OPERATING AND SERVICE MANUAL

8673B
SYNTHESIZED SIGNAL GENERATOR
2.0 — 26.0 GHz
(Including Options 001 through 009)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2332A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

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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.

WARNINGS

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 result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

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 neutral (that is, the grounded side of the mains supply).

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 many 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 of 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.

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 (see Table of Contents for page references).

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.

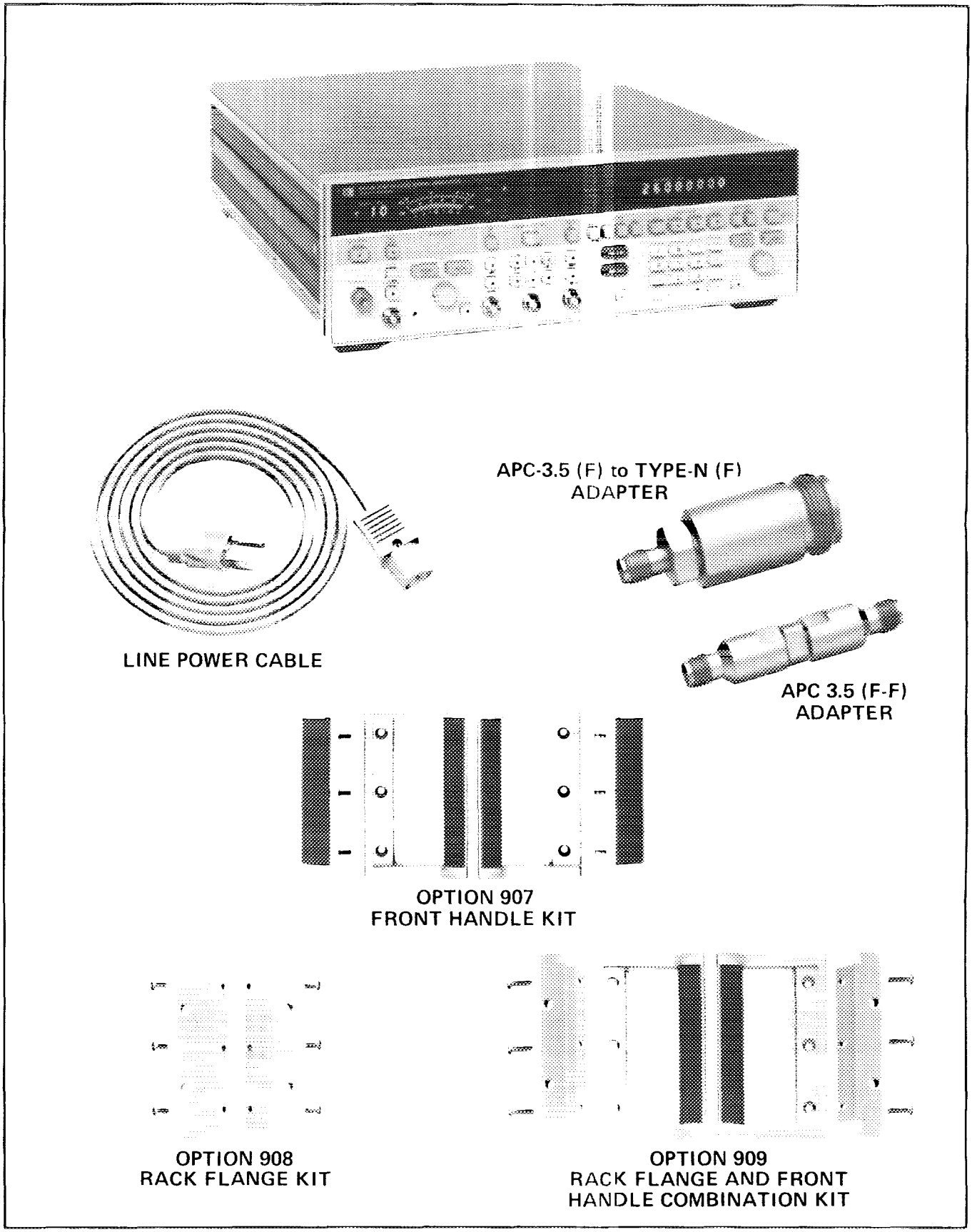


Figure 1-1. HP Model 8673B Accessories Supplied, and Options 907, 908, and 909.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, adjust and service the Hewlett-Packard 8673B Synthesized Signal Generator. Figure 1-1 shows the Signal Generator with all of its externally supplied accessories.

The 8673B Operating and Service manual has eight sections. The subjects addressed are:

Section I, General Information
Section II, Installation
Section III, Operation
Section IV, Performance Tests
Section V, Adjustments
Section VI, Replaceable Parts
Section VII, Manual Changes
Section VIII, Service

The 8673B 10 MHz Reference Oscillator A3A8, is a field repairable component. A separate operating and service manual, HP Part No. 10811-90002, is provided for this assembly and should be retained with the 8673B manual.

Two copies of the operating information are supplied with the Signal Generator. One copy is in the form of an Operating Manual. The Operating Manual is a copy of the first three sections of the Operating and Service Manual. The Operating Manual should stay with the instrument for use by the operator. Additional copies of the Operating Manual can be ordered separately through your nearest Hewlett-Packard office. The 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 x 150 millimetre (4 x 6 inch) microfilm transparencies of this manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement, as well as all pertinent Service Notes.

1-2. SPECIFICATIONS

Instument 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 listed in Table 1-2. 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 should 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 for installation, operation, performance testing, adjustment, or service is found in appropriate places throughout this manual.

1-4. INSTRUMENTS COVERED BY THIS MANUAL

Attached to the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. The first four digits and the letter are the serial number prefix. The last five digits are the suffix. The prefix is the same for identical instruments; it changes only when a configuration 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 serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-5. MANUAL CHANGES SUPPLEMENT

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 Manual Changes suppllement. The supplement contains "change information" that explains how to adapt this manual to the newer instrument.

MANUAL CHANGES SUPPLEMENT (cont'd)

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep the manual as current and as accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement is identified with the manual print date and part number, both of which appear 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 on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-6. DESCRIPTION

The HP Model 8673B Synthesized Signal Generator has a frequency range of 2.0 to 26.0 GHz (1.95 to 26.5 GHz overrange). The output is leveled and calibrated from +8 dBm to -100 dBm, depending on the frequency. (The output is leveled and calibrated from +10 to -10 dBm for Option 001, from +7 to -100 dBm for Option 004, and from +9 to -10 dBm for Option 005 and +8 to -100 dBm at 2 — 18 GHz; +7 to -100 dBc at 18.0 — 26.0 GHz for Option 008.) AM, FM, and pulse modulation modes can be selected. Frequency, output level, modulation modes, and most other functions can be remotely programmed via HP-IB.

Long-term frequency stability is dependent on the time base, either an internal or external reference oscillator. The internal crystal reference oscillator operates at 10 MHz while an external oscillator may operate at 5 or 10 MHz. The output of the Signal Generator is exceptionally flat due to the action of the internal automatic leveling control (ALC) loop.

External drive signals are required for all modulation modes. AM depth and FM deviation vary linearly with the applied external voltage. Full scale modulation is attained with a 1.0 volt peak signal. Pulse modulation is compatible with TTL levels.

Two ranges of AM depth can be selected: 30% and 100%. The front panel meter can be used to set AM depth. Specified AM rates are from 100 Hz to 100 kHz. However, useable amplitude modulation can be performed at any modulation frequency between 20 Hz and 100 kHz.

Six ranges of FM deviation are selectable: 0.03, 0.1, 0.3, 1, 3, and 10 MHz. FM peak deviation can be set using the front panel meter. At output frequencies below 6.6 GHz, peak deviation is limited to 10 MHz or five times the modulation frequency, whichever is lower. From 6.6 to 12.3 GHz, peak deviation is limited to the lesser of 10 MHz or ten times the modulation frequency; from 12.3 to 18.6 GHz the lesser of 10 MHz or fifteen times the modulation frequency; from 18.6 to 26.0 GHz the lesser of 10 MHz or twenty times the modulation frequency. Usable modulation rates fall between 100 Hz and 10 MHz.

Pulse modulation has two operating modes: NORM (normal mode) and COMPL (complement mode). In normal mode the RF output is On when the drive signal is the TTL high state. In the complement mode the RF output is On when the drive signal is in the TTL low state.

The Signal Generator is compatible with HP-IB to the extent indicated by the following code: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, and C0. The Signal Generator interfaces with the bus via three-state TTL circuitry. An explanation of the compatibility code can be found in IEEE Standard 488 (1978), "IEEE Standard Digital Interface for Programmable Instrumentation" or 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 III of this manual.

1-7. OPTIONS

1-8. Electrical Options

Option 001. The internal 10 dB/step attenuator has been deleted. The specified output level is +10 dBm to -10 dBm from 2.0 to 18.0 GHz, +6 dBm to -10 dBm from 18.0 to 22.0 GHz, and +3 dBm to -10 dBm from 22.0 to 26.0 dBm.

Option 002. The internal 10 MHz crystal reference is removed. An external 5 or 10 MHz reference must be used.

Option 003. A special fan allows opertion from 400 Hz power mains.

Option 004. The Signal Generator's RF OUTPUT connector is located on the rear panel. Maximum output power is +7 dBm to -100 dBm from 2.0 to 18.0 GHz, +2 dBm to -100 dBm from 18.0 to 22.0 GHz, and -2 dBm to -100 dBm from 22.0 to 26.0 GHz.

Electrical Options (cont'd)

Option 005. The Signal Generator's RF OUTPUT connector is located on the rear panel and the attenuator is removed. This combines Options 001 and 004. The specified output level is +9 dBm to −10 dBm from 2.0 to 18.0 GHz, +4 dBm to −10 dBm from 18.0 to 22.0 GHz, and +1 dBm to −10 dBm from 22.0 to 26.0 GHz.

Option 008. The Signal Generator uses an internal GaAs FET Amplifier to deliver a +8 dBm leveled output to 18 GHz and +7 dBm leveled output from 18 to 26 GHz. Option 008 may also be combined with Option 001 to provide a leveled output of +10 dBm from 2 to 26 GHz. Additionally, Option 008 may be combined with Options 004 and 005. From 2 to 18 GHz, with both Options 004 and 005, the leveled output specification remains unchanged. From 18 to 26 GHz the leveled output, for Option 004 is +5 dBm, and for Option 005 is +8 dBm.

1-9. Mechanical Options

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

Option 006 (Chassis Slide Mount Kit). This kit is extremely useful when the Signal Generator is rack mounted. Access to the internal circuits and components, or the rear panel is possible without removing the Signal Generator from the rack. The Chassis Slide Mount Kit part number is 1494-0017. An adapter (HP part number 1494-0023) is needed if the instrument rack mounting slides are to be mounted in a standard EIA rack. The slides without the adapter can be directly mounted in the HP system enclosures.

Option 907 (Front Handle Kit). Ease of handling is increased with the front panel handles. The Front Handle Kit part number is 5061-0089.

Option 908 (Rack Flange Kit). The Signal Generator can be solidly mounted to the instrument rack using the flange kit. The Rack Flange Kit part number is 5061-0077.

Option 909 (Rack Flange and Front Handle Combination Kit). This is a unique part which combines both functions. It is not simply a front handle kit and a rack flange kit packaged together. The Rack Flange and Front Panel Combination Kit part number is 5061-0083.

1-10. ACCESSORIES SUPPLIED

The accessories supplied with the Signal Generator are shown in Figure 1-1.

a. The line power cable is supplied in several configurations, depending on the destination of the original shipment. Refer to Power Cables in Section II of this manual.

b. An additional fuse is shipped only with instruments that are factory configured for 100/120 Vac operation. This fuse has a 2A rating and is for reconfiguring the instrument for 220/240 Vac operation.

c. Two adapters are provided: APC-3.5(F) to TYP-N(F); HP Part No. 1250-1745. APC-3.5(F-F); HP Part No. 1250-1749.

1-11. EQUIPMENT REQUIRED BUT NOT SUPPLIED

For Option 002 instruments, which lack an internal frequency standard, an external reference must be used. The performance of the external reference should at least match the specifications of the HP Model 10811B Crystal Oscillator. In particular, the frequency should be within ±50 Hz of 10 MHz. When using an external oscillator, microphonically generated or line related spurious signals may increase. SSB phase noise may also be degraded at some offsets from the carrier.

An external signal source is required if amplitude, frequency, or pulse modulation is desired. For AM, the source should have a variable output of 0 to 1 volt peak into 600 ohms, frequency rates up to 100 kHz, and distortion of less than 1%. For FM, the source should have a variable output of 0 to 1 volt peak into 50 ohms, frequency rates up to 10 MHz, and distortion of less than 1%. For pulse modulation, the source should have TTL output levels (>2.4V for a TTL high state and <0.4V for a TTL low state) and 50 ohms nominal impedance. Pulse repetition frequency rates should be 1 Hz to 1 MHz with transition times <10 ns.

1-12. ELECTRICAL EQUIPMENT AVAILABLE

The Signal Generator has an HP-IB interface and can be used with any HP-IB compatible computing controller or computer for automatic systems applications.

ELECTRICAL EQUIPMENT AVAILABLE (cont'd)

The HP-IB Controller and various ROMs are needed to do the automated SRD Bias, YTM Tune, Flatness and ALC, and Pulse adjustment procedures. Specific equipment needed for automated adjustments are:

Test Cassette HP Part No. 11726-10001
HP 85F Controller
82903A 16K Memory Module
00085-15005 Advanced Programming ROM
00085-15002 Plotter/Printer ROM
00085-15004 Matrix ROM
HP 3455A Digital Voltmeter
HP 436A/HP 8455A Power Meter and Sensor

Although the test cassette is part of the HP 11726A Support Kit, it can be ordered separately through the nearest Hewlett-Packard Office. The HP 11726A Support Kit is available for maintaining and servicing the Signal Generator. It consists of cables, adapters, termination, prerecorded programs, extender boards and test extender boards.

The HP 8116A Pulse/Function Generator is adequate for modulating the Signal Generator and meeting stated standards. This remotely programmable signal source is convenient for full remote control of modulation levels and rates.

For pulse modulation requiring pulse delay, the HP 8112A Pulse Generator is recommended.

1-13. RECOMMENDED TEST EQUIPMENT

Table 1-3 lists the test equipment recommended for testing, adjusting and servicing the Signal Generator. Essential requirements for each piece of test equipment are described in the Critical Specifications column. Other equipment can be substituted if it meets or exceeds these critical specifications.

Table 1-1. Specifications (1 of 6)

Note: Specifications apply after 1-hour warm-up, over temperature range 0 to 55°C (except specifications for harmonically related spurious signals, RF output, pulse peak level accuracy, and amplitude modulation, which apply +15 to +35°C).

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—26.0 GHz (1.95—26.5 GHz overrange)	
Resolution	1 kHz 2 kHz 3 kHz 4 kHz	2.0 to 6.6 GHz >6.6 to 12.3 GHz >12.3 to 18.6 GHz >18.6 to 26.0 GHz
Accuracy and Stability	Same as reference oscillator	
Reference Oscillator: Frequency Aging Rate	10 MHz <5 x $10\mu^{10}$/day	After a 10 day warmup (typically 24 hours in a normal operating environment)
Switching Time (for frequency to be within specified resolution and output power to be within 3 dB of set level)	<20 ms	CW and AM modes; AUTO PEAK disabled
For Option 008: Switching time (for frequency table within specified resolution and output power to be within 3 dB of set level)	<25 ms for frequency changes across 16 GHz	CW and AM modes; AUTO, PEAK disabled

Table 1-1. Specifications (2 of 6)

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Single-sideband Phase Noise		1 Hz bandwidth; CW mode
2.0—6.6 GHz	-58 dBc	10 Hz offset from carrier
	-70 dBc	100 Hz offset from carrier
	-78 dBc	1 kHz offset from carrier
	-86 dBc	10 kHz offset from carrier
	-110 dBc	100 kHz offset from carrier
>6.6—12.3 GHz	-52 dBc	10 Hz offset from carrier
	-64 dBc	100 Hz offset from carrier
	-72 dBc	1 kHz offset from carrier
	-80 dBc	10 kHz offset from carrier
	-104 dBc	100 kHz offset from carrier
>12.3—18.6 GHz	-48 dBc	10 Hz offset from carrier
	-60 dBc	100 Hz offset from carrier
	-68 dBc	1 kHz offset from carrier
	-76 dBc	10 kHz offset from carrier
	-100 dBc	100 kHz offset from carrier
>18.6—26.0 GHz	-46 dBc	10 Hz offset from carrier
	-58 dBc	100 Hz offset from carrier
	-66 dBc	1 kHz offset from carrier
	-74dBc	10 kHz offset from carrier
	-98 dBc	100 kHz offset from carrier
Harmonics	<-40 dBc	Up to 26 GHz; output level meter readings ≤ = 0 dB on 0 dBm range and below
Subharmonics and Multiples thereof	<-25 dBc	2.0 to 18.6 GHz
	<-20 dBc	18.6 to 26.0 GHz
For Option 008		
Subharmonics and Multiples thereof	<-25 dBc	2.0 to 26 GHz
	<-15 dBc	18.6 to 26 GHz (1/2 and 3/4 subharmonics only)
Spurious Signals		CW and AM modes
Nonharmonically Related	<-70 dBc	2.0 to 6.6 GHz
	<-64 dBc	>6.6 to 12.3 GHz
	<-60 dBc	>12.3 to 18.6 GHz
	<-58 dBc	>18.6 to 26.0 GHz
Power line related and fan rotation related within 5 Hz below line frequencies and multiplies thereof		
2.0—6.6 GHz	-50 dBc	<300 Hz offset from carrier
	-60 dBc	300 Hz to 1 kHz offset from carrier
	-65 dBc	>1 kHz offset from carrier

Table 1-1. Specifications (3 of 7)

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY (cont'd)		
6.6—12.3 GHz	-44 dBc	<300 Hz offset from carrier
	-54 dBc	300 Hz to 1 kHz offset from carrier
	-59 dBc	>1 kHz offset from carrier
12.3—18.6 GHz	-40 dBc	<300 Hz offset from carrier
	-50 dBc	300 Hz to 1 kHz offset from carrier
	-55 dBc	>1 kHz offset from carrier
18.6—26.0 GHz	-38 dBc	<300 Hz offset from carrier
	-48 dBc	300 Hz to 1 kHz offset from carrier
	-53 dBc	>1 kHz offset from carrier
RF OUTPUT		
Output Level:		+15 to +35°C
Standard Leveled Output	+8 dBm to -100 dBm	2.0 to 18.0 GHz
	+4 dBm to -100 dBm	18.0 to 22.0 GHz
	0 dBm to -100 dBm	22.0 to 26.0 GHz
Option 001 Leveled Output	+10 dBm to -100 dBm	2.0 to 18.0 GHz
	+6 dBm to -100 dBm	18.0 to 22.0 GHz
	+3 dBm to -100 dBm	22.0 to 26.0 GHz
Option 004 Leveled Output	+7 dBm to -100 dBm	2.0 to 18.0 GHz
	+2 dBm to -100 dBm	18.0 to 22.0 GHz
	-2 dBm to -100 dBm	22.0 to 26.0 GHz
Option 005 Leveled Output	+9 dBm to -100 dBm	2.0 to 18.0 GHz
	+4 dBm to -100 dBm	18.0 to 22.0 GHz
	+1 dBm to -100 dBm	22.0 to 26.0 GHz
Option 008 Level Output	+8 dBm to -100 dBm	2.0 to 18.0 GHz
	+7 dBm to -100 dBm	18.0 to 26.0 GHz
Remote Programming Absolute Level Accuracy		
2.0 — 6.6 GHz	±1.25 dB	+10 dBm output level range
	±1.00 dB	0 dBm output level range
	±1.50 dB	-10 dBm output level range
	±1.70 dB	-20 dBm output level range
	±2.00 dB	-30 dBm output level range
	±2.00 dB plus ±0.1 dB per 10 dB step below -30 dBm	< -30 dBm output range
>6.6 — 12.3 GHz	±1.50 dB	+10 dBm output level range
	±1.25 dB	0 dBm output level range
	±1.75 dB	-10 dBm output level range
	±1.95 dB	-20 dBm output level range
	±2.25 dB	-30 dBm output level range
	±2.25 dB plus ±0.1 dB per 10 dB step below -30 dBm	< -30 dBm output range

Table 1-1. Specifications (4 of 7)

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT (cont'd)		
>12.3 — 18.6 GHz	±1.75 dB ±1.50 dB ±2.10 dB ±2.30 dB ±2.70 dB ±2.70 dB plus ±0.2 dB per 10 dB step below -30 dBm	+10 dBm output level range 0 dBm output level range -10 dBm output level range -20 dBm output level range -30 dBm output level range <-30 dBm output range
>18.6 — 26.0 GHz	±2.00 dB ±2.55 dB ±2.85 dB ±3.30 dB ±3.30 dB plus ±0.2 dB per 10 dB step below -30 dBm	0 dBm output level range -10 dBm output level range -20 dBm output level range -30 dBm output level range <-30 dBm output range
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy, meter accuracy, and measurement uncertainty
Remote Programming Output Level Resolution	0.1 dB	
For Option 008	0.1 dB	+7 to -100 dBm, plus 6 dB of overrange
Flatness	 ±0.75 dB ±1.00 dB ±1.25 dB ±1.75 dB	0 dBm range; +15 to +35°C 2.0 to 6.6 GHz 2.0 to 12.3 GHz 2.0 to 18.6 GHz 2.0 to 26.0 GHz (Min. to max. variation in power level across specified frequency limits is less than 2 times flatness spec.)
Output Level Switching Time (to be within ±1 dB of final level)	<25 ms	

Table 1-1. Specifications (5 of 7)

Electrical Characteristics	Performance Limits	Conditions
PULSE MODULATION		
ON/OFF Ratio	>80 dB	
Rise and Fall Times	<35 ns	AUTO PEAK enabled
For Option 003	<40 ns	
Minimum Leveled RF Pulse Width	<100 ns	
Pulse Repetition Frequency	dc to 1 MHz	
Minimum Duty Cycle	<0.0001	When internally leveled; no restriction when unleveled
Minimum Pulse Off-Time	<300 ns	
Maximum Peak Power	Same as in CW mode	
Peak Level Accuracy	+1.5 dB, -1.0 dB	Relative to CW; +15 to +35°C
Overshoot, Ringing	<0.2 <0.25	2.0 to 6.6 and 6.7 to 26.0 GHz 6.6 to 6.7 GHz
For Option 008	<0.25	
AMPLITUDE MODULATION		
Depth		+15 to +35°C
	0 to 75%	2.0 to 18.0 GHz; 0 dBm maximum carrier level
	0 to 75%	>18.0 to 24.0 GHz; -3 dBm maximum carrier level
	0 to 50%	>24.0 to 26.0 GHz; -5 dBm maximum carrier level
For Option 008	0 to 75%	At range and vernier settings of 0 dBm and below
Rates	20 Hz to 100 kHz	3 dB bandwidth, 30% depth
Sensitivity (% AM per Vpk)	30%/V and 100%/V (depending on range)	Maximum input 1 Vpk into 600Ω nominal; AM depth is linearly controlled by varying input level between 0 and 1V peak

Table 1-1. Specifications (6 of 7)

Electrical Characteristics	Performance Limits	Conditions
AMPLITUDE MODULATION (cont'd)		
Indicated Meter Accuracy	±7% of reading ±3% of range	100 Hz to 10 kHz rates
Accuracy Relative to External AM Input Level	±4% of reading ±2% of range	100 Hz to 10 kHz rates
Incidental Phase Modulation (100 Hz to 10 kHz rates; 30% depth)	<0.4 radians	2.0 to 6.6 GHz
	<0.8 radians	>6.6 to 12.3 GHz
	<1.2 radians	>12.3 to 18.6 GHz
	<1.6 radians	>18.6 to 24.0 GHz
	<2.5 radians	>24.0 to 26.0 GHz
Incidental FM	Incidental phase modulation x f_{mod}	
FREQUENCY MODULATION		
Frequency Response Relative to a 100 kHz Rate	±2 dB, 100 Hz to 3 MHz	30 and 100 kHz/V ranges
	±2 dB, 3 kHz to 3 MHz	300 kHz/V and 1, 3, and 10 MHz/V ranges
Maximum Peak Deviation	The smaller of 10 MHz or f_{mod} x 5	2.0 to 6.6 GHz
	The smaller of 10 MHz or f_{mod} x 10	>6.6 to 12.3 GHz
	The smaller of 10 MHz f_{mod} x 15	>12.3 to 18.6 GHz
	The smaller of 10 MHz f_{mod} x 20	>18.6 to 26.0 GHz
Sensitivity (peak deviation per Vpk)	Maximum input 1 Vpk into 50 ohms nominal	All ranges; peak deviation is linearly controlled by varying input level between 0 and 1 Vpk
Indicated Meter Accuracy	±12% of reading ±3% of range	100 kHz rate
Accuracy Relative to External FM Input Level	±7% of reading ±3% of range	100 kHz rate
Incidental AM	<5%	Rates <100 kHz; peak deviations ≤1 MHz

Table 1-1. Specifications (7 of 7)

Electrical Characteristics	Performance Limits	Conditions
DIGITAL SWEEP		
Sweep Function	Start/Stop or ΔF (Span) Sweep	
Sweep Modes	Manual, Auto, Single	
Step Size	Maximum of 9999 frequency points per sweep	Maximum of 9999 frequency points per sweep.
Dwell Time	Set from 1 to 255 ms per step	
Markers	5 independent, fixed frequency markers set from front panel	Resolution and accuracy are identical to RF output
REAR PANEL AUXILIARY CONTROL CONNECTOR		
14-Pin Connector	Trigger Output Stop Sweep Input End Sweep Output Trigger Sweep Input Negative Z-axis Blanking Service Function Frequency Increment Frequency Decrement Blank Frequency Display Recall Register 1 Sequential Register Recall Ground	
Input Required	Contact closure to ground or 5 μs, negative true TTL pulse	(Internal debounce circuit available to debounce external inputs.)
Outputs	5 μs negative true TTL pulse	
REMOTE PROGRAMMING	All functions HP-IB programmable, except LINE switch	
GENERAL		
Operating Temperature Range	0 to +55°C	
Power Requirements:		
Line Voltage (100, 120, 220, or 240V)	+5, −10%	48—66 Hz
Power Dissipation	400 V·A maximum	
Conducted and Radiated Electromagnetic Interference	MIL-STD 461A-1968	Conducted and radiated interference is within the requirements of methods CE03 and RE02 of MIL-STD 461A, VDE 0871, and CISPR publication 11.
Net Weight	29 kg (64 lb)	
Dimensions: Height Width Depth	146 mm (5.7 in.) 425 mm (16.8 in.) 620 mm (24.4 in.)	For ordering cabinet accessories, module sizes are 5-1/4H, 1MW, 23D.

Table 1-2. Supplemental Characteristics (1 of 2)

Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.

FREQUENCY

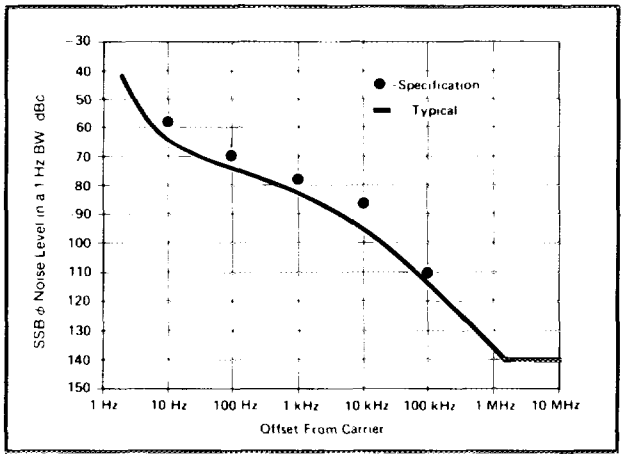
Internal Reference: The internal reference oscillator accuracy is a function of time base calibration ± aging rate, ± temperature effects, and ± line voltage effects. Typical temperature and line voltage effects are $<1 \times 10^{-10}$/°C and $<5 \times 10^{-10}$/+5% to -10% line voltage change. Reference oscillator is kept at operating temperature in STANDBY mode with the instrument connected to mains power. For instruments disconnected from mains power less than 24 hours, the aging rate is $<5 \times 10^{-10}$/day after a 24 hour warmup.

External Reference: 5 or 10 MHz at a level of 0.1 to 1 Vrms into 50 ohms. Stability and spectral purity of the microwave output will be partially determined by characteristics of the external reference frequency.

Reference Outputs: 10 MHz and 100 MHz at a level of 0.2 Vrms nominal into 50 ohms.

SPECTRAL PURITY

Single-sideband Phase Noise (1 Hz BW, CW mode, 2.0 to 6.6 GHz):*



**Add 6 dB for 6.6 to 12.3 GHz, 10 dB for 12.3 to 18.6 GHz, and 12 dB for 18.6 to 26.0 GHz.*

Residual FM in CW and FM Modes, 2.0 to 6.6 GHz* (noise and power line related):

Mode/FM Range	Post-Detection Bandwidth	
	300 Hz—3 kHz	50 Hz—15 kHz
CW, 30, and 100 kHz/V	12 Hz rms	60 Hz rms
300 kHz/V, and 1, 3, and 10 MHz/V	15 Hz rms	75 Hz rms

*Residual FM doubles for 6.6—12.3 GHz, triples for 12.3—18.6 GHz, and quadruples for 18.6—26.0 GHz.

Spurious Signals (CW and AM modes), Option 003 instruments (400 Hz line operation): Power line related and fan rotation related within 5 Hz below line frequency and multiples thereof:

Frequency Range (GHz)	Offset from Carrier		
	<2 kHz	2 to 8 kz	>8 kHz
2.0–6.6	-40 dBc	-50 dBc	-65 dBc
>6.6–12.3	-34 dBc	-44 dBc	-59 dBc
>12.3–18.6	-30 dBc	-40 dBc	-55 dBc
>18.6–26.0	-28 dBc	-38 dBc	-53 dBc

RF OUTPUT

Output Level Switching Time (to be within ±1 dB of final level with no range change):

Operating Mode	Output Level Switching Time
CW	<15 ms
AM, Pulse, Sweep	<5 ms

For power settings >0 dBm, changes in frequency of several GHz in one step may require additional AUTO PEAK enabling to stabilize power at the desired level. Spurious output oscillations may occur for settings above +8 dBm.

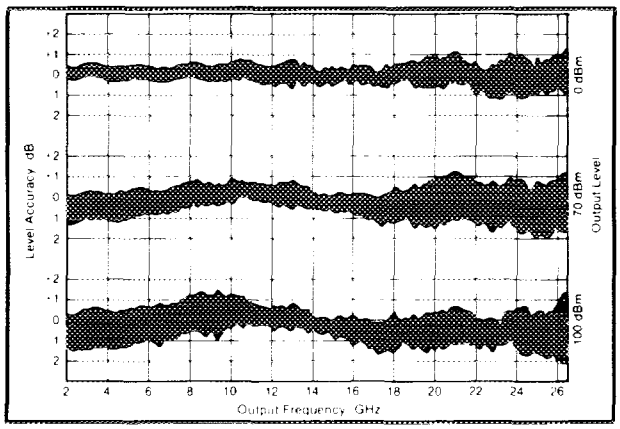
External leveling device characteristics will determine output flatness, absolute level accuracy, and switching time in external leveling modes.

Impedance: 50 ohms.

Source SWR: <2.0.

Table 1-2. Supplemental Characteristics (2 of 2)

Output Level Accuracy:



Typical 8673B output level accuracy at 0, −70, and −100 dBm level settings.

PULSE MODULATION

Pulse Width: Pulse widths less than 100 ns are possible with degraded peak power level accuracy relative to CW.

Pulse Input:

Normal Mode: >3V on, <0.5V off

Complement Mode: <0.5V on, >3V off

Impedance: 50 ohms nominal

Damage Level: more positive +6 Vpk from <50 ohm source or more negative than −0.5 Vpk from ≤50 ohm source.

Pulse Width Compression: <35 ns.

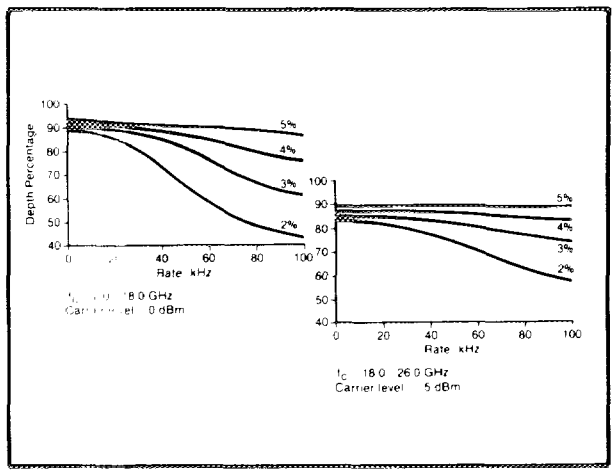
Maximum Delay Time: 150 ns.

Video Feedthrough: <−50 dBc.

AMPLITUDE MODULATION

Frequency Response Relative to a 1 kHz Rate: ±0.25 dB, 100 Hz—10 kHz.

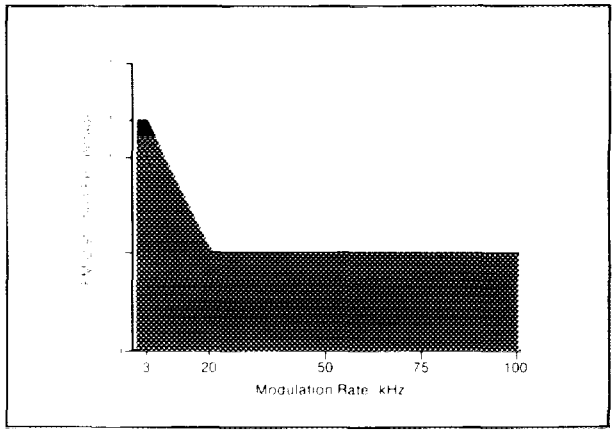
Distortion:



Typical 8673B AM distortion versus modulation rate and depth.

FREQUENCY MODULATION

Rates (3 dB bandwidth): 100 Hz to 10 MHz, 30 and 100 kHz/V ranges; 1 kHz to 10 MHz, 300 kHz/V, and 1, 3, and 10 MHz/V ranges.



Typical 8673B FM distortion versus modulation rate.

DIGITAL SWEEP

Rear Panel BNC Sweep Connections:

Sweep Out: 0 to +10V ramp start to stop (maximum adjustable from +4 to +12V)

Sweep Reference: 1V/GHz ramp (+18V maximum)

Z-Axis Blanking/Markers

Tone Marker Output

Penlift

Table 1-3. Recommended Test Equipment (1 of 4)

Instrument	Critical Specifications	Recommended Model	Use*
AC Voltmeter	Range: 1 mV to 10V Accuracy: ±1.5% of full scale ±1.5% of reading Frequency Response: 3 kHz to 3 MHz	HP 400E	P, A
Attenuator, Fixed 3 dB	Range: dc to 1 GHz Accuracy: ±0.5 dB SWR: < 1.3	HP 8491A Option 003	P, A
Attenuator, Fixed 6 dB	Range: dc to 26 GHz Accuracy: ±0.6 dB SWR: < 1.6	HP 8493C Option 006	P
Attenuator, Fixed 10 dB	Range: dc to 12.4 GHz Accuracy: ±0.6 dB SWR: < 1.3	HP 8491A Option 010	P
Attenuator, Fixed 20 dB	Range: dc to 26 GHz Accuracy: ±1.0 dB SWR: < 1.6	HP 8493C Option 020	P, A
Attenuator, 10 dB Step	Range: dc to 26 GHz Accuracy: ±7% SWR: < 2.2	HP 8495D Option 004	P
Audio Analyzer[1]	Frequency Range: 20 Hz to 100 kHz Accuracy: ±4% of full scale	HP 8903A	P
Audio Source[1]	Frequency Range: 20 Hz to 100 kHz Output Level: 1 mV to 6V open circuit Flatness: ±2.5%	HP 8903A	P
Cable, Special Interconnect	Special (see Figure 1-2)	Locally Fabricated	A
Controller, HP-IB	HP-IB compatibility as defined by IEEE Standard 488-1978 and the identical ANSI Standard MC1.1: SH1, AH1, T2, TE0, L2, LE0, SR0, RL0, PP0, DC0, DT0, and C1, 2, 3, 4, 5. No substitute available for adjustments.	HP 85F/82903A/ 00085-15002/ 00085-15004 with 00085-15001/ 00085-15002/ 00085-15004	C A
Crystal Detector	Frequency Range: 2 to 26 GHz Frequency Response: ±1.5 dB	HP 8473C	P
Current Probe	Frequency Range: 2 to 35 MHz	HP 1110B	A

Table 1-3. Recommended Test Equipment (2 of 4)

Instrument	Critical Specifications	Recommended Model	Use*
Current Tracer	TTL compatible	HP 547A	T
Digital Voltmeter	Automated adjustment programs require specific test equipment. No substitute is recommended.	HP 3455A	P, A, T
Foam Pads (2 required)	43 × 58 cm (17 × 23 in.), 5 cm (2 in.) thick		P
Frequency Counter	Range: 10 Hz to 500 MHz and 2 to 26 GHz Resolution: 10 Hz to 500 MHz — 1 Hz 2 to 26 GHz — 100 Hz	HP 5343A	P, A
Frequency Standard	Long Term Stability: Better than 10^{-10}/day	HP 5065A	P, A
Local Oscillator	Range: 2 to 26 GHz Level: 2 to 18.6 GHz — +7 dBm 18.6 to 26 GHz — +3 dBm Single Sideband Phase Noise and Spurious Signals: Same as Model 8673A.	HP 8673B	P, A
Logic Pulser	TTL compatible	HP 546A	T
Mixer	Response: 2 to 26 GHz	RHG DMS1—26[2]	P
Modulation Analyzer	Frequency Range: 150 to 990 MHz Input Level: −20 to +13 dBm Amplitude Modulation: Rates — 25 Hz to 25 kHz Depth — to 99% Accuracy — ±2% at 1 kHz Flatness — ±0.5% Demodulated Output Distortion — <0.3% for 50% depth; <0.6% for 90% depth Incidental Phase Modulation — <0.05 radians for 50% depth at 1 kHz rate (50 Hz to 3 kHz bandwidth) Frequency Modulation: Rates — 25 Hz to 25 kHz Deviation — to 99 kHz Accuracy — ±2% at 1 kHz	HP 8901A	P, A
Oscilloscope	Bandwidth: 200 MHz Vertical Sensitivity: 10 mV/div Vertical Input: 50Ω ac or dc coupled Delayed Sweep Mode: 20 ns/dv External Trigger Capability	HP 1715A	C,P, A,T

Table 1-3. Recommended Test Equipment (3 of 4)

Instrument	Critical Specifications	Recommended Model	Use*
Power Meter	Automated adjustment programs require specific test equipment. Therefore, no substitute is recommended.	HP 436A	P, A
Power Sensor	Frequency Range: 2 to 26 GHz Input Impedance: 50Ω SWR: < 1.25 Must be compatible with power meter	HP 8485A	P, A
Power Source, Variable Frequency AC	Range: 60 Vac to 240 Vac Frequency: 48 to 400 Hz Accuracy ± 2 Hz	California Instruments 501TC/800T3	P P
Preamp - Power Amp	Preamp Frequency: 100 kHz to 1.3 GHz Gain: 26 ± 2 dB Output Power: > 7 dBm Noise Figure: < 8.5 dB Impedance: 50Ω Power Amp Frequency: 100 kHz to 1.3 GHz Gain: 40 ± 3 dB Output Power: > 6 dBm Noise Figure: < 5 dBm Impedance: 50Ω	HP8447F	P
Probe, 10:1	Must be compatible with the oscilloscope.	HP 10017A	P, A
Pulse Generator	Rate: 10 Hz to 4 MHz Rise and Fall Times: < 5 ns Output Impedance: 50Ω Output Level: 0 to 3.5V Pulse Width: 90 ns to 2 μs	HP 8013B	C, P, A
Signal Generator	Output Level: -5 to -20 dBm at 240 MHz	HP 8640B	A
Signature Analyzer	Because the signatures documented are unique to a given signature analyzer, no substitution is recommended.	HP 5004A	T
Spectrum Analyzer	Frequency Range: 20 Hz to 300 kHz Frequency Span/Division: 20 Hz minimum Noise Sidebands: > 90 dB below CW signal, 3 kHz offset, 100 Hz IF bandwidth Input Level Range: -10 to -60 dBm Log Reference Control: 70 dB dynamic range in 10 dB steps Accuracy: ± 0.2 dB	HP 8556A/ 8552B/141T	P

Table 1-3. Recommended Test Equipment (4 of 4)

Instrument	Critical Specifications	Recommended Model	Use*
Spectrum Analyzer	Frequency Range: 5 Hz to 40 kHz Resolution Bandwidth: 3 Hz minimum Frequency Span/Division: 50 Hz to 500 MHz Amplitude Range: 0 to −70 dB	HP 3580A	P
Spectrum Analyzer System	Frequency Range: 2 to 26 GHz Frequency Span/Division: 1 kHz minimum Amplitude Range: 0 to −70 dB Noise Sideband: > 75 dB down 30 kHz from signal at 1 kHz resolution bandwidth	HP 8569B/ 11517A Option E80 (Note: The HP 11517 Option E80 comprises an external mixer, adapters, waveguide taper section, and necessary cables.)	P, A
Support Kit	Required for servicing and troubleshooting. Includes test cassette with automated adjustment programs.	HP 11726A	A, T
Sweep Oscillator	Center Frequency: 150 to 200 MHz Center Frequency Resolution: 0.1 MHz Sweep Range: 10 and 200 MHz	HP 86222B/ 8620C	A
Termination 50Ω	50Ω BNC	HP 11593A	P, A
Test Oscillator	Level: 0 to 3V into 50Ω or 600Ω Range: 10 kHz to 1 MHz	HP 654A	C, P

* C = Operator's Check, P = Performance Tests, A = Adjustments, T = Troubleshooting

[1] The HP 8903A is recommended for the combined use as an analyzer and audio source. A separate audio analyzer and an audio source can be used if critical specifications are met.

[2] RHG Electronics Laboratory, Inc., 161 East Industry Court, Deer Park, NY 11729, Tel. (516) 242-1100, TWX 510-227-6083.

[3] California Instruments, 5150 Convoy Street, San Diego, CA 92111, Tel. (714) 279-8620.

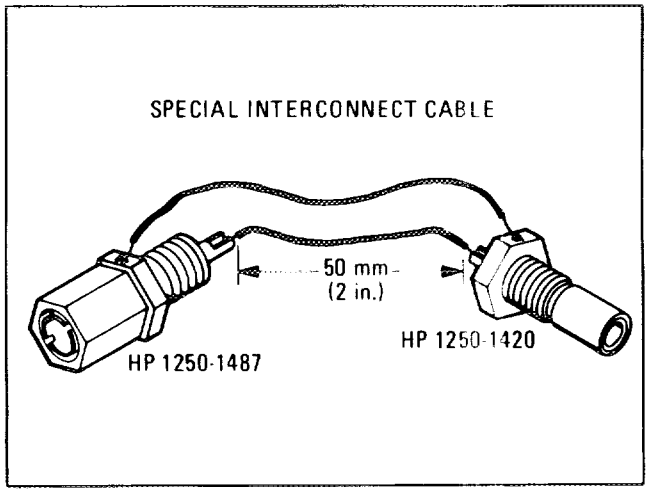


Figure 1-2. Special Interconnect Cable

SECTION II
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 selection, power cables, interconnection, environment, instrument mounting, storage and shipment.

2-2. INITIAL INSPECTION

WARNING

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

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. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. 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

2-4. Power Requirements

The Signal Generator requires a power source of 100, 120, 220 or 240 Vac, +5% to −10%, 48 to 66 Hz single phase (for Option 003 instruments, 400 Hz single phase and 120 Vac, +5%, −10% only). Power consumption is 400 V·A maximum.

WARNINGS

This is a Safety Class I product (that is, provided with a protective earth terminal). 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. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an external autotransformer, make sure the autotransformer's common terminal is connected to the neutral (that is, the grounded side of the mains supply).

2-5. Line Voltage and Fuse Selection

CAUTION

BEFORE PLUGGING THIS INSTRUMENT into the mains (line) voltage, be sure the correct voltage and fuse have been selected.

Verify that the line voltage selection card and the fuse are matched to the power source. Refer to Figure 2-1, Line Voltage and Fuse Selection.

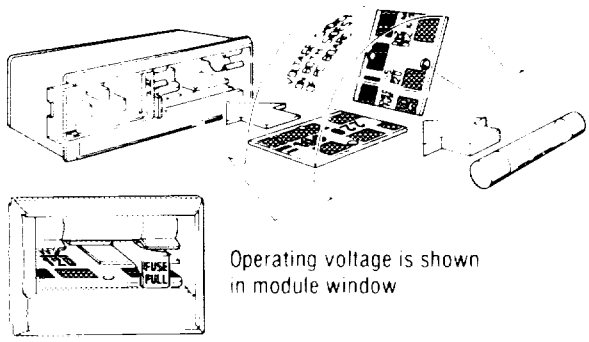
Fuses may be ordered under HP part numbers 2110-0055, 4.0A (250V) for 100/120 Vac operation and 2110-0002, 2.0A (250V) for 220/240 Vac operation.

2-6. Power Cables

WARNING

BEFORE CONNECTING THIS INSTRUMENT, the protective earth terminal of this 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).

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument



SELECTION OF OPERATING VOLTAGE

1. Open cover door, pull the FUSE PULL lever and rotate to left. Remove the fuse.
2. Remove the Line Voltage Selection Card. Position the card so the line voltage appears at top-left corner. Push the card firmly into the slot.
3. Rotate the FUSE PULL lever to its normal position. Insert a fuse of the correct value in the holder. Close the cover door.

WARNING

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz (leakage currents at these line settings may exceed 3.5 mA).

Figure 2-1. Line Voltage and Fuse Selection

This instrument is equipped with two three-wire power cables. When connected to an appropriate ac power receptacle, these cables ground the instrument cabinet. The power cable plugs shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of power cables available.

2-7. HP-IB Address Selection

In the Signal Generator, the HP-IB talk and listen addresses can be selected by an internal switch or by a front panel setting. Refer to Table 2-1 for a listing of talk and listen addresses. The address is factory set for a Talk address of "S" and a Listen address of "3". (In binary this is 10011; in decimal this is 19.)

Front Panel HP-IB Address Setting. To set the Signal Generator's HP-IB address set from the front panel, the FRONT PNL ENABLE switch on the HP-IB address switch must be set to "1". To change the address from the front panel, key in the desired address, press the STO key, then press the LOCAL key. Refer to Remote Operation, HP-IB, in Section III for additional information.

Internal Switch Setting. To change the internal HP-IB address switch, proceed as follows:

WARNINGS

Internal switch settings should be changed only by service trained persons who are

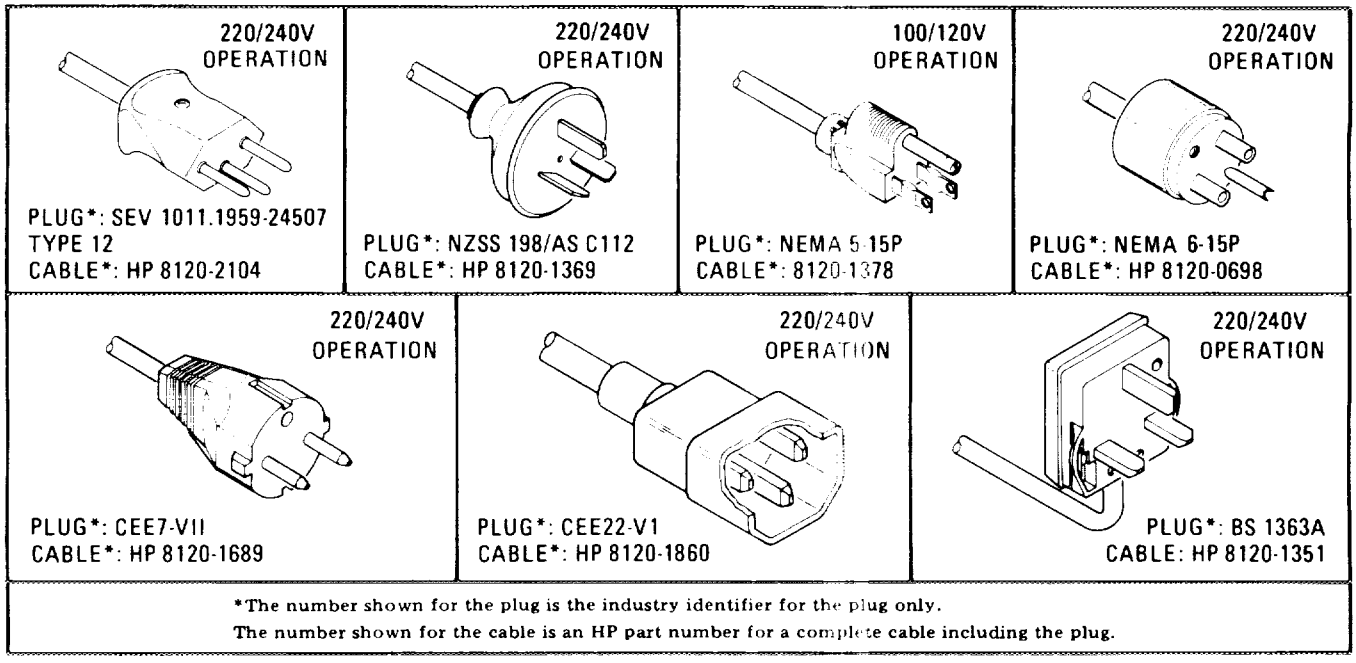


Figure 2-2. Power Cable and Mains Plug Part Numbers

HP-IB Table 2-1. Allowable HP-IB Address Codes

Address Switches					Talk Address Character	Listen Address Character	Decimal Equivalent
MSB				LSB			
0	0	0	0	0	@	SP	0
0	0	0	0	1	A	!	1
0	0	0	1	0	B	"	2
0	0	0	1	1	C	#	3
0	0	1	0	0	D	$	4
0	0	1	0	1	E	%	5
0	0	1	1	0	F	&	6
0	0	1	1	1	G	'	7
0	1	0	0	0	H	(	8
0	1	0	0	1	I	)	9
0	1	0	1	0	J	*	10
0	1	0	1	1	K	+	11
0	1	1	0	0	L	,	12
0	1	1	0	1	M	-	13
0	1	1	1	0	N	.	14
0	1	1	1	1	O	/	15
1	0	0	0	0	P	0	16
1	0	0	0	1	Q	1	17
1	0	0	1	0	R	2	18
1	0	0	1	1	S	3	19
1	0	1	0	0	T	4	20
1	0	1	0	1	U	5	21
1	0	1	1	0	V	6	22
1	0	1	1	1	W	7	23
1	1	0	0	0	X	8	24
1	1	0	0	1	Y	9	25
1	1	0	1	0	Z	:	26
1	1	0	1	1	[	;	27
1	1	1	0	0	Y	<	28
1	1	1	0	1	]	=	29
1	1	1	1	0	^	>	30

HP-IB Address Selection (cont'd)

WARNINGS (cont'd)

aware of the potential shock hazard of working on an instrument with protective covers moved.

To avoid hazardous electrical shock, the line (mains) power cables should be disconnected before attempting to change the internal HP-IB address switch settings.

a. Set the LINE switch to STBY. Disconnect the line power cable.

b. Remove the Signal Generator's top cover by removing the two plastic feet from the rear of the top cover and loosening the screw at the middle of the rear edge of the top cover.

c. Remove the A2 Assembly's protective cover.

d. Remove the A2A9 Freq Output HP-IB Assembly. This assembly can be recognized as having one black and one white printed circuit board extractor.

e. Set the switches to the desired HP-IB address (in binary) and the Talk Only or Listen Only condition. The switch is illustrated in Figure 2-3. If both the Talk Only and the Listen Only switches are set to "1", the Talk Only setting overrides the Listen Only setting.

f. Reinstall the A2A9 Assembly.

g. To confirm the setting, press and hold the LOCAL/DISPLAY ADDRESS key on the front panel. The current HP-IB address will be displayed in decimal in the FREQUENCY MHz display.

h. Replace the A2 Assembly's internal cover and the Signal Generator's top cover.

i. Connect the line (mains) power cables to the Line Power Module and set the LINE switch to ON.

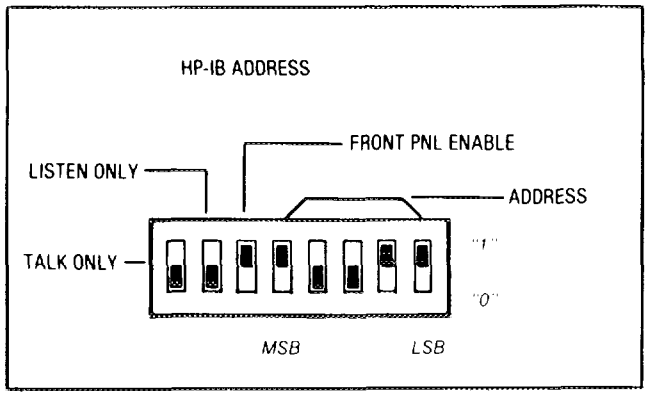


Figure 2-3. HP-IB Address Switch Shown as Set by the Factory

2-8. Interconnections

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

2-9. Mating Connectors

HP-IB Interface Connector. The HP-IB mating connector is shown in Figure 2-4.

AUX Interface Connector. The rear panel AUX control connector requires a male 14-pin Micro-

Mating Connectors (cont'd)
Ribbon (57 Series) connector. The HP part number is 1251-0142. This connector is also available from Amphenol (Oak Brook, Illinois 60521). Interconnection data for the rear panel AUX control connector is provided in Figure 2-5.

Coaxial Connectors. Coaxial mating connectors used with the Signal Generator should be 50Ω APC 3.5 female connectors.

2-10. Operating Environment

The operating environment should be within the following limitations:

Temperature	0 to +55°C
Humidity	<95% relative
Altitude	<4570 metres (15 000 feet)

2-11. Bench Operation

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

2-12. Rack Mounting

WARNING

The Signal Generator weighs 29 kg (64 lbs), 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 the kits were not ordered with the instrument as options, they may be ordered through the nearest Hewlett-Packard office. Refer to the paragraph entitled Mechanical Options in Section I.

2-13. STORAGE AND SHIPMENT

2-14. Environment

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

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

2-15. Packaging

Tagging for Service. If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the back of this manual and attach it to the instrument.

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. 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 re-packaging with commercially available materials:

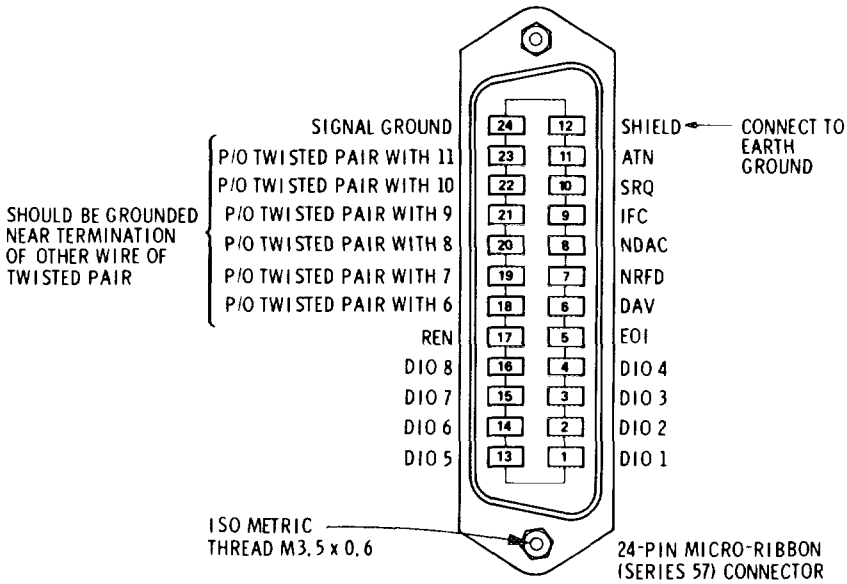
a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, complete one of the blue tags mentioned above and attach it to the instrument.)

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 mm layer; 3 to 4 inches) around all sides of the instrument to provide firm cushion and 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.



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 +5.0 Vdc.

Programming and Output Data Format

Refer to Section III, Operation.

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

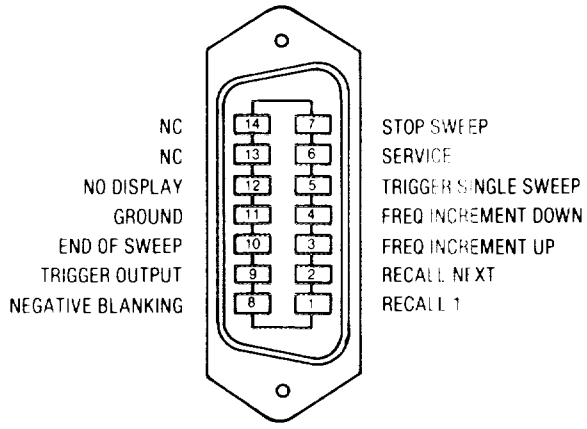
HP 10833A, 1 metre (3.3 ft), HP 10833B, 2 metres (6.6 ft)
HP 10833C 4 metres (13.2 ft), HP 10833D, 0.5 metres (1.6 ft)

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 20.0 metres (65.6 ft).

Figure 2-4. Hewlett-Packard Interface Bus Connection



14-Pin Micro-Ribbon (57 Series) Connector

Logic Levels

The rear panel AUX connector logic levels are TTL compatible (5 microseconds negative-true TTL pulse or a contact closure to ground).

Internal Jumper Selection

If the signals to the rear panel AUX connector require contact debouncing (e.g., for mechanical switches), an internal jumper must be changed. The jumper is installed at the factory for electronically clean input signals (i.e., those signals that do not require the use of the debounce circuit). The jumper is located on the A2A2 Key-Code board. To change the jumper position, the top cover of the Signal Generator must be removed.

WARNINGS

This task should be performed by service trained persons who are aware of the potential shock hazard of working on an instrument with protective covers removed.

To avoid hazardous electrical shock, the line (mains) power cable should be disconnected before removing the Signal Generator's cover.

The following procedure describes how to locate and change the jumper position.

a. Set the LINE switch to STBY and disconnect the line power cable.

b. Remove the Signal Generator's top cover by removing the two plastic feet from the rear of the top cover and loosening the screw at the middle of the rear edge of the top cover.

c. Remove the A2A2 Key-Code board by gently lifting the board's extractors (the extractors are color-keyed red and black).

d. The jumper is located on the center of the board.

e. To enable the debounce circuit remove the jumper from W2 and reinstall the jumper at W1.

f. Reinstall the A2A2 Key-Code board and the Signal Generator's top cover.

Figure 2-5. AUX Interface Connector

SIMPLIFIED OPERATION

PRESETTING FRONT PANEL

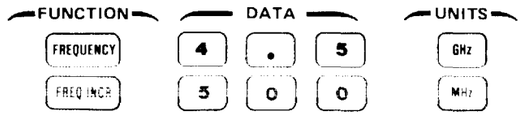
Press [RCL] [0] to set the front panel to the following conditions:

RF OUTPUT to ON
ALC INTERNAL to ON
RANGE to −70 dBm (except Options 001 and 005)
RANGE to 0 dBm (for Options 001 and 005 only)
AUTO PEAK to ON
Meter Scale to LVL
AM, FM, and PULSE Modulation to OFF
FREQUENCY to 3000.000 MHz
FREQ INCR to 1.000 MHz
START to 2000.000 MHz
STOP to 4000.000 MHz
ΔF to 2000.000 MHz
MKRS to OFF (initialized to 3, 6, 9, 12, and 15 GHz)
SWEEP MODE to OFF
STEP to 100 steps (20.000 MHz)
DWELL to 20 ms
TUNE Knob to ON

FREQUENCY

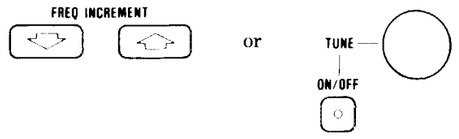
Frequency and frequency increment values are set in a Function-Data-Units format.

For example, to set frequency to 4.5 GHz and frequency increment to 500 MHz:



Frequencies may be entered in GHz, MHz, or kHz, but are always displayed in MHz.

To change the current frequency by the selected increment value, use:



SETTING OUTPUT LEVEL

The output level is set with the RANGE and VERNIER controls.

First press RANGE ⇩ ⇧ to step the output level down or up by increments of 10 dB. The selected range is shown in the RANGE dBm display.

Then, press MTR LVL to select OUTPUT LEVEL VERNIER to be displayed on the meter. Adjust VERNIER between −10 and +3 dB, as read on the meter.

The output level is determined by adding the meter display to the RANGE dBm display.

To maintain output power at a constant level press ALC INTERNAL.

Press AUTO PEAK to maximize power at the output frequency, to minimize power of spurious signals and to optimize pulse shape for pulse modulation.

STORE/RECALL

Up to nine front panel settings can be stored for later use. All Signal Generator front panel functions can be stored, although OUTPUT LEVEL VERNIER is stored in remote mode only.

[STO] [3] stores a front panel setting in register 3.

[RCL] [4] recalls a front panel setting stored in register 4 and changes the output of the Signal Generator to the recalled parameters.

MODULATION

Three types of modulation are available: amplitude (AM), frequency (FM), and pulse. Each type requires an external drive signal. Front panel keys select the maximum percent of AM, FM deviation in MHz, and normal (NORM) or complement (COMPL) pulse mode. For AM and FM, a 1 Vpk signal develops full scale modulation. Modulation varies linearly with the input signal. For pulse modulation, a TTL level positive-true pulse turns RF on in normal mode. A TTL level negative-true pulse turns RF on in complement mode.

MESSAGES

Entry errors, hardware malfunctions, and other significant conditions are indicated by the lighted MESSAGE key.

Press MESSAGE to read the two-digit code in the FREQUENCY MHz display. The codes are explained in Table 3-8 and on the operating information pull-out card.

FRONT PANEL FEATURES

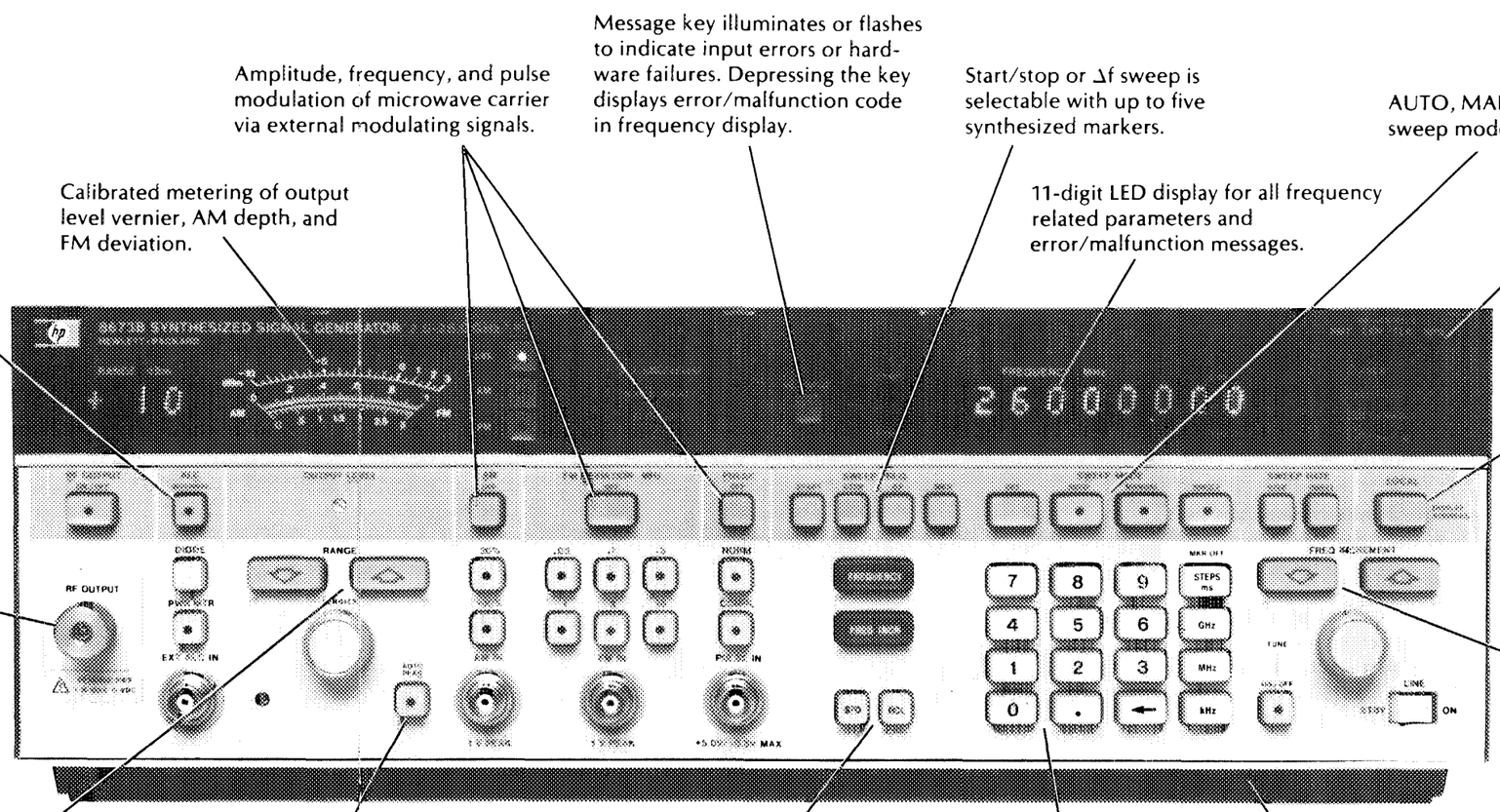


Figure 3-1. Front Panel Features

-5. Operator's Checks

perator's Checks are procedures designed to verify the proper operation of ıe Signal Generator's main functions. Two procedures are provided as escribed below.

asic Functional Checks. This procedure requires a function generator, a ıicrowave frequency counter, a power meter, a power sensor, a crystal etector, and interconnecting cables. It assures that most front panel con-'olled functions are being properly executed by the Signal Generator.

P-IB Functional Checks. These procedures require an HP-IB compatible ɔmputing controller, an HP-IB interface, and connecting cable. The proce-ures check all of the applicable bus messages summarized in Table 3-4. The IP-IB Checks assume that front panel operation has been verified by erforming the Basic Functional Checks.

-6. Operator's Maintenance

WARNING

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

Operator's maintenance consists of replacing defective fuses and adjusting ne mechanical zero of the front panel meter.

The primary power fuse is located within the Line Power Module Assembly. Refer to Figure 2-1 for instructions on how to change the fuse.

To mechanically zero the front panel meter, set the LINE switch to the STBY position and place the Signal Generator in its normal operating position. Turn the mechanical zeroing adjustment clockwise to move the needle up scale or counterclockwise to move the needle down scale. The zero point is located at the left end of the 0—1 or the 0—3 scales. DO NOT zero on the left end of the top dB scale at -10 because this is not the proper zeroing point.

If the instrument does not operate properly and is being returned to Hewlett-Packard for service, please complete one of the blue tags located at the end of this manual and attach it to the instrument. Refer to Section II for packag-ng instructions.

SWEEP

Values for SWEEP FREQ (START, STOP, ΔF, and MKR) and SWEEP RATE (STEP and DWELL) are entered in a Function-Data-Units format.

SWEEP FREQ

The SWEEP FREQ keys set the span of the sweep (that is, the range that the sweep covers). The sweep span can be set with either the START and STOP keys or with the FREQUENCY and ΔF keys.

For example, to set a sweep span of 4 GHz with a start frequency of 2 GHz and a stop frequency of 6 GHz press:

FUNCTION	DATA	UNITS		FUNCTION	DATA	UNITS
START	2	GHz	or	FREQUENCY	4	GHz
STOP	6	GHz		ΔF	4	GHz

SWEEP RATE

During a sweep, the Signal Generator changes frequency in discrete steps. Sweep rate is determined by the number of steps and the dwell time. The number of steps can be set in either of two ways.

To set the number of steps to be used in a sweep press STEP, use the numeric keys to enter the number of steps, then press STEPS ms.

The sweep span is divided by the number of steps to determine the step size.

To set the step size, press STEP, use the numeric keys to enter the frequency of the step, then press GHz or MHz or kHz.

The sweep span is divided by the step size to determine the number of steps.

The dwell time determines how much time elapses before the next frequency step is taken.

To set the dwell time press DWELL, use the numeric keys to enter the time in milliseconds, then press STEPS ms.

SWEEP MODE

To start a sweep press:

AUTO ○ selects a repetitive sweep. If band crossings are required it will perform a single sweep indicated by message 16, and continuous Flashing Auto key annunciator light.

MANUAL ○ for a sweep that is controlled by the TUNE knob or the FREQ INCREMENT Up and Down keys.

SINGLE ○ for one sweep only. Press this key once to tune the Signal Generator to the start frequency. Then, press this key again to actually initiate the sweep.

To stop a sweep, in any mode, press OFF.

3-7. TURN-ON INSTRUCTIONS

WARNINGS

Before the instrument 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.

Only 250V normal blow fuses with the required rated current should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

CAUTIONS

Before the instrument is switched on, it must be set to the voltage of the power source or damage to the instrument may result.

The Signal Generator's RF OUTPUT is protected against reverse power applications up to 1W. However, for greatest protection of expensive internal components, be careful not to apply any reverse power to the RF OUTPUT.

3-8. Turn-On

Turn-On Procedure. The Signal Generator has a standby state and an on state. Whenever the power cable is plugged in, an oven is energized to keep the reference oscillator at a stable operating temperature. If the Signal Generator is already plugged in, set the LINE switch to ON.

If the power cable is not plugged in, follow these instructions.

On the rear panel:

1. Check the line voltage switch for correct voltage selection.
2. Check that the fuse rating is appropriate for the line voltage used (see Figure 2-1). Fuse ratings are printed on the rear panel.
3. Plug in the power cable.

On the front panel, set the LINE switch to ON.

NOTE

The OVEN COLD status annunciator should light to indicate that the Signal Generator requires warming up. The annunciator should turn off within five minutes and the Signal Generator should be ready for general use.

Turn-On Configuration. The Signal Generator turns on to the same control settings it had before it was switched to STBY or even completely off (that is, if line power was removed). The exception to this rule is that it always turns on in local mode.

Turn-On Memory Check. The Signal Generator performs a quick memory check at turn-on. It checks for a failure in ROM (permanent memory) or in RAM (temporary memory), and for the presence of correct data stored in RAM.

NOTE

An internal battery is used to retain data in RAM during standby and off periods. The data restores the last control setup and the nine storage registers.

If a ROM or serious RAM failure occurs, the Signal Generator will attempt to turn on to its last control setup. The Signal Generator might be useable but does require service.

If any, but not all, of the stored data is found to be incorrect, the Signal Generator will turn on to the configuration stored in the first good register. This control setup will then be stored in registers 1 through 9. Incorrect stored data could be caused by even a single bit of data being lost due to line transients, noise or other unpredictable conditions. The Signal Generator should be useable and does not require service unless this situation occurs repeatedly.

If all of the register data has been altered (for example, if the battery failed) the Signal Generator will reinitialize to the front panel preset values stored in register 0 (refer to Simplified Operation for a list of preset values). The initialized control setup will then be stored in all of the registers. The Signal Generator might be useable but does require service.

3-9. Frequency Standard Selection

A FREQ STANDARD INT/EXT switch and two connectors are located on the rear panel. A jumper

Frequency Standard Selection (cont'd)

normally connects the FREQ STANDARD INT connector (A3J9) to the FREQ STANDARD EXT connector (A3J10). The FREQ STANDARD EXT connector can accept a reference signal to be used instead of the Signal Generator's internal frequency standards.

The internal frequency standard is a 10.000 MHz signal at +7 dBm (nominal) with an aging rate of $<5 \times 10^{-10}$/day after warmup (typically 24 hours). When the FREQ STANDARD INT/EXT switch is in the INT position and the jumper is connected between A3J9 and A3J10, the internal reference is enabled.

When the FREQ STANDARD INT/EXT switch is in the EXT position and the jumper is disconnected from the FREQ STANDARD EXT connector, a frequency standard of 5 or 10 MHz at 0 dBm (nominal) can be connected.

NOTE

The EXTERNAL REF status annunciator on the front panel will light when an external reference is being used. Also, the NOT ϕ LOCKED status annunciator may light if the external reference is not of sufficient accuracy in frequency or has an insufficient power level. The external reference must be within ±200 Hz of 10 MHz or ±100 Hz of 5 MHz for reliable locking to occur. If the external reference level is not within the specified limits (0.1 to 1 Vrms into 50 ohms), its level may be sufficient to turn off the NOT ϕ LOCKED status annunciator. However, the phase noise of the Signal Generator may be degraded.

Table 3-2. Index of Detailed Operating Instructions

This table is reserved for the final manual.

3-10. ADDITIONAL OPERATING INFORMATION

Performance, from the Signal Generator, can be maximized and optimized by considering the effect of the following controls on the RF output:

a. AUTO PEAK
b. ALC
c. PULSE Modulation Mode
d. SWEEP Mode in a Master/Slave configuration
e. SWEEP Mode (Option 008 only)

3-11. AUTO PEAK

Major power and pulse modulation specifications cannot be met unless AUTO PEAK feature is on. Auto Peak, when activated, guarantees that maximum specified power is available at the RF output connector. Unless AUTO PEAK is turned off, it is automatically on whenever the instrument LINE switch is pressed ON. Selecting PULSE MODE also turns on AUTO PEAK. In this mode of operation, changes in frequency of 50 MHz or more result in the instrument re-peaking the output power level. At any one frequency, when the VERNIER is used to change the output power level by more than ≥0.4 dB, a "scratch pad" memory records and stores every 0.4 dB point crossing for the VERNIER's entire range. Subsequent changes in RF output power level, for the frequency setting, will be automatically peaked.

3-12. ALC (Automatic Level Control)

Output power leveling for the instrument's frequency range occurs from three sources selected by the operator. These sources are:

a. INTERNAL
b. DIODE
c. PWR MTR (Power Meter)

INTERNAL. RF power output from the signal generator is automatically leveled.

DIODE. RF output power is leveled externally using a diode detector connected to the instrument's EXT ALC IN connector.

PWR MTR (Power Meter). RF output power is leveled externally using a power meter connected to the instrument EXT ALC IN connector.

CAL Adjustment. Power level at the load is adjusted to agree with the OUTPUT LEVEL Meter when external leveling is used in DIODE or PWR MTR. External leveling techniques are discussed in Hewlett-Packard Application Note 281-5 Microwave Synthesizer Series, May 1981, HP Part Number 5952-8251. Application Note 218-5 specifically applies to the 8672A; however, the main principles of applications also apply to the 8673B. Additionally, the input voltage fed back to the 8673B EXT ALC IN connector should be within a −1V to +1V range. Polarity is of no consequence because an internal circuit in the 8673B performs an absolute value function on the input voltage.

3-13. PULSE Modulation

Guaranteed pulse modulation characteristics and power specifications are met only when Auto Peak is on. Load variations, such as an external attenuator setting change cause reflections that slightly change the RF power output. AUTO PEAK must then be recycled (Off-On) to ensure peaked power output. With a change in output power level of ≥0.4 dB the instrument microprocessor switches to CW for about 200 μsecs. During this time period the injected pulse amplitude is updated. Pulse mode is then re-enabled and the injected pulse amplitude is the correct value to produce fast risetime pulses. Switching speed is slowed to about 100 nsec by this process. The "scratch pad memory", described in paragraph 3-11, again may be used to record and store every 0.4 dB point crossing for the particular frequency in-use.

3-14. SWEEP Mode in MASTER/SLAVE Configuration

In a Master Slave configuration, two signal generators are interconnected to obtain two swept microwave signals, at a fixed offset from each other. The two instruments are interconnected through the Hewlett-Packard Interface Bus (HP-IB). The MASTER is set to HP-IB address 50 and the SLAVE unit is set to HP-IB address 40. The desired sweep start and stop frequencies are set to identical frequencies on both the master and slave instruments. Desired offsets are then entered on the slave unit using the FREQ INCREMENT control. Swept signals from the instruments will be offset by the FREQ INCREMENT value.

In each sweep mode of operation, the designated Slave Unit will have the MAN and SINGLE pushbutton lamps lit. The designated Master Unit will have only the selectd mode pushbutton lamp lit. A step-by-step example follows:

a. Interconnect two instruments for HP-IB. Designate one instrument as the Master Unit and set its HP-IB Address to 50. Designate the other instrument as the Slave Unit and set its HP-IB Address to 40.

b. On both units, set SWEEP START to 2000 MHz and SWEEP STOP to 12000 MHz. On the Slave Unit set either the number of steps or step size. (As one example: set both master and slave units for 500 steps.)

c. On the Slave Unit select a 50 MHz offset using the FREQ INCR, STEP and the FREQ INCREMENT (◆) or (◆).

d. Press and hold SWEEP START on the Slave Unit and check for a 50 MHz offset (Display should read 12050 MHz).

e. For AUTO Mode: Press AUTO on Master Unit; Slave Unit will have MAN and SINGLE pushbutton lamps lit.

f. For MANUAL Mode: Press MAN on Master Unit; Slave Unit will have MAN and SINGLE pushbutton lamps lit. On Master Unit enable TUNE ON/OFF. Use the TUNE Knob to tune both Master and Slave Units according to STEP SIZE set on respective units.

g. For SINGLE Mode: On Master Unit, press SINGLE once to enable the sweep. Press it a second time to start one sweep. If SINGLE is pressed during a sweep, the in-progress sweep stops and re-enables.

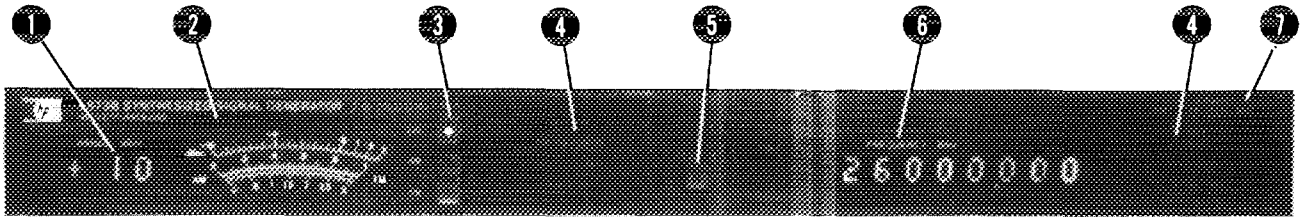
Disabling Master/Slave Mode. Press SWEEP OFF on both Master and Slave Units. All sweep lamps will be off and only the Master Unit TUNE Knob will cause changes on the Master Unit Display.

SWEEP mode (Option 008 only).

Option 008 adds a power amplifier which operates from 16 GHz to 26 GHz for increased output power. This power amp is switched out below 16 GHz and switched in ≥16 000.002 MHz.

If an AUTO Sweep is initiated which has 16 GHz between the start and stop frequencies, only one, single sweep, will be executed. The sweep will then be halted at the stop frequency. This frequency will be displayed in the frequency display and the AUTO Sweep key LED will flash continuously. The message key will also light indicating error 16.

This feature prevents excessive wear during sweep modes, on the microwave relays which switch in the power amplifier.



1 RANGE dBm Display. Indicates the selected range of the RF output in 10 dB steps from −90 to +10 dBm. Range is set by the RANGE (◀ and ▶) keys.

2 Meter. Monitors power level, AM depth, or FM deviation. Meter function is selected by the MTR keys.

3 MTR Keys. Select the meter function.

LVL: selects OUTPUT LEVEL VERNIER for −10 to +3 dB scale indication. Read relative to the RANGE dBm display.

AM: selects 30% (read on the 0 to 3 scale) or 100% (read on the 0 to 1 scale) AM depth, full scale. A 1 volt peak signal applied to the AM IN connector develops full scale modulation.

FM: selects FM deviation. Full scale indication read on the 0 to 3 scale is 30 kHz, 300 kHz, or 3 MHz. Full scale indication read on the 0 to 1 scale is 100 kHz, 1 MHz, or 10 MHz. A 1 volt peak signal applied to the FM IN connector develops full scale modulation.

4 Status Annunciators. Display the internal conditions of the Signal Generator.

ALC UNLEVELED: lights when RF OUTPUT is turned off, more power is requested than is available, no signal is applied to EXT ALC IN when PWR MTR or DIODE is selected, no signal is applied to PULSE IN when NORM pulse mode is selected, overmodulation occurs in AM mode, or pulse width is less than 100 ns.

NOT ϕ LOCKED: lights when one or more of the phase lock loops is unlocked, the RF OUTPUT is OFF, or the INT-EXT switch is in the EXT position with no external reference connected.

FM OVERMOD: lights when the signal applied to the FM IN connector exceeds 1 volt peak or when the modulation index exceeds 5 (2.0 to 6.6 GHz), 10 (6.6 to 12.3 GHz), 15 (12.3 to 18.6 GHz), or 20 (18.6 to 26.0 GHz). The modulation index is equal to the maximum peak deviation divided by f_{mod}. Refer to Table 1-1, Specifications, for additional information.

STANDBY: lights when power is applied but the LINE switch is in the STBY position.

OVEN COLD: lights when the crystal oven is not up to nominal operating temperature.

OUT OF RANGE: lights only in sweep mode when a combination of ΔF and FREQUENCY would cause the sweep frequency to be out of range.

EXTERNAL REF: lights when the rear panel INT-EXT switch is in the EXT position.

5 MESSAGE Key. Lights to indicate entry errors and flashes to indicate hardware malfunctions. A two-digit code appears in the FREQUENCY MHz display when this key is pressed. Refer to the pull-out card or the Messages Detailed Operating Instruction for an explanation of the codes.

6 FREQUENCY MHz Display. Normally indicates output frequency. Message codes and previously set values for FREQ INCR, SWEEP FREQ, and SWEEP RATE functions are displayed for as long as their respective keys are pressed.

7 HP-IB STATUS Annunciators. Indicate the status of the Signal Generator when it is operating via the HP-IB.

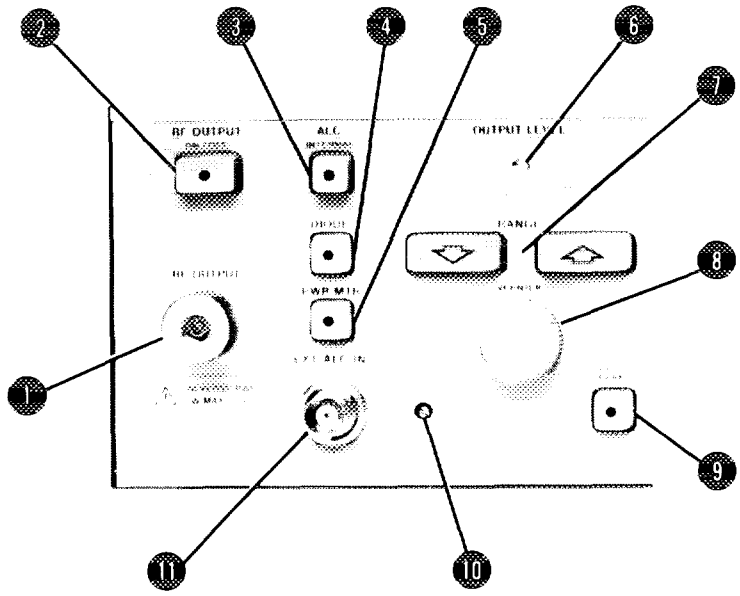
RMT: lights when the Signal Generator is in remote mode.

LSN: lights when the Signal Generator is addressed to listen.

TLK: lights when the Signal Generator is addressed to talk.

SRQ: lights when the Signal Generator is issuing the Require Service message.

Figure 3-2. Displays and Status Annunciators



1 RF OUTPUT Connector. 50 ohm APC 3.5 male connector supplies RF output over the entire frequency range of 2 to 26 GHz.

2 RF OUTPUT ON/OFF Key. Completely turns off the RF output when set to OFF. Setting the RF output to OFF causes the NOT ϕ LOCKED and ALC UNLEVELED status annunciators to light. When the RF OUTPUT is set to ON, the Signal Generator returns to normal operation.

3 INTERNAL Key. Selects internal circuitry for leveling the output power at the front panel RF OUTPUT connector.

4 DIODE Key. Selects external leveling mode for leveling power using an external diode detector. The output of the diode is connected to the EXT ALC IN connector.

5 PWR MTR Key. Selects external leveling mode for leveling power using an external power meter. The output of the power meter is connected to the EXT ALC IN connector.

6 Mechanical Meter Zero. Sets meter suspension so that the meter indicates zero when power is removed from the Signal Generator and the Signal Generator is in its normal operating position.

7 OUTPUT LEVEL RANGE Keys [▽ and △]. Select the RF output level range in 10 dB steps from −90 to +10 dBm. The selected range is displayed in the RANGE dBm display.

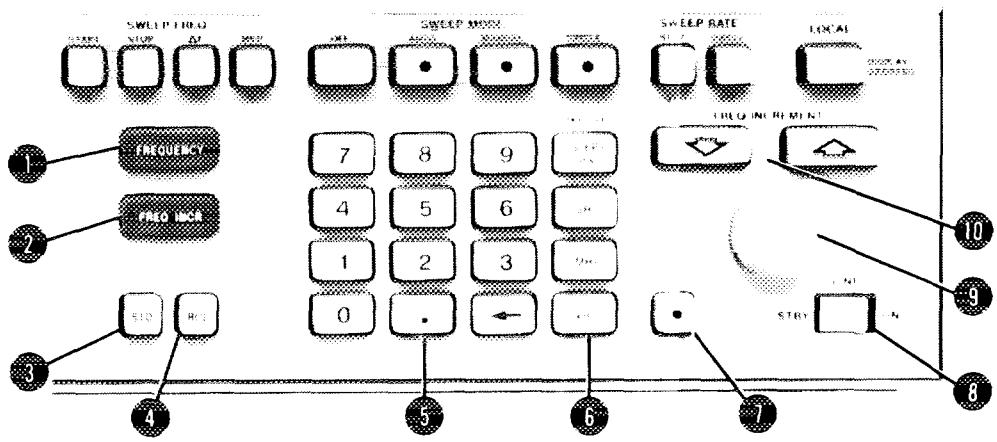
8 OUTPUT LEVEL VERNIER. Adjusts the RF output level over the range of −10 to +3 dB, relative the LVL scale as read on the meter.

9 AUTO PEAK Key. Maximizes power at the output frequency and optimizes pulse shape for pulse modulation.

10 CAL Control. Adjusts the power level at the load when using a diode detector or power meter for external leveling.

11 EXT ALC IN Connector. BNC female connector with high input impedance (approximately 50 kΩ). Accepts positive or negative leveling signals from either a diode detector or power meter.

Figure 3-3. Output Level Features



1 FREQUENCY Key. Used as a prefix to the Data and Units keys to set a continuous wave (CW) frequency or center frequency for a ΔF sweep.

2 FREQ INCR Key. Used as a prefix to the Data and Units keys to set the step size for the FREQ INCREMENT ▼ and ▲ keys or the TUNE knob. Pressing the FREQ INCR key recalls the current increment value to the FREQUENCY MHz display (for as long as the key is depressed).

3 STO Key. Used as a prefix to a numeric key (a single digit 1—9 to identify the storage register) to save the current instrument settings in an internal storage register. All front panel functions can be stored, although OUTPUT LEVEL VERNIER can be stored only in remote mode.

4 RCL Key. Used as a prefix to a numeric key (a single digit 0—9 to identify the storage register) to recall the contents saved in that register. The instrument settings change to the recalled parameter values.

RCL 0 is used to preset the front panel. Refer to Simplified Operation in this section for a list of preset conditions.

5 Data Keys (0-9, ., and ←). Used with Function keys (that is, FREQUENCY, FREQ INCR, and sweep function keys) and Units keys to set value-selectable parameters. Data keys 1—9 are also used with STO and RCL to identify the storage register.

The backspace key (←) clears one digit at a time starting with the least significant digit. It is used only during data entry and before any Units key is pressed.

6 Units Keys (MKR OFF/STEPS/ms, GHz, MHz, and kHz). Used as a suffix to Function and Data keys to set value-selectable parameters. Frequency entries can terminate in GHz, MHz, or kHz but they are always displayed in MHz.

The MKR OFF/STEPS/ms key serves as a terminator for setting the number of steps in a sweep, the dwell time in ms, or as a means of turning off markers. The selected function automatically determines the applicable terminator.

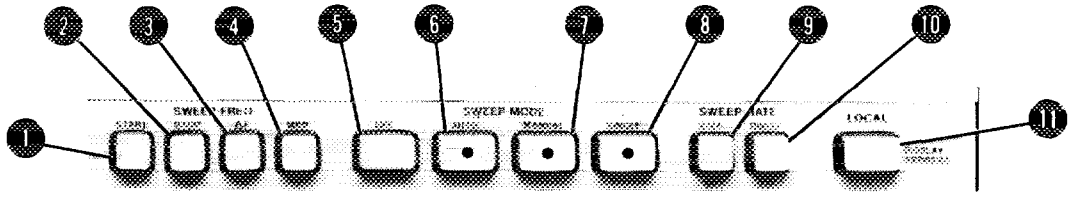
7 TUNE ON/OFF key. Enables the TUNE knob when ON; disables the TUNE knob when OFF. The key LED lights when it is ON.

8 LINE Switch. Applies power to the Signal Generator when set to the ON position. Power is supplied to the crystal oven and the battery charger circuit in the STBY and ON positions.

9 TUNE Knob. Changes the CW frequency by the value set with FREQ INCR. The knob is enabled by the ON/OFF key. The knob also serves as a manual sweep mode control.

10 FREQ INCREMENT ▼ and ▲ Keys. Decrease or increase the CW frequency in steps; the step size is set with the FREQ INCR key. Holding either key down causes the frequency to continuously change. These keys also serve as a manual sweep mode control.

Figure 3-4. Frequency Control Features and LINE Switch



SWEEP FREQ

1 START Key. Used as a prefix to the Data and Units keys to set the beginning frequency of a sweep. Pressing this key displays the present START value in the FREQUENCY MHz display (for as long as the key is depressed).

2 STOP Key. Used as a prefix to the Data and Units keys to set the ending frequency of a sweep. Pressing this key displays the present STOP value in the FREQUENCY MHz display (for as long as the key is depressed).

3 ΔF Key. Used as a prefix to the Data and Units keys to set sweep span. Pressing this key displays the present span value in the FREQUENCY MHz display (for as long as the key is depressed). Center frequency of the span is set with the FREQUENCY key.

4 MKR Key. Enables previously selected marker frequencies when used as a prefix to Data keys 1 through 5. For example, pressing MKR and 1 enables Marker 1. When used as prefix to the Data and Unit keys, it sets marker frequencies. For example, pressing MKR, 3, 15, and GHz sets the frequency of Marker 3 to 15 GHz. (The first digit pressed after the MKR key is always the marker number.) Pressing the MKR key displays all currently enabled marker numbers within the set sweep range in the FREQUENCY MHz display. Pressing the MKR key and a Data key displays the present frequency of the requested marker.

SWEEP MODE

5 OFF Key. Disables the sweep.

6 AUTO Key. Starts a repetitive sweep (restarting at the end of each sweep). Executes single sweep only for Option 008 in some modes. (See Additional Operating Information of this manual.)

7 MANUAL Key. Enables the sweep circuitry. It does not start a sweep. The TUNE knob (if enabled) or the FREQ INCREMENT (◀ and ▶) keys control the sweep.

8 SINGLE Key. Arms the trigger for single sweep and tunes the Signal Generator to the start frequency. The sweep does not begin until the key is pressed again to trigger the sweep. When pressed during a sweep, the in-progress sweep aborts and rearms the trigger.

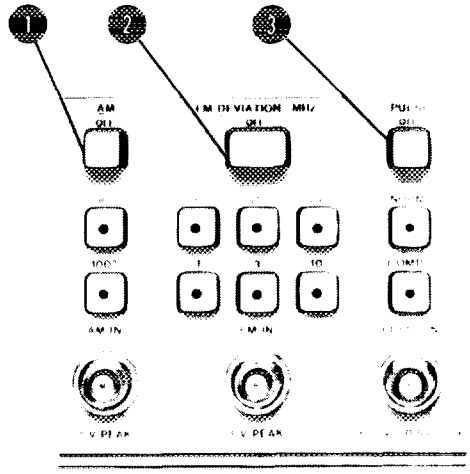
SWEEP RATE

9 STEP Key. Used as a prefix to the Data and Units keys to set the number of steps or the size of each step of a sweep. When the entry is terminated by STEPS, the number of steps is set. When the entry is terminated by GHz, MHz, or kHz, the step size is set. When this key is pressed, the number of steps is displayed on the left side of the FREQUENCY MHz display and the step size is displayed on the right side. The maximum number of steps allowed is 9999.

10 DWELL Key. Used as a prefix to the Data and ms keys to set the time interval between sweep steps. Pressing this key displays the present dwell time value in the FREQUENCY MHz display (for as long as the key is depressed). The allowable values for dwell time range from 1 to 255 ms.

11 LOCAL/DISPLAY ADDRESS Key. Returns the Signal Generator to local keyboard control from HP-IB (remote) control provided the instrument is not in local lockout. Also displays the current HP-IB address in the FREQUENCY MHz display for as long as the key is depressed.

Figure 3-5. Sweep Features and LOCAL Key



1 AM

AM OFF Key. Disables AM.

AM 30% Key. Enables AM and selects 30% full scale modulation for 1 volt peak applied to the AM IN connector.

AM 100% Key. Enables AM and selects 100% full scale modulation for 1 volt peak applied to the AM IN connector.

AM IN Connector. BNC female connector with an input impedance of 600 ohms. 1 volt peak sets full scale modulation as selected by the AM 30% or 100% key. AM depth varies linearly with the input signal level.

2 FM DEVIATION

FM DEVIATION MHz OFF Key. Disables FM.

FM DEVIATION Keys (.03, .1, .3, 1, 3, and 10). Enables FM and selects the peak deviation sensitivity in MHz obtained when a signal is applied to the FM IN connector. The peak deviation is read on the meter.

FM IN Connector. BNC female connector with an input impedance of 50 ohms. 1 volt peak gives full scale modulation. Deviation varies linearly with the input signal level. Deviation ranges are controlled by the FM DEVIATION keys.

3 PULSE

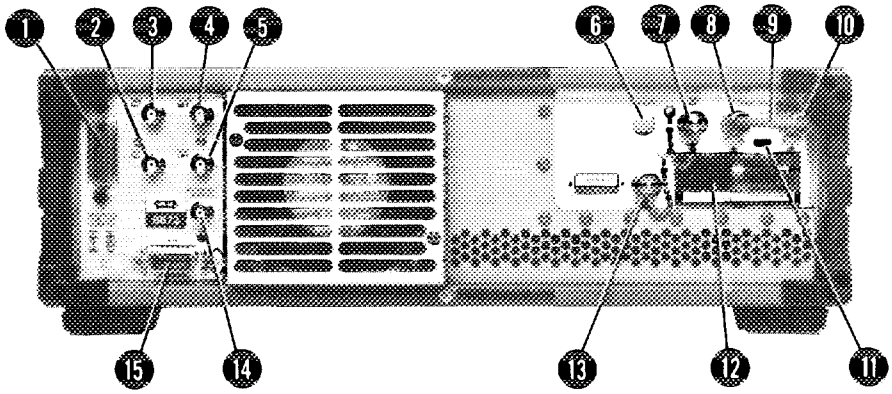
PULSE OFF Key. Disables pulse modulation.

NORM (Normal Mode) Key. Triggers RF output on when the signal to the PULSE IN connector is greater than 2.4 volts.

COMPL (Complement Mode) Key. Triggers RF output on when the signal to the PULSE IN connector is less than 0.4 volts.

PULSE IN Connector. BNC female connector with an input impedance of 50 ohms. Accepts TTL levels.

Figure 3-6. Modulation Features



1. **HP-IB Connector.** Connects the Signal Generator to the Hewlett-Packard Interface Bus for remote operation.

2. **FREQ REF.** BNC female connector. Output impedance is 100Ω nominal. Provides a 1V/GHz ramp (+18V maximum) that is always on, even when sweep is off.

3. **SWP OUT.** BNC female connector. Output impedance is 100Ω nominal. Provides a 0 to +10V ramp from start to stop. An internal adjustment can set the slope of the ramp from 0 to between +4 and +12V.

4. **TONE MKR.** BNC female connector. Output impedance is 600Ω nominal, 5 kHz sine wave. Can be connected to front panel AM IN to provide AM markers.

5. **PEN LIFT.** BNC female connector. TTL-high lifts pen; TTL-low lowers pen. 100 ms delay to lift or lower pen in single sweep mode.

6. **RF OUT (A3J6).** For Options 004 and 005 only. 50Ω APC 3.5 male output connector.

7. **10 MHz OUT (A3J8).** 0 dBm (nominal) into 50Ω, can be used as an external timebase and for troubleshooting.

8. **FREQ STANDARD Output (A3J9).** 10.000 MHz into 50Ω at +7 dBm (nominal) from the internal frequency standard except when INT/EXT switch is in the EXT position.

9. **Jumper (A3W3).** Normally connects the Internal Frequency Standard Output (A3J9) to the External Frequency Standard Input (A3J10).

10. **FREQ STANDARD Input (A3J10).** Normally connected by A3W3 to A3J9. Also used to connect an external frequency standard of 5 or 10 MHz at 0 dBm to the Signal Generator.

11. **FREQ STANDARD INT/EXT Switch.** Normally left in the INT position. Removes power from internal frequency standard when in the EXT position.

12. **Line Power Module.** Permits operation from 100, 120, 220, or 240 Vac. The number visible in the window displays the nominal line (mains) voltage for which the Signal Generator is set (see Figure 2-1). The protective grounding conductor connects to the Signal Generator through this module. The line power fuse is part of this module and is the only part to be changed by the operator.

13. **100 MHz OUT (A3J7).** 0 dBm (nominal) into 50Ω; can be used as an external timebase and for troubleshooting.

14. **BLANKING/MARKER.** BNC female connector. Output impedance is 100Ω nominal. Provides +5V at the beginning of each frequency change for blanking a swept display (to eliminate display of switching transients). Goes to -5V during remainder of frequency step for Z-Axis intensity marker or to 0V for non-marker frequencies.

15. **AUX Connector.** Allows remote control of frequency increment, display blanking, register recall, and start and stop sweep. Refer to Table 3-3, AUX Connector Functions, for additional information.

Figure 3-7. Rear Panel Features

3-15. OPERATOR'S CHECKS

3-16. Basic Functional Checks

DESCRIPTION: The purpose of these checks is to give reasonable assurance that the instrument is operating properly.

Each check has been designed to be performed with a minimum of test equipment, and in as short a time as possible. Therefore, although these checks are extremely valuable in locating malfunctions, they are not a substitute for the Performance Tests in Section IV, which verify that the instrument is performing within its published specifications.

Each check is independent from the others and can be performed separately. Simply press RCL 0 to preset the Signal Generator to a known state before beginning an individual check.

If a malfunction is suspected and the Signal Generator is being returned to Hewlett-Packard for service, perform the entire procedure. Document the checks that failed on a blue repair tag located at the rear of this manual and attach the tag to the instrument. This will help ensure that the malfunction has been accurately described to service technicians for the best possible service.

EQUIPMENT:

Test Oscillator	HP 654A
Pulse Generator	HP 8013B
Oscilloscope	HP 1740A or HP 1715A
Termination, 50-ohm	HP 8493B, Option 010

PROCEDURE:

Turn-On Check

1. Set the LINE switch to STBY. Remove all external cables from the front and rear panels of the Signal Generator, including the power cable connecting the instrument to mains power.
2. Set the rear panel FREQ STANDARD INT EXT switch to INT and the JUMPER (A3W3) to connect A3J9 and A3J10.
3. After the power cable has been disconnected from the Signal Generator for at least 1 minute, reconnect it to the Signal Generator. Check the front panel of the instrument to verify that the STANDBY and OVEN COLD status annunciators are on.
4. Leave the instrument's LINE switch set to STBY until the OVEN COLD status annunciator turns off. This should occur in 15 minutes or less, depending upon how long the Signal Generator was disconnected from mains power. (The OVEN COLD annunciator may flicker off and on temporarily just as the oven stabilization temperature is reached. This is normal operation.) Once the OVEN COLD status annunciator is off set the LINE switch to ON.

NOTES

If the MESSAGE key light is on or flashing, the instrument self-diagnostics detected a malfunction during turn-on. Press and hold the MESSAGE key to display the message code in the FREQUENCY MHz display. Any code other than 00 represents an error. Refer to the operating information pull-out card for a complete listing of message codes and the malfunctions they represent.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

NOTES (cont'd)

Occasionally, due to line transients or other external conditions, the instrument self-diagnostics may indicate a false error. Pressing the MESSAGE key and repeating the turn-on procedure will usually differentiate between real and false errors. Errors that repeat are usually real.

5. Set the FREQ STANDARD INT/EXT switch to EXT. Verify that the EXT REFERENCE and NOT ϕ LOCKED status annunciators turn on. Set the switch back to INT. The status annunciators should then turn off.

6. Press RCL 0. Verify that the instrument is now preset to the following conditions:
   RF OUTPUT to ON
   ALC INTERNAL to ON
   OUTPUT LEVEL RANGE to −70 dBm
   AUTO PEAK to ON
   Meter scale to LVL
   AM, FM, and Pulse Modulation to OFF
   FREQUENCY to 3000.000 MHz
   FREQ INCR to 1.000 MHz
   START to 2000.000 MHz
   STOP to 4000.000 MHz
   ΔF to 2000.000 MHz
   SWEEP to OFF
   STEP to 100 Steps (20.000 MHz)
   DWELL to 20 ms
   TUNE Knob to ON
   All Status Annunciators off
   MESSAGE key light off

Frequency Check:

The FREQUENCY MHz display and NOT ϕ LOCKED status annunciator are used to check that the internal phase-lock loops remain phase locked across their tuning range. The actual frequency at the RF OUTPUT connector is not checked. However, this connector can be monitored with a microwave frequency counter or spectrum analyzer for greater assurance that the Signal Generator is operating properly.

7. Press RCL 0. Then, set the Signal Generator's frequency to 2 GHz and frequency increment to 1 kHz. Slowly tune from 2000.000 MHz to 2000.010 MHz. Verify that the NOT ϕ LOCKED annunciator remains off at each step.

8. Set FREQ INCR to the values shown in the following table. For each FREQ INCR value, slowly tune from the corresponding start frequency to the stop frequency. Each time, verify that the NOT ϕ LOCKED status annunciator remains off. (Each phase-lock loop is tuned over its entire range.)

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

FREQ INCR	Start Frequency	Stop Frequency
10 kHz	2000.010 MHz	2000.100 MHz
100 kHz	2000.100 MHz	2001.000 MHz
1 MHz	2001.000 MHz	2010.000 MHz
10 MHz	2010.000 MHz	2100.000 MHz
100 MHz	2100.000 MHz	3000.000 MHz
1 GHz	3000.000 MHz	26000.000 MHz

9. Set FREQUENCY to 1.95 GHz and then to 26.5 GHz. (This is the overrange region of operation.) Verify that the NOT ϕ LOCKED annunciator remains off at both frequencies.

Output Level Check:

The Signal Generator's output leveling loop is checked to ensure that it remains locked at all specified power levels. The internal output leveling loop monitors most of the RF output circuitry.

10. Press RCL 0 to set the Signal Generator to a known state.

11. Connect a 50-ohm load or 10 dB attenuator to the Signal Generator's RF OUTPUT connector. (This reduces unwanted power reflections back into the RF OUTPUT connector, thereby preventing a false ALC UNLEVELED annunciator indication.)

12. Set FREQUENCY to 6.6 GHz and Output Level VERNIER to -2 dB. Press the RF OUTPUT key to OFF. Verify that the ALC UNLEVELED and NOT ϕ LOCKED status annunciators turn on and that the meter indicates <-10dB.

13. Press the RF OUTPUT ON/OFF key to ON. Verify that the status annunciators turn off and that the meter indicates -2 dB.

14. Step the output level down in 10 dB steps from -70 to -90 dBm using the RANGE key. Then, step the output level up in 10 dB steps from -90 to +10 dBm. Verify that the ALC UNLEVELED annunciator remains off.

15. Set Output Level RANGE to 0 dBm and sweep the Output Level VERNIER from -10 dB to +3 dB. Verify that the ALC UNLEVELED annunciator remains off at all VERNIER settings.

16. Set FREQ INCR to 10 MHz. Then, set the output level to the values shown in the following table. Tune from the corresponding start frequency to the stop frequency for each output level. Verify that the indicated power level on the meter remains constant and stable and that the ALC UNLEVELED annunciator remains off. (This ensures that the instrument can generate specified output power and remain leveled.)

OPERATOR'S CHECKS

3-11. Basic Functional Checks (cont'd)

Output Level			Start Frequency	Stop Frequency
Model	Range	VERNIER		
Std/008	+10 dBm	-2 dB	2000.000 MHz	18000.000 MHz
Std only	+10 dBm	-6 dB	18010.002 MHz	22000.000 MHz
Std only	0 dBm	0 dB	22010.000 MHz	26000.000 MHz
Opt. 008 only	+10 dBm	-3 dB	18000.003 MHz	26000.000 MHz

Sweep Check:

The FREQUENCY MHz display is used to check the ability of the internal phase-lock loops to remain phase locked while sweeping. A spectrum analyzer can be used to monitor the signal at the RF OUTPUT connector for greater assurance that the Signal Generator is operating properly.

17. Press RCL 0 to set the instrument to a known state. Then, press the AUTO sweep key. Verify that the FREQUENCY MHz display now shows a start frequency of 2000.000 MHz and a stop frequency of 4000.000 MHz. The AUTO key light should flash once each time a new sweep begins.

18. Press SWEEP OFF. Verify that the FREQUENCY MHz display returns to 3000.000 MHz.

19. Press the MANUAL sweep key. The FREQUENCY MHz display should show 2000.000 MHz. Tune the frequency up by turning the TUNE knob clockwise. Verify that the FREQUENCY MHz display changes in 20 MHz increments and stops at 4000.000 MHz.

20. Tune the frequency down to 2000.000 MHz by turning the TUNE knob counter-clockwise. Verify that the FREQUENCY MHz display changes in 20 MHz steps and stops at 2000.000 MHz.

21. Press the SWEEP OFF key and verify that the FREQUENCY MHz returns to 3000.000 MHz.

22. Press the SINGLE sweep key. Verify that the key light turns on and the FREQUENCY display shows 2000.000 MHz.

23. Press the SINGLE sweep key again. A single sweep should now be executed. Verify that the FREQUENCY MHz display changes in 20 MHz steps very rapidly until 4000.000 MHz is reached. The display then returns to the START frequency of 2000.000 MHz.

24. Press the SWEEP OFF key. Verify that the FREQUENCY MHz display returns to 3000.000 MHz.

NOTE

For Option 008, Auto Sweep mode will only execute one sweep if 16 GHz is within start and stop frequencies. Sweep will then halt at programmed stop frequency, Auto Sweep key will flash, and message key will display error 16.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

AM Check

The front panel meter is used as an indication of AM. The meter monitors input signal level only, rather than actual AM. A spectrum analyzer can be used to monitor the signal at the RF outut connector for greater assurance of AM performance. The ALC UNLEVELED status annunciator is used to verify that overmodulation does not occur.

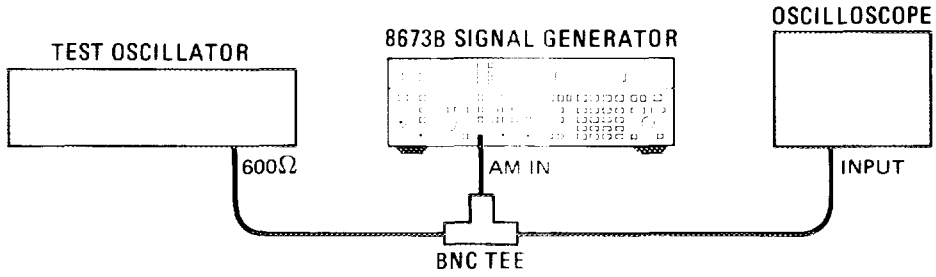


Figure 3-8. AM Functional Check Setup

25. Press RCL 0 to preset the Signal Generator to a known state.

26. Set the test oscillator to 10 kHz at an output level of 0V. Then, connect the test oscillator and oscilloscope to the Signal Generator as shown in Figure 3-8.

27. Set the Signal Generator to each setting shown in the table below. For each setting, slowly increase the test oscillator's output level (starting from 0V) while observing the Signal Generator's meter in AM mode. The meter should indicate a smooth and continuous increase in AM depth. When the meter displays the %AM indicated in the table, verify that the oscilloscope shows the corresponding voltage. The ALC UNLEVELED status annunciator should remain off at all times.

Signal Generator					Oscilloscope
FREQUENCY	RANGE	VERNIER	AM Key	% AM	Display
18 GHz	0 dBm	0 dB	100%	75	0.75V peak
24 GHz	0 dBm	-3 dB	100%	75	0.75V peak
26 GHz	0 dBm	-5 dB	100%	50	0.5V peak
26 GHz	0 dBm	-5 dB	30%	30	1.0V peak

28. Press AM OFF and disconnect the test oscillator and oscilloscope from the Signal Generator.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

FM Check

The front panel meter is used to monitor input signal level, which is proportional to FM deviation. A spectrum analyzer can be used to monitor the signal at the RF OUTPUT connector for greater assurance of FM performance. The FM OVERMOD status annunciator detects a deliberate FM overmodulation condition.

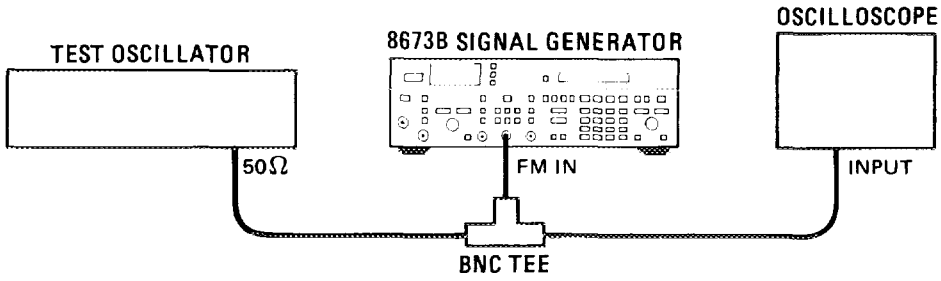


Figure 3-9. FM Functional Check Setup

29. Press RCL 0 to preset the Signal Generator to a known state. Set Output Level RANGE to 0 dBm, Output Level VERNIER to 0 dB, and FM DEVIATION range to .03 MHz. Then, set the meter scale to FM.

30. Set the test oscillator to 10 MHz at an output level of 0V. Then, connect test oscillator and oscilloscope to the Signal Generator as shown in Figure 3-9.

31. Slowly increase the output level of the test oscillator (starting from 0V) until the Signal Generator's meter reads full scale. Verify that the meter increases slowly and continuously and that the FM OVERMOD status annunciator remains off. The oscilloscope display should be approximately 1V peak.

32. Repeat step 31 for each of the following FM deviation ranges: .1, .3, 1, 3, and 10 MHz.

33. Set the Signal Generator's FM DEVIATION range to 10 MHz. Increase the test oscillator output level until a full scale reading is obtained. Decrease the test oscillator frequency slowly until the Signal Generator's FM OVERMOD status annunciator turns on. This should occur at a modulation frequency of 1 to 2 MHz.

34. Press FM DEVIATION MHz OFF and disconnect the test oscillator and oscilloscope from the Signal Generator.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

Pulse Modulation Check:

Pulse modulation is checked using various front panel status annunciators. Although pulse modulation is not monitored at the RF OUTPUT connector, the status annunciators give a high degree of confidence that pulse modulation is functionally working.

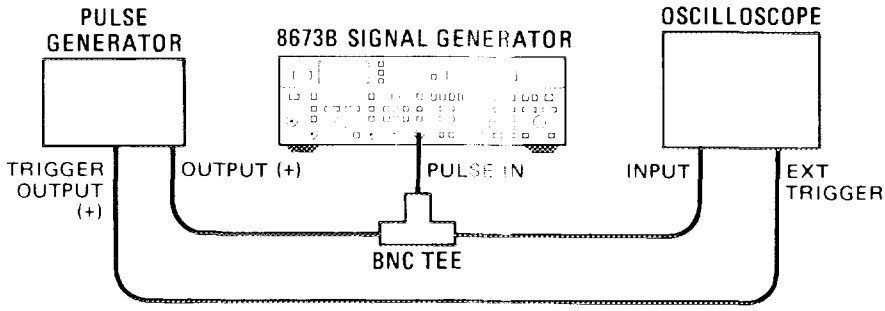


Figure 3-10. Pulse Modulation Functional Check Setup

35. Press the RCL 0. Set Output Level RANGE to 0 dBm and Output Level VERNIER to 0 dB.

36. Press the PULSE COMPL key. The ALC UNLEVELED status annunciator should remain off.

37. Press the PULSE NORM key. Verify that the ALC UNLEVELED status annunciator turns on. Press PULSE OFF and verify that ALC UNLEVELED status annunciator now turns off.

38. Connect the pulse generator and oscilloscope to the Signal Generator as shown in Figure 3-10.

39. Set the oscilloscope to 50 ohm input and external horizontal trigger.

40. Set the pulse generator to the following:

    pulse period range ..... 20 ns - 1 μs
    pulse delay range ..... 35 ns - 1 μs
    pulse width range ..... 10 ns - 1 μs
    amplitude range ..... 2 - 5V

    In addition, internal load and normal pulse should be selected. (Internal load places a 50Ω internal load on output pulse for proper impedance matching.)

OPERATOR'S CHECKS

3-11. Basic Function Checks (cont'd)

41. On the pulse generator, adjust the pulse period vernier for an oscilloscope display of 1 pulse per microsecond. Then, adjust the pulse width vernier (and oscilloscope) for an individual pulse width of approximately 150 ns. Adjust the amplitude vernier for a pulse height of approximately 3V peak.

42. With Pulse OFF selected (CW mode), note the indicated power level on the Signal Generator's meter (should be 0 dBm). Press PULSE NORM and PULSE COMPL keys while observing any change in indicated output power level. Indicated level should not vary more than ± 1 dB from the level referenced with pulse off, (CW mode).

43. While in PULSE NORM mode, slowly reduce the pulse width from 150 ns to 50 ns. The ALC UNLEVELED annunciator should come on as 100 ns pulse width is approached. It should remain on down to at least 50 ns. The output level indicated on Signal Generator meter may also vary >1dB as the ALC UNLEVELED annunciator comes on. This is normal instrument operation, indicating a "pulse unleveled" condition.

44. Press PULSE OFF and disconnect the oscilloscope and test oscillator from the Signal Generator.

Memory Check

45. Set FREQUENCY to 15 GHz and Output Level RANGE to -20 dBm.

46. Turn the Signal Generator's LINE switch to STBY, wait 30 seconds, then turn the LINE switch to ON. Verify that the FREQUENCY MHz display shows 15000.000 MHz and the RANGE dBm display shows -20 dBm.

Message Check

47. Press RCL 0 to preset the Signal Generator to a known state. Set FREQUENCY to 30 GHz and verify that the MESSAGE key light turns on.

48. Press and hold the MESSAGE key. The FREQUENCY MHz display should show message code 01 (frequency out of range).

49. Release the MESSAGE key. Verify that the key light turns off.

OPERATOR'S CHECKS

3-17. HP-IB Functional Checks

DESCRIPTION: These procedures check the Signal Generator's ability to process or send the HP-IB messages described in Table 3-4. Only the Signal Generator, a controller, and an HP-IB interface are needed to perform these checks.

These procedures do not check if all Signal Generator program codes are being properly interpreted and executed by the instrument. However, if the power-up sequence (including the memory checks) and the front panel operation is good, the program codes, in all likelihood, will be correctly implemented.

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

a. The Signal Generator performs properly when operated via the front panel keys (that is, in local mode). This can be verified by the Basic Functional Checks.

b. The bus controller properly executes HP IB operations.

c. The bus controller's HP-IB interface properly executes the HP-IB operations.

If the Signal Generator appears to fail any of these HP-IB checks, the validity of the above assumptions should be confirmed before attempting to service the instrument.

The select code of the controller's HP-IB interface is assumed to be "7". The address of the Signal Generator is assumed to be "19" (its address as set at the factory). This particular select code address combination (that is, 719) is not necessary for these checks to be valid. However, the program lines presented here have to be modified for any other combination.

These checks can be performed together or separately. Any special requirements for a check are described at the beginning of the check.

INITIAL SETUP: The test setup is the same for all of the checks. Connect the Signal Generator to the bus controller via the HP-IB interface.

EQUIPMENT:

HP IB Controller	HP 9825A/98213A (General and Extended I/O ROM) —or— HP 85F/82903A (16K Memory Module)/00085-15005 (Advanced Programming ROM)
HP-IB Interface	HP 98034A (for HP 9825A) HP 82937A (for HP 85F)

Remote and Local Messages and the LOCAL Key

NOTE: This check determines if the Signal Generator properly switches from local to remote control, from remote to local control, and if the LOCAL key returns the instrument to local control. If the Signal Generator is in remote mode (that is, the front panel RMT annunciator is on), switch the instrument to STBY, then to ON.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send the Remote message (by setting Remote Enable, REN, true and addressing the Signal Generator to listen).	rem 719	REMOTE 719

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT and LSN annunciators are on.

Send the Local message to the Signal Generator.	lcl 719	LOCAL 719

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is off but its LSN annunciator is on.

Send the Remote message to the Signal Generator.	rem 719	REMOTE 719

OPERATOR'S RESPONSE: Check that both the Signal Generator's RMT and LSN annunciators are on. Press the LOCAL key on the Signal Generator. Check that the Signal Generator's RMT annunciator is now off, but that its LSN annunciator remains on.

Sending the Data Message

NOTE: This check determines if the Signal Generator properly issues Data messages when addressed to talk. Before beginning this check, turn the Signal Generator's LINE switch to STBY, then to ON. Then key in RCL 0 to preset the front panel.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Address the Signal Generator to talk and store its output in variable V.	red 719, V	ENTER 719; V
Display the value of V.	dsp V	PRINT V

OPERATOR'S RESPONSE: Check that the Signal Generator's TLK annunciator is on. The controller's display should read 3000000000.00 (HP 9825A) or 3000000000 (HP 85F). This corresponds to the data output shown in the FREQUENCY MHz display.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Receiving the Data Message

NOTE: This check determines if the Signal Generator properly receives Data messages.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send the first part of the Remote message (enabling the Signal Generator to remote).	rem 7	REMOTE 7
Address the Signal Generator to listen (completing the Remote message), then send a Data message.	wrt 719; "fr15gz"	OUTPUT 719; "FR15GZ"

OPERATOR'S RESPONSE: Check that both the Signal Generator's RMT and LSN annunciators are on and that the FREQUENCY MHz display shows 15000.000 MHz.

Local Lockout and Clear Lockout/Set Local Messages

NOTE: This check determines if the Signal Generator properly receives the Local Lockout message, disabling the LOCAL key. The check also determines if the Clear Lockout/Set Local message is properly received and executed by the Signal Generator. This check assumes that the Signal Generator is in the remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send the Local Lockout message.	llo 7	LOCAL LOCKOUT 7

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is on. Press the Signal Generator's LOCAL key. The RMT annunciator should remain on.

Send the Clear Lockout/Set Local message.	lcl 7	LOCAL 7

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is off.

Return the Signal Generator to remote mode if the remaining checks in this section are to be performed.	rem 719	REMOTE 719

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is on.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Clear Message

NOTE: This check determines if the Signal Generator properly responds to the Clear message. This check assumes that the Signal Generator is in the remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send a Data message that turns AUTO PEAK off.	wrt 719, "k0"	OUTPUT 719; "K0"

OPERATOR'S RESPONSE: Check that the Signal Generator's AUTO PEAK key light is off.

Send the Clear message (turning the Signal Generator's AUTO PEAK function on).	clr 719	CLEAR 719

OPERATOR'S RESPONSE: Check that the Signal Generator's AUTO PEAK key light is on.

Abort Message

NOTE: This check determines if the Signal Generator becomes unaddressed when it receives the Abort message. This check assumes that the Signal Generator is in the remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Address the Signal Generator to listen.	wrt 719	OUTPUT 719

OPERATOR'S RESPONSE: Check that the Signal Generator's LSN annunciator is on.

Send the Abort message, unaddressing the Signal Generator from listening.	cli 7	ABORTIO 7

OPERATOR'S RESPONSE: Check that the Signal Generator's LSN annunciator is off.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Status Byte Message

NOTE: This check determines if the Signal Generator sends the Status Byte message. Before beginning this check, turn the Signal Generator's LINE switch to STBY, then to ON.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Place the Signal Generator in serial-poll mode (causing it to send the Status Byte message).	rds (719) →V	V=SPOLL (719)
Display the value of V.	dsp V	PRINT V

OPERATOR'S RESPONSE: The controller's display should read 12.00 (HP 9825A) or 12 (HP 85F).

Require Service Message

NOTE: This check determines if the Signal Generator can issue the Require Service message (set the SRQ bus control line true). This check can be performed in either local or remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send a Data message to set the Request Mask to 32.	wtb 719, "@1", 32	OUTPUT 719 USING "2A, B"; "@1", 32
Send a Data message containing an invalid HP-IB code. This causes a Require Service message to be sent.	wrt 719, "fr 35 gz"	OUTPUT 719; "FR 35 GZ"

OPERATOR'S RESPONSE: Check that the SRQ annunciator is on.

Read the binary status of the controller's HP-IB interface and store the data in variable V (in this step, 7 is the interface's select code).	rds (7 →V	STATUS 7, 2;V
Display the value of the SRQ bit (in this step 7 is the SRQ bit for the HP 9825A and 6 is the SRQ bit for the HP 85F, numbered from 0).	dsp"SRQ=", bit(7,V)	PRINT"SRQ="; BIT(V,6)

OPERATOR'S RESPONSE: Check that the SRQ value is 1, indicating the Signal Generator issued the Require Service message.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Status Bit Message

NOTE: This check determines whether or not the Signal Generator sends the Status Bit message. This check can be performed in either local or remote mode. If the Signal Generator's SRQ annunciator is off, perform the first part of the Require Service Message check before beginning this check.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Configure the Signal Generator to respond to a parallel poll on HP-IB data line DI03.	polc 719, 10	SEND 7; LISTEN 19 CMD 5 SCG 10
Place the Signal Generator in parallel poll mode (causing it to send the Status Bit message) and store the result in variable V.	pol(7) →V	V = PPOLL (7)
Display the value of V.	dsp V	PRINT V

OPERATOR'S RESPONSE: Check that the SRQ annunciator is on and that the response to the parallel poll is 4, indicating that the Signal Generator issued the Status Bit message.

Unconfigure the Signal Generator from responding to a parallel poll.	polu 719	SEND 7; LISTEN 19 CMD 5 SCG 18
Place the Signal Generator in parallel poll mode.	pol(7) →V	V = PPOLL (7)
Display the value of V.	dsp V	PRINT V

OPERATOR'S RESPONSE: Check that the SRQ annunciator is on and that the response to the parallel poll is 0, indicating that the Signal Generator is no longer configured to respond to a parallel poll. Then, turn the LINE switch to STBY, then to ON, to turn the SRQ annunciator off.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Trigger Message

NOTE: This check determines if the Signal Generator responds to the Trigger message. This check assumes that the Signal Generator is in remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send a Data message to set the Signal Generator's frequency to 9999 MHz.	wrt 719, "fr 9999 mz"	OUTPUT 719; "FR 9999 MZ"
Set the Signal Generator's frequency increment to 1111 MHz.	wrt 719, "fi 1111 mz"	OUTPUT 719; "FI 1111 MZ"

OPERATOR'S RESPONSE: Check that the Signal Generator's frequency is set to 9999 MHz. Then press the Signal Generator's FREQ INCR key to check for an increment of 1111 MHz. This keyboard function is possible in the remote state (even if local lockout is enabled).

Configure the Signal Generator's trigger response to be an INCREMENT (down) function (that is, dn).	wrt 719, "ct dn"	OUTPUT 719; "CT DN"
Send a Trigger message.	trg 719	TRIGGER 719

OPERATOR'S RESPONSE: Check that the Signal Generator's frequency changes to 8888 MHz.

3-18. REMOTE OPERATION, AUXILIARY CONTROL

3-19. AUX Input Lines

A limited number of instrument functions can be controlled through the rear panel AUX connector. These functions are listed in the table below.

The input lines are TTL compatible and negative-edge sensitive. They require a minimum of 5 μs between negative edges. Input signals can be generated by clean TTL drivers or by mechanical switches that require debouncing. The Signal Generator has a built-in debouncing circuit that should be enabled or bypassed depending upon which type of driver is used.

The Signal Generator is shipped from the factory configured for electrically-clean control signals (that is, the internal debouncing circuit is bypassed). One way to determine if the debouncing circuit is bypassed is described below.

- Set FREQ INCR to 1 GHz.
- Ground pin 3 (FREQ INCREMENT Up) several times and observe the change in frequency.
- If the FREQ INCREMENT steps are erratic, the debouncing circuit is still bypassed.
- If the frequency consistently changes in steps of 1 GHz, the debouncing circuit is enabled.

Refer to Section II, Installation, for the procedure for enabling or bypassing the debouncing circuit.

NOTE

Section II, Installation, also shows the pinout configuration of the AUX connector as well as information for a recommended mating connector.

3-20. AUX Output Lines

The AUX connector also has a ground line and three TTL-compatible output lines. The output lines are normally held at the high TTL level. The End of Sweep line produces one 5 μs low-going pulse at the end of each sweep. The Trigger line produces one 5 μs low-going pulse when the Signal Generator has made a large frequency change that may cause loss of phase lock in an instrument tracking the Signal Generator. The Negative Blanking line produces -5V for Z-axis blanking of CRT displays that require a negative blanking voltage.

Table 3-3 AUX Connector Functions

	Pin	Function	Description
INPUTS	1	Recall 1	Recalls the contents of internal storage register 1.
	2	Recall Next	Sequential recall of internal storage registers 2 through 9
	3	FREQ INCREMENT Up	Same as FREQ INCREMENT Up key
	4	FREQ INCREMENT Down	Same as FREQ INCREMENT Down key
	5	Trigger Single Sweep	Same as SINGLE key
	6	Service	Same as internal service switch (on A2A2 Key Code Assembly). Refer to Section VIII, Service
	7	Stop Sweep	Stops sweep. Sweep resumes when this line goes high
	12	No Display	Blanks FREQUENCY MHz display when this pin is grounded and the existing display changes
OUTPUTS	8	Negative Blanking	-5V for blanking
	9	Trigger	One pulse when the Signal Generator has made a frequency change that may cause loss of phase lock to an instrument tracking the Signal Generator
	10	End of Sweep	One pulse at end of each sweep
	11	Ground	

3-21. 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 that of the LINE switch and the backspace key) and remote-only functions are programmable via HP-IB.

A quick test of the Signal Generator's HP-IB interface is described earlier in this section under Remote Operator's Checks. These checks verify that the Signal Generator can respond to or send each of the applicable bus messages described in Table 3-4.

3-22. HP-IB Compatibility

The Signal Generator has a three-state, TTL, HP-IB interface which can be used with any HP-IB computing controller or computer for automatic system applications. The Signal Generator is programmable via the HP Interface Bus. Its programming capability is described by the twelve HP-IB messages listed in Table 3-4. The Signal Generator's compatibility with HP-IB is further defined by the following list of interface functions: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, and C0. A more detailed explanation of these compatibility codes can be found in IEEE Standard 488-1978 (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).

3-23. Remote Mode

Remote Capability. The Signal Generator communicates on the bus in both remote and local modes. In remote, most of the Signal Generator's front panel controls are disabled. Exceptions are the LINE switch, the LOCAL key, the MTR keys, the MESSAGE key, and the FREQUENCY, FREQ INCR, SWEEP FREQ and SWEEP RATE keys for displaying "hidden" parameters. However, front panel displays remain active and valid. In remote, the Signal Generator can be addressed to talk or listen. When addressed to listen, the Signal Generator automatically stops talking and responds to the following messages: Data, Trigger (if configured), Clear (SDC), Remote, Local, Local Lockout, and Abort. When addressed to talk, the Signal Generator automatically stops listening and sends one of the following messages: Data, Require Service, or Status Byte. Whether addressed or not, the Signal Generator responds to the Clear (DCL), Local Lockout, Clear Lockout/Set Local, and Abort messages. In addition, the Signal Generator can issue the Require Service message and the Status Bit message.

Local-to-Remote Mode Changes. The Signal Generator switches to remote operation upon receipt of the Remote message. The Remote message has two parts. They are:

a. Remote enable bus control line (REN) set true.

b. Device listen address received once (while REN is true).

When the Signal Generator switches to remote, the RMT annunciator on the front panel turns on. With the exception of VERNIER, which may change by less than 0.1 dB, the Signal Generator's control settings remain unchanged with the Local-to-Remote transition.

3-24. Local Mode

Local Capability. In local, the Signal Generator's front panel controls are fully operational and the instrument responds to the Remote message. The Signal Generator can send a Require Service message, a Status Byte messsage, and a Status Bit message.

Remote-to-Local Mode Changes. The Signal Generator always switches to local from remote whenever it receives the Local message (GTL) when addressed to listen or the Clear Lockout/Set Local message. The Clear Lockout/Set Local message sets the Remote Enable control line [REN] false.) The Signal Generator can also be switched to local by pressing the front panel LOCAL key (assuming Local Lockout is not in effect). With the exception of VERNIER, which may change by less than 0.1 dB, the Signal Generator's control settings remain unchanged with the Remote-to-Local transition.

Local Lockout. When a data transmission is interrupted, which can happen by pressing the LOCAL key to return the Signal Generator to local mode, the data could be lost. This would leave the Signal Generator in an unknown state. To prevent this, a local lockout is recommended for purely automatic

Table 3-4. Message Reference Table (1 of 2)

HP-IB Message	Applicable	Response	Related Commands and Controls	Interface Functions*
Data	Yes	All front panel functions (except the LINE switch and the Backspace key) and remote-only functions are bus programmable		AH1 SH1 T5 TE0 L3 LE0
Trigger	Yes	If in remote and addressed to listen, the Signal Generator executes a previously selected program code. It responds equally to the Group Execute Trigger (GET) bus command and program code TR (a Data message).	GET	DT1
Clear	Yes	Sets output to 3000.000 MHz at −70 dBm with sweep and modulation off. Resets many additional parameters as shown in Table 3-6. Responds equally to Device Clear (DCL) and Selected Device Clear (SDC) bus commands.	DCL SDC	DC1
Remote	Yes	Remote mode is enabled when the REN bus control line is true. However, remote mode is not entered until the first time the Signal Generator is addressed to listen. The front panel RMT annunciator lights when the instrument is actually in the remote mode.	REN	RL1
Local	Yes	The Signal Generator returns to local mode (front panel control). It responds equally to the Go To Local (GTL) bus command and the front panel LOCAL key.	GTL	RL1
Local Lockout	Yes	The LOCAL key is disabled. Only the controller can return the Signal Generator to local (front panel control).	LLO	RL1
Clear Lockout/ Set Local	Yes	The Signal Generator returns to local (front panel control) and local lockout is cleared when the REN bus control line goes false.	$\overline{\text{REN}}$	RL1
Pass Control/Take Control	No	The Signal Generator has no controller capability.		C0
Require Service	Yes	The Signal Generator sets the SRQ bus control line true if one of the following conditions exists and it has been enabled by the Request Mask to send the message for that condition: Front Panel Key Pressed, Front Panel Entry Complete, Change in Extended Status, Source Settled, End of Sweep, Entry Error, and Change in Sweep Parameters.	SRQ	SR1
Status Byte	Yes	The Signal Generator responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit byte when addressed to talk. If the instrument is holding the SRQ control line true (issuing the Require Service message) bit 7 (RQS bit) in the Status Byte and the bit representing the condition causing the Require Service message to be issued will both be true. The bits in the Status Byte are latched but can be cleared upon receiving the Clear Status (CS) program code, executing the Output Status function, or executing a serial poll while the SRQ control line is held true.	SPE SPD	T5

Table 3-4. Message Reference Table (2 of 2)

HP-IB Message	Appli-cable	Response	Related Commands and Controls	Interface Functions
Status Bit	Yes	The Signal Generator responds to a Parallel Poll Enable (PPE) bus command by sending a bit on a controller selected HP-IB data line.	PPE PPD PPC PPU	PP1
Abort	Yes	The Signal Generator stops talking and listening.	IFC	T5,TE0 LE,LE0

*Commands, Control lines, and Interface Functions are defined in IEEE Std 488-1978. Knowledge of these may 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 ANSI Std MC1.1 is: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, and C0.

Local Mode (cont'd)

applications. Local lockout disables the LOCAL key and allows return-to-local only under program control.

NOTE

Return-to-local can also be accomplished by turning the Signal Generator's LINE switch to STBY, then back to ON. However, this technique has some disadvantages:

a. It defeats the purpose and advantage of local lockout (that is, the system controller loses control of a system element).

b. There are several HP-IB conditions that reset to default states at turn-on.

3-25. Addressing

The Signal Generator interprets the byte on the eight HP-IB data lines as an address or a bus command if the bus is in the command mode. The command mode is defined as attention control line (ATN) true and interface clear control line (IFC) false. Whenever the Signal Generator is addressed (if in local or remote), either the TLK or LSN annunciator on the front panel turns on.

The Signal Generator's Talk and Listen addresses can be set from switches located inside the instrument or from the front panel. The address selection procedure is described in Section II.

The decimal equivalent of the addresses can be displayed in the FREQUENCY MHz display by pressing and holding the LOCAL key. This is the decimal equivalent of the last five bits of both the Talk and Listen ASCII address codes. Refer to Table 2-1 for a comprehensive listing of all valid HP-IB address codes.

Listen Only Mode. If the internal Listen Only switch is set to "1", the Signal Generator is placed in the Listen Only mode. The instrument then responds to all Data messages, and the Trigger, Clear, and Local Lockout messages. It can also respond to a parallel poll with the Status Bit message. However, the Signal Generator cannot send Data messages and cannot respond to a serial poll with the Status Byte message.

The Signal Generator's Listen Only address can also be set from the front panel by keying in 4 0, then pressing the STO key and the LOCAL key. Note that the FRONT PNL ENABLE switch on the internal HP-IB address switch must be set to "1" to allow front panel entries.

Talk Only Mode. If the internal address switches are set to a valid Talk address and the Talk Only switch is set to "1", the Signal Generator is placed in the Talk Only mode. In this mode the instrument is configured to send Data messages whenever the bus is in the data mode. It can also send the Status Byte message in response to a serial poll.

Addressing (cont'd)
The Signal Generator's Talk Only address can also be set from the front panel by keying in 5 0, then pressing the STO key and the LOCAL key. Note that the FRONT PNL ENABLE switch on the internal HP-IB address switch must be set to "1" to allow front panel entries.

3-26. Turn-on Default Conditions

Several HP-IB parameters are reset at turn-on. The parameters and their default conditions are listed below.

- HP-IB Local Mode
- Immediate Execution Mode
- Unaddressed
- Trigger Configuration cleared
- Request Mask cleared
- SRQ cleared

3-27. Displays

The RMT annunciator is on when the Signal Generator is in the remote mode and after it has received its first Data message. The TLK annunciator is on when the Signal Generator is currently addressed to talk; the LSN annunciator is on when the Signal Generator is currently addressed to listen. The SRQ annunciator is on when the Signal Generator is sending the Require Service message.

The MESSAGE key lights for the same conditions in remote as in local. The message can be read in either remote or local when the Signal Generator is under program control. Once the message has been read the key light turns off, whether or not the causing condition has been crorrected.

The FREQUENCY MHz and RANGE dBm displays operate in remote mode just as they do in local. Hidden parameters can still be displayed in the FREQUENCY MHz display by pressing and holding their front panel keys. (This capability is not available to the controller since it cannot hold a program code in the same manner that an operator can hold down a key. However, the Output Active Parameter talk function allows the controller to use its display for showing the current value of hidden parameters.)

3-28. Output Level

of 10 dBm and displayed in the RANGE dBm display. The VERNIER knob sets the intermediate values of output power and is read on the meter. In remote, VERNIER is set in 0.1 dB steps. A selection of programming codes allows either combined or independent setting of the RANGE and VERNIER power. The entry format is [Program Code] [Numeric Value] [Units Terminator]. The code LE sets both range and vernier. The code RA sets just the range. The code VE sets just the vernier.

In going from local to remote the output level might change by a fraction of a dB. In going from remote to local the front panel knob takes control. There is no assurance of whether the power will go up, go down, or stay the same.

3-29. Data Messages

The Signal Generator communicates on the interface bus primarily with Data messages. Data messages consist of one or more bytes sent over the bus' data lines when the bus is in the data mode (attention control line|ATN|false). Unless it is set to Talk Only, the Signal Generator receives Data messages when addressed to listen. Unless it is set to Listen Only, the Signal Generator sends Data messages or the Status Byte message when addressed to talk. Virtually all instrument operations available in local mode can be performed in remote mode via Data messages. The major exceptions are changing the LINE switch setting and changing the HP-IB address of the Signal Generator.

3-30. Receiving Data Messages

The Signal Generator responds to Data messages when it is enabled to remote (REN control line true) and it is addressed to listen. The instrument remains addressed to listen until it receives an Abort message or until its talk address or a universal unlisten command is sent by the controller.

Data Message Input Format. The Data message string, or program string, consists of a series of ASCII codes. Each code is typically equivalent to a front panel keystroke in local mode and follows one of three formats:

- [Program Code] [Numeric Value] [Units Ter-

Receiving Data Messages (cont'd)
Program codes are typically 2 character mnemonics. All codes normally used by the operator to control the Signal Generator are given in Table 3-7, HP-IB Program Codes.

Numeric values are either a single decimal digit, a set of 11 characters or less representing a number, or a string of binary bytes. A string of 11 characters maximum can be expressed in decimal form only. Digits beyond the front panel display capability of a particular parameter are truncated. Therefore, it is best to format the data so that it is rounded to the correct number of digits.

Units terminators are 2 character codes that terminate and scale the associated numeric value. Frequency can be entered in GHz, MHz, kHz, or Hz. Sweep time values are entered in milliseconds. Power values are entered in dB.

End-of-String messages (EOS) can be the ASCII characters Line Feed (LF), semicolon (;), or the bus END message (that is, bus lines EOI true and ATN false). The at sign (@) acts as an EOS when the Signal Generator is in the Deferred Execution mode.

Valid Characters. The ASCII characters used for program strings are: A-Z a-z 0-9 . - + LF , ; @. The alpha program codes can be either upper or lower case since the Signal Generator will accept either type (they can be interchanged). Spaces, unnecessary signs (+, -), leading zeros, and carriage returns (CR) are ignored. However, if a space or other such character were inserted between 2 characters of a program code, the program code would be invalid and any remaining characters in a string might be misinterpreted by the Signal Generator. After receiving an invalid program code, the Signal Generator requires a valid program code before it will respond to numeric entries.

Immediate Execution Mode. ASCII characters can be accepted in the Deferred or Immediate execution modes. Immediate Execution is the default mode at turn-on. It can be set, if necessary, by sending the program code @3. In this mode the Signal Generator produces an End-of-String (EOS) message at the end of each character and does not require one from the controller. The Signal Generator processes each character before accepting the final EOS message than it can in the other mode. This is useful when the system controller is slow enough (data rate <1000 bytes/second) that it cannot take advantage of the Deferred mode's transfer speed or when switching time, independent of message length, is more important than program execution speed.

Deferred Execution Mode. This ASCII mode must be selected by sending the program code @2. In this mode, the Signal Generator accepts strings up to 96 characters at a time, executing the string upon receiving an EOS message. The Signal Generator produces its own EOS message upon receipt of the 96th character in a string. If a block of strings containing more than 96 characters is sent, the first 96 characters are accepted and the Signal Generator holds the bus busy until it executes them. Then the next 96 characters are accepted and so on until the entire block is accepted. If only one string of less than 96 characters is sent, the Signal Generator accepts the strings and frees the bus allowing program execution to continue.

Binary Mode. The Signal Generator's Request Mask is programmed in binary format. Also, learn mode data is sent and received in binary. Binary data is always processed in the Immediate Execution mode.

3-31. Sending the Data Message

The Signal Generator can send Data messages when addressed to talk. It remains configured to talk until it is unaddressed to talk by the controller. To unaddress the Signal Generator, the controller must send the Signal Generator's listen address, an Abort message, a new talk address, or a universal untalk command.

Talk Functions. The types of information that the Signal Generator can send in a Data message are:

- Front Panel Learn Mode
- Special Function Learn Mode
- Messages
- Output Active Parameter
- Output Couple
- Output Lock Frequency
- Test Interface
- Output Status
- Output Request Mask Value (explained later

Sending the Data Message (cont'd)

erator must receive a Data message with the appropriate program code. When the Signal Generator is addressed to talk, it will output data for the selected talk function. If the controller does not repeat the program code or send a new one, the Signal Generator sends data for the last selected talk function when it is addressed to talk. However, it is recommended that a talk function program code be sent each time, prior to addressing the Signal Generator to talk. This will ensure that the Signal Generator sends the appropriate data. Refer to Table 3-5 for a summary of talk functions.

Front Panel Learn Mode. The front panel learn mode uses the controller's memory to learn and store a data string that describes the Signal Generator's current front panel setting. Once an instrument state has been learned, the Signal Generator can be restored to that configuration at a later time. The learn mode requires a controller that can transfer information in binary form.

After receiving an L1 program code (Front Panel Learn Mode) and when addressed to talk, the Signal Generator sends 2 ASCII characters, @ and A, followed by a string of 94 8-bit binary bytes containing information on the front panel configuration. This binary data can then be stored in the controller's memory for future use. In addition, as each configuration goes out onto the bus, it is also stored in the Signal Generator's register 9. The most straight-forward way to program the system controller is to use a loop to read 96 binary characters and store them in an array.

When the Signal Generator is addressed to listen, the binary data can be returned to it in 96-byte strings. When the Signal Generator detects the @A, it will expect the next 94 characters to be in the learn mode string. A checksum is embedded in the string so that possible errors in the storage or transmission of the data will be detected, and the input will be ignored.

Whenever data is being transferred between controller and Signal Generator, it must do so in uninterrupted strings. If a data string is broken or interrupted, the data could be lost or offset, and misinterpreted by the Signal Generator. An offset of data bytes can persist through later data strings until the Signal Generator is eventually switched to standby, then on again.

Special Function Learn Mode. This mode is intended for servicing the Signal Generator. It is similar in operation to the front panel learn mode. After receiving an L2 program code (Special Function Learn Mode) and when addressed to talk, the Signal Generator sends 2 ASCII charcters, @ and 9, followed by a string of 24 8-bit binary bytes. This binary data can then be stored in the controller's memory.

The binary characters are directly related to the digital outputs of the Signal Generator's internal controller. There is no checksum or other error detecting scheme, allowing diagnostic and other special functions that are not normally possible with the Signal Generator. Refer to Section VIII, Service, for additional information.

Messages. This function enables the MESSAGE key to be read under program control. After receiving an MG program code (Message) and when addressed to talk, the Signal Generator sends a two-digit number coded in ASCII followed by a Line Feed (LF) and EOI. The codes represent entry errors and instrument malfunctions. The two-digit codes are explained on the operating information pull-out card and in the Message Detailed Operating Instruction. The Message can always be read by pressing the MESSAGE key, even when the Signal Generator is in remote mode. However, reading the Message once, either in remote or local, clears it to 00 (No Error) whether or not the causing condition has been corrected.

Output Active Parameter. This function allows the user to determine the present value of a specific parameter. After receiving the program code for a value-selectable parameter followed by the program code OA (Output Active) and when addressed to talk, the Signal Generator will output a string over the bus consisting of the following: [Selected Program Code][Current Numeric Value][Units Terminator][LF and EOI]. Any parameter that has a numeric value associated with it can be interrogated. An exception to this output format is Steps. When the controller sends "SPOA", the Signal Generator returns with the string: SP[Step Size]HZ, SP[Number of Steps]SS,[LF and EOI]. The Signal Generator may output a program code that differs from the code sent to it by the controller. For example, the Signal Generator responds with the program code CF (center frequency) when sent FR (frequency) and MK (marker) when sent M1, M2, M3, M4, or M5 (Markers 1 through 5).

Table 3-5. Talk Functions

Function	Program Code	Signal Generator Output Response to Program Code	Comments
Front Panel Learn Mode	L1	96 Binary Bytes |EOI|	
Special Function Learn Mode	L2	26 Binary Bytes |EOI|	See Section VIII, Service
Message	MG	2 Digits |LF and EOI|	
Output Active Parameter	|Progam Code| OA	|Program Code||Numeric Value||Units Terminator||LF and EOI|	Valid Functions: CF, FI, FA, FB, FS, M1-5, DW, LE, VE, RA
	SPOA	SP |Step Size| Hz, SP |# of Steps| SSSP |LF and EOI|	
Output Couple	OC	|START Value|, |Center-Frequency Value|, |Dwell Value||LF and EOI|	Frequency is in Hz; dwell is in seconds.
Output Lock Frequency	OK	FR |Numeric Value| Hz |LF and EOI|	
Test Interface	TI |1 Byte|	1 Byte |EOI|	
Output Status	OS	2 Bytes |EOI|	
Output Request Mask	OR	1 Byte |EOI|	

Sending the Data Message (cont'd)

Output Couple. After receiving the program code OC (Output Couple) and when addressed to talk, the Signal Generator sends a data string that gives the current numeric values for the following parameters in the order listed: |START|, |Center Frequency|, |DWELL| |LF and EOI|. No program codes prefix the numeric values. Hz is the implied terminator for start and center frequency; seconds is the implied terminator for dwell time.

Output Lock Frequency. This function causes the Signal Generator to output the value of its tuned frequency. After receiving the program code OK and when addressed to talk, the Signal Generator sends the value of the frequency at which it is currently phase locked. The data output from the Signal Generator is in the following format: FR |Numeric Value| HZ |LF and EOI|.

Test Interface Function. This function allows testing of the HP-IB interface. After receiving the program code TI, followed by an 8-bit byte representing one or more data lines (see table below) and when addressed to talk, the Signal Generator sends the binary byte that it just received. Refer to Section VIII, Service, for additional information.

HP-IB Data Line	DI08	DI07	DI06	DI05	DI04	DI03	DI02	DI01
Weight	128	64	32	16	8	4	2	1

Output Status. After receiving the program code OS (Output Status) and when addressed to talk, the Signal Generator sends two binary bytes, each 8 bits wide. The first byte is identical to the Status Byte of the Serial Poll. The second byte is the Extended Status Byte which provides additional information. See Figure 3-11 for a description of each Status Byte. Bits in the main Status Byte are cleared upon execution of the Output Status function or the Clear Status (CS) program code. Bits on the Extended Status Byte are cleared by removing the causing condition and performing the Output Status function.

3-32. Receiving the Clear Message

The Signal Generator responds to the Clear message by assuming the settings detailed in Table 3-6. The Signal Generator responds equally to the Selected Device Clear (SDC) bus command when addressed to listen, and the Device Clear (DCL) bus command whether addressed or not. The Clear message clears any pending Require Service message.

Table 3-6. Response to a Clear Message

Parameter	Condition
Execution Mode	Immediate
Request Mask	Cleared
Require Service (SRQ)	Cleared
Trigger Configuration	Cleared
MESSAGE	Cleared (set to 00)
RF OUTPUT	ON
ALC	INTERNAL
RANGE	-70 dBm
VERNIER	0.0 dB
AUTO PEAK	ON
MTR	LVL
AM, FM, and Pulse Modulation	OFF
FREQUENCY	3000.000 MHz
FREQ INCR	1.000 MHz
START	2000.000 MHz
STOP	4000.000 MHz
ΔF	2000.000 MHz
MKR	OFF
SWEEP MODE	OFF
STEP	100 steps (20.000 MHz)
DWELL	20 ms
TUNE Knob	ON

3-33. Receiving the Trigger Message

The Signal Generator responds to a Trigger message only if a response has been pre-programmed (see Configure Trigger). Otherwise, it ignores a Trigger message. It responds equally to a Trigger message (with bus command GET) and a Data message with program code TR (Trigger).

Configure Trigger. The Signal Generator's response to a Trigger message is set when it receives a Data message containing the program code CT followed by one valid program code. For example, CTW6 causes a single sweep (W6) when the Trigger message is received.

3-34. Receiving the Remote Message

The Remote message has two parts. First, the remote enable bus control line (REN) is held true; second, the device listen address is sent by the controller. These two actions combine to place the Signal Generator in remote mode. Thus, the Signal Generator is enabled to go into remote when the controller begins the Remote message, but it does not actually switch to remote until addressed to listen the first time. When actually in remote, the Signal Generator's front panel RMT annunciator lights.

3-35. 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 front panel control when it receives the Local message.

When the Signal Generator goes to local mode, the front panel RMT annunciator turns off. However, even when in local, if the Signal Generator is being addressed, its front panel LSN or TLK annunciator turns on.

3-36. Receiving the Local Lockout Message

The Local Lockout message is the means by which the controller sends the Local Lockout (LLO) bus command. If in remote, the Signal Generator responds to the Local Lockout Message by disabling the front panel LOCAL key. The local lockout mode prevents loss of data or system control due to someone accidentally pressing front panel keys. If, while in local, the Signal Generator is enabled to remote (that is, REN is set true) and it receives the Local Lockout message, it will switch to remote mode with local lockout the first time it is addressed to listen. When in local lockout, the Signal Generator can be returned to local only by the controller (using the Local or Clear Lockout/Set Local messages), by setting the LINE switch to STBY and back to ON, or by removing the bus cable.

3-37. Receiving the Clear Lockout/Set Local Message

The Clear Lockout/Set Local message is the means by which the controller sets the Remote Enable (REN) bus control line false. The Signal Generator returns to local mode (full front panel control) when it receives the Clear Lockout/Set Local message. When the Signal Generator goes to local mode, the front panel RMT annunciator turns off.

3-31. Receiving the Pass Control Message

The Signal Generator does not respond to the Pass Control message because it does not have this controller capability.

3-32. Sending the Require Service Message

The Signal Generator sends a Require Service message if one or more of the following conditions exist and if it has been pre-programmed to send the message by the Request Mask.

- Front Panel Key Pressed: when the Signal Generator is in local mode and one of the front panel keys is pressed.
- Front Panel Entry Complete: when the Signal Generator is in local mode and is finished processing a front panel entry.
- Change in Extended Status: when one of the bits on the Extended Status Byte changes.
- Source Settled: when the Signal Generator is settled. Switching transients occur when RF and AUTO PEAK are turned on, and when FM ranges and frequency are changed. If the controller responds to the Signal Generator as soon as the source is settled, instead of waiting a specified time, program speed is increased.
- Entry Error: When an invalid keystroke or program command occurs.
- New Sweep Parameters: when the value of START, STOP, ΔF DWELL, STEP, or any Marker changes.

The Signal Generator can send a Require Service message in either the local or remote mode.

The Signal Generator sends a Require Service message by setting the Service Request (SRQ) bus line true. The SRQ annunciator on the front panel turns on when the Require Service message is being sent. The Require Service message is cleared after the Output Status function or the Clear Status (CS) program code has been executed by the controller.

Request Mask. The Request Mask functions within the Status Byte. It determines which bits can set the RQS bit true (see Figure 3-11) and consequently set the SRQ bus line true.

The Request Mask is set by the program code @1 followed by an 8-bit byte (a Data Message). The value of the byte is determined by summing the weight of each bit to be checked. Each bit, if true, enables a corresponding conditon to set the RQS bit true. This message is executed immediately and does not require an End-of-String message to be sent. At turn-on, the Request Mask is cleared (that is, set to 0).

Sending the Request Mask Value (a Data Message). After receiving an OR program code (Output Request Mask) and when addressed to talk, the Signal Generator will send a single binary word (8 bits) that describes the present state of the mask. The bit pattern can be interpreted with the information in Figure 3-11.

NOTE

This byte is sent with the bus EOI line true, thus terminating the message.

3-33. Sending the Status Byte Message

After receiving a Serial Poll Enable bus command (SPE) and when addressed to talk, the Signal Generator sends a Status Byte message. The message consists of one 8-bit byte of which 7 bits correspond to the pattern and descriptions for the Request Mask. The remaining bit, bit 7, is the RQS Request Service bit (see Figure 3-11).

The RQS bit is set when one of the other seven conditions exists and that condition has been enabled by the Request Mask. Bits 1—6 and 8 might be true regardless of conditioning by the Request Mask. However, if a condition has not been selected by the mask, it cannot cause the RQS bit to be set true.

Extended Status Byte. A second status byte is available but can only be accessed via the Output Status function (see explanation under Sending the Data Message). Bit 3 of the Status Byte indicates whether a change has occurred in the Extended Status Byte. If Bit 3 is true, the second status byte should be accessed via the Output Status function to determine the cause of the status change. The bit pattern can be interpreted with the information in Figure 3-11.

3-34. Clearing the Status Byte

Once the Signal Generator sets the SRQ bus line true, it is no longer allowed to alter the Status Byte. If a bit has been enabled and the condition occurs after the SRQ bus line has been set true, the

STATUS BYTE (#1)								
BIT	8	7	6	5	4	3	2	1
WEIGHT	128	64	32	16	8	4	2	1
Condition	Change in Sweep Parameters	RQS Bit Request Service	Entry Error	End of Sweep	Source Settled	Change in Extended Status	Front Panel Entry Complete	Front Panel Key Pressed

EXTENDED STATUS BYTE (#2)								
BIT	8	7	6	5	4	3	2	1
WEIGHT	128	64	32	16	8	4	2	1
Condition	0 (always)	ALC Unleveled	Power Failure/On	Not ϕ Locked	External Ref	0 (always)	FM Overmod	Self-Test Failed

Figure 3-11. Status Byte Information

Clearing the Status Byte (cont'd)

bit is stored in a buffer and is read the next time the Signal Generator receives the Serial Poll Enable (SPE) bus command. When addressed to talk (following SPE), the Signal Generator sends the Status Byte message.

After the Status Byte message has been sent it will be cleared if the Serial Poll Disable (SPD) bus command is received, if the Abort message is received, or if the Signal Generator is unaddressed to talk. However, bits stored in the buffer waiting to be read are not cleared. Regardless of whether or not the Status Byte message has been sent, the Status Byte and any Require Service message pending will be cleared if a Clear Status (CS) program code is received or the Output Status function is executed.

NOTE

The Signal Generator must receive a universal untalk command after sending the Status Byte message. Most system controllers send this automatically. However, if a universal untalk command is not sent, the SRQ bus line may not be re-initialized and pending Service Requests may get lost.

3-42. Sending the Status Bit Message

The Signal Generator sends the Status Bit message (if configured) as part of the interface's response byte to the Parallel Poll Enable (PPE) bus command. In order for the Signal Generator to respond to a Parallel Poll Enable bus command it must be assigned a single HP-IB data line by the controller. The controller also assigns the logic level of the bit. Both tasks can be accomplished by the Parallel Poll Configure (PPC) bus command. If the Signal Generator is sending the Require Service message, it will set its assigned status bit true. The Signal Generator can send the Status Bit message without being addressed to talk.

The data line that the Signal Generator is assigned to respond on can be cleared by turning the instrument to STBY or by sending the Parallel Poll Unconfigure (PPU) bus command.

3-43. Receiving the Abort Message

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

Table 3-7. HP-IB Program Codes

Program Code	Parameter
AO	AM OFF
AP	Level (RANGE and VERNIER)
A0	AM OFF
A1	AM OFF
A2	AM 30%
A3	AM 100%
BY1	Bypass
CF	Center Frequency
CS	Clear Status
CT	Configure Trigger
CW	CW Frequency
C1	ALC INTERNAL
C2	ALC DIODE
C3	ALC PWR MTR
DB	dB
DF	ΔF
DM	dBm
DN	FREQ INCREMENT (Down)
DO	FM DEVIATION OFF
DW	DWELL
D0	FM DEVIATION OFF
D1	FM DEVIATION OFF
D2	FM DEVIATION .03 MHz
D3	FM DEVIATION .1 MHz
D4	FM DEVIATION .3 MHz
D5	FM DEVIATION 1 MHz
D6	FM DEVIATION 3 MHz
D7	FM DEVIATION 10 MHz
FA	START Sweep Frequency
FB	STOP Sweep Frequency
FI	FREQ INCR
FN	FREQ INCR
FR	FREQUENCY
FS	ΔF
F1	FREQ INCR
GZ	GHz
HZ	Hz
IF	FREQ INCREMENT (Up)
IP	Instrument Preset
KZ	kHz
K0	AUTO PEAK OFF
K1	AUTO PEAK ON
K2	AUTO PEAK without extra settling time
LE	Level (RANGE and VERNIER)
L1	Front Panel Learn Mode
L2	Special Function Learn Mode
MG	MESSAGE
MO	Marker(s) OFF
MS	milliseconds
MZ	MHz
M0	Marker(s) OFF
M1	Marker 1
M2	Marker 2
M3	Marker 3
M4	Marker 4
M5	Marker 5
NM	Normal
NO	TUNE Knob OFF
N0	TUNE Knob OFF
N1	TUNE Knob ON
OA	Output Active Parameter
OC	Output Couple
OK	Output Lock Frequency
OL	Front Panel Learn Mode
OR	Output Request Mask
OS	Output Status
PL	Power Level (RANGE and VERNIER)
PO	PULSE OFF
P0	PULSE OFF
P1	PULSE OFF
P2	PULSE NORM
P3	PULSE COMP
RA	RANGE
RC	Recall (RCL)
RD	RANGE Down 10 dB
RF0	RF OFF
RF1	RF ON
RL	Recall (RCL)
RM	RQS Mask
RO	RF OFF
RS	Reset Sweep
RU	RANGE Up 10 dB
R0	RF OFF
R1	RF ON
SD	Slave Down
SF	STEP
SM	MANUAL Sweep
SP	STEP
SS	Steps (suffix)
ST	Store (STO)
SU	Slave Up
SV	Service Function
TI	Test Interface
TR	Execute Trigger
T1	Meter LVL
T2	Meter AM
T3	Meter FM
UP	FREQ INCREMENT (Up)
VE	VERNIER
WO	SWEEP MODE OFF
W0	SWEEP MODE OFF
W1	SWEEP MODE OFF
W2	AUTO Sweep
W3	MANUAL Sweep
W4	SINGLE Sweep
W5	SINGLE Sweep: Arm Only
W6	SINGLE Sweep: Arm and Begin
W7	Master Sweep
W8	Slave Sweep
X0	Marker(s) OFF
X1	Marker 1
X2	Marker 2
X3	Marker 3
X4	Marker 4
X5	Marker 5
Yi	Display On
Yo	Display Off
@A	Start of Front Panel Learn Mode
@1	Prefix for Request Mask
@2	Deferred Execution Mode
@3	Immediate Execution Mode
@9	Start of Special Function Learn Mode

Table 3-8. Messages

Code	Definition
00	NO ERROR
Messages 01 -- 09 are operator errors. The entry is ignored and the previous values are retained.	
01	FREQUENCY OUT OF RANGE
02	FREQ INCR OUT OF RANGE
04	CANNOT STORE 0
05	STEP SIZE OUT OF RANGE
07	NUMBER OF STEPS OUT OF RANGE
08	DWELL OUT OF RANGE
09	MARKER NUMBER NOT 1 – 5
Messages 10 through 16 are "soft errors" that result from unusual combinations of sweep entries. A message is displayed and all entered values are stored in anticipation that further entries will resolve the conflict.	
10	START FREQ STOP FREQ. No sweep.
11	SWEEP SPAN RESULTS IN START FREQUENCY TOO HIGH. Truncated sweep will result.
12	SWEEP SPAN RESULTS IN STOP FREQUENCY TOO LOW. Truncated sweep will result.
13	NUMBER OF STEPS ADJUSTED TO GIVE STEP SIZE IN EVEN kHz. Press STEP to see result.
14	STEP SIZE TOO SMALL FOR SPAN. Press STEP to see result maximum number of steps is 9999.
15	STEP SIZE SPAN. Step size is set to span.
16	BAND CROSSING IN AUTO SWEEP
Messages 20 -- 24 are HP-IB errors. The entry is ignored.	
20	INVALID HP-IB CODE
21	HP-IB DATA WITHOUT VALID PREFIX
22	INVALID HP-IB ADDRESS ENTRY
23	TALK FUNCTION NOT PROPERLY SPECIFIED.
24	OUTPUT LEVEL OUT OF RANGE
Messages 30 -- 99 are service-related errors. Refer to Section VIII in the manual.	
90	AUTO PEAK MALFUNCTION
92	RECALL CHECKSUM ERROR
95	LOSS OF DATA ON POWER UP
96	MEMORY TEST FAILURE
97	ROM TEST FAILURE, A2A10
98	RAM TEST FAILURE, A2A11
99	RAM NOT FUNCTIONAL AT POWER UP