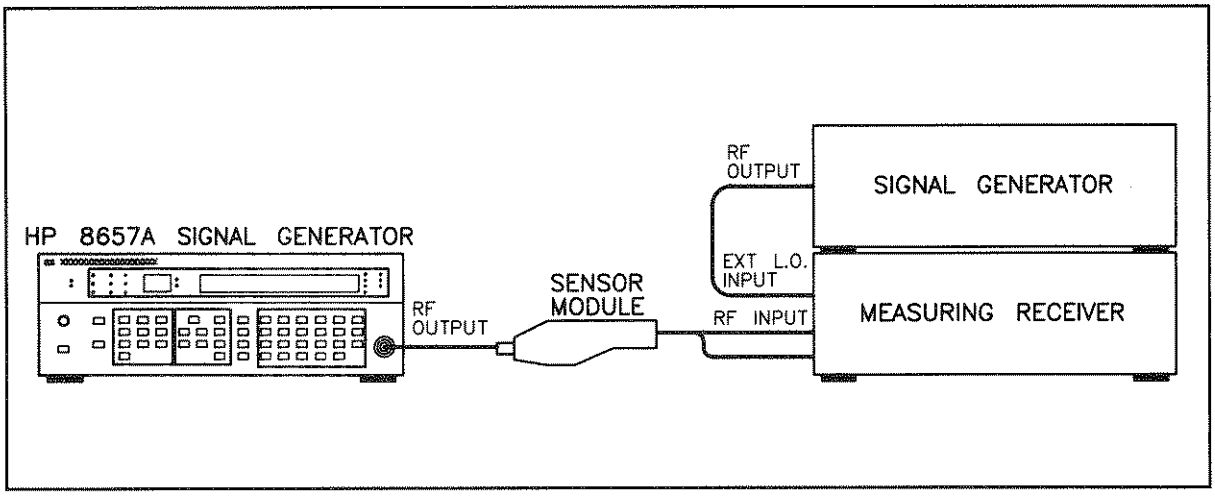


Figure 4–4a. *Residual Test Setup*

10a. Set the measuring receiver as follows:

Measurement ..... FM
Detector ..... RMS
FM De-Emphasis ..... Off
Automatic Operation ..... Selected

11a. Set the Signal Generator under test as follows:

Frequency ..... Any From Chart
Amplitude ..... 0.0 dBm
Modulation ..... Off

12a. Connect the instruments as shown in Figure 4–4a.

13a. Set the Signal Generator frequency and select the measuring receiver high-pass and low-pass filters as indicated in the following table. Verify that the measured results do not exceed the limits specified.

Optional Residual FM Test Specifications

Signal Generator Frequency (MHz)	Modulation Analyzer Filter		Results (Hz rms)	
	High Pass (Hz)	Low Pass (Hz)	Actual	Max.
0.15 to 130	300	3	_____	< 4
130 to 260	300	3	_____	< 1
260 to 520	300	3	_____	< 2
520 to 1040	300	3	_____	< 4
0.15 to 130	50	15	_____	< 6
130 to 260	50	15	_____	< 1.5
260 to 520	50	15	_____	< 3
520 to 1040	50	15	_____	< 6

SSB PHASE NOISE (1 HZ BANDWIDTH)

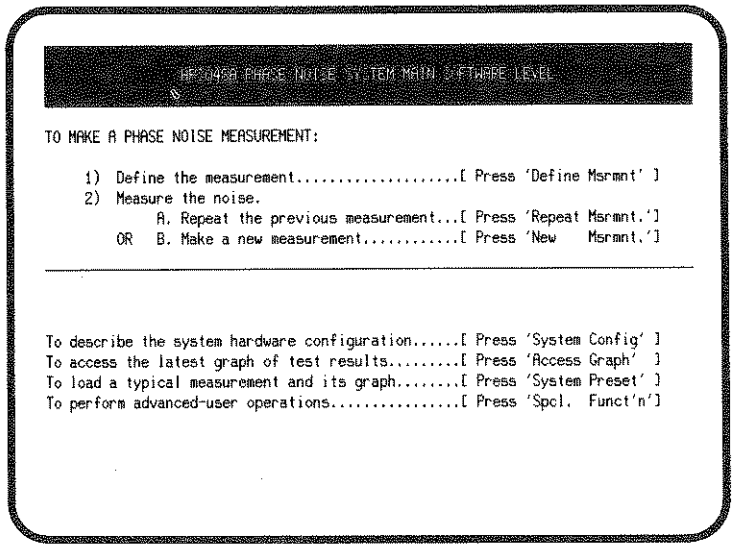
Description

Single-sideband (SSB) phase noise of the HP 8657A is measured at the offset frequency of 20 KHz by the HP 3048A Phase Noise System using its Phase Lock Loop measurement type. The system software provides both the measurement program and the BASIC operating system for the controller. This procedure provides the steps for entering the specific measurement parameters required for this test.

NOTE

This test measures the total SSB phase noise of both generators. This test assumes that the noise level of the reference source you are using is lower than or equal to the noise level of the HP 8657A being tested. If the reference source's phase noise level is equal to the HP 8657A's, the actual noise level for both sources is 3 dB below the level measured by the HP 3048A.

1. The HP 3048's BASIC operating system and system software must be loaded, the HP 8657A's HP-IB address entered, and system operation verified before this test is run. Refer to the HP 3048A Phase Noise Measurement System Operating Manual, Appendix A for the required procedures.
2. If you are not at the HP 3048A's Main Software Level, press the **Done** or **Abort** Softkey. The Main Software Level menu provides access to each of the HP 3048's main functions. You will always return to this menu when you exit the selected function.



Defining the Measurement

3. Press the **Define Msrmt** Softkey to display the Measurement Definition Menu.
4. Press the **Test Files** softkey.
5. Position the curser at the file labeled HP EXAMPLE RF SYNTHESIZER (8662/3 DCFM).
6. Press the **Load File** key. After the HP 3048A has completed the file loading sequence, press the **Done** key.

NOTE

This example file contains many of the measurement parameters required for this test. Table 4-2 lists the paramaters that have been loaded from this file. The following steps will guide you through the process of making the necessary changes to the parameters to meet the specific requirements of this test.

7. Press the **Instr Params** key. Enter a carrier frequency of 640 E+6 Hz. Enter a Detector/Disc. Input frequency of 640 E+6 Hz. Enter a VCO Tuning Constant of 1 E+3 Hz/volt. Enter the Voltage Tuning Range of VCO as 5 volts. The remaining entries do not need to be changed. Press the **Done** key.
8. Press the **Calibr Process** key. Press the **Tuning Const** key to select Compute from expected T. Constant. Press the **Done** key.
9. Press the **Source Control** key. Press the **Ref. Source** key as needed to select 8657A SYSTEM CNTRL. Press the **Done** key when you have completed this operation.

NOTE

The HP 8657A under test is configured as the reference source in this display to enable the HP 3048A to control it using control routines built into the HP 3048A's software. The measurement results will still reflect the noise level of the HP 8657A under test. If you are not able to select the HP 8657A as the reference source using the Ref. Source key, then the HP 8657A has not yet been entered into the HP 3048A's Configuration Table. To enter the HP 8657A, return to the Main Software Menu and press the **System Config** *key.*

10. Press the **Define Graph** key. Enter an appropriate graph title for your test. Press the **Done** key to exit this menu, and then press the **Done** key again to return to the Main Software level.

Beginning the Measurement

11. Press the **New Msrmnt** key to begin the phase noise measurement.
12. When the hardware connect diagram appears in the display, connect the HP 8657A and reference source to the HP 3048A as shown. (Note that the reference source is labeled USERS's DUT on the screen. Figure 4-5 also shows the cable connections for this measurement.)
13. Adjust the reference source's center frequency to 640 MHz and its amplitude to 0 dBm. (The HP 8657A's setting will be adjusted by the HP 3048A via its HP-IB connection.)

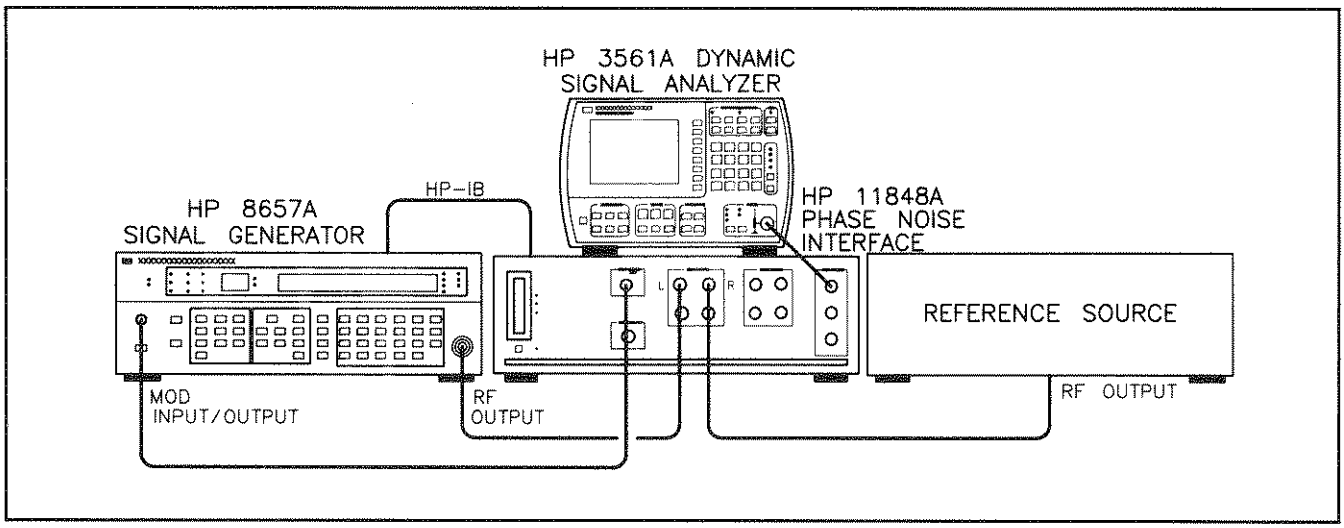


Figure 4–5. *Setup Diagram for SSB Phase Noise Measurement*

14. After you have connected the cables, press the **Proceed** key to run the measurement. (If you wish to measure the phase noise level of the HP 8657A at other center frequency settings after this test is completed, change the center frequency on the reference source to the desired frequency. Enter the desired frequency as the carrier frequency and detector/disc input frequency in the Source and Interface Parameter Entry menu.)

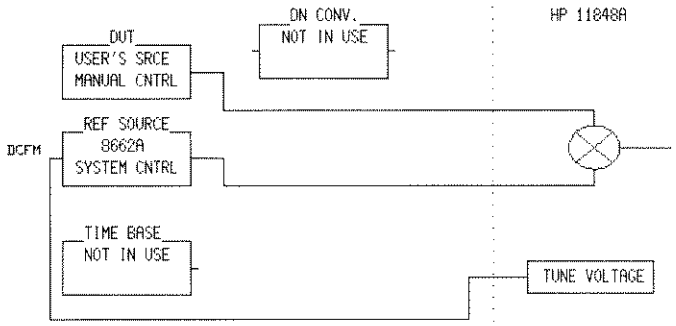
NOTE

If the noise level measured by the HP 3048A exceeds the HP 8657A's specified noise level and the exact noise level of the reference source is not known, the exact level of each source should determined by measuring each source against a third signal source and comparing the measurement results for all three measurements.

15. The Measured SSB Phase Noise should be at or below the specified value.

Offset from Carrier	SSB Phase Noise		Carrier Frequency (MHz)
	Min.	Actual	
20 kHz	−124 dBc/Hz	_____	0.1 to 129
	−136 dBc/Hz	_____	130 to 260
	−130 dBc/Hz	_____	260 to 520
	−124 dBc/Hz	_____	520 to 1040

Table 4–2. *Parameter Data Loaded from HP Example RF Synthesizer (HP 8662/3 DCFM file)*

Parameters	Data
Measurement Type **Frequency Range** Start Freq. Stop Freq. Averages	Phase Noise Using a Phase Lock Loop 1 Hz 100 E + 3 Hz 4
Source Parameters Carrier Frequency Detector/Discr. Input Frequency VCO Tuning Constant Center Voltage of VCO Tuning Curve Voltage Tuning Range of VCO VCO Tune-Port Input Resistance Internal Phase Detector	 500 E + 6 Hz 500 E + 6 Hz 25 E + 3 Hz/V 0 Volts ±2 Volts 600 ohms 5 MHz to 1600 MHz
Phase Detector Constant VCO Tuning Constant PLL Suppression	Measure the Detector Constant Measure the VCO Tuning Constant Will be verified
Source Control	
Define Graph Title Minimum X Maximum X Minimum Y Maximum Y Graph Type	 RF SYNTHESIZER VERSUS HP 8662/3A USING DC FM. 1 Hz 100 E + 3 Hz −170 0 Single Sideband Phase Noise (dBc/Hz)

Performance Test 2

OUTPUT LEVEL ACCURACY AND FLATNESS TESTS

- **Level Flatness**
- **Absolute Level Accuracy**

Specifications

Electrical Characteristics	Performance Limits	Conditions
Output		
Level Range	+13 dBm to −143.5 dBm +10 dBm to −143.5 dBm	Into 50 ohms 100 kHz to 1 MHz
Resolution	0.1 dB	
Absolute Level Accuracy(1)	≤ ±1.0 dB	Output levels of +7 dBm to −127 dBm
	< ±1.5 dB	> +7 dBm
Level Flatness	≤ ±0.5 dB	Output level setting of 0.0 dBm; frequencies form 100 kHz to 1040 MHz

(1) Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement errors.

Description

Output level accuracy and flatness are verified using a measuring receiver and a sensor module.

Equipment

Measuring Receiver ..... HP 8902A
Sensor Module ..... HP 11722A

Procedure

Level Flatness

1. Connect the sensor module to the measuring receiver. Zero and calibrate the sensor module and measuring receiver.
2. Connect the sensor module to the Signal Generator as shown in Figure 4-6.

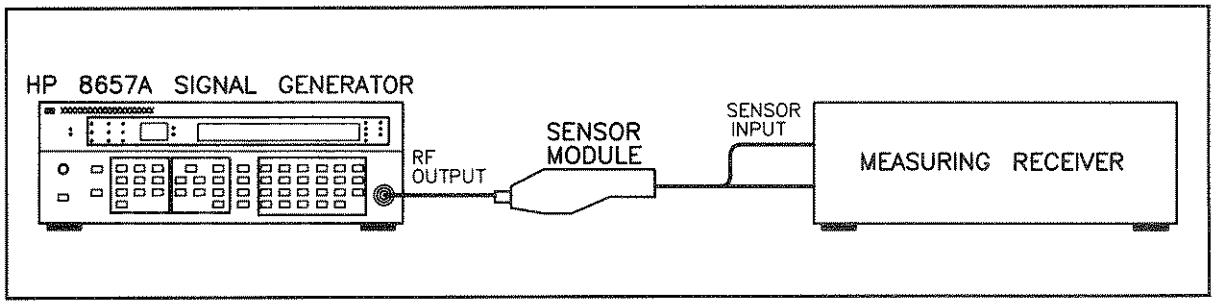


Figure 4-6. *Output Level Accuracy and Flatness Test Setup*

3. Set the measuring receiver as follows:

Measurement ..... RF POWER
Display ..... LOG
Frequency ..... 150 kHz
Frequency Increment ..... 100 kHz

4. Set the Signal Generator as follows:

Frequency ..... 150 kHz
Frequency Increment ..... 100 kHz
Amplitude ..... 0.0 dBm
Modulation ..... Off

5. Wait for the power measurement to settle and then select DISPLAY RATIO to set a 0.0 dB. reference.
6. Step the Signal Generator and measuring receiver through the frequency range of 150 kHz to 1040 MHz (use 10 MHz steps above 10 MHz) and record the highest and lowest readings.

_____ Highest Reading _____ Frequency

_____ Lowest Reading _____ Frequency

The amplitude variation should not exceed 1.0 dB. Record the maximum variation (highest reading − lowest reading).

_____ <1.0 dB

Absolute Level Accuracy

7. Set the Signal Generator as follows:

Frequency ..... 3 MHz
Amplitude ..... +13 dBm
Amplitude Increment ..... 5 dBm
Modulation ..... Off

8. Set the measuring receiver as follows:

   Measurement ..... RF POWER

9. Begin decrementing the Signal Generator's amplitude in 5 dB steps. At each step, the measuring receiver reading must be within the tolerances shown in the following Table, RF Output Frequencies. Step the amplitude down to −2 dBm. Change the measuring receiver's measurement to TUNED RF LEVEL. If RECAL or UNCAL is displayed press and release the CALIBRATE key. Continue to step the amplitude down to −127 dBm; and each time RECAL is displayed press and release the CALIBRATE key.

RF Output Frequencies 0.15 to 1040 MHz

Amplitude Setting (dBm)	Minimum (dBm)	Actual (dBm)	Maximum (dBm)
+8.0	+6.5	_____	+9.5
+3.0	+2.0	_____	+4.0
−2.0	−3.0	_____	−1.0
−7.0	−8.0	_____	−6.0
−12.0	−13.0	_____	−11.0
−17.0	−18.0	_____	−16.0
−22.0	−23.0	_____	−21.0
−27.0	−28.0	_____	−26.0
−32.0	−33.0	_____	−31.0
−37.0	−38.0	_____	−36.0
−42.0	−43.0	_____	−41.0
−47.0	−48.0	_____	−46.0
−52.0	−53.0	_____	−51.0
−57.0	−58.0	_____	−56.0
−63.0	−63.0	_____	−61.0
−67.0	−68.0	_____	−66.0
−72.0	−73.0	_____	−71.0
−77.0	−78.0	_____	−76.0
−82.0	−83.0	_____	−81.0
−87.0	−88.0	_____	−86.0
−92.0	−93.0	_____	−91.0
−97.0	−98.0	_____	−96.0
−102.0	−103.0	_____	−101.0
−107.0	−108.0	_____	−106.0
−112.0	−113.0	_____	−111.0
−117.0	−118.0	_____	−116.0
−122.0	−123.0	_____	−121.0
−127.0	−128.0	_____	−126.0

Performance Test 3

MODULATION TESTS

- **AC Modulation**
  - AM Indicator Accuracy
  - Incidental Phase Modulation
  - AM Distortion
  - FM Indicator Accuracy
  - Incidental AM
  - FM Distortion
- **DC Modulation**
  - DC FM Center Frequency Accuracy
  - DC FM Center Frequency Stability

Specifications

Electrical Characteristics	Performance Limits	Conditions
Amplitude Modulation		
Depth[1]	0 to 99%	Output levels to < +7 dBm; frequencies from 100 kHz to 1040 MHz.
	0 to 30%	Output levels to +10 dBm; frequencies from 100 kHz to 1040 MHz.
Resolution	1%	
Incidental Phase Modulation	< 0.3 radian peak	30% AM depth and internal rates.
Indicator Accuracy	+2% (±6% of reading)	Depths < 90% and internal rates and levels < +7 dBm.
AM Rates		
Internal	400 and 1 kHz, ±3%	
External	20 Hz to 40 kHz	1 dB bandwidth, ac coupled
AM Distortion (internal rates, levels < +10 dBm)	< 1.5%	0 to 30% AM
	< 3%	31 to 70% AM
	< 4%	71 to 90% AM
FM Modulation		
Maximum Peak Deviation (Δfpk):[2]		
Rates ≥ 25 Hz (ac mode)	99 kHz	0.1 to 130 MHz (fc)
Rates ≥ 50 Hz (ac mode)	50 kHz	130 to 260 MHz (fc)
Rates ≥ 50 Hz (ac mode)	99 kHz	260 to 520 MHz (fc)
Rates ≥ 25 Hz (ac mode)	99 kHz	520 to 1040 MHz (fc)

(1) AM Depth is further limited by the Indicator Accuracy specification.
(2) FM deviation is further limited by the Indicator Accuracy specification.

Electrical Characteristics	Performance Limits	Conditions
FM Modulation (cont'd)		
Maximum Peak Deviation (Δfpk):(3) (cont'd)		
Rates < 25 Hz (ac mode)	4000 × Rate Hz	0.1 to 130 MHz (fc)
Rates < 50 Hz (ac mode)	1000 × Rate Hz	130 to 260 MHz (fc)
Rates < 50 Hz (ac mode)	2000 × Rate Hz	260 to 520 MHz (fc)
Rates < 25 Hz (ac mode)	4000 × Rate Hz	520 to 1040 MHz (fc)
Rates (dc mode)	99 kHz	0.1 to 130 MHz (fc)
	50 kHz	130 to 260 MHz (fc)
	99 kHz	260 to 520 MHz (fc)
	99 kHz	520 to 1040 MHz (fc)
Center Frequency Accuracy (dc mode)	±500 Hz	0.1 to 130 MHz (fc)
	± 125 Hz	130 to 260 MHz (fc)
	± 250 Hz	260 to 520 MHz (fc)
	± 500 Hz	520 to 1040 MHz (fc)
Stability (dc mode)	< 10 Hz/hour	
Resolution	0.1 kHz	Deviations < 10 kHz
	1 kHz	Deviations ≥ 10 kHz
Incidental AM	< 0.1%	< 20 kHz peak deviation and internal rates: ≥ 500 kHz (fc)
Indicator Accuracy(3)	±5% of reading	At internal rates.
FM Distortion (Total Harmonic Distortion)(4,5)	<0.5%	≥ 3 kHz peak deviations and at internal rates.
FM Rates:		
Internal	400 and 1 kHz, ±3%	
External	dc to 50 kHz	ac coupled, ±1 dB 20 Hz to 50 kHz.
	dc to 100 kHz	±3 dB.

(3) FM deviation is further limited by the Indicator Accuracy specification.
(4) FM distortion only applies at deviation up to 25 kHz or 130 < fc <260 MHz, and 50 kHz for 260 < fc < 520 MHz. Typical total FM distortion (harmonic and non-harmonic) is less that 1.5% for all specified deviations and external rates of dc to 100 kHz.
(5) Typically < 0.5% THD for peak deviations > 1 kHz and at internal rates.

AC MODULATION

Description

AC modulation specifications are verified by measuring the specified parameters with a measuring receiver. Distortion is verified by measuring the demodulated output from the measuring receiver with a distortion analyzer.

Equipment

Measuring Receiver ..... HP 8902A
Sensor Module ..... HP 11722A
Audio Source ..... HP 8903B
AM/FM Test Source ..... HP 11715A
Cable (UG-21D/U type N connectors) ..... HP 11500B
Cable (UG-88C/U BNC and dual banana plug connectors ..... HP 11001-60001

Procedure

AM Indicator Accuracy

1. Connect the RF OUTPUT of the Signal Generator to the input of the measuring receiver as shown in Figure 4-7.

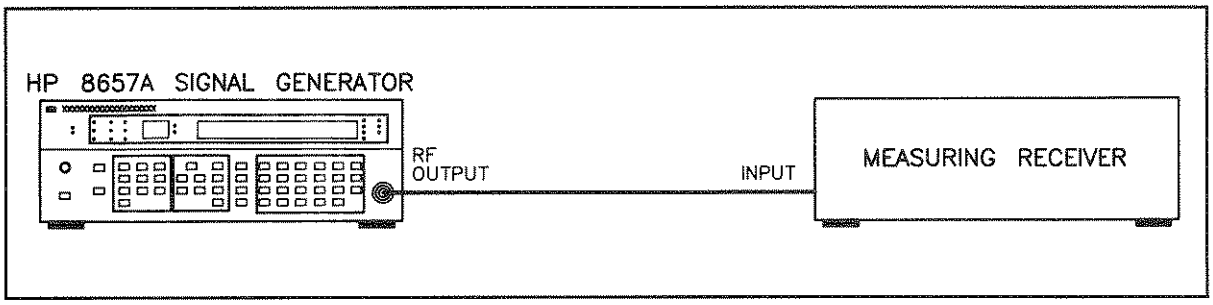


Figure 4-7. *Modulation Test Setup*

2. Set the measuring receiver as follows:

Measurement ..... AM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 15 kHz
FM De-Emphasis ..... Off
Automatic Operation ..... Selected

3. Set the Signal Generator as follows:

Frequency ..... 100 MHz
Amplitude ..... +7 dBm
Modulation ..... 1 kHz (Int.) AM 10%

4. Set the AM depth to the values listed in the following table and verify that the measured results are within the limits specified.

5. Repeat step 5 with the Signal Generator set to frequencies of 240 MHz, 400 MHz and 1040 MHz.

6. Select the measuring receiver's 50 Hz high-pass filter. Verify the AM accuracy with the Signal Generator frequency at 100 MHz and internal 400 Hz AM modulation.

MHz	AM Depth	Results		
		Min.	Actual	Max.
100	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%
240	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%
400	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%
1040	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%

Incidental Phase Modulation

7. Set the measuring receiver as follows:

   Measurement ..... Phase Modulation
   HP Filter ..... 300 Hz
   LP Filter ..... 15 kHz
   Detector ..... Peak+

8. Set the Signal Generator as follows:

   Frequency ..... 100 kHz
   Frequency Increment ..... 100 kHz
   Amplitude ..... +7 dBm
   Modulation ..... 1 kHz (Int.) AM 30%

9. Step the Signal Generator through the frequency range of 150 kHz to 1040 MHz use 10 MHz steps above 10 MHz) and record the highest reading. The highest reading should not exceed the limit specified.

Signal Generator Frequency		Result	
Min.	Max.	Actual	Max.
150 kHz	1040 MHz	_____	< 0.3 radian peak

AM Distortion

10. Set the measuring receiver as follows:

    Measurement ..... 1 kHz Audio Distortion
    HP Filter ..... 300 Hz
    LP Filter ..... 15 kHz
    Detector ..... Peak+

11. Set the Signal Generator as follows:

    Frequency ..... 10 MHz
    Amplitude ..... +7 dBm
    Modulation ..... 1 kHz (Int.) AM 30%

12. Set the AM depth to the values listed in the following table and verify that the measured results do not exceed the limits specified.

13. Repeat step 13 with the Signal Generator set to frequencies of 240 MHz, 400 MHz, and 1040 MHz.

MHz	AM Depth	Results	
		Actual	Max.
100	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%
240	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%
400	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%
1040	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%

FM Indicator Accuracy

14. Set the measuring receiver as follows:

    Measurement ..... FM
    Detector ..... Peak+
    HP Filter ..... 300 Hz
    LP Filter ..... 3 kHz

15. Set the Signal Generator as follows:

    Frequency ..... 100 MHz
    Amplitude ..... +7 dBm
    Modulation ..... 1 kHz (Int) FM 5 kHz

16. Set FM deviation to the values listed in the following table and verify that the measured results are within the limits specified.

FM Deviation for 100 MHz	Results		
	Min.	Actual	Max.
5.0 kHz	4.75 kHz	_____	5.25 kHz
30.0 kHz	28.50 kHz	_____	31.50 kHz
70.0 kHz	66.50 kHz	_____	73.50 kHz
99.0 kHz	94.05 kHz	_____	103.95 kHz

Incidental AM

The incidental AM specification of the Signal Generator is not equivalent to the published specification of the HP 8902A Measuring Receiver. To make a valid incidental AM measurement, the incidental AM of the measuring receiver must be four times better than the specification being tested. In order to verify that the incidental AM of the measuring receiver is adequate to measure the Signal Generator's incidental AM specification, the incidental AM of the measuring receiver must be verified to ensure the validity of the measurement. If the Signal Generator's incidental AM is measured frequently, it is not necessary to verify the incidental AM of the measuring receiver each time; however, it is recommended that it be verified monthly to ensure an accurate measurement.

17. Verify the incidental AM of the measuring receiver as follows:

    a. Connect the FM divide-by-4 output of the AM/FM test source to the input of the measuring receiver and the 50 ohm output of the test oscillator to the audio input of the AM/FM test source, as shown in Figure 4–8.

    b. Set the measuring receiver as follows:

    Measurement ..... Frequency

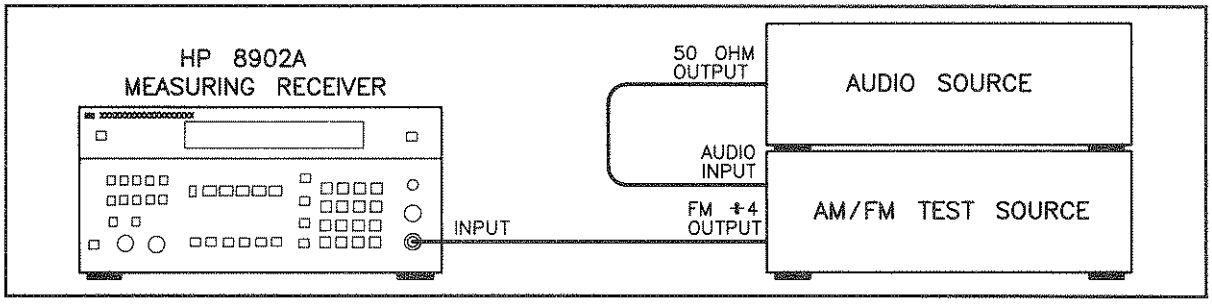


Figure 4–8. *Measuring Receiver Incidental AM Verification Test Setup*

    c. Set the AM/FM test source as follows:

    Test Mode ..... FM

    d. Tune the carrier frequency on the AM/FM test source for a measuring receiver reading of 100 MHz ±0.1 MHz.

    e. Set the test oscillator as follows:

    Frequency ..... 1 kHz
    Output Attenuator ..... −10 dBm
    Amplitude Course ..... Fully ccw

f. Set the measuring receiver as follows:

Measurement ..... FM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 3 kHz

g. Increase the output of the test oscillator by rotating the Amplitude Coarse control clockwise until the measuring receiver indicates 20.0 kHz ±0.1 kHz peak deviation.

h. Set the measuring receiver as follows:

Measurement ..... AM

i. The modulation must be < 0.02% AM to test the incidental AM of the Signal Generator.

18. Set the measuring receiver as follows:

Measurement ..... AM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 3 kHz

19. Set the Signal Generator as follows:

Amplitude ..... +7 dBm
Modulation ..... 1 kHz (Int) FM 20 kHz

20. Connect the equipment as shown in Figure 4-7, Modulation Test Setup.

21. Set the Signal Generator frequency to a value within the range specified in the following table and verify that the measured result does not exceed the limit specified.

Signal Generator Frequency		Result	
Min.	Max.	Actual	Max.
10 MHz	1040 MHz	_____	< 0.1%

NOTE

Below 10 MHz, the incidental AM of the Signal Generator is less than that of the measuring receiver.

FM Distortion

22. Set the measuring receiver as follows:

Measurement ..... FM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 3 kHz

23. Set the distortion analyzer as follows:

Function ..... Distortion
Analyzer Input Select ..... Distortion
Frequency ..... 1 kHz

24. Set the Signal Generator as follows:

    Frequency ..... 100.0 MHz
    Amplitude ..... +7 dBm
    Modulation ..... 1 kHz (Int) FM

25. Connect the equipment as shown in Figure 4-7, Modulation Test Setup.

26. Verify that the measured Total Harmonic Distortion does not exceed 0.5%.

27. Set the Signal Generator FM deviation to a value within the range specified in the following table and verify that the measured result does not exceed the limit specified.

FM Deviation		Result	
Min.	Max.	Actual	Max.
3 kHz	99 kHz	_____	<0.5%

NOTE

At peak deviations less than 3 kHz, residual FM and other type of FM distortion become a greater portion of the distortion reading. If the distortion falls within tolerance at or above 3 kHz, it may be safely assumed that the Signal Generator meets the test requirements.

DC MODULATION

Description

DC FM specifications are verified by measuring the RF OUTPUT frequency offset with a frequency counter.

Equipment

Frequency Counter ..... HP 5328B OPT 31

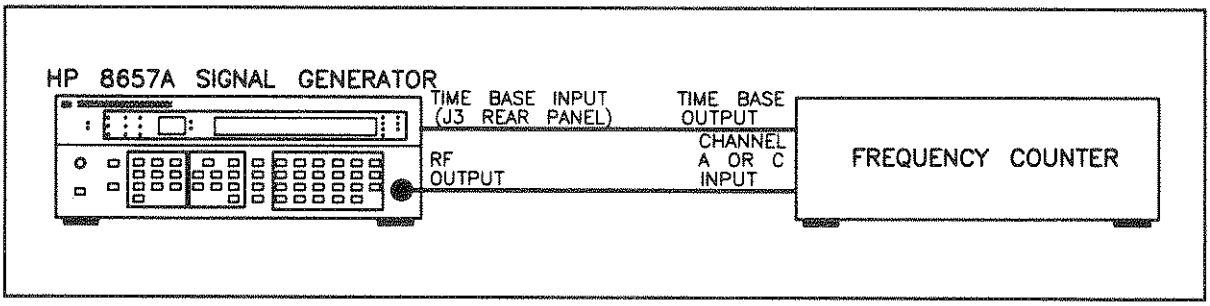


Figure 4-9. DC FM Test Setup

Procedure

DC FM Center Frequency Accuracy

28. Connect the RF OUTPUT from the Signal Generator to the INPUT of the frequency counter, and connect the Signal Generator TIME BASE INPUT to the Frequency counter TIME BASE OUTPUT as shown in Figure 4-9.

29. Set the frequency counter as follows:

INPUT ..... CHANNEL A
TRIGGER ..... CHANNEL A

30. Set the Signal Generator as follows:

Frequency ..... 100 MHz
Amplitude ..... 0 dBm
Modulation ..... DC FM

31. Set the Signal Generator FM deviation to a value for the frequency range specified in the following table. Verify that the measured frequency does not exceed the limits specified.

Frequency (MHz)	DC FM Deviation(kHz)	Frequency	
		Offset(kHz)	Drift(Hz/Hr)
0.1 to 130	1 to 99	_____ ±500 Hz	_____ ±10
130 to 260	1 to 50	_____ ±125 Hz	_____ ±10
260 to 520	1 to 99	_____ ±250 Hz	_____ ±10
520 to 1040	1 to 99	_____ ±500 Hz	_____ ±10

DC FM Center Frequency Stability

32. Set the Signal Generator FM deviation and frequency as shown in the following table and verify that the frequency drift does not exceed the limits specified.

AM Depth for 100 MHz	Results		
	Min.	Actual	Max.
10%	7.6%	_____	12.4%
30%	26.8%	_____	33.2%
70%	65.2%	_____	74.8%
90%	84.4%	_____	95.6%

Performance Test 4

OUTPUT LEAKAGE TESTS

Specification

Leakage limits are within those specified in MIL STD 461B, and FTZ 1115. Furthermore, less than 1.0 μV is induced in a two-turn, 2.5 cm (1 inch) diameter loop held 2.5 cm (1 inch) away from the front surface and measured into a 50Ω receiver.

Description

Output leakage is verified by holding a loop antenna 2.5 cm (1 inch) from the front surface of the Signal Generator and measuring the resulting signal with a spectrum analyzer.

The loop antenna is suspended in a molding so that when the molding is in contact with a surface, the loop antenna is one inch from the surface.

NOTE

The use of a screen room may be necessary to reduce external radiated interference.

Equipment

One-Inch Loop Antenna	HP 08640-60501
26 dB Amplifier	HP 8447D
Spectrum Analyzer	HP 8558B or HP 8568B
50Ω Termination	HP 908A

Procedure

1. Connect equipment as shown in Figure 4-10.

NOTE

To avoid disturbing the antenna's field and causing measurement error, grasp the antenna at the end that has the BNC connector.

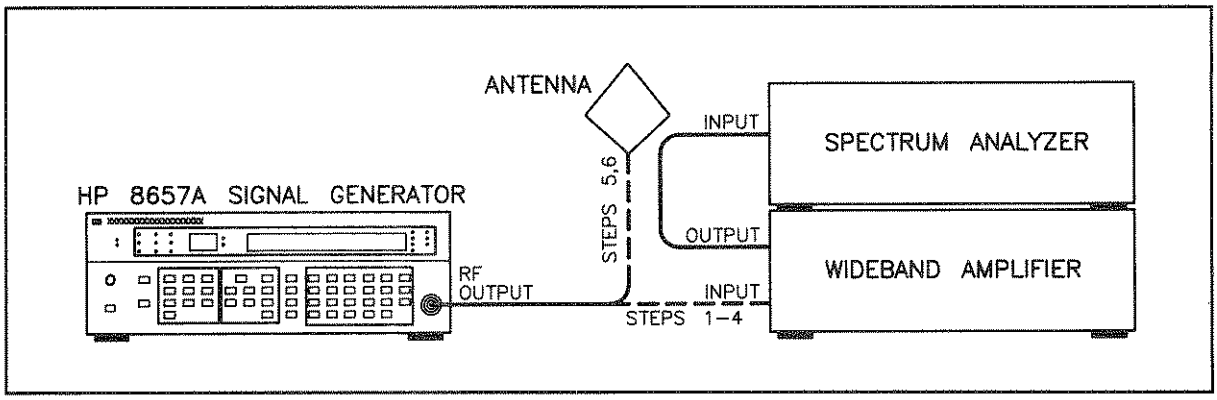


Figure 4-10. *Output Leakage Test Setup*

2. Set the Signal Generator as follows:

   Frequency ..... 100 MHz
   Amplitude ..... −107 dBm
   Modulation ..... Off

3. Set the spectrum analyzer as follows:

   Center Frequency ..... 100 MHz
   Input Attenuation ..... −40 dB
   Reference Level ..... −20 dBm
   Frequency Span ..... 20 MHz
   Resolution Bandwidth ..... 10 kHz

4. View the signal on the spectrum analyzer and adjust the reference level controls of the spectrum analyzer to set the −107 dBm signal from the Signal Generator to reference graticule line on the spectrum analyzer display. Set the video filter to further separate the signal from the noise. Disconnect the Signal Generator from the spectrum analyzer, and connect a 50 ohm termination to the Signal Generator's RF OUTPUT connector.

5. Connect the one-inch loop antenna to the analyzer through the 26 dB amplifier as shown in Figure 4-10. Hold the end of the loop antenna cylinder in contact with the front surfaces of the Signal Generator. All signals and noise should be below the reference graticule line (i.e.,below −107 dBm).

   _____ < −107 dBm (<1.0 μV) at 100 MHz

6. Repeat step 5 for frequencies of 300, 500, 700, 900, and 1040 MHz.

   _____ < −107 dBm (<1.0 μV) at 300 MHz
   _____ < −107 dBm (<1.0 μV) at 500 MHz
   _____ < −107 dBm (<1.0 μV) at 700 MHz
   _____ < −107 dBm (<1.0 μV) at 900 MHz
   _____ < −107 dBm (<1.0 μV) at 1040 MHz

Performance Test 5

SWR TEST

- **< −4 dBm (10 dB Attenuator Pad Selected)**
- **> −3 dBm (Attenuator Pads Not Selected)**

Specification

Electrical Characteristics	Performance Limits	Conditions
SWR:		
RF OUTPUT	< 2.0, −9.6 dB Return Loss	≥ −3.5 dBm
	< 1.5, −14 dB Return Loss	< −3.5 dBm
Impedance	50 ohms nominal	
Reverse Power	50 watts	RF power to 1040 MHz into RF OUTPUT, dc voltage cannot exceed 25V.

Description

SWR is verified by comparing the reflected power (frequencies 0.5 to 1040 MHz from an RF signal source) to a reference that represents 100% return loss. The reference level is determined by disconnecting the SWR bridge from the Signal Generator under test, and connecting a short to the SWR bridge (100% reflected power) to the spectrum analyzer. The reference is established on the spectrum analyzer display. The SWR bridge is then connected to the Signal Generator under test, and return loss for the frequency is displayed on the spectrum analyzer. The output frequency of Signal Generator under test must be set 100 MHz from the frequency of the RF signal source.

Equipment

RF Signal Source ..... HP 8657A
Spectrum Analyzer ..... HP 8558B/853A
SWR Bridge ..... Wiltron 60N50
Cables (UG-21D/U type N connectors) ..... HP 11500B (2 Required)

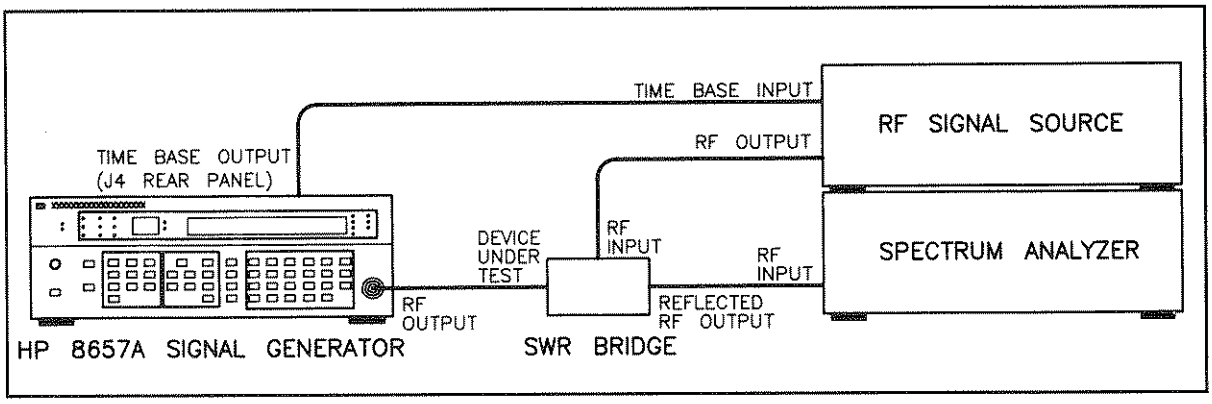


Figure 4–11. SWR Performance Test Setup (Out of Band)

Procedure

≤ −4 dBm (10 dB Attenuator Pad Selected)

1. Set the Signal Generator (HP 8657A) as follows:

   Frequency ..... 0.1 MHz
   Modulation ..... Off
   Amplitude ..... −10 dBm

2. Set the spectrum analyzer as follows:

   Frequency Span ..... 100 MHz
   Resolution Bandwidth ..... 300 kHz
   Reference Level ..... 0 dBm
   Center Frequency ..... 100 MHz

3. Set the RF signal source as follows:

   Output Level ..... +10 dBm
   Frequency ..... 100 MHz

4. Connect the equipment as shown in Figure 4-11.

5. With the SWR bridge disconnected from the Signal Generator under test, and a short connected to the SWR bridge, set the reference level on the spectrum analyzer for a 100% reflected signal.

6. Connect the SWR bridge to the Signal Generator's RF OUTPUT connector. The difference, in dB, of the level on the display and the reference is the return loss of the Signal Generator's RF OUTPUT connector. The return loss must be >14 dB.

   _____ 14 dB

7. Repeat steps 3 through 6 with the RF signal source set to any frequency between 5 MHz and 1040 MHz and 100 MHz from the Signal Generator's frequency.

   _____ 14 dB

SWR Test > −3 dBm (Attenuator Pads Not Selected)

SWR, without any attenuation, is verified by the following procedure. Set the amplitude of the Signal Generator under test and turn off the RF signal source. Then the amplitude of the reflected signal from the RF source is set to an equal level with the Device Under Test port shorted. The maximum and minimum voltages in dB are read from the spectrum analyzer to compute the SWR using the equation listed below.

8. Set the Signal Generator (HP 8657A) as follows:

   Frequency ..... 100 MHz
   Modulation ..... Off
   Amplitude ..... −2 dBm

9. Set the spectrum analyzer as follows:

   Frequency Span ..... 0 Hz
   Resolution Bandwidth ..... 3 MHz
   Reference Level ..... 0 dBm
   Center Frequency ..... 100 MHz
   Scale ..... LOG 2dB/Div

10. Set the RF signal source as follows:

    Amplitude ..... −127 dBm
    Modulation ..... Off
    Frequency ..... 100 MHz
    RF ..... Off

11. Connect the equipment as shown in Figure 4-11.
12. With the SWR bridge connected to the Signal Generator under test, and the amplitude of the RF signal source turned off, set a reference on the spectrum analyzer. Tune the frequency of the spectrum analyzer for maximum level on the display.
13. Disconnect the SWR bridge from the Signal Generator under test and connect a short to the Device Under Test port.
14. Set the amplitude of the RF signal source to +13 dBm.
15. Set the amplitude of the RF signal source to the same level on the spectrum analyzer as set in step 12.
16. Remove the short from the SWR bridge, and connect the SWR bridge to the Signal Generator under test.
17. Press and release the Blue SHIFT key. Press and hold the Phase Decrement DOWN key (frequency decrement DOWN key). The level on the spectrum analyzer changes as the phase changes.

NOTE

Each time the Phase Decrement key is released, the Blue SHIFT must be pressed to reselect the Phase Decrement function.

18. Read the maximum and minimum levels from the spectrum analyzer and substitute their value in the following equation and solve for the SWR of the Signal Generator.

_____ <2.0

19. Repeat steps 8 through 18 for each frequency between 5 and 1040 MHz SWR is to be checked.

$$SWR = \frac{1+\rho}{1-\rho} = \frac{E_{max}}{E_{min}}$$

$$E_{max} = A + \rho A$$

$$E_{min} = A - \rho A$$

$$SWR = \frac{E_{max}/A}{E_{min}/A} = \frac{E_{max}}{E_{min}}$$

$$20\ log\ E_{max} = E_{max}dB$$

$$20\ log\ E_{min} = E_{min}dB$$

$$20\ log\ SWR = 20\ log\frac{(E_{max})}{(E_{min})}$$

$$20\ log\ SWR = 20\ logE_{max} - 20\ logE_{min}$$

$$20\ log\ SWR = E_{max}\ dB - E_{min}\ dB$$

$$SWR = 10^{\frac{E_{max}\ dB - E_{min}\ dB}{20}}$$

Section 5
ADJUSTMENTS

5-1. INTRODUCTION

This section contains adjustments and checks that assure peak performance of the Signal Generator. The instrument should be readjusted after repair or failure to pass a performance test. Allow a 30-minute warm-up prior to performing the adjustments. Removal of the instrument top and bottom covers is required for most adjustments. Included in this section are test setups and diagrams that show the location of each assembly. Adjustment location diagrams are provided in Figure 5-26 at the end of this section. (Removal and disassembly procedures are provided in Section 8.) To determine which performance tests and adjustments to perform after a repair, refer to Table 5-2, Post-Repair Adjustments.

5-2. SAFETY CONSIDERATIONS

Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information.

5-3. EQUIPMENT REQUIRED

All adjustment procedures contain a list of required test equipment. The test equipment is also identified by callouts in the test setup diagrams, where included. If substitutions must be made for the specified test equipment, refer to the Recommended Test Equipment table in Section 1 of this manual for the minimum specifications. It is important that the test equipment meet the critical specifications listed in the table if the Signal Generator is to meet is to performance requirements.

5-4. FACTORY-SELECTED COMPONENTS

Factory-selected components are identified on the schematics and parts lists by asterisk (*) which follows the reference designator. The nominal value or range of the components is shown. Manual Update addition and replacement pages provide updated information pertaining to selected components. Table 5-1 lists the reference designator, the basis used for selecting a particular value, the nominal value range, and the service sheet where the component part is shown.

5-5. POST-REPAIR ADJUSTMENTS

Table 5-2 lists the adjustments related to repairs or replacement of any of the assemblies.

5-6. RELATED ADJUSTMENTS

The procedures in this section can be done in any order; however, it is suggested that the power supply voltage, reference voltage, and audio oscillator adjustments be performed first. Changes in these adjustments can affect other adjustments, especially level and modulation accuracies.

WARNING

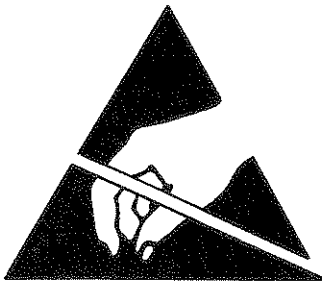
Maintenance described herein is performed with power supplied to the instrument, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.

Table 5-1. *Factory Selected Components*

<table>
<tr><th>Reference Designator</th><th>Service Sheet</th><th>Range of Values</th><th>Basis of Selection</th></tr>
<tr><td>A3C23</td><td>16</td><td>33 pF to 47 pF</td><td>Select capacitor so that the output level of the 50 MHz Reference Oscillator can be adjusted to greater than +17 dBm.</td></tr>
<tr><td>A3L6</td><td>16</td><td>680 nH or 470 nH</td><td>Select inductor so that the 50 MHz crystal can be tuned to 50 MHz ±1250 Hz using an external reference.</td></tr>
<tr><td>A3R303</td><td>11</td><td>3.16k to 4.64k</td><td>Nominal value 3.16k. Select alternate values (3.48k or 4.64k) to insure correct operation of Fractional-N IC (A3U17).</td></tr>
<tr><td>A4R6, 7, 10</td><td>1</td><td>See table under "Basis of Selection"</td><td>Attenuator pad selected for −10 dBm input to mixer A4U1. Measure power level at RF Test Point A4TP3 as described in Adjustment 9. Select pad values for −10 dBm to mixer. Level must be checked whenever the A3A1, A4, A8, or FL1 assemblies are replaced.
<table>
<tr><th>Attenuation (dB)</th><th>R6, R10 (ohms)</th><th>HP Part No. (Check Digit)</th><th>R7 (ohms)</th><th>HP Part No. (Check Digit)</th></tr>
<tr><td>2</td><td>422</td><td>0698-7227 (6)</td><td>10</td><td>0698-7189 (9)</td></tr>
<tr><td>3</td><td>287</td><td>0698-7223 (2)</td><td>17.8</td><td>0698-7194 (6)</td></tr>
<tr><td>4</td><td>215</td><td>0698-7220 (9)</td><td>23.7</td><td>0698-7197 (9)</td></tr>
<tr><td>5</td><td>178</td><td>0698-7218 (5)</td><td>31.6</td><td>0698-7200 (5)</td></tr>
<tr><td>6</td><td>147</td><td>0698-7216 (3)</td><td>38.3</td><td>0698-7202 (7)</td></tr>
<tr><td>7</td><td>133</td><td>0698-7215 (2)</td><td>46.4</td><td>0698-7204 (9)</td></tr>
<tr><td>8</td><td>121</td><td>0698-7214 (1)</td><td>51.1</td><td>0698-7205 (0)</td></tr>
<tr><td>9</td><td>110</td><td>0698-7213 (0)</td><td>61.9</td><td>0698-7207 (2)</td></tr>
<tr><td>10</td><td>100</td><td>0698-7212 (9)</td><td>75.0</td><td>0698-7209 (4)</td></tr>
</table></td></tr>
<tr><td>A4C155</td><td>1</td><td>10 pF to 33 pF</td><td>Decrease the value of C155 if the 494–990 MHz oscillator fails to oscillate at 494 MHz only. Increase C15's value if spurs are present at half the fundamental frequency from 494 to 990 MHz.</td></tr>
<tr><td>A6C232</td><td>4</td><td>0 or 1.8 pF</td><td>Removed to eliminate spurs at 1200 to 1400 MHz when the RF OUTPUT is 600 MHz to 700 MHz.</td></tr>
<tr><td>A8C5</td><td>3</td><td>47 pF to 82 pF</td><td>Select A8C5 to maximize DC voltage measured at J2 pin 4.</td></tr>
<tr><td>A8C19</td><td>3</td><td>20 pF to 39 pF</td><td>Select A8C19 to maximize DC voltage measured at J2 pin 6.</td></tr>
<tr><td>A8C40</td><td>3</td><td>0 or 1000 pF</td><td>Selected to eliminate a spurious signal at 700 MHz.</td></tr>
</table>

Table 5–2. *Post-Repair Adjustments*

Assembly Repaired or Replaced	Reference Service Sheet No.	Related Adjustments
A1	21	—
A2	21 – 24	—
A3	11	—
A3	12	15
A3	13	16
A3	14	14
A3	15	17,19
A3	16	5,6
A3A1	9	7,9
A4	1	9,10,11
A4	2	—
A6	4	12,13
A6	5	—
A8	1	9
A8	3	8,9
A9	8	2
A10	6	2
A10	7	3,4,12,13,20,18,21
A10	25	1
A11	17 – 20	—
A16	25	22
FL1	3	9



ATTENTION
Static Sensitive Devices

When handling equipment containing static sensitive devices, adaquate precautions must be taken to prevent device damage or destruction. Only those who are thoroughly familiar with industry accepted techniques for handling static sensitive devices should attempt to service circuitry with these devices.

Adjustment 1

POWER SUPPLY VOLTAGE ADJUSTMENT

- **Service Sheets 10 and 25.**

Description

The +5.4 Vdc power supply is adjusted for +5.4 Vdc ±0.02 Vdc at A10J2 pin 10 using a digital multimeter.

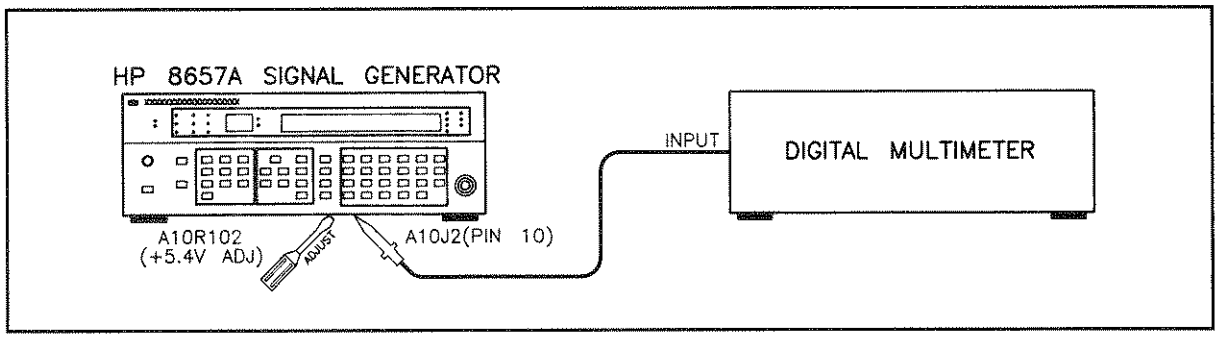


Figure 5–1. *+5.4 Vdc Power Supply Adjustment Setup*

Equipment

Digital Multimeter ..... HP 3466A

Procedure

1. Set the digital multimeter as follows:

   Function ..... Vdc
   Range 20V

2. Set the Signal Generator as follows:

   Frequency ..... 140 MHz
   Amplitude ..... −10 dBm
   Modulation ..... AM 50%

3. Connect the digital multimeter to A10J2 pin 10. Adjust A10R102 (+5.4V ADJ) for a reading of +5.4 Vdc ±0.02 Vdc on the digital multimeter.

Adjustment 2

REFERENCE VOLTAGE ADJUSTMENT

- **Service Sheet 6**

Description

The +2 Vdc reference is adjusted for +2.000 Vdc ±0.004 Vdc at A10TP12 using a digital multimeter.

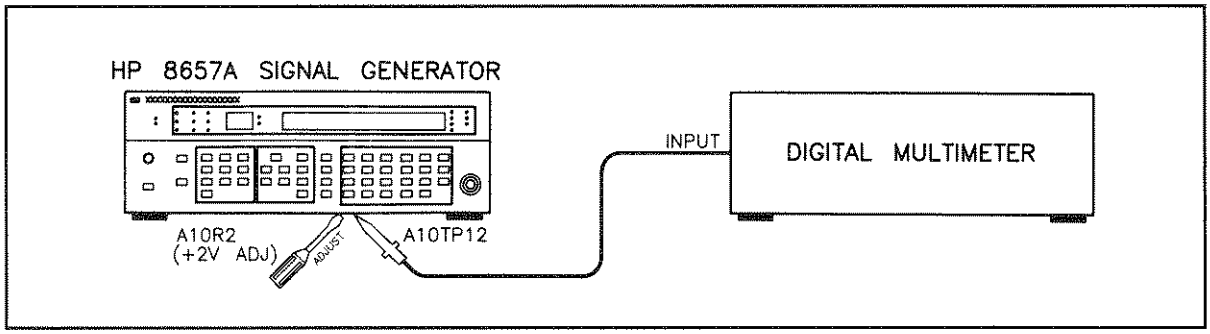


Figure 5–2. *+2 Vdc Reference Adjustment Setup*

Equipment

Digital Multimeter ..... HP 3466A

Procedure

1. Set the digital multimeter as follows:

   Function ..... Vdc
   Range 20V

2. Set the Signal Generator as follows:

   Frequency ..... 140 MHz
   Amplitude ..... −10 dBm
   Modulation ..... AM 50%

3. Connect the digital multimeter to A10TP12 and adjust A10R2 (+2V ADJ) for a reading of 2.000 Vdc ±0.004 Vdc on the digital multimeter.

Adjustment 3

AUDIO OSCILLATOR LEVEL ADJUSTMENT

- **Service Sheet 7**

Description

The internal 1 kHz modulation source is adjusted to 0.707 Vrms ±0.007 Vrms at A10TP11 (OSC). Then, the internal 400 Hz modulation source is checked to ensure that it is within the same limits.

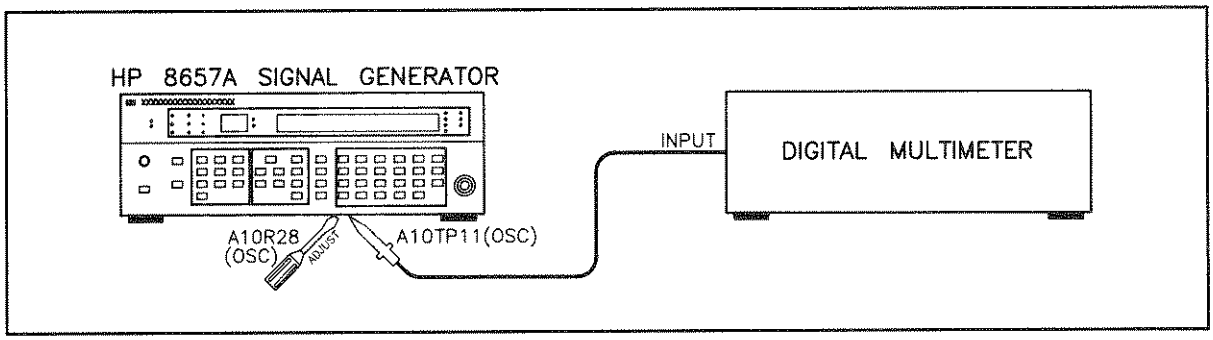


Figure 5–3. *Audio Oscillator Level Adjustment Setup*

Equipment

Digital Multimeter ..... HP 3466A

Procedure

1. Set the digital multimeter as follows:

   Function ..... Vac
   Range 2V

2. Set the Signal Generator as follows:

   Frequency ..... Any
   Amplitude ..... Any
   Modulation ..... AM
   Source ..... 1 kHz

3. Connect the digital multimeter to A10TP11 (OSC).
4. Adjust A10R28 (OSC) for a 0.707 Vrms ±0.007 Vrms reading on the digital multimeter.
5. Select the internal 400 Hz modulation source. Check that the 400 Hz oscillator level is within 0.707 Vrms ±0.007 Vrms. If it is not, repeat step 4 until both readings are within the specified limits.

Adjustment 4

AM OFFSET ADJUSTMENT

- **Service Sheet 7**

Description

The dc offset of the AM Offset Buffer is adjusted for 0.000 Vdc ±0.001 Vdc at A10TP10 (AM) with the reference inputs to the Level DAC and AM% DAC grounded, and the digital input to each programmatically set to zero.

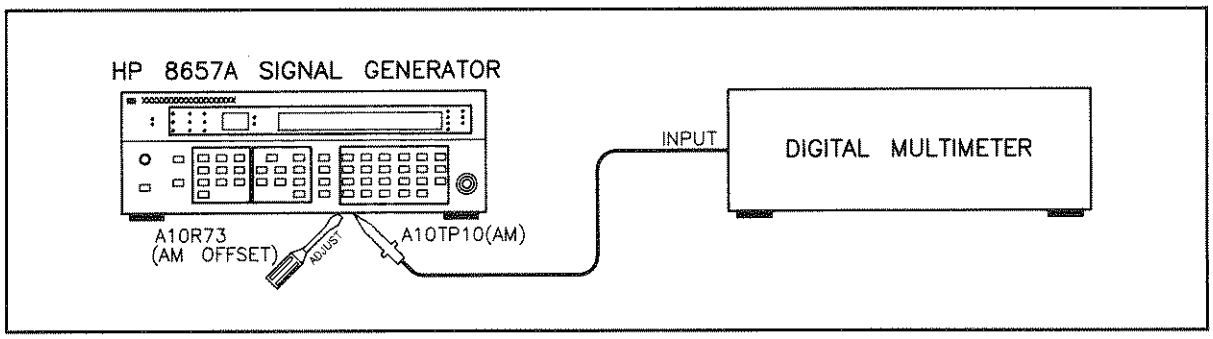


Figure 5–4. *AM Offset Adjustment Setup*

Equipment

Digital Multimeter ..... HP 3466A

Procedure

1. Set the digital multimeter as follows:

   Function ..... Vdc
   Range ..... 200 mV

2. Set the Signal Generator modulation off.
3. Short A10TP7 and A10TP8 to ground.
4. Select Keyboard Invoked Test number 2 by pressing the SHIFT key, and then the INCR SET key. Next, press the AMPTD up-arrow key once to show the number "2" in the MODULATION Display. Press the INCR SET key once to zero the AM and FM modulation DACs. In the AMPLITUDE DISPLAY "00" should be seen to indicate that test number 2 is complete.
5. Connect the digital multimeter to A10TP10 (AM).
6. Adjust A10R73 (AM OFFSET) for 0.000 Vdc ±0.001 Vdc.
7. Remove the two shorts installed in step 3.
8. Press the AMPTD up arrow key five times until "7" is shown in the MODULATION Display.
9. Press the INCR SET key once to exit from the Keyboard Invoked Tests.

Adjustment 5

50 MHZ REFERENCE OSCILLATOR FREQUENCY ADJUSTMENT

- **Service Sheet 16**

Description

The internal 50 MHz Reference Oscillator frequency is adjusted to 50.0000 MHz ±100 Hz by adjusting the TIME BASE OUTPUT for 10.000 000 MHz ±20 Hz (50 MHz reference divided-by-10) using a frequency counter.

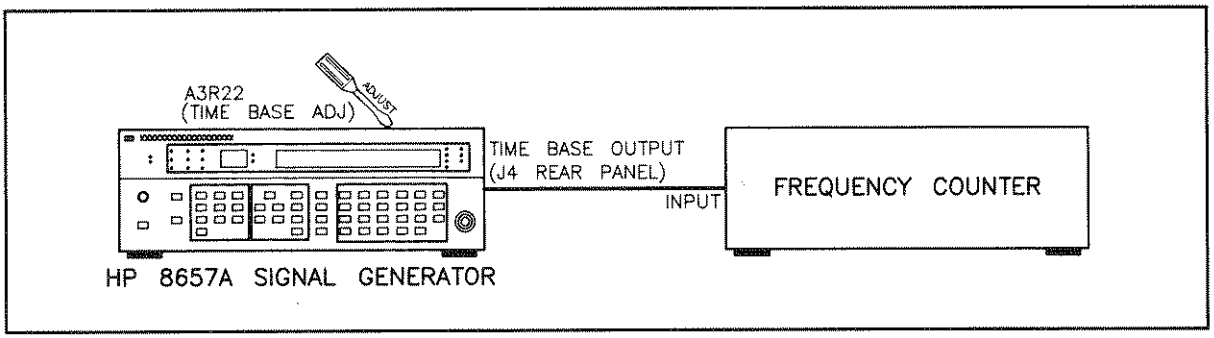


Figure 5–5. *50 MHz Reference Oscillator Frequency Adjustment Setup*

Equipment

Frequency Counter ..... HP 5328B
Cable BNC(m) ..... HP 10503A

NOTE

If the Signal Generator has Option 001 installed disconnect coaxial cable A16W2 from the rear-panel TIME BASE INPUT connector J3.

Procedure

1. Connect the frequency counter to J4 using the BNC cable.
2. Adjust A3R22 (TIME BASE ADJ) for a frequency counter reading of 10.000 000 MHz ±20 Hz.

Adjustment 6

50 MHZ REFERENCE OSCILLATOR LEVEL ADJUSTMENT

- **Service Sheet 16**

Description

The output power level of the 50 MHz Reference Oscillator is adjusted for a maximum level between +16 and +19 dBm at A3J8 using a measuring receiver.

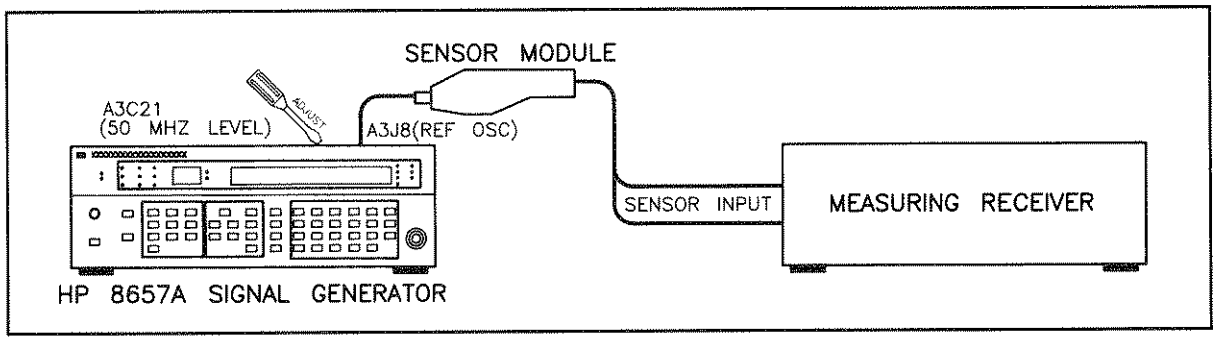


Figure 5–6. *50 MHz Reference Oscillator Level Adjustment Setup*

Equipment

Measuring Receiver	HP 8902A
Sensor Module	HP 11722A
Cable BNC(m) to SMC(f)	HP 08662-60075
Adapter N(f) to BNC(m)	HP 1250-0077
Adapter BNC(f) to BNC(f)	HP 1250-0080

PROCEDURE

1. Set the measuring receiver with the sensor module precalibrated and connected as follows:

Measurement	RF POWER
Display	LOG

2. Disconnect coaxial cable W5 from A3J8 (50 MHz Reference Oscillator output). Connect the sensor module to A3J8 using the appropriate cable and adapters.
3. Press the FREQ key on the measuring receiver for calibration, then press the RF POWER key.
4. Adjust A3C21 (50 MHZ LEVEL ADJ) for a maximum RF Power reading from +16 dBm to +19 dBm. Do not adjust for a reading greater than +19 dBm.

NOTE

Do not remove the 50 MHz Section covers for this adjustment.

5. Disconnect the measuring receiver and reconnect W5 to A3J8.

Adjustment 7

122 MHZ HARMONIC ADJUSTMENT

- **Service Sheet 9**

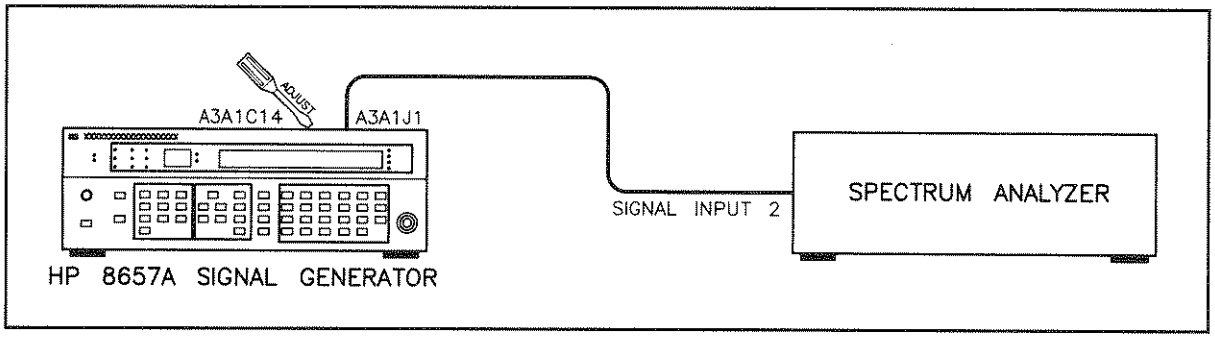


Figure 5–7. 122 MHz Harmonic Adjustment Setup

Description

The Signal Generator's frequency is set to 539 MHz for a Low Frequency VCO Frequency of 61 MHz. The 122 MHz Harmonic is adjusted for a minimum.

Equipment

Spectrum Analyzer	HP 8568B or 8558B
Cable BNC(m) to SMC(f)	HP 08662-60075
Adapter N(f) to BNC(m)	HP 1250-0077

Procedure

1. Set the spectrum analyzer as follows:

Center Frequency	95 MHz
Frequency Span	100 MHz
Reference Level	0 dBm

2. Set the Signal Generator as follows:

Frequency	539 MHz
Amplitude	Any
Modulation	Off

3. Connect the output of the A3A1 Assembly at A3A1J1 to the spectrum analyzer SIGNAL INPUT 2 using the appropriate cable and adapter (HP 1250-0077 and HP 08662-60075).

4. Adjust A3A1C14 for minimum 122 MHz harmonic.

Adjustment 8

400 MHZ BANDPASS FILTER ADJUSTMENT

- **Service Sheet 3**

Description

The 400 MHz Bandpass Filter is adjusted to peak the 800 MHz signal at RF Test Point A8TP3 using a measuring receiver.

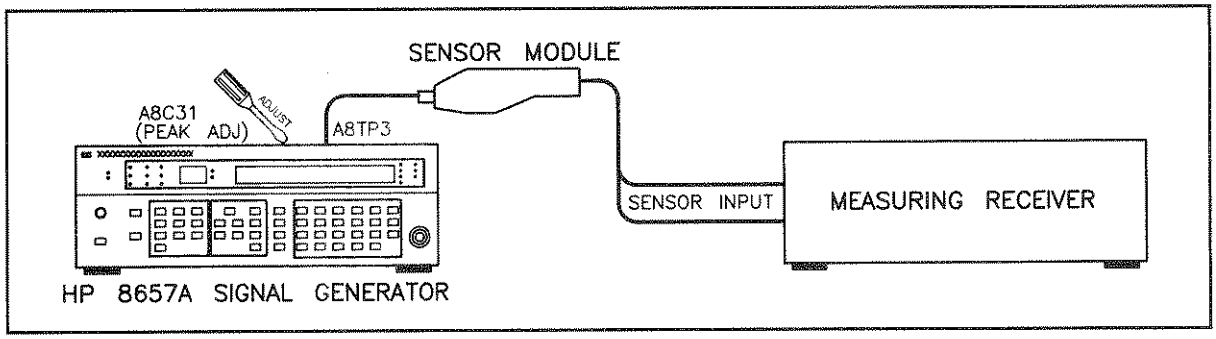


Figure 5–8. *400 MHz Bandpass Filter Adjustment Setup*

Equipment

Measuring Receiver	HP 8902A
Sensor Module	HP 11722A
Adapter Probe	HP 1250-1598
Adapter N(f) to BNC(m)	HP 1250-0077
Adapter BNC(f) to BNC(f)	HP 1250-0080
Cable BNC(m) to SMC(f)	HP 08662-60075

Procedure:

1. Set the measuring receiver with the sensor module precalibrated and connected as follows:

Measurement	RF POWER
Display	LOG

2. Set the Signal Generator as follows:

Frequency	Any
Amplitude	−10 dBm
Modulation	Off

3. Zero the measuring receiver and wait for the zero LED to go out.
4. Connect the sensor module to the Signal Generator at RF Test Point A8TP3 using an adapter (HP part number 1250-1598).
5. Tune the measuring receiver to 800 MHz and adjust A8C31 (PEAK ADJ) for a maximum RF Power reading.

Adjustment 9

690 TO 740 MHZ IF COMPENSATION ADJUSTMENT AND ATTENUATOR PAD SELECT

- **Service Sheets 1, 3, and 9**

Description

A function generator is used to sweep the A3A1 Low Frequency VCO and provide a swept 690 to 740 MHz IF signal at A4TP3. The IF signal is adjusted for flatness within 3 dB. The average power level of the IF signal is then found and an attenuator pad is selected to provide an average IF input level of −9 dBm to mixer A4U1.

NOTE

The 690 to 740 MHz IF Compensation Adjustment and Attenuator Pad Select must be performed whenever the A3A1, A4, A8, or FL1 assemblies are replaced.

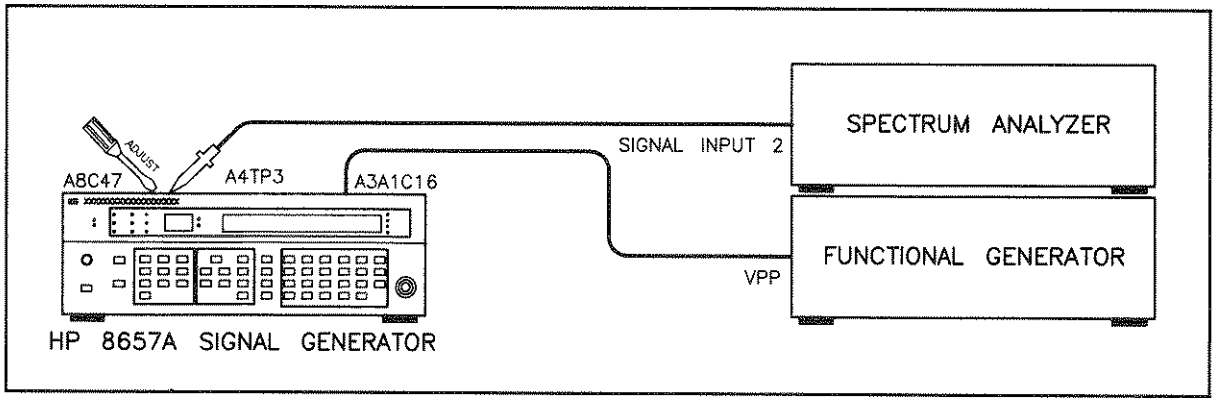


Figure 5–9. *690 to 740 MHz IF Compensation and Attenuator Pad Select*

Equipment

Spectrum Analyzer	HP 8568A
Function Generator	HP 3312A
Cable BNC	HP 8120-1840
Test Leads alligator clips to BNC	HP 8120-1292
Adapter N(f) to BNC(m)	HP 1250-0077
Adapter Probe	HP 1250-1598
Cable BNC(m) to SMC(f)	HP 08662-60075

Procedure

1. Set the Signal Generator as follows:

   Frequency ..... 700 MHz
   Amplitude ..... Any
   Modulation ..... Off

2. Set the function generator as follows:

   Frequency ..... 60 Hz
   Function ..... Triangle Wave
   Offset ..... On
   Amplitude Range 0
   Symmetry ..... Cal
   Modulation ..... Off

3. Preset the spectrum analyzer and set as follows:

   RF Input ..... Input 2
   Start Frequency ..... 690 MHz
   Stop Frequency ..... 740 MHz
   Reference Level ..... 0 dBm
   Scale ..... Log 5dB/Div

4. Remove jumper A3W6 and connect the function generator to the Low Frequency VCO at feedthrough capacitor A3A1C16 using the appropriate cable and adapter.

NOTE

If A4R6 and A4R7 (P/O selectable attenuator pad) are already in the A4 assembly, they must be isolated from the circuit before proceeding with the next step. Replacement A4 assemblies are shipped from the factory without the attenuator pad installed.

5. Connect the spectrum analyzer SIGNAL INPUT 2 to the Signal Generator at A4TP3 using using the appropriate cable and adapters (HP 1250-0780, HP 08662-60075, and HP 1250-1598).
6. Adjust the amplitude and offset of the function generator until the swept IF signal displayed on the spectrum analyzer starts just before 690 MHz and stops just after 740 MHz.
7. Adjust the spectrum analyzer's reference level so that the highest level of the IF signal is even with the top graticule on the CRT.
8. Set the scale of the spectrum analyzer to display 1 dB/Div and adjust the reference level so that the swept IF signal is centered in the spectrum analyzer's display. Set sweep time to 2 seconds.
9. Adjust A8C47 until the difference between the maximum and minimum IF levels is $\leq$ 3 dB.
10. Find the average IF level by dividing the difference between the maximum and minimum IF levels by 2, and then adding the result to the minimum IF level.
11. Refer to Table 5-1 (Factory Selected Components) and select the values of A4R6, R7, and R10 necessary for an average IF level of -10 dBm into mixer A4U1.

Adjustment 10

NOTCH FILTER ADJUSTMENTS

- **Service Sheet 1**

Description

The Signal Generator is placed into Keyboard Invoked Test No. 3 to continuously ramp the High Frequency Loop Amplifier and to sweep the High Frequency VCO. The Signal Generator frequency is set to 650 MHz to select the 50 MHz IF and to not select the 50 MHz Notch Filter. The detected beat notes are monitored with an oscilloscope and the 350, 300, 250, 200, 150, and 100 MHz Notch Filters are adjusted to minimize their associated beat notes. The Signal Generator's frequency is then set to 520 MHz to not select the 50 MHz IF. The 50 MHz Notch Filter is adjusted to minimize it's beat note.

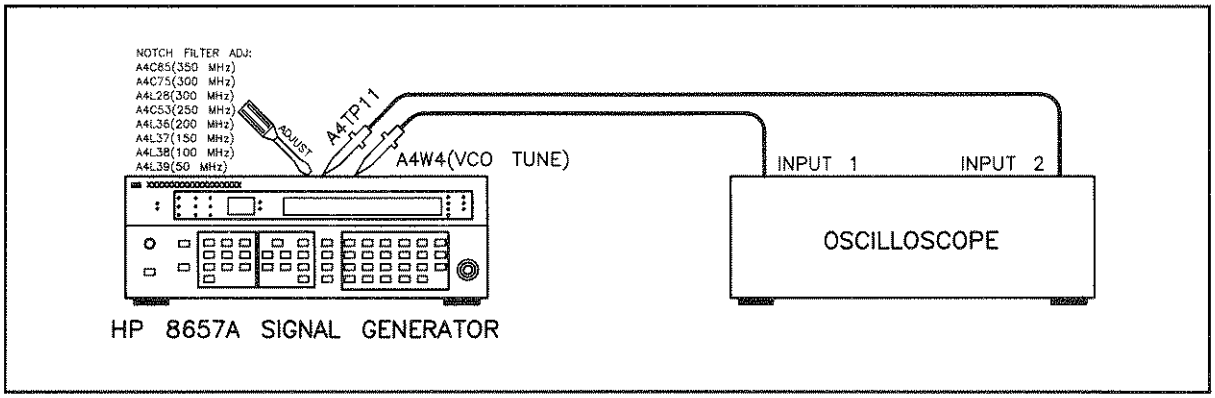


Figure 5–10. *Notch Filters Adjustment Setup*

Equipment

Oscilloscope ..... HP 54201A
Oscilloscope Probe (2 required) ..... HP 10040A

Procedure

1. Enter Keyboard Invoked Test No. 3 by pressing the SHIFT key, and then the INCR SET key. Next, press the AMPT up-arrow key three times until the number "3" appears in the MODULATION Display, then press INCR SET and "00" should appear in the AMPLITUDE Display.
2. Keyboard Invoked Test No. 3 allows you to enter data to the Signal Generator while the test is running. Press the AMPT up-arrow key four times until a "7" is displayed in the AMPLITUDE Display, then press INCR SET. The Signal Generator will go through it's power-up routine and will then be ready to accept data. The test will continue to run until the Signal Generator is reset.

3. Set the Signal Generator as follows:

Frequency	650 MHz
Amplitude	Any
Modulation	Off

4. Connect oscilloscope INPUT 1 to the High Frequency VCO Tune at A4W4.

5. Connect oscilloscope INPUT 2 to A4TP11.

6. Set the oscilloscope as follows:

CHAN

Channel	1
Range	40V
Offset	600 mV
Probe	10:1
Coupling	dc, 1 MΩ
Channel	2
Range	1.6V
Offset	500 mV
Probe	10:1
Coupling	ac

TIME

Mode	Auto
Range	10 mS
Reference	Left

TRIG

Source	Chan 1, + Slope
Level	Adjust, 9.6V

DISPLAY

Graticle Type	Grid
Number of Graphs	2
Connect Dots	On
Data Filter	On

8. The oscilloscope display for nonadjusted Notch Filters is shown in Figure 5-11.

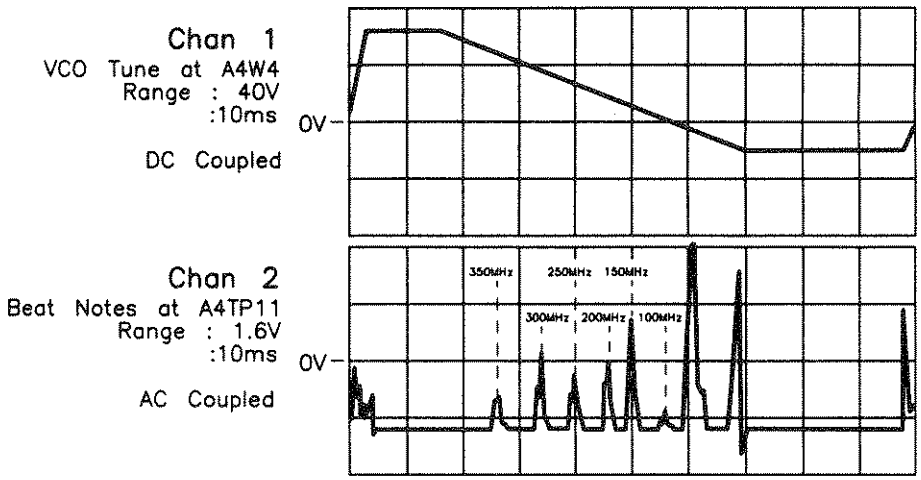


Figure 5-11. *Frequency Response at Notch Filters, 650 MHz Setting.*

9. Readjust the oscilloscope as follows:

DISPLAY

Number of Graphs 1
1: ..... Chan 2

10. Observe the oscilloscope Chan 2 display (beat notes) and refer to Figure 5-11. Adjust A4C85 (350 MHz Notch Filter) until you see the 350 MHz beat note change on the display, then adjust the beat note for minimum amplitude.
11. Adjust A4C75 and L28 (300 MHz Notch Filters) for minimum 300 MHz beat note.
12. Adjust A4C53 (250 MHz Notch Filter) for minimum 250 MHz beat note.
13. Adjust A4L36 (200 MHz Notch Filter) for minimum 200 MHz beat note.
14. Adjust A4L37 (150 MHz Notch Filter) for minimum 150 MHz beat note.
15. Adjust A4L38 (100 MHz Notch Filter) for minimum 100 MHz beat note.
16. Set the Signal Generator frequency to 520 MHz and observe the oscilloscope Chan 2 display. The beat note levels should resemble those shown for channel 2 in Figure 5-12. (the 50 MHz beatnotes are shown with nonadjusted levels.) Adjust A4L39 (50 MHz Notch Filter) until the 50 MHz beat notes are at their minimum amplitude.

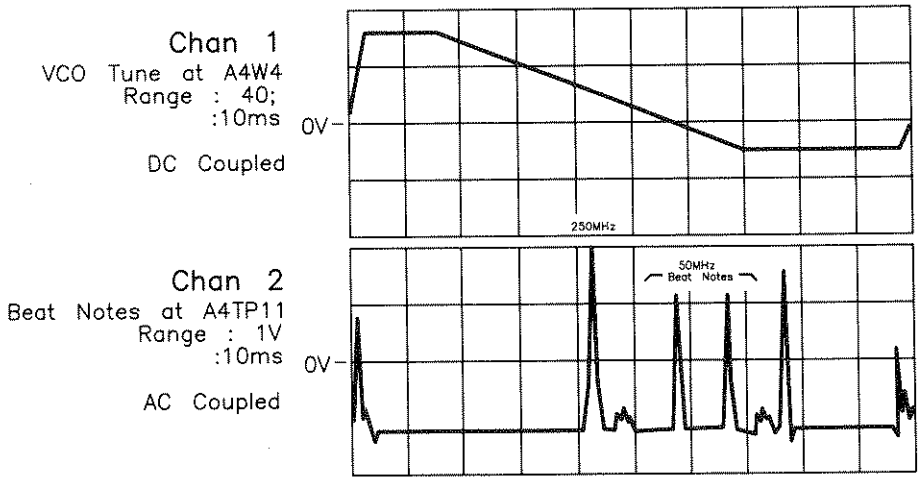


Figure 5–12. *Frequency Response at Notch Filters, 520 MHz Setting.*

17. Adjust A4C75 (300 MHz Notch Filter) to maximize the 250 MHz beat note while keeping the 300 MHz beat note at a minimum. The 250 MHz beat note is not filtered.
18. Set the Signal Generator frequency to 1015 MHz.
19. Adjust A4C85 (350 MHz Notch Filter) to maximize the 300 MHz beat note while keeping the 350 MHz beat note to a minimum. The 300 MHz beat note is not filtered.
20. Reset the Signal Generator by pressing the SHIFT key and then the "0" key.

Adjustment 11

400 MHZ NOTCH FILTER ADJUSTMENT

- **Service Sheet 1**

Description

The 400 MHz Notch Filter is in the circuit all of the time and is adjusted for 1 MHz offset spurious signals from the selected frequency of 501 MHz.

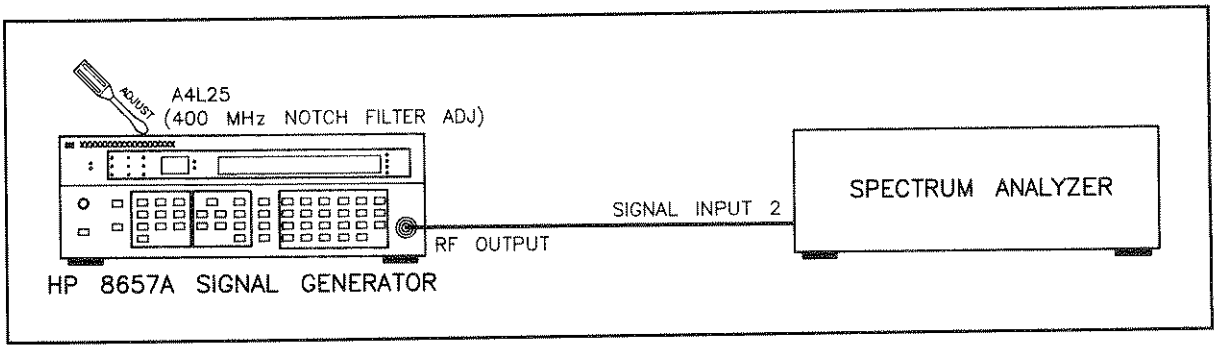


Figure 5–13. *400 MHz Notch Filter Adjustment Setup.*

Equipment

Spectrum Analyzer	HP 8568B or HP 8558B
Cable (N(m) 2 183 cm)	HP 11500A

Procedure

1. Set the spectrum analyzer as follows:

Center Frequency	501 MHz
Frequency Span	10 MHz
Reference Level	0 dBm

2. Set the Signal Generator as follows:

Frequency	501 MHz
Amplitude	0 dBm
Modulation	Off

3. Connect the Signal Generator RF OUTPUT to spectrum analyzer SIGNAL INPUT 2.
4. Adjust A4L25 for a minimum spurious signal at 500 MHz.

Adjustment 12

LEVEL AND ALC LOOP DETECTOR ADJUSTMENTS

- **Service Sheets 4 and 7**

DESCRIPTION

First, the reference level to the Level Digital to Analog Converter (DAC) is adjusted for +7.00 dBm ±0.02 dB at the Signal Generator's RF OUTPUT. Then the detector bias reference level to the ALC Amplifier is adjusted.

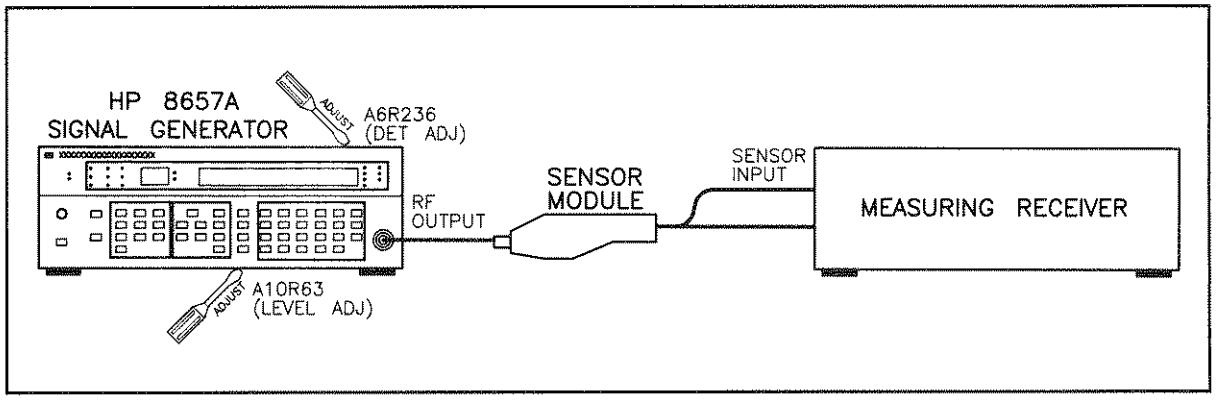


Figure 5-14. Level and ALC Loop Detector Adjustment Setup

EQUIPMENT

Measuring Receiver	HP 8902A
Sensor Module	HP 11722A

PROCEDURE

1. Set the measuring receiver with the sensor module precalibrated and connected as follows:

Measurement	RF POWER
Display	LOG

2. Set the Signal Generator as follows:

Frequency	820 MHz
Amplitude	+7 dBm
Modulation	Off
Amplitude Increment	10 dB

NOTE

Before making the adjustment, the instrument must be warmed up for a minimum of 1/2 hour.

3. Zero the sensor module and connect it to the RF OUTPUT connector on the Signal Generator.
4. Tune the measuring receiver to the Signal Generator frequency by pressing the FREQ key. Press the RF POWER key and adjust A10R63 (LEVEL ADJ) for a reading of +7 dBm ±0.2 dB.
5. Press the RATIO key on the measuring receiver to set a reference level of 0 dB.
6. Step the signal Generator amplitude down to −3 dBm.
7. Adjust A6R236 (DET ADJ) for an RF Power level of −10.00 dB ±0.1 dB on the measuring receiver.
8. Repeat steps 4, 5, 6, and 7 until both readings are within the required tolerance.

Adjustment 13

AM% AND ALC LOOP AM ADJUSTMENTS

- **Service Sheets 4 and 7**

Description

The reference level to the AM% Digital to Analog Converter (DAC) is adjusted for an average amplitude modulation of 21.4%. The AM reference to the ALC Amplifier is adjusted for minimum distortion of the modulation.

NOTE

The AM Offset, and Level and ALC Loop Adjustments must be performed before performing these adjustments. Refer to Adjustment 4 and Adjustment 12.

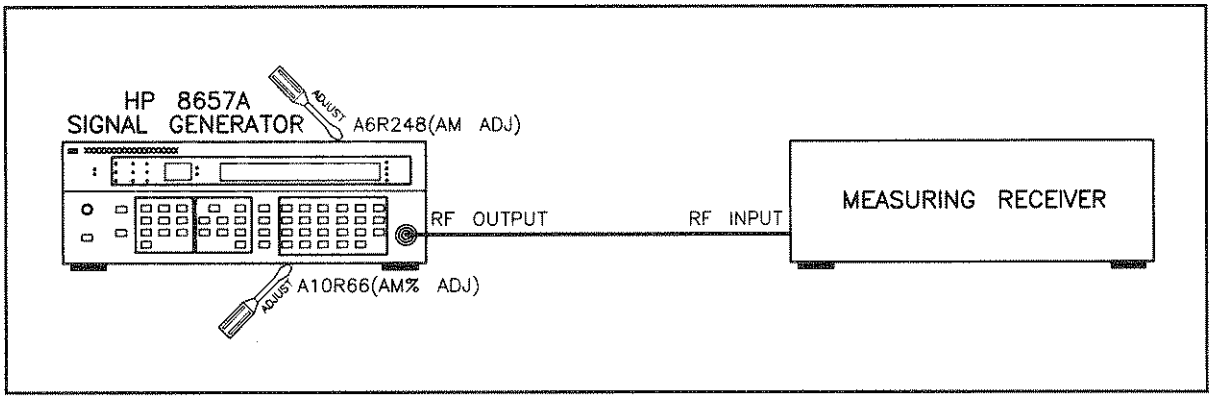


Figure 5–15. *AM% and ALC Loop AM Adjustments Setup*

Equipment

Measuring Receiver ..... HP 8902A

Procedure

1. Set the measuring receiver as follows:

   Measurement ..... AM
   Detector ..... AVG
   HP Filter ..... 50 Hz
   LP Filter ..... 15 kHz

2. Set the Signal Generator as follows:

   Frequency ..... 200 MHz
   Amplitude ..... +4 dBm
   Modulation ..... AM 30%
   Source ..... 1 kHz (Int.)
   Amplitude Increment ..... 8 dB

3. Connect the measuring receiver to the RF OUTPUT connector on the Signal Generator and connect the distortion analyzer as shown in Figure 5-15.
4. Adjust A10R66 (AM% ADJ) for a reading of 21.40% on the measuring receiver.

NOTE

Do not remove any of the internal RF covers for this adjustment.

5. Set the Signal Generator as follows:

Frequency ..... 200 MHz
Amplitude ..... −3 dBm
Modulation ..... AM 90%

6. Set the measuring receiver as follows:

Detector ..... PEAK -

6. Adjust A6R248 (AM ADJ) for a minimum reading on the measuring receiver as close to 90% as possible, while keeping the 1 kHz audio distortion less than 4%. Select the Audio Distortion measurement on the measuring receiver for a 1 kHz audio signal to measure the distortion.

Adjustment 14

FM CALIBRATION PRETUNE ADJUSTMENT

- **Service Sheet 14**

Description

The Low Frequency Loop is locked during this adjustment. The output of the integrator is adjusted so that the bottom of the integrator waveform is −6.0 volts. This adjustment assures that the VCO's tune voltage will have sufficient range.

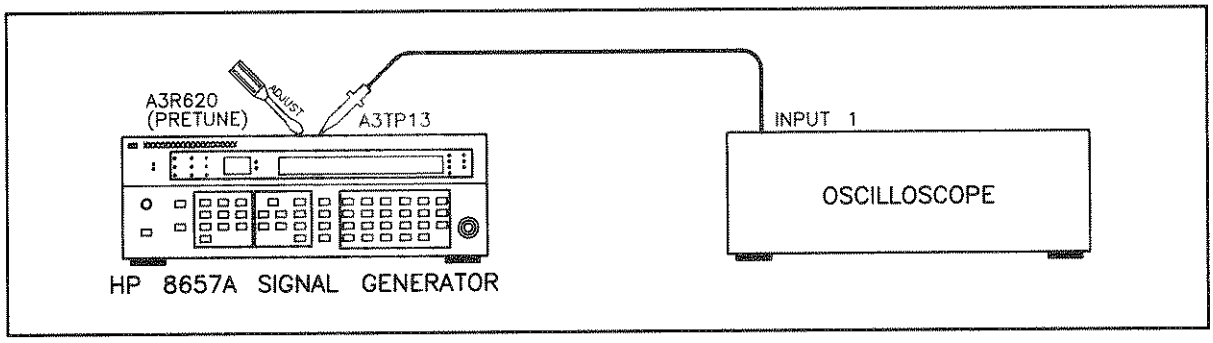


Figure 5–16. *FM Calibration Pretune Adjustment Setup*

Equipment

Oscilloscope	HP 54201A
Oscilloscope Probe	HP 10040A

Procedure

1. Set the oscilloscope as follows:

CHAN

Channel	1
Range	4V
Offset	−5V
Probe	10:1
Coupling	dc, 1MΩ

TIME

Mode	Auto
Range	20 μs
Delay	0 s
Reference	Left

TRIG

Source ..... Chan 1, + Slope
Level ..... Adjust −5V

DISPLAY

Graticule Type ..... Grid
Number of Graphs 1
Connect Dots ..... On
Data Filter ..... On

2. Set the Signal Generator as follows:

Frequency ..... 117 MHz
Amplitude ..... Any
Modulation ..... Off

3. Connect the oscilloscope probe to A3TP13, Integrator Output.
4. Adjust A3R620 (PRETUNE) for a voltage of −6.0 volts ±0.5 volts at the bottom of the integrator waveform.

Adjustment 15

API 1, 2, 3 AND 4 ADJUSTMENTS

- **Service Sheet 12**

Description

The API, Analog Phase Interpolation, spurious signals are adjusted for −60 dBc using a spectrum analyzer.

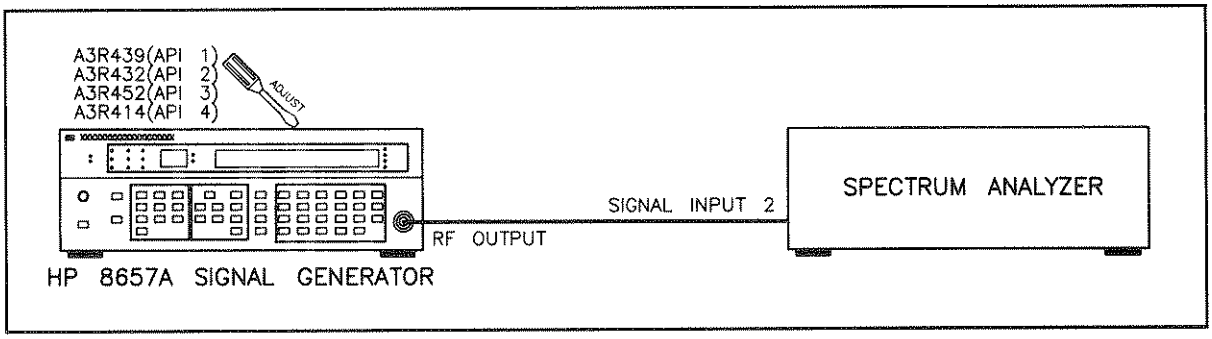


Figure 5–17. *API 1, 2, 3 and 4 Adjustment Setup*

Equipment

Spectrum Analyzer ..... HP 8568B
Cable (50 ohm coax, UG-21D/U type N (m) connectors) ..... HP 11500A

NOTE

The A3 Assembly must be fastened to RFI cover (MP12) with hex nuts before making API adjustments.

Procedure

1. Set the spectrum analyzer as follows:

   Center Frequency ..... 65 MHz
   Frequency Span ..... 10 kHz
   Reference Level ..... 0 dBm

2. Set the Signal Generator as follows:

   Frequency ..... 65 MHz
   Amplitude ..... 0 dBm
   Modulation ..... Off

3. Connect the RF OUTPUT of the Signal Generator to the spectrum analyzer SIGNAL INPUT 2 as show in Figure 5–17.
4. Offset the Signal Generator frequency by 2 kHz to 65.002 MHz.
5. Adjust A3R439 (API 1) so the spurious signals 1 and 2 kHz from the carrier are −60 dBc.
6. Offset the Signal Generator frequency by 200 Hz to 65.0002 MHz.

7. Adjust A3R432 (API 2) so the spurious signals 1 and 2 kHz from the carrier are −60 dBc.
8. Offset the Signal Generator frequency by 20 Hz to 65.00002 MHz.
9. Adjust A3R452 (API 3) so the spurious signals 1 and 2 kHz from the carrier are −60 dBc.
10. Offset the Signal Generator frequency by 10 Hz to 65.00001 MHz.
11. Set the spectrum analyzer frequency span to 25 kHz.
12. Adjust A3R414 (API 4) so spurious signals 5 and 10 kHz from the carrier are −60 dBc.

Adjustment 16

PEDESTAL ADJUSTMENT

- **Service Sheet 13**

Description

The Sample and Hold circuit current is adjusted for continuous voltage using an oscilloscope.

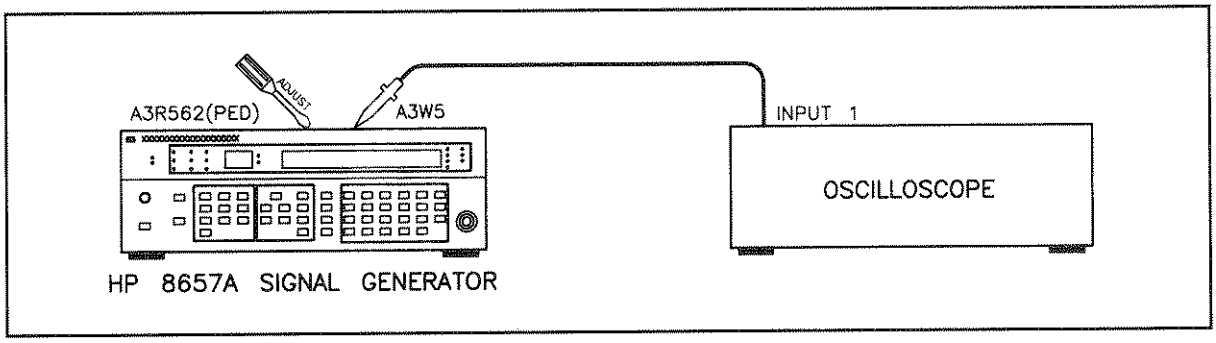


Figure 5–18. *Pedestal Adjustment Setup*

Equipment

Oscilloscope	HP 54201A
Oscilloscope Probe (1:1)	HP 10021A

PROCEDURE:

1. Set the Signal Generator as follows:

Frequency	65 MHz
Amplitude	Any
Modulation	Off

2. Connect oscilloscope INPUT 1 to A3W5.
3. Set the oscilloscope as follows:

CHAN

Channel	1
Range	40 mV
Offset	0.00V
Probe	1:1
Coupling	ac

TIME

Mode	Auto
Range	20 μs real Time
Delay	0S
Reference	Left

TRIG

Source ..... Chan 1, + Slope
Level ..... Adjust, 5 mV

DISPLAY

Gradicule Type ..... Grid
Number of Graphs 1
Connect Dots ..... On
Data Filter ..... On

4. Refer to Figure 5-19 and adjust A3R562 (PED) for a minimum peak value.

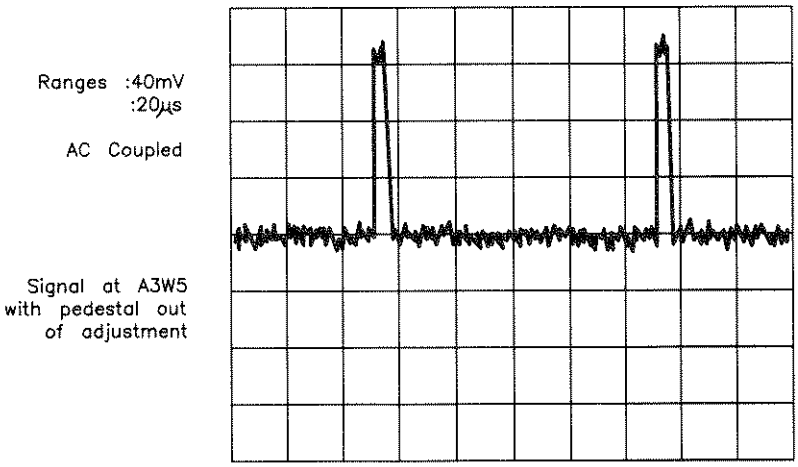


Figure 5-19. *Oscilloscope Display with Pedestal Needing Adjustment*

Adjustment 17

DC FM ADJUSTMENT

- **Service Sheet 15**

Description

The DC FM spurious signals are adjusted using a spectrum analyzer and a dc power supply.

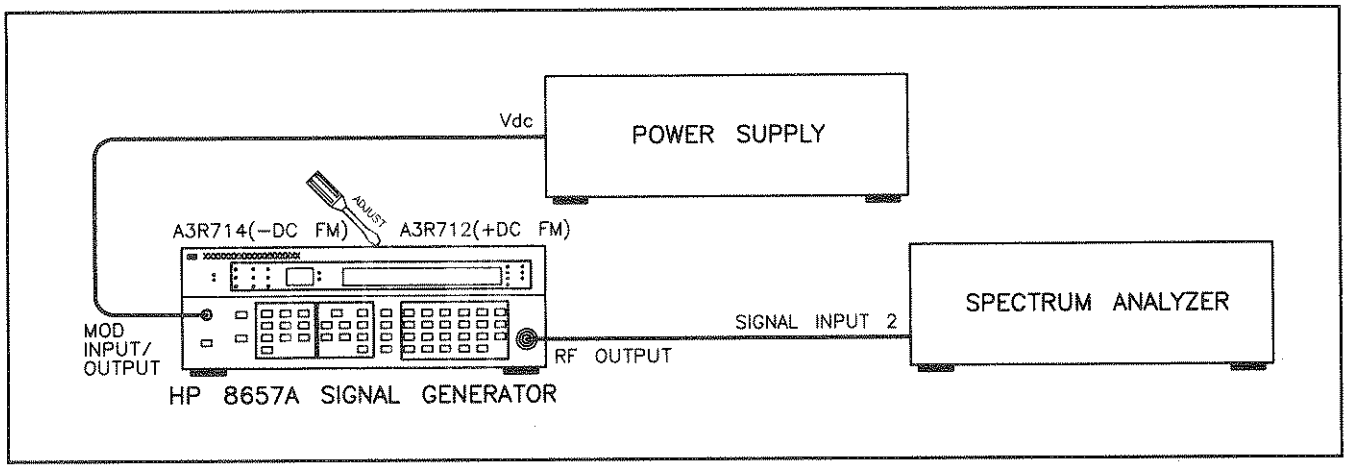


Figure 5–20. DC FM Adjustment Setup

Equipment

Spectrum Analyzer	HP 8568B or 8558B
Power Supply	HP 6214B
Cable (50 ohm coax, UG-21D/U type N(m) connectors)	HP 11500A
Cable (112 cm 50 ohm coax, UG-88C/U BNC to dual banana plug)	HP 11001-60001

Procedure

1. Set the spectrum analyzer as follows:

Center Frequency	66 MHz
Frequency Span	10 kHz
Reference Level	0 dBm

2. Set the power supply as follows:

Meter	Volts
Voltage	1 Vdc

3. Set the Signal Generator as follows:

Frequency	66 MHz
Amplitude	0 dBm
Modulation	DC FM, 3 kHz

4. Connect the Signal Generator RF OUTPUT to the spectrum analyzer SIGNAL INPUT 2 and the MOD INPUT/OUTPUT to the power supply +1 Vdc as shown in Figure 5-21.

NOTE

The LO EXT Modulation annunciator remains on regardless of the dc input level applied to the MOD INPUT/OUTPUT connector.

5. Adjust A3R712 (+DC FM) so spurious signals are −50 dBc.
6. Connect −1 Vdc to the MOD INPUT/OUTPUT.
7. Adjust A3R714 (−DC FM) so spurious signals are −50 dBc.

Adjustment 18

VOLTAGE OFFSET ADJUSTMENT

- **Service Sheet 7**

Description

The DC offset of the FM Deviation Summing Amplifier is adjusted for 0.000 Vdc ±0.001 Vdc at A10TP6.

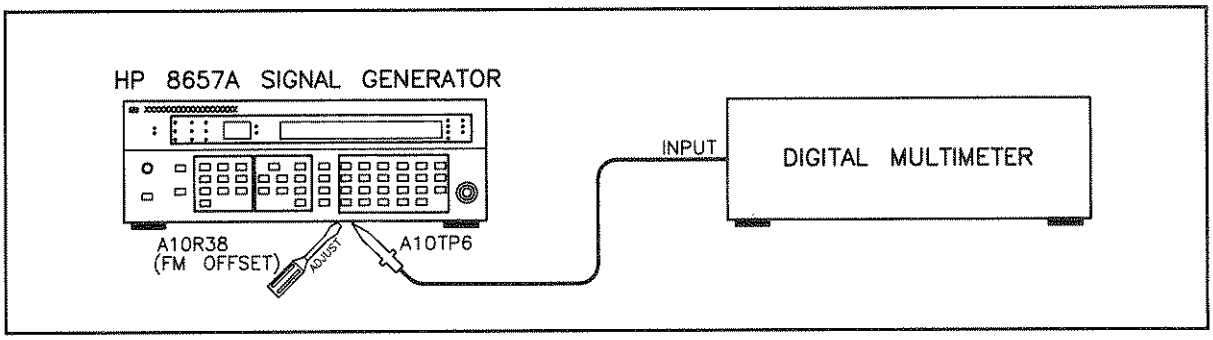


Figure 5-21. *DC FM Offset Adjustment Setup*

Equipment

Digital Multimeter ..... HP 3466A

NOTE

The A10 Assembly must be fastened to RFI cover (MP22) with hex nuts before making the Voltage Offset Adjustment

Procedure

1. Set the digital multimeter as follows:

   Function ..... Vdc
   Range ..... 200 mV

2. Set the Signal Generator as follows:

   Frequency ..... 65 MHz
   Amplitude ..... Any
   Modulation ..... DC FM, 99 kHz

3. Remove any signal connected to the Signal Generator MOD INPUT/OUTPUT connector.
4. Connect the digital multimeter to A10TP6 as shown in Figure 5-21.
5. Adjust A10R38 (FM OFFSET ADJ) for 0.000 Vdc ±0.001 Vdc.

Adjustment 19

FM IN-BAND GAIN ADJUSTMENT

- **Service Sheet 15**

Description

An external modulation signal whose frequency is outside the Low Frequency Loop bandwidth is used to frequency modulate the Signal Generator. The frequency modulation is measured with the EXT FM of the Signal Generator set to 50 kHz for a reference. The external modulation signal is changed to 100 Hz and the FM IN-BAND GAIN is adjusted for the same FM peak deviation.

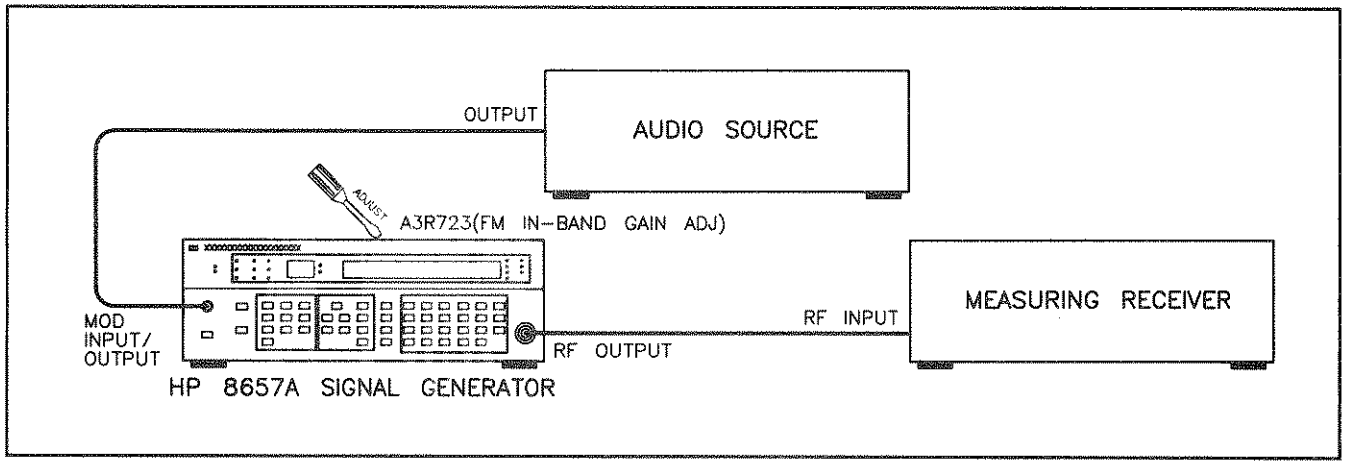


Figure 5-22. FM In-band Gain Adjustment Setup

Equipment

Measuring Receiver	HP 8902A
Audio Source	HP 8903B
Cable (50 ohm coax, UG-21D/U type N(m) connectors)	HP 11500A
Cable, BNC Connectors	HP 10503A

Procedure

1. Set the measuring receiver as follows:

Measurement	FM, PEAK+

2. Set the audio source as follows:

Frequency	20 kHz
Amplitude	1.414 Vac

3. Set the Signal Generator as follows:

Frequency	65 MHz
Amplitude	0 dBm
Modulation	EXT FM, 50 kHz

4. Connect the Signal Generator RF OUTPUT to the measuring receiver INPUT, and the Signal Generator MOD INPUT/OUTPUT to the audio source OUTPUT as shown in Figure 5-22. The Signal Generator LO EXT and HI EXT LED's should be out.
5. Adjust A10R39 (FM Gain ADJ) if necessary, for a reading of 50.0± 0.2 KHz on the measuring receiver.

NOTE

If it is necessary to adjust A110R39, the FM Deviation Adjustment 20 must be performed.

6. Set the measuring receiver to RATIO and the audio source frequency to 100 Hz.
7. Adjust A3R723 (FM IN-BAND GAIN ADJ) for a reading of 100% on the measuring receiver.
8. Repeat steps 6 through 8 and readjust A3R723 if required.

Adjustment 20

FM DEVIATION ADJUSTMENT

- **Service Sheet 7**

Description

The FM deviation is adjusted with a maximum FM peak deviation of 99 kHz entered into the Signal Generator. The carrier frequency is stepped down in 10 MHz steps from 1040 to 990 MHz and A10R39 is adjusted for an equal error around 99 kHz deviation.

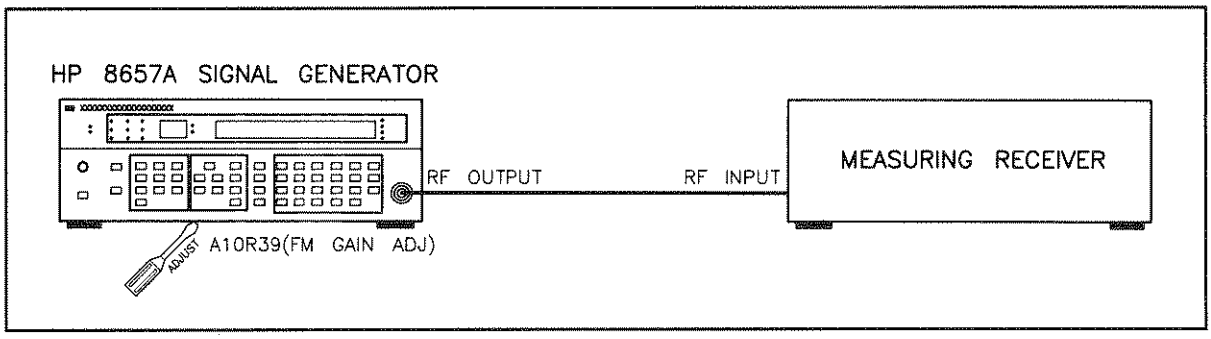


Figure 5–23. *FM Deviation Adjustment Setup*

Equipment

Measuring Receiver ..... HP 8902A
Cable (50 ohm coax, UG-21D/U type N (m) connectors) ..... HP 11500A

Procedure

1. Set the measuring receiver as follows:

   Measurement ..... FM
   Detector ..... +Peak
   HP Filter ..... 300 Hz
   LP Filter ..... 3 kHz

2. Set the Signal Generator as follows:

   Frequency ..... 1040 MHz
   Frequency Increment ..... 10 MHz
   Amplitude ..... +4 dBm
   Modulation ..... FM 99 kHz
   Source ..... 1 kHz (Int.)

3. Connect the measuring receiver input to the RF OUTPUT connector on the Signal Generator.
4. Adjust A10R39 (FM GAIN ADJ) for a 99.0 kHz deviation reading on the measuring receiver.
5. Step the frequency down from 1040 to 990 MHz and record the deviation at each of the 10 MHz steps.

6. Adjust A10R39 for equal error ±2 kHz from 99 kHz at the frequencies of maximum and minimum peak kHz deviation.

_____ 1040 MHz

_____ 1030 MHz

_____ 1020 MHz

_____ 1010 MHz

_____ 1000 MHz

_____ 990 MHz

Adjustment 21

DC FM OFFSET ADJUSTMENT

- **Service Sheet 7**

Description

The DC Offset of the FM Deviation Amplifier is adjusted for an output frequency error of +10 Hz with DC FM selected.

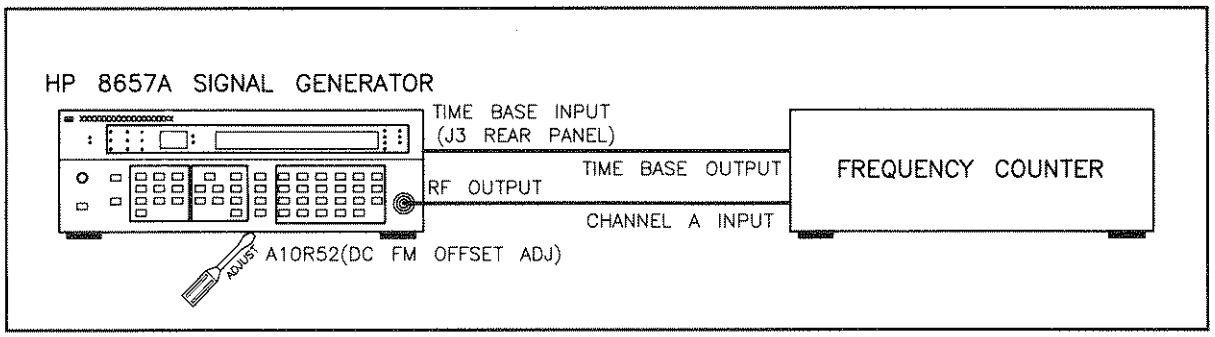


Figure 5–24. *DC FM Frequency Offset Adjustment Setup*

Equipment

Frequency Counter ..... HP 5328B
Adapter, N(m) to BNC (f) ..... HP 1250-0780
Cable, BNC (2 EA) ..... HP 10503A

NOTE

Both the A3 and A10 Assemblies must be fastened to RFI cover (MP22) with hex nuts before making the DC FM Adjustment.

Procedure

1. Set the frequency counter as follows:

   Frequency ..... Input A

2. Set the Signal Generator as follows:

   Frequency ..... 65 MHz
   Amplitude ..... 0 dBm
   Modulation ..... DC FM, 99 kHz

3. Connect the Signal Generator RF OUTPUT to the frequency counter CHANNEL A INPUT and the counter time base OUT to the Signal Generator Time Base INPUT as shown in Figure 5-24.

4. Adjust A10R52 (DC FM OFFSET ADJ) for a frequency counter reading of 65.000000 MHz ±10 Hz.

Adjustment 22

OPTION 001 10 MHZ REFERENCE OSCILLATOR FREQUENCY ADJUSTMENT

- **Service Sheet 25**

Description

The Option 001 10 MHz Reference Oscillator frequency is adjusted to 10.000 MHz ±10.0 Hz using a frequency counter.

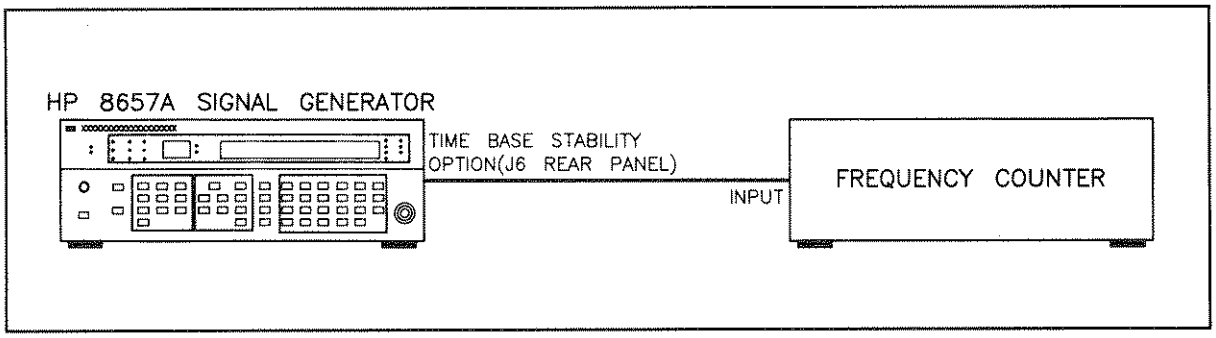


Figure 5–25. *10 MHz Reference Oscillator Frequency Adjustment Setup*

Equipment

Frequency Counter ..... HP 5328B

NOTE

Before making the adjustment, the instrument must be warmed up for a minimum of 24 hours.

Procedure

1. Remove the COARSE and FINE screws on the oscillator cover (accessed through the rear panel).
2. Connect the frequency counter to the TIME BASE HIGH STABILITY OPTION connector (J6) on the rear-panel of the Signal Generator.
3. Adjust the COARSE and FINE adjustments for a reading of 10.000 MHz ±10 Hz on the frequency counter.
4. Replace the COARSE and FINE screws.