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Errata

Title & Document Type:

Manual Part Number:

Revision Date:

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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OPERATING MANUAL

8656A
SIGNAL GENERATOR
0.1 — 990 MHz
(Including Options 001 and 002)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2035A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 2032A, 2027A, 2026A, 2025A, 2024A, 2023A, 2022A, 2018A, 2014A, and 2009A.

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

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1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

OPERATING MANUAL PART NO. 08656-90108
Operating and Service Manual Part No. 08656-90107
Microfiche Operating and Service Manual Part No. 08656-90109

Printed: MAY 1981

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MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 8656A
Date Printed: May 1981
Part Number: 08656-90108

SIGNAL GENERATOR
OPERATING MANUAL

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after printing the manual.

To use this supplement, first, make all ERRATA corrections and then all appropriate serial number related changes indicated in the tables below.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
2107A, 2111A	Errata Only
2115A, 2117A	Errata Only
2124A, 2127A	Errata Only
2128A, 2131A	Errata Only
2132A, 2135A	Errata Only
2136A, 2141A	Errata Only
2142A, 2146A	Errata Only
2148A, 2150A	Errata Only
2151A, 2208A	Errata Only
2214A, 2228A	Errata Only
2232A, 2233A	Errata Only
2245A, 2312A	Errata Only
2326A, 2341A	Errata Only
>> 2352A, 2402A	Errata Only

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

>> NEW ITEM

NOTE:
Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies, quote the manual identification information from your supplement or the model number and print date from the title page of the manual.

Printed in U.S.A.

HEWLETT PACKARD

20 January 1984
2 Pages Text

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ERRATA

Page 1-4. Table 1-1:
Under SPECTRAL PURITY, change the performance limit for Harmonics to < -25dBc.

>> Page 1-7, Table 1-2:
In the "**Supplemental Characteristics**" under "**Modulation**" change "**Modulating Signal Output:**" to read:

Internal modulating signal is provided at the front-panel BNC connector: nominally 1V peak into a 600 ohm resistive load.

Page 1-10, Table 1-3:
Change RF Cable, BNC(f) to BNC(f), 08662-60080, to RF Cable, BNC(m) to SMC(f), 08662-60075.

Page 2-1, paragraph 2-4:
In the first sentence following the first warning, change "115 (90 to 126) Vac or 230 (198 to 252) Vac" to "100, 120, 220, or 240 Vac, +5%, -10%".

Page 2-2, paragraph 2-7:
In this section any information referring to an inductive-jumper should be changed to read resistive-jumper.

Page 2-7/2-8, Section 2-13 **Rack Mounting (Cont'd):**
Delete: Standard Tilt Slide Kit for HP rack enclosures.....HP 1494-0025
Add: Special Tilt Slide Kit for HP rack enclosures.....HP 08656-82001

Page 3-4, paragraph 3-11:
In this section any information referring to an inductive-jumper should be changed to read resistive-jumper.

>> Page 3-8, Figure 3-4:
Under "**MOD INPUT/OUTPUT Connector**" in the fifth sentence delete "±5% minimum".

Page 3-23, paragraph 3-18:
In the sixth sentence change SH1 to SH0.

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SAFETY CONSIDERATIONS

GENERAL – This is a Safety Class I instrument (provided with terminal for protective earthing).

OPERATION – BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and Safety Precautions are taken (see the following warnings). In addition, note the instrument's external markings which are described under "Safety Symbols."

WARNINGS

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

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

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

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal is likely to make this instrument dangerous. Intentional interruption is prohibited.

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

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

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

SAFETY SYMBOLS



Instruction manual symbol: the apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.



Indicates dangerous voltages.



Earth terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

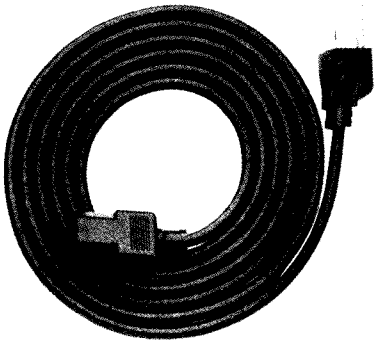
WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

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 equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

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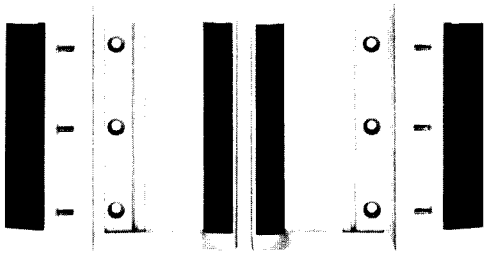


MODEL 8656A

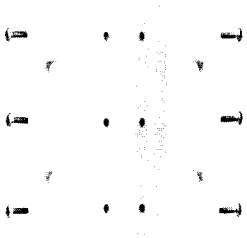


LINE POWER CABLE

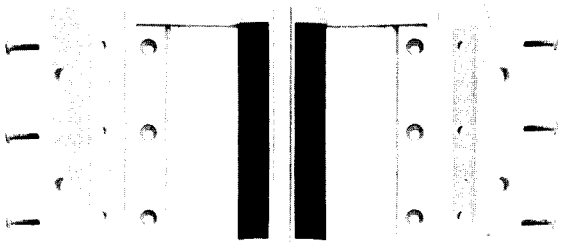
OPTION 001
TIME BASE CABLE



OPTION 907
FRONT HANDLE KIT



OPTION 908
RACK FLANGE KIT



OPTION 909
RACK FLANGE AND FRONT HANDLE
COMBINATION KIT

NOTE: Refer to ACCESSORIES SUPPLIED for more details.

Figure 1-1. HP Model 8656A Signal Generator with Option 001 and Accessories Supplied

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 8656A Signal Generator. The Model 8656A will generally be referred to as the Signal Generator throughout this manual. Figure 1-1 shows the Signal Generator with all of its externally supplied accessories. This manual also documents Signal Generators supplied with the high stability time base, Option 001 and rear panel connectors, Option 002.

This section of the manual describes the instruments documented by this manual and covers instrument description, options, accessories, specifications, and other basic information. The other sections contain the following information:

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

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

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

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

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

Section VII, Manual Changes: with the backdating information, this manual applies to all instruments as indicated on the title page.

Section VIII, Service: provides the information required to repair the instrument.

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 simply 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 may be ordered separately through your nearest Hewlett-Packard office. Its part number is listed on the title page of this manual.

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

1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested. Supplemental characteristics are 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 must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information pertinent to the task at hand, that is, installation, operation, performance testing, adjustment, or service is found throughout this manual.

1-4. INSTRUMENTS COVERED BY THIS MANUAL

This instrument has a two-part serial number in the form 0000A00000 which is stamped on the serial number plate attached to the rear of the instrument. The first four digits and the letter con-

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INSTRUMENTS COVERED BY THIS MANUAL (Cont'd)

stitute the serial number prefix and the last five digits form the suffix. The prefix is the same for all identical instruments. It changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

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

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest MANUAL CHANGES supplement. The supplement for this manual is identified with the manual print date and part number, both 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.

1-5. DESCRIPTION

The Hewlett-Packard Model 8656A is a synthesized signal generator with a carrier frequency range of 100 kHz to 990 MHz. Its output amplitude is leveled and calibrated from +13 to −127 dBm. AM and/or FM functions can be individually selected. The carrier frequency, output amplitude, and modulation functions can be remotely programmed via the Hewlett-Packard Interface Bus. The unique modular design and incorporated service features permit rapid and easy calibration and service.

1-6. Carrier Frequency

The Signal Generator covers a carrier frequency range of 100 kHz to 990 MHz (10 kHz to 990 MHz with underrange) which can be extended to 1.8 GHz with an external doubler. Frequency resolution is 100 Hz or 250 Hz depending on the carrier frequency selected. An 8-digit LED display of the carrier frequency in MHz is provided. Pushbutton keys permit coarse tuning, fine tuning, and incrementing of the carrier frequency.

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

1-7. Output Amplitude

The Signal Generator has precise power levels from +13 to −127 dBm (+1.00V to +0.100 μV) with overrange at decreased accuracy. The output amplitude from +13 to −127 dBm is accurate to less than or equal to ±1.5 dB from 100 kHz to 990 MHz. Level flatness is less than or equal to ±1.0 dB with an output amplitude setting of 0.0 dBm. Output amplitude resolution is 0.1 dB. A 3-1/2-digit LED display of output amplitude is provided with 7 LED annunciators used to display unit information. Easy conversion of units between dBm, μV, EMF, and so forth is possible.

1-8. Modulation Capabilities

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

1-9. OPTIONS

The following options are available and may have been ordered and received with the Signal Generator. If they were not received with the original shipment and are now desired, except for option

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OPTIONS (Cont'd)
002, they may be ordered from your nearest Hewlett-Packard office using the part number included in each of the following paragraphs.

1-10. Electrical Options

Option 001 provides a 10 MHz crystal reference for increased frequency accuracy and stability. Order HP part number 08656-60079.

1-11. Mechanical Options

The mechanical options except Option 002 are shown in Figure 1-1.

Rear Panel Inputs and Outputs Option 002. RF Output and Modulation Input/Output Connectors are located on the rear panel. The SEQ (sequencing) input is eliminated.

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

Rack Flange Kit Option 908. This kit contains all necessary hardware and installation instructions for mounting the Signal Generator in a rack with 482.5 millimeter (standard 19-inch) spacing. Order HP part number 5061-0077.

Rack Flange and Front Handle Combination Kit Option 909. This kit is not simply a front handle kit and rack flange kit packaged together. The combination is made up of unique parts which include both functions. Order HP part number 5061-0083.

1-12. HEWLETT-PACKARD INTERFACE BUS HP-IB*

1-13. Compatibility

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

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

1-14 Selecting the HP-IB Address

Five miniature HP-IB address switches are located inside the Signal Generator. These switches represent a five-bit binary number (00 through 31 in decimal). HP-IB addresses greater than 30 (decimal) are invalid. When the instrument is shipped from the factory, the HP-IB address is preset to 07 (decimal). To determine the Signal Generator's HP-IB address, refer to HP-IB Address Display in Section III of this manual. To change the HP-IB address, refer to paragraph 2-8, HP-IB Address Selection.

1-15. ACCESSORIES SUPPLIED

The accessories supplied with the Signal Generator are shown in Figure 1-1. The power cable and fuse supplied are selected at the factory according to the Mains voltage available in the country of destination. For the part numbers of the power cables and Mains plugs available, refer to paragraph 2-6, Power Cables. For the part numbers and ratings of the fuses available, refer to paragraph 2-5, Line Voltage and Fuse Selection. If the Signal Generator is equipped with Option 001, a coaxial time base cable is supplied. This cable must be connected between the rear panel TIME BASE HIGH STABILITY OPTION connector and the TIME BASE INPUT connector.

1-16 RECOMMENDED TEST EQUIPMENT

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

The Recommended Model column may suggest more than one model. The first model listed is usually the least expensive, single-purpose model. Alternate models are suggested for additional features that would make them a better choice in some applications. For example, reasons for recommending an alternate model might be:

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

Table 1-4 presents the advantages of the alternate suggestions.

*HP-IB SYSTEMS Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a measurement system.

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Table 1-1. Specifications (1 of 3)

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	100 kHz to 990 MHz	
Resolution	100 Hz	
	250 Hz	
SPECTRAL PURITY		
Spurious Signals:		
Harmonics	<–30 dBc	≤+7 dBm output levels
Non-harmonics	<–60 dBc	>5 kHz from carrier in CW mode
Sub-harmonics	None	
Residual Modulation CW Mode:		
AM (0.05 to 15 kHz Post Detection Noise Bandwidth)	<–70 dBc	0.1 to 990 MHz
FM (0.3 to 3 kHz Post Detection Noise Bandwidth)	<15 Hz rms	0.1 to 123.5 MHz
	<3 Hz rms	123.5 to 247 MHz
	<6 Hz rms	247 to 494 MHz
	<15 Hz rms	494 to 990 MHz
FM (0.05 to 15 kHz Post Detection Noise Bandwidth)	<30 Hz	0.1 to 123.5 MHz
	<8 Hz	123.5 to 247 MHz
	<16 Hz	247 to 494 MHz
	<30 Hz	494 to 990 MHz
OUTPUT		
Level Range	+13 dBm to –127 dBm	Into 50 ohms
Resolution	0.1 dB	
Absolute Level Accuracy[1]	≤±1.5 dB	Output levels of +13 dBm to –127 dBm; frequencies from 100 kHz to 990 MHz
Level Flatness	≤±1.0 dB	Output level setting of 0.0 dBm; frequencies from 100 kHz to 990 MHz
AMPLITUDE MODULATION		
Depth[2]	0 to 99%	Output levels of +7 dBm and below; frequencies from 100 kHz to 990 MHz
	0 to 30%	Output levels of +10 dBm and below; frequencies from 100 kHz to 990 MHz
Resolution	1%	
Incidental Phase Modulation	<0.3 radian peak	30% AM depth and internal rates

[1]Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement error.
[2]AM depth is further limited by the Indicator Accuracy specification.

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Table 1-1. Specifications (2 of 3)

Electrical Characteristics	Performance Limits	Conditions
AMPLITUDE MODULATION (Cont'd)		
Indicator Accuracy[2]	±2% (±4% of reading)	Depths <90% and internal rates
AM Rates:		
Internal	400 and 1 kHz, ±3%	
External	25 Hz to 25 kHz	1 dB bandwidth, ac coupled
AM Distortion (internal rates)	<1.5% <3% <5%	0 to 30% AM 31 to 70% AM 71 to 90% AM
FM MODULATION		
Maximum Peak Deviation (Δfpk):[3]		
Rates ≥60 Hz	99 kHz 25 kHz 50 kHz 99 kHz	0.1 to 123.5 MHz (fc) 123.5 to 247 MHz (fc) 247 to 494 MHz (fc) 494 to 990 MHz (fc)
Rates <60 Hz	1600 x Rate 400 x Rate 800 x Rate 1600 x Rate	0.1 to 123.5 MHz (fc) 123.5 to 247 MHz (fc) 247 to 494 MHz (fc) 494 to 990 MHz (fc) (FM not specified for fc — Δfpk <100 kHz)
Resolution	0.1 kHz 1 kHz	Deviations <10 kHz Deviations ≥10 kHz
Incidental AM	<0.1%	<20 kHz peak deviation and internal rates and carrier frequency ≥500 kHz.
Indicator Accuracy[3]	±5% of reading	At internal rates. Add ±5%, if 250 Hz frequency increments are used.
FM Distortion (Total Harmonic Distortion)	<0.5%	100 Hz to 99 kHz peak deviations and internal rates.
FM Rates:		
Internal	400 and 1 kHz, ±3%	
External	25 Hz to 25 kHz	1 dB bandwidth, ac coupled
GENERAL		
Operating Temperature Range	0 to 55°C	
Power Requirements		
Line Voltage	100, 120, 220, or 240 Vac, +5%, −10%	

[2]AM depth is further limited by the Indicator Accuracy specification.
[3]FM deviation is further limited by the Indicator Accuracy specification.

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Table 1-1. Specifications (3 of 3)

Electrical Characteristics	Performance Limits	Conditions
GENERAL (Cont'd)		
Line Frequency	48 to 66 Hz	
Power Dissipation	125VA maximum	
Conducted and Radiated Electromagnetic Interference	MIL STD 461A, VDE 0871	Conducted and radiated interference is within the requirements of methods CE03 and RE02 of MIL STD 461A, VDE 0871, and CISPR Publication 11.
	<1.0 μV	Induced in a two-turn 2.5 cm (1 inch) diameter loop held 2.5 cm (1 inch) away from the front surface.
Net Weight	18.1 kg (40 lb)	
Dimensions (Full Envelope):		
Height Width Depth	133 mm (5.25 in.) nominal 425 mm (16.75 in.) nominal 520 mm (20.5 in.) nominal.	NOTE: For ordering cabinet accessories, the module sizes are 5-1/4H, 1MW, 17D.
Electrical Characteristics	**Features**	
REMOTE OPERATION		
HP-IB (IEEE 488) Capability:		
Interface	Hewlett-Packard Interface Bus (HP-IB). HP-IB is Hewlett-Packard's implementation of IEEE Standard 488 (and the identical ANSI Standard MC1.1). The Signal Generator's compatibility with HP-IB is defined by the following list of interface functions: SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0.	
Functions Controlled	All functions controlled from the front panel with the exception of DISPLAY, DISPLAY in conjunction with SEQ, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS are programmable with the same accuracy and resolution as in local operation.	

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Table 1-2. Supplemental Characteristics

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

FREQUENCY

Accuracy and Stability: same as internal time base.

Time Base Characteristics:

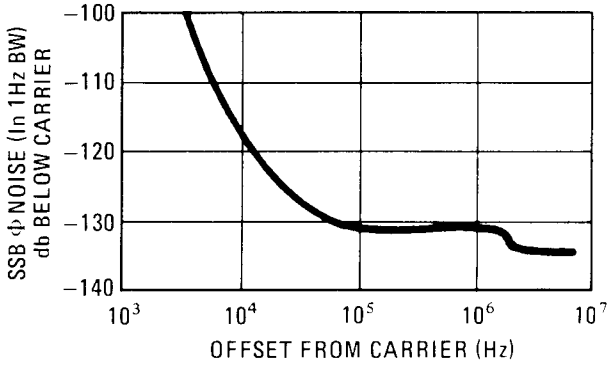
Characteristic	Standard Time Base	Option 001 Time Base
Aging Rate	±2 ppm/year	1×10^{-9}/day
Temperature	±10 ppm (0—55°C)	7×10^{-9} (0—55°C)
Line Voltage	—	2×10^{-9} (+5 to −10%)
Frequency	50 MHz	10 MHz
Time Base Reference Signal (Rear Panel)	Available at a level of >0.15 Vrms into 50 ohms (output of 10, 5 or 1 MHz is selectable via internal jumper). If the Option 001 or another external reference is used, only that reference frequency is available as an output.	
External Reference Input (Rear Panel)	Accepts any 10, 5 or 1 MHz (±0.002%) frequency standard at a level >0.15 Vrms into 50 ohms.	

Frequency Switching Speed: <2 seconds to be within 100 Hz of selected frequency.

SPECTRAL PURITY

SSB ϕ Noise (CW only):

Offset from Carrier	0.1 to 123.5 MHz (dBc/Hz)	123.5 to 247 MHz (dBc/Hz)	247 to 494 MHz (dBc/Hz)	494 to 990 MHz (dBc/Hz)
20 kHz	<−115	<−127	<−121	<−115
500 kHz	<−125	<−135	<−131	<−125



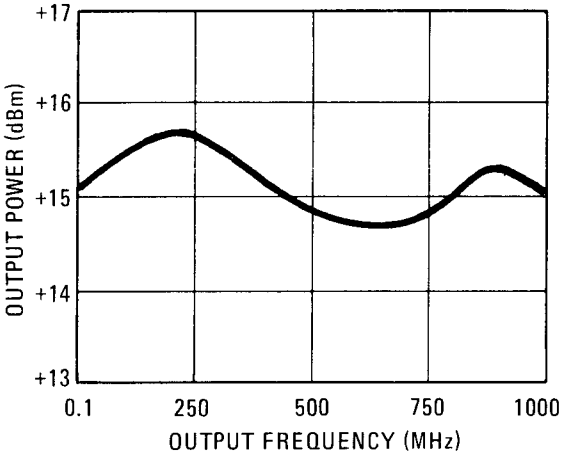
Typical SSB ϕ Noise, f_c = 450 MHz.

OUTPUT

SWR: <2, 0.1 to 990 MHz and <+13 dBm; < 1.5, 1.0 to 990 MHz and <−5 dBm.

Impedance: 50 ohms nominal.

Reverse Power Protection: protects Signal Generator from application of up to 50 watts of RF power to 990 MHz into RF OUTPUT connector; dc voltage cannot exceed 25V.



Typical maximum power output versus frequency (output set to +17 dBm).

MODULATION

(Amplitude and Frequency Modulation)

External Sensitivity: 1V peak for indicated accuracy. Front-panel annunciators indicate application of 1V peak signal ±5%.

External Modulation Input: front-panel BNC; ac-coupled, 600 ohms.

Modulating Signal Output: internal modulating signal is provided at the front-panel BNC connector at 1V peak, ±5% into 600-ohm resistive load.

Digital FM Modulation: will accept digital unsquelching signals. Sag of resultant demodulated signal is less than 8% at 1 kHz deviation for a 10 Hz square-wave modulating signal.

Simultaneous Modulation: internal and external AM and FM. Internal/external AM/FM, FM/AM, AM/AM, and FM/FM.

AM Incidental to FM: <1% for 200 kHz ≤f_c<500 kHz and <5% for 100 kHz ≤f_c<200 kHz.

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

Instrument	Critical Specifications	Recommended Model	Use[1]
AM/FM Test Source (required for modulation analyzer verification)	Range: 10 to 400 MHz Residual AM[2] FM Flatness: ±1% (dc to 250 kHz) Peak Deviation: to 100 kHz)	HP 11715A	P
Attenuator, Fixed	Attenuation: 20 dB Frequency Range: 10 MHz to 990 MHz SWR: <1.2	HP 8491A Option 020	A
Attenuator, Fixed	Attenuation: 60 dB Frequency Range: 100 kHz to 990 MHz Accuracy: ±2 dB ±0.16 dB at Standards Calibration Lab, Frequencies of 10, 100, 201, 801, 901, and 990 MHz. SWR: <1.3	HP 8491A Option H56	P
Controller, HP-IB	HP-IB compatibility as defined by IEEE Standard 488 and the identical ANSI Standard MC1.1: SH0, AH1, T4, TE0, L0, LE0, SR0, RL0, PP0, DC0 DT0, and C1, 2, 3, 28.	HP 9825A/98034A/ 98213A or HP 9835A/ 98332A/98034A (see Table 1-4)	A, T
Digital Multimeter	Accuracy: 4-1/2 digit, ±0.02% of reading ±1 digit Ranges: 20 mV to 30 Vdc and 2 Vac Sensitivity: 100 μV	HP 3465A or HP 3455A (see Table 1-4)	P, A, T
Distortion Analyzer	Distortion Range: <0.1% Range: 25 Hz to 25 kHz	HP 339A or HP 8903A (see Table 1-4)	P, T
Frequency Counter	Range: 10 MHz Resolution: 1 Hz	HP 5328A Option 031 or HP 5328A Options 001 and 031 (see Table 1-4)	A
Frequency Counter	Range: 990 MHz Resolution: 10 Hz	HP 5328A Option 031	T
Loop Antenna 2.5 cm (1 in.)	To ensure measurement accuracy, no substitution is possible. Fabrication depends upon machining and assembling to close tolerances.	HP 008640-60501	P
Modulation Analyzer	Frequency Range: 150 kHz to 990 MHz Input Level: −20 to +13 dBm Amplitude Modulation: Rates[3]: 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 ΦM: <0.05 radians for 50% depth at 1 kHz rate (50 Hz to 3 kHz bandwidth) Residual AM[2]	HP 8901A	P, A

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

Instrument	Critical Specifications	Recommended Model	Use[1]
Modulation Analyzer (Cont'd)	Frequency Modulation: Rates: 25 Hz to 25 kHz Deviation: to 99 kHz Accuracy: ±2% at 1 kHz Demodulated Output Distortion: <0.3% Incidental AM[3]: Residual FM: <8 Hz rms at 1300 decreasing linearly with frequency to <1 Hz rms for 100 MHz and below (50 Hz to 3 kHz bandwidth).		
Oscilloscope	Vertical Sensitivity: 10 mV/div Bandwidth: 50 MHz	HP 1222A or HP 1801A/1820C/181A (see Table 1-4)	A, T
Power Meter and Sensor	Frequency Range: 100 kHz to 990 MHz Power Range: +17 to −25 dBm with HP 8482A Frequency Range: 10 to 990 MHz Power Range: −20 to −60 dBm with HP 8484A Accuracy: ±0.2 dB	HP 436A or HP 436A Option 022 with HP 8484A and HP 8484A (see Table 1-4)	P, A, T
Signal Source	Frequency: 50 to 300 MHz Level: −20 dBm	HP 8640B	A, T
Signature Analyzer	Provides perferred method for troubleshooting digital circuitry.	HP 5004A	T
Spectrum Analyzer, RF	Frequency Range: 0.1 to 990 MHz Resolution Bandwidth: <1 kHz to 3 kHz	HP 8568A or HP 8558B/P/181T or (see Table 1-4)	P, A, T
Spectrum Analyzer, RF	Frequency: 10 to 990 MHz Resolution Bandwidth: <100 kHz Video Average: 25 Sweeps	Model 8568A	P, A, T
Test Oscillator	Level: 0.0 to 1 Vpk into 50 and 600 ohms Frequency: 25 Hz to 25 MHz	HP 651B	P, T
Wideband Amplifier	Gain: 20 or greater Frequency Range: 10 MHz to 990 MHz Impedance: 50 ohms Connector: Type N	HP 8447D Option 010	P

Adapter	Qty.	Type	Recommended Model	Use[1]
Coaxial	1	BNC(f) to BNC(f)	HP 1250-0080	A, T
Coaxial	1	N(f) to BNC(m)	HP 1250-0077	A
Coaxial	3	N(m) to BNC(f)	HP 1250-0780	P, A, T
Probe	2	SMC(f) to RF Test Point	HP 1250-1598	A, T

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

Cable	Qty.	Type	Recommended Model	Use[1]
RF	2	BNC(f) to BNC(f)	HP 08662-60080	P
RF	1	Connector: UG-210/U Type N(m)	HP 11500A	P, A, T
RF	2	Connector: UG-210/U Type N(m)	HP 11500B	P, A, T

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

[2]The residual AM specification of both the HP 8901A Modulation Analyzer and HP 11715A AM/FM Test Source are stated in a 50 Hz to 3 kHz bandwidth. In order to assure the validity of the residual AM measurement in the bandwidths stated for the HP 8656A Signal Generator (namely, 50 Hz to 15 kHz) the combined performance of both the HP 8901A and HP 11715A must be verified to be better than 0.022% rms for the 50 Hz to 15 kHz bandwidth. See paragraph 4-7, step 4, for the verification procedure.

[3]The incidental AM specification of the Signal Generator is not equivalent to the published specification of the Model 8901A Modulation Analyzer. In order to assure the validity of the incidental AM measurement, the incidental AM of the modulation analyzer must be verified to be less than 0.02% for the 300 Hz to 3 kHz bandwidth and 20 kHz peak deviation at internal rates. Refer to paragraph 4-10, step 18, for the verification procedures.

Table 1-4. Alternate Test Equipment

Instrument	Recommended Model	Suggested Alternative	Advantages of Alternative
Controller, HP-IB	HP 9825A/98213A/ 98034A	HP 9835A/98332A/ 98034A	CRT Display HP Enhanced BASIC Larger Memory
Digital Voltmeter (DVM)	HP 3465A	HP 3455A	HP-IB* Compatible
Distortion Analyzer	HP 339A	HP 8903A	HP-IB* Compatible
Frequency Counter	HP 5328A Option 031	HP 5328A Options 001 and 031	HP-IB* Compatible
Power Meter	HP 436A	HP 436A Option 022	HP-IB* Compatible
Oscilloscope	HP 1222A	HP 1801A/1820C/ 181A	Satisfies all requirements for testing the Signal Generator. Also has increased vertical sensitivity (0.05 mV/ div) and a Persistance Display that makes it possible to troubleshoot the Low Frequency Loop circuits.
Spectrum Analyzer, RF	HP 8568A	HP 8558B/P/181T or HP 8554B/8552B/ 141T	Satisfies most of the requirements for testing the Signal Generator. The exception is the Low Level Accuracy test. In this case, the spectrum analyzer's noise level is high enough that the measurements are meaningless.

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

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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 and fuse selection, power cables, time base selection, HP-IB address selection, interconnection, mating connectors, operating environment, instrument mounting, storage, and shipment.

2-2. INITIAL INSPECTION

WARNING

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

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. 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

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 settings may exceed 3.5 mA.

The Signal Generator requires a power source of 115 (90 to 126) Vac or 230 (198 to 252) Vac, 48 to 66 Hz single phase. Power consumption is 125 VA maximum.

WARNINGS

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

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

2-5. Line Voltage and Fuse Selection

CAUTION

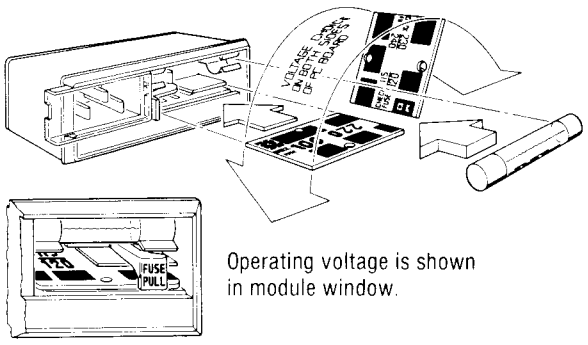
BEFORE PLUGGING THIS INSTRUMENT into the Mains (line) voltage, be sure the correct voltage and fuse have been selected.

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

WARNING

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

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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

Table 2-1. Line Fuse Ratings and Part Numbers

Line Voltage	Rating	Part Number
100/120V	1.25A, 250V, SLO-BLO	HP 2110-0305
220/240V	0.6A, 250V, SLO-BLO	HP 2110-0016

2-6. Power Cables

WARNING

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

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

2-7. Time Base Selection

One of three time base output signals (1, 5, or 10 MHz at a level greater than 0.15 Vrms into 50 ohms) is accessible at the rear panel TIME BASE OUTPUT connector. This output signal is derived from the internal reference oscillator frequency and is jumper-selectable through an inductor located inside the Signal Generator on the Low Frequency Loop Assembly — A3. When the instrument is shipped from the factory, the inductive-jumper is hard-wired to provide a 10 MHz time base output signal. If the Option 001 or another external 10 MHz reference is applied to the rear panel TIME BASE INPUT connector, only that reference frequency will be available as an output signal. Also, if either a 1 or 5 MHz output signal is desired, the internal inductive-jumper will have to be repositioned. Similarly, if an external 1 or 5 MHz reference input is to be applied to the rear panel TIME BASE INPUT connector, the inductive-jumper will have to be repositioned to the position that corresponds to the frequency of the external reference input. The top cover of the Signal Generator will have to be removed to gain access to the time base jumper. The following procedure describes how to change the location of the inductive-jumper.

a. Remove the top cover from the Signal Generator by first removing the two screws used to secure the strap handle to each side of the instrument. Next, remove the front and rear caps, slide the side cover in the direction of the arrow, then lift the side cover away from the frame. Finally, lift the top cover away from the frame.

b. Locate the time base jumper on the Low Frequency Loop Assembly — A3 (see Figure 2-3).

c. Unsolder one end of the inductive-jumper and resolder it in the position that corresponds to the desired time base output or to the external reference input.

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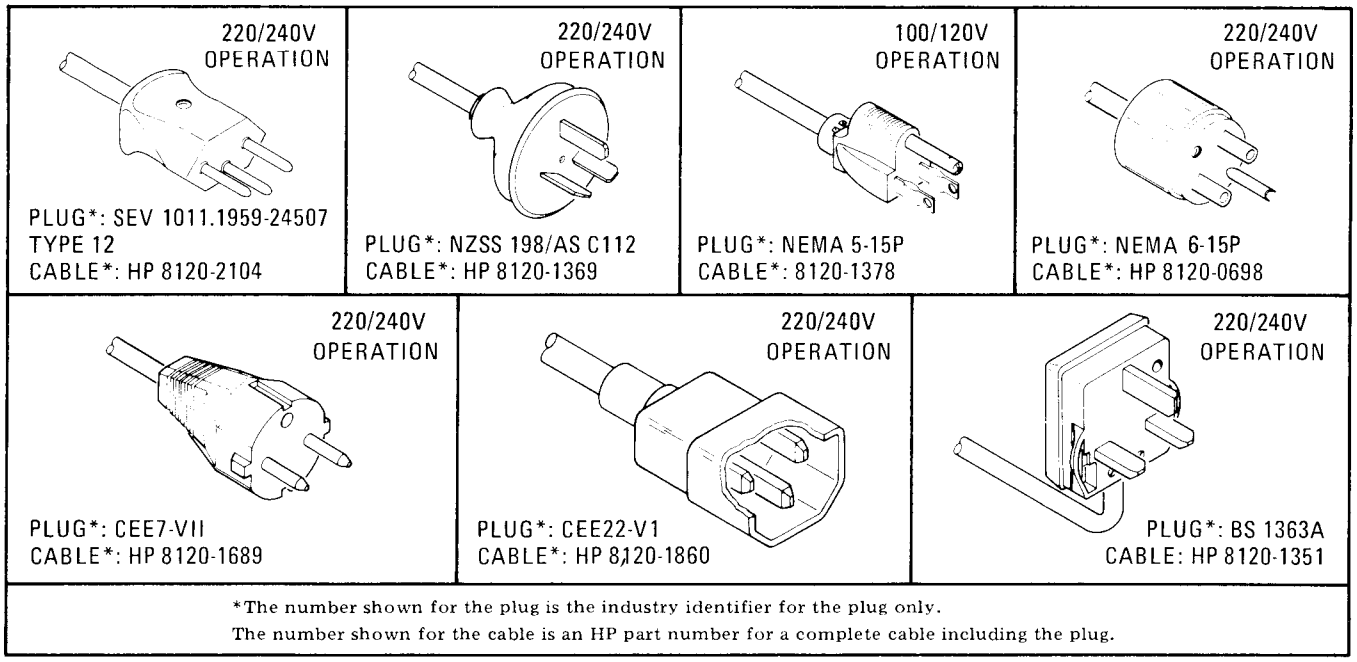


Figure 2-2. Power Cable and Mains Plug Part Numbers

Time Base Selection (Cont'd)

d. Reinstall the top cover by reversing the procedure given in step a.

e. If the Signal Generator is equipped with Option 001, ensure that the coaxial time base cable (A16W2) is connected between the rear panel TIME BASE HIGH STABILITY OPTION connector and the TIME BASE INPUT connector.

2-8. HP-IB Address Selection HP-IB

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

The following procedure describes how to change the settings of the HP-IB address switches.

NOTE

The HP-IB address stored in memory will only change when the instrument is powered up or reset. Therefore, the instrument must be unplugged or reset once the settings of the HP-IB address switches have been changed, otherwise, the stored HP-IB address will remain unchanged.

a. Remove the bottom cover from the Signal Generator by first removing the two screws used to secure the strap handle to each side of the instrument. Next, remove the front and rear caps, slide the cover in the direction of the arrow, then lift the side cover away from the frame. Finally, lift the bottom cover away from the frame.

b. Locate the HP-IB address switches S3 and S4 on the Microprocessor/Memory/ HP-IB Assembly — A11 (see Figure 2-4).

c. Use a pencil to set the switches to the desired HP-IB address in binary (see Figure 2-4). The five switches are labeled A1 through A5, where A1 is the least significant address bit and A5 is the most

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

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

Indicates factory-set address.

HP-IB Address Selection HP-IB (Cont'd)

significant address bit. Pressing the right-hand side of the switch (as viewed from the front of the instrument) "sets" the corresponding address bit (bit=1), while pressing the left-hand side "clears" the bit (bit=0). Setting all of the address bits to "1" will result in an invalid HP-IB address (31 decimal). In this case, an HP-IB address of 30 (decimal) will be stored in memory once the instrument is powered up or reset.

d. Reinstall the bottom cover by reversing the procedure given in step a.

e. To confirm the HP-IB address, simply press and hold the front panel HP-IB ADRS key. The internally-set, decimal HP-IB address will be displayed in the MODULATION Display as long as the HP-IB ADRS key remains pressed.

2-9. Interconnection

Interconnection data for the Hewlett-Packard Interface Bus is provided in Figure 2-5.

2-10. Mating Connectors

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

Interface Connector. HP-IB mating connector is shown in Figure 2-5. Note that the two securing screws are metric.

2-11. Operating Environment

The operating environment should be within the following limitations:

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

2-12. 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-alignment of instruments when they are stacked.) The tilt stands raise the front of the Signal Generator for easier viewing of the front panel.

2-13. Rack Mounting

WARNING

The Signal Generator weighs 18.1 kg (40 lb); therefore, care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting.

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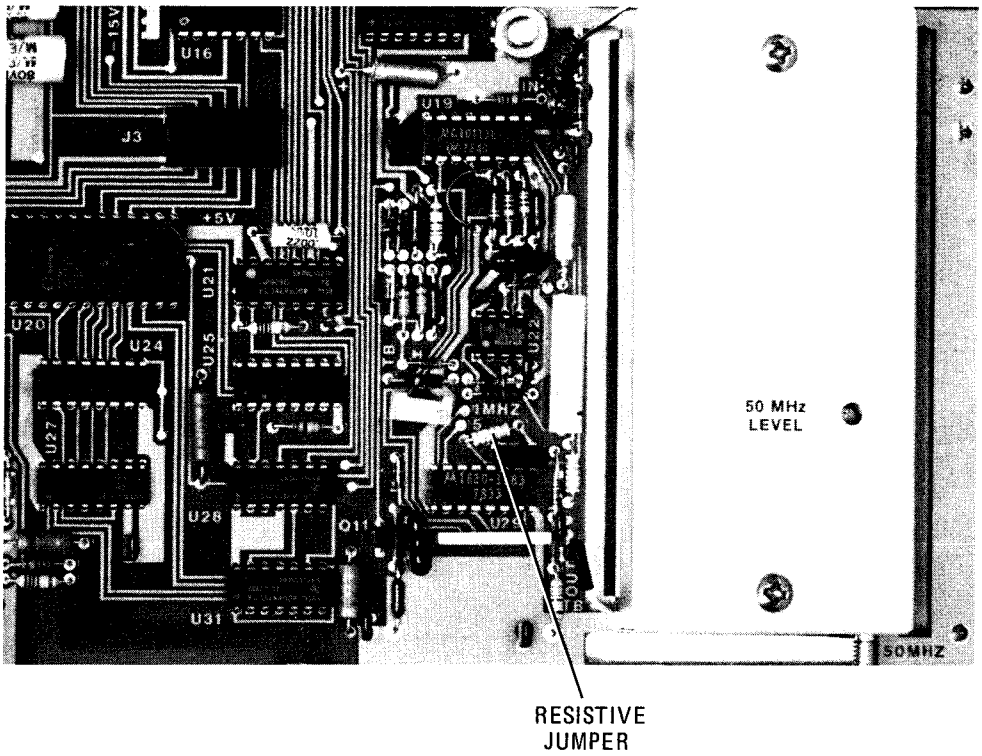
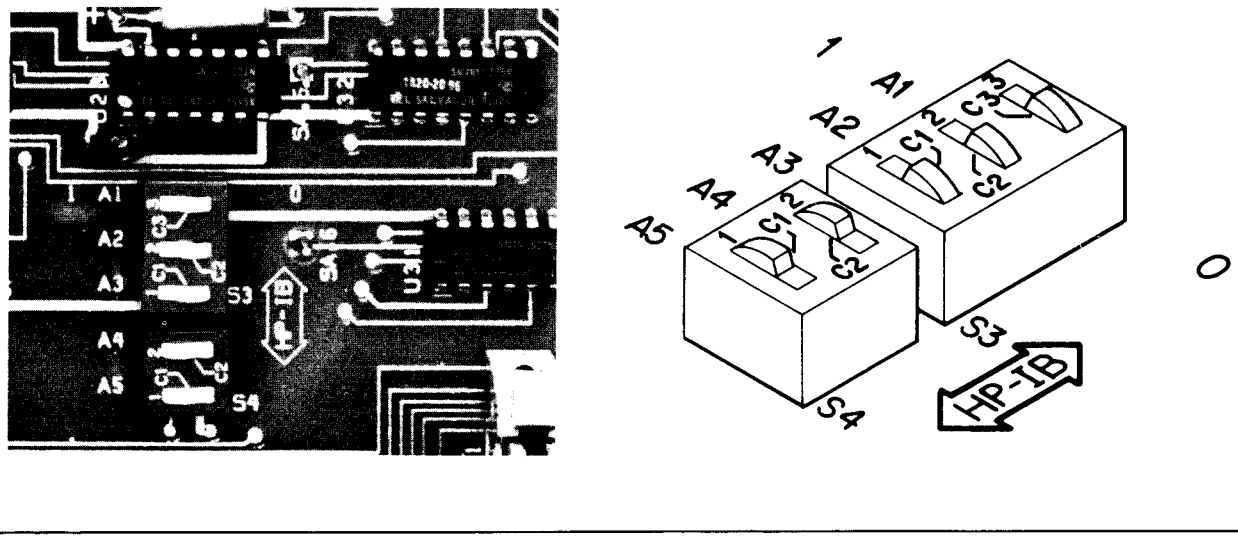


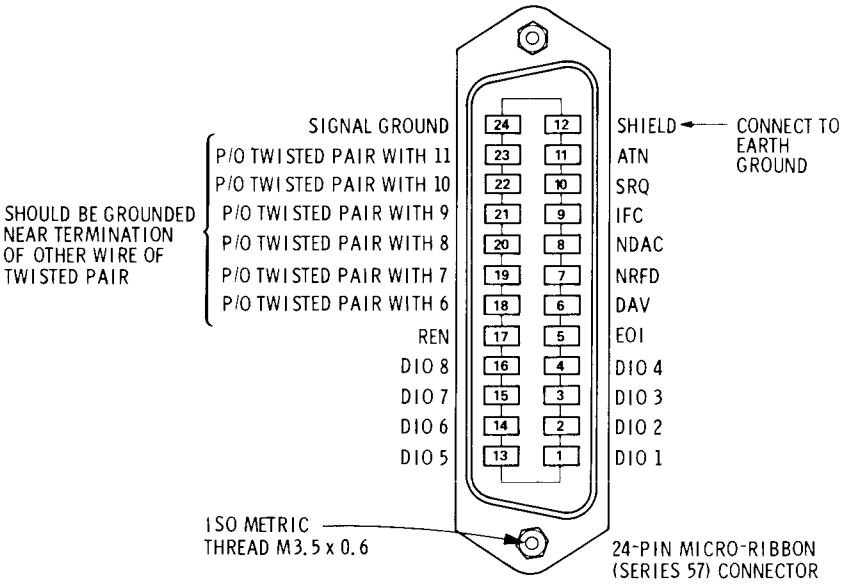
Figure 2-3. Time Base Jumper Location



HP-IB Figure 2-4. HP-IB Address Switch Location and Settings

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HP-IB



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 2-5. Hewlett-Packard Interface Bus Connections

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Rack Mounting (Cont'd)

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

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

Standard Slide Kit for HP rack enclosures ..... HP 1494-0018
Standard Tilt Slide Kit for HP rack enclosures ..... HP 1494-0025
Slide Adapter Bracket Kit for Standard Slides (for non HP rack enclosures) .... HP 1494-0023

2-14. STORAGE AND SHIPMENT

2-15. Environment

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

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

2-16. Packaging

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

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

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number).

b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

c. Use enough shock-absorbing material (75 to 100 millimetre layer; 3 to 4 inches) around all sides of the instrument to provide a firm cushion and to prevent movement in the container. Protect the front panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

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SECTION III
OPERATION

3-1. INTRODUCTION

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

3-2. Operating Characteristics

Table 3-2 briefly summarizes the major operating characteristics of the Signal Generator. This table is not intended to be an in-depth listing of all characteristics. For more detailed information on the Signal Generator's characteristics, refer to Table 1-1, Specifications and Table 1-2, Supplemental Characteristics. For information on the instrument's HP-IB capabilities, refer to the summary contained in Table 3-4, HP-IB Message Reference Table.

3-3. Local Operation

Information covering front panel operation of the Signal Generator is presented in five areas of this section, namely Simplified Front Panel Features, Simplified Operation, General Operating Instructions, Detailed Panel Features, and Detailed Operating Instructions.

Simplified Front Panel Features. Figure 3-1 on the backside of this foldout illustrates the front panel of the Signal Generator and provides simplified descriptions of each key, connector, switch, and display. In addition, references are provided to the more detailed descriptions.

Simplified Operation. The instructions on the backside of this foldout provide a quick introduction to front panel operation of the Signal Generator. These instructions are designed to rapidly acquaint the novice user with the basic operation of the instrument. Included are instructions for setting carrier functions, setting modulation functions, and changing parameter values. This is a good starting point for the first-time user. Table 3-3 provides an index (in functional order) to the detailed operating instructions. This index is intended to direct the user to the more complete operating instructions which are arranged alphabetically at the end of this section.

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

Detailed Panel Features. Front and rear panel features are described in detail in Figures 3-2 through 3-7.

Detailed Operating Instructions. The detailed operating instructions present the most comprehensive information about all of the Signal Generator's functions. These instructions are arranged alphabetically by subject and are included at the end of this section for easy reference. They are indexed in functional order in Table 3-3.

3-4. Remote Operation HP-IB

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

a. General HP-IB information begins with paragraph 3-17.

b. A summary of HP-IB capabilities is provided in Table 3-4.

c. A summary of program codes is provided in Tables 3-8 and 3-9.

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

3-5. Operator's Checks

Operator's checks are simple procedures designed to verify that the main functions of the Signal

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operate properly. Two procedures are provided, one for basic -IB functional checks and the other for HP-IB functional checks.

tional Checks. This procedure requires only a frequency counter, analyzer, and the interconnecting cables and adapters. It pro- ance that most of the front panel controlled functions are being ecuted by the Signal Generator.

tional Checks. This series of procedures requires only an HP-IB computing controller and an HP-IB interface with its intercon- le. These procedures assume that front panel operation has been verified, that is, that the basic functional checks have been performed. The procedures check all of the applicable bus mes- narized in Table 3-4.

tor's Maintenance

aintenance that the operator should normally perform is the t of the primary power fuse. All other maintenance should be ualified service personnel.

RAL OPERATING INSTRUCTIONS

WARNINGS

the Signal Generator is switched on, all protective earth als, extension cords, autotransformers, and devices con- to it should be connected to a protective earth grounded Any interruption of the protective earth grounding will a potential shock hazard that could result in personal

ntinued protection against fire hazard, replace the line ith only a 250 V slo-blo fuse of the same rating. Do not use d fuses or short circuited fuseholders.

CAUTIONS

the Signal Generator is switched on, it must be set to the ne voltage as the power source or damage to the instru- ay result.

nal Generator is protected against reverse power applica- to 50 watts; however, for greatest protection of expensive l components be careful not to apply any reverse power to OUTPUT connector.

-On Procedure

Generator has a standby state and an on state. Whenever the is plugged in, the internal power supply is activated. If the s equipped with the high stability reference (Option 001), the energized to keep the reference oscillator stable. If the Signal already plugged in, set the RESET/STBY/ON switch to ON. cable is not plugged in, follow these instructions:

1. Check that the line voltage setting matches the power source. Refer to paragraph 2-5.
2. Check that the fuse rating is appropriate for the line voltage being used. Refer to paragraph 2-5.
3. Plug in the power cable.
4. Set the RESET/STBY/ON switch to ON.

3-9. Power-On Sequence

When the RESET/STBY/ON switch is set to ON after the instrument is first connected to Mains power or after it is reset, an internal memory check is initiated. This check tests for a failure in ROM (read-only memory) and in RAM (read-write memory). During this check, all front panel indicators will light for approximately 1.5 seconds to provide a quick visual inspection of each front panel annunciator and display segment. If a memory failure is detected, all front panel annunciators and display segments will remain lit until any front panel key is pressed. If the memory check was successful, the front panel indicators will display a carrier frequency of 100.0000 MHz, an output amplitude of −127.0 dBm, and no modulation. All annunciators (except dBm) will remain off. Table 3-1 lists the conditions of the Signal Generator as a result of a successful initialization sequence.

Table 3-1. Initialized Conditions

Parameter	Initialized Condition
Carrier Frequency	100.0000 MHz
Output Amplitude	−127.0 dBm
AM Depth	0%
FM Peak Deviation Frequency	0.0 kHz
Carrier Frequency Increment	10.0000 MHz
Output Amplitude Increment	10.0 dB
AM Depth Increment	1%
FM Peak Deviation Frequency Increment	1.0 kHz
Coarse and Fine Tune Pointer	10.0000 MHz
Sequence Counter	0
All 10 Internal Storage Registers	100.0000 MHz and −127.0 dBm with no modulation

3-10. Keystroke Sequences

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

a. One of the three remaining functions is selected.
b. One of the STORE-RECALL-DISPLAY keys is pressed.
c. The instrument is reset or unplugged.

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

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

Table 3-2. Operating Characteristics

Frequency

Range: 100 kHz to 990 MHz

Resolution: 100 Hz
250 Hz

Amplitude

Range: +13 dBm to −127 dBm (+1.00V to +.100 μV)

Resolution: 0.1 dB

Absolute Level Accuracy: ≤±1.5 dB

Level Flatness: ≤±1.0 dB (100 kHz to 990 MHz with output level setting of 0.0 dBm)

Modulation

AM

Depth: 0% to 99% to +7 dBm
0% to 30% to +10 dBm

Resolution: 1%

FM

Peak Deviation:

Carrier Frequency (MHz)	Maximum Peak Deviation	
	Rates ≥60 Hz	Rates <60 Hz
0.1 — 123.5	99 kHz	1600 × Rate
123.5 — 247	25 kHz	400 × Rate
247 — 494	50 kHz	800 × Rate
494 — 990	99 kHz	1600 × Rate

Resolution: 0.1 kHz (deviations <10 kHz)
1 kHz (deviations ≥10 kHz)

Rates: 400 Hz or 1 kHz ±3%, internal
25 Hz to 25 kHz, external (ac coupled, 1 dB bandwidth)

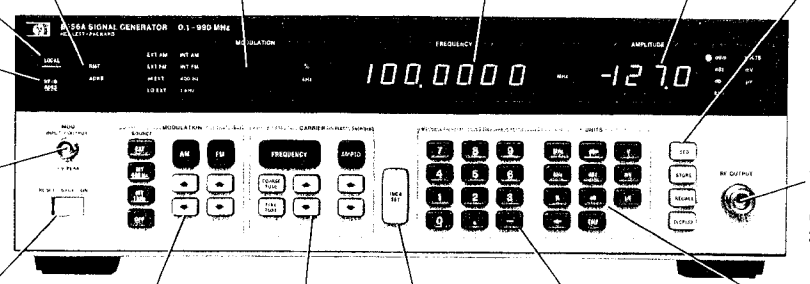
External Modulation Source: 600 ohms nominal, ac coupled

Mixed Modulation: Any combination of internal AM, internal FM, external AM, or external FM is possible.

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ion

'LIFIED FRONT PANEL FEATURES AND OPERATION



Remote Annunciators

2 LED annunciators used to indicate remote operation status (see Figure 3-2).

LOCAL Key

ıs the Signal Generator to local oper- provided that it is not in local lock- ee Figure 3-2).

HP-IB ADRS Key

s the internally-set, decimal HP-IB ss to be displayed in the MODULA-)isplay (see Figure 3-2).

10D INPUT/OUTPUT Connector

upled input for an external modula- ource or DC-coupled output for the al modulation source (see Figure

MODULATION Display

2 digit display of AM depth, FM peak deviation frequency, or modulation increment. 10 LED annunciators display internal and external modulation source information. Also used to display the internally-set, decimal HP-IB address (see Figure 3-2).

FREQUENCY Display

8 digit display of frequency or frequency increment in megahertz (see Figure 3-2).

AMPLITUDE Display

3-1/2 digit display of RF output level or amplitude increment. 7 LED annunciators display unit information. Also used to display the current contents of the internal sequence counter and to indicate that a reverse power condition has been detected (see Figure 3-2).

STORE-RECALL-DISPLAY-SEQUENCE Keys

Stores up to ten complete front panel settings for selectable recall or display at a later time. The SEQ key permits a sequential recall of stored front panel settings or a display of the internal sequence counter contents when it is used in conjunction with the DISPLAY key (see Figure 3-6).

RF OUTPUT Connector

Provides an AC-coupled, reverse-power protected RF output signal with a frequency range of 100 kHz to 990 MHz and a leveled output of +13 dBm to −127 dBm (see Figure 3-3).

UNITS Entry Keys

Terminates a data entry for any one of the four main functions. The backspace key (←) clears the last digit or decimal point visible in a display to permit the entry to be corrected (see Figure 3-5).

RESET/STBY/ON Switch

Controls the operating state of the internal microprocessor. The internal power supply (and optional reference oscillator) remain energized as long as the power cable is connected to Mains power (see Figure 3-6).

Data Entry Keys

Ten numeric entry keys, a decimal point key, and a minus sign key used for frequency, amplitude, AM, FM, or increment value data entry. Numeric entry keys are also used in conjunction with the STORE, RECALL, or DISPLAY keys to select one of the ten internal storage registers (see Figure 3-5).

CARRIER Keys

Selects and permits tuning of the basic carrier functions (see Figure 3-3).

MODULATION Keys

Selects either internal, external, or mixed AM or FM functions (see Figure 3-4).

INCR SET Key

Selects the value of the frequency, amplitude, AM, or FM increment. Also used to display the stored increment value for each of the four main functions (see Figure 3-6).

Figure 3-1. Simplified Front Panel Features

SETTING CARRIER FUNCTIONS

	FUNCTION	DATA	UNITS
Carrier Frequency:	FREQUENCY	1 2 . 3	MHz
Output Amplitude:	AMPTD	- 7 . 2	dBm

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

SETTING MODULATION FUNCTIONS

	SOURCE	FUNCTION	DATA	UNITS
AM Depth:	INT 400 Hz	AM	5 0	%
FM Peak Deviation Frequency:	INT 1 kHz	FM	7 5	kHz

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

CHANGING PARAMETERS VALUES

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

Step Up and Down Keys ▲ ▼

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

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

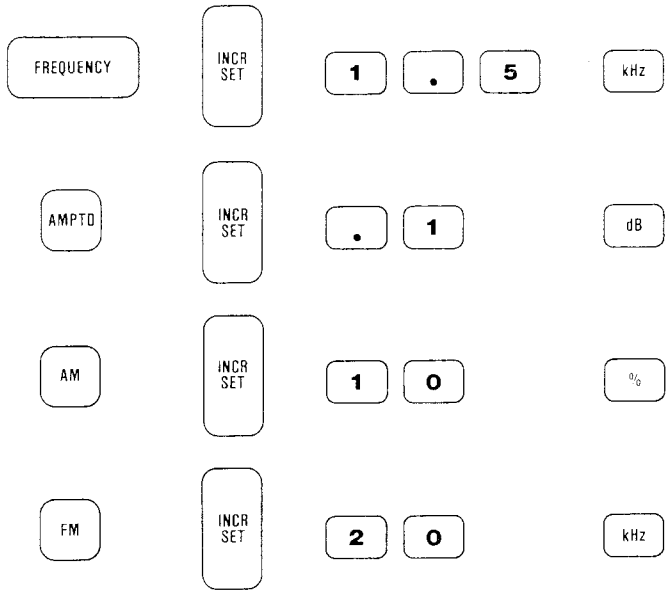
INCR SET

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

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CHANGING PARAMETERS VALUES (Cont'd)

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



The maximum allowable increment value for each of the four main functions is as follows:

Carrier Frequency	≤989.99 MHz
Output Amplitude	≤144 dB
AM Depth	≤99%
FM Peak Deviation Frequency	≤99 kHz

NOTE

The carrier frequency increment is rejected if it is not a multiple of 100 Hz or 250 Hz.



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

STORE-RECALL-DISPLAY-SEQUENCE

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

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Table 3-3. Index of Detailed Operating Instructions

Instruction	Page
Frequency	3-39
Frequency, Coarse and Fine Tune	3-41
Frequency, Up/Down	3-43
Amplitude	3-32
Amplitude Conversion	3-34
Amplitude, Up/Down	3-36
Modulation, AM	3-49
Modulation, AM Up/Down	3-50
Modulation, External Source	3-51
Modulation, FM	3-52
Modulation, FM Up/Down	3-54
Modulation, Mixed	3-55
Modulation, Off	3-59
Increment Value Change	3-46
Increment Value Display	3-48
Display	3-37
Display Sequence	3-38
Recall	3-61
Sequence	3-62
Store	3-63
HP-IB Address Display	3-44

The actual detailed operating instructions are arranged in alphabetical order at the end of this section.

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

Store-Recall-Display Keystroke Sequence. Up to ten complete front panel settings (exclusive of increment values) can be stored for either selectable or sequential recall at a later time. Stored front panel settings can also be displayed without actually changing the output signal. A two keystroke sequence is necessary to store, recall, or display front panel settings. First, the desired function is entered followed by a numeric entry (0—9). This numeric entry represents the location of the internal storage register.

3-11. Time Base Selection

The Signal Generator is shipped from the factory with an inductive-jumper hard-wired to provide a 10 MHz time base output signal at the rear panel TIME BASE OUTPUT connector. If either a 1 or 5 MHz output signal is desired, this internal inductive-jumper will have to be repositioned. Also, if an external 1 or 5 MHz reference input is to be applied at the rear panel TIME BASE INPUT connector, this internal inductive-jumper will have to be repositioned. In either case, this internal inductive-jumper has to be installed in the position that corresponds to the frequency of the time base input or output signal being used. Refer to paragraph 2-7 for the time base selection procedure.

3-12. OPERATOR'S MAINTENANCE

WARNING

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

The only maintenance that the operator should normally perform is the replacement of the primary power fuse located within the Line Power Module — A15. For instructions on how to change the fuse, see Figure 2-1, steps 1 and 3.

Fuses may be ordered under HP Part Numbers 2110-0305 (1.25A, 250V, slo-blo) for 100/120 Vac operation and 2110-0016 (0.6A, 250V, slo-blo) for 220/240 Vac operation.

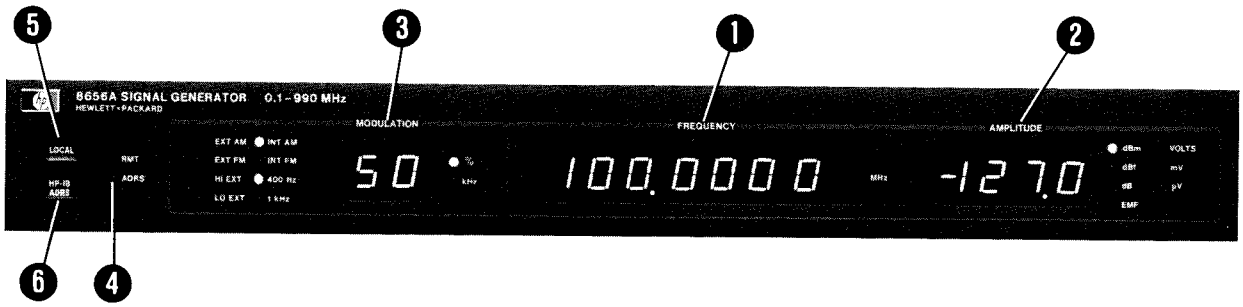
3-13. DETAILED PANEL FEATURES

The Signal Generator is designed to be simple and easy to operate through the front panel. The front panel primarily consists of 48 pushbutton keys, three digital displays, and 19 LED annunciators. Each key has a single purpose and only one key should ever be pressed at any given time. In most cases, keys are pressed, then released, with the action occurring as the key is pressed. In some cases, a key must be pressed and held for the action to occur. The four main functions of the Signal Generator are selected by the four dark gray colored keys labeled FREQUENCY, AMPTD, AM, and FM. The 27 medium gray colored keys are used to control the modulation source, enter numeric data, and select the unit(s) which terminates the data entry. The 15 light gray colored keys are used to set an increment value for each of the four main functions, change main function parameters by the set increment values, and store up to ten complete front panel settings (exclusive of increment values) for either selectable or sequential recall or display at a later time. The two remaining dark gray colored keys (located in the upper left-hand corner of the front panel) select local operation and display the internally-set, decimal HP-IB address.

The three digital displays show the frequency of the carrier in megahertz (the least significant or eighth digit will either be blanked or a numeral 5 depending on the frequency selected), the output amplitude of the carrier in one of fourteen possible units, and the percentage of AM depth or frequency of FM peak deviation used to modulate the carrier. In addition, the FREQUENCY Display can show the value of the carrier frequency increment; the AMPLITUDE Display can show the value of the output amplitude increment or current contents of the internal sequence counter; and the MODULATION Display can show the value of the modulation increment or internally-set, decimal HP-IB address.

The 19 LED annunciators are used to indicate remote operation status, internal or external modulation source and unit information, and amplitude unit information. All of the front and rear panel features are described in detail in Figures 3-2 through 3-7.

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1 FREQUENCY Display

The FREQUENCY Display provides an 8 digit display of carrier frequency from 10 kHz to 990 MHz with a resolution of 100 Hz or 250 Hz. Carrier frequencies are always displayed in megahertz. Any selected frequency between 10 kHz and 100 kHz will result in an uncalibrated output amplitude. When the selected carrier frequency is a multiple of 100 Hz, the resolution will be 100 Hz and the least significant (eighth) digit will be blanked. In cases where the selected carrier frequency is a multiple of 250 Hz, the resolution will be 250 Hz and the least significant digit will be a 5. Digits selected beyond the specified resolution will be truncated and leading zeros will be blanked.

The FREQUENCY Display is also used to display the value stored in the internal carrier frequency increment register. This stored value is used in conjunction with the step up and step down keys associated with the frequency function to change the carrier frequency.

2 AMPLITUDE Display

The AMPLITUDE Display provides a 3-1/2 digit display of output amplitude from +17 to −127 dBm with a resolution of 0.1 dB. Amplitude levels are displayed in dBm, dBf, V, mV, and µV, while relative levels are displayed in dB and EMF. Calibrated levels from +13 to −127 dBm are possible with overrange to the maximum available power (amplitude set to +17 dBm). Digits selected beyond the specified resolution will be truncated and leading zeros will be blanked.

The AMPLITUDE Display is also used to display the value stored in the internal output amplitude increment register. This stored value is used in conjunction with the step up and step down keys associated with the amplitude function to change the output amplitude.

Further, the least significant digit of the AMPLITUDE Display is used to display the stored contents of the internal sequence counter.

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

Seven LED annunciators are used to display output amplitude unit information. Fourteen unit combinations are possible which will cause one or more LED's to light. The valid output amplitude units are listed as follows:

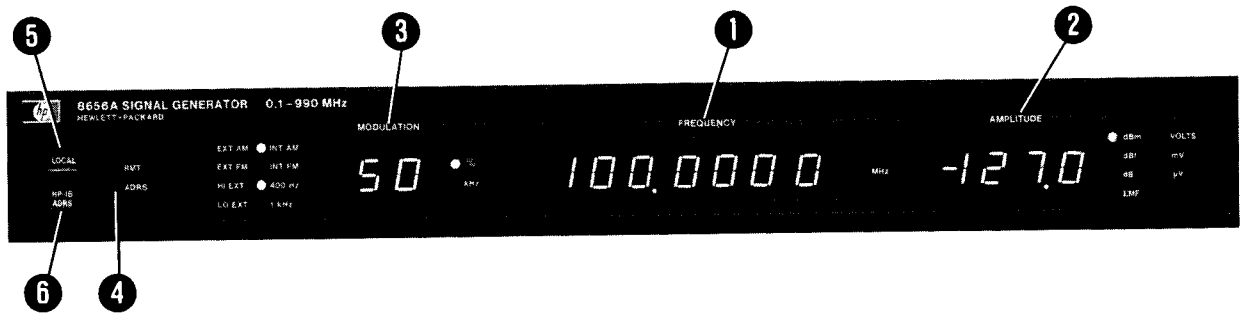
dBm	dB µV	V	EMF mV
dBf	dB EMF V	mV	EMF µV
dB V	dB EMF mV	µV	
dB mV	dB EMF µV	EMF V	

3 MODULATION Display

The MODULATION Display provides a 2 digit display of AM depth from 0 to 99% with a resolution of 1% or FM peak deviation frequency from 0 to 99 kHz with a resolution of 0.1 kHz (for deviations <10 kHz) or 1 kHz (for deviations ≥10 kHz). AM depth is always displayed in percent,

Figure 3-2. Display and Remote Features (1 of 2)

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3 MODULATION Display (Cont'd)

and FM peak deviation frequency is always displayed in kHz. Digits selected beyond the specified resolution will be truncated and leading zeros will be blanked.

If one modulation parameter is being displayed when the other modulation function is selected, the MODULATION Display will be updated to display the newly selected parameter. Selecting the other function will restore the original display.

If a change in carrier frequency causes the FM peak deviation frequency allowed for that frequency band to be exceeded, the MODULATION Display will flash until a carrier frequency within the correct band is selected or the FM, FM step up, or FM step down key is pressed. In this later case, the maximum FM peak deviation frequency permitted for the currently selected carrier frequency will automatically be selected.

The MODULATION Display is also used to display the values stored in the internal AM depth and FM peak deviation frequency increment registers. These stored values are used in conjunction with the step up and step down keys associated with the modulation functions to change the percentage of AM depth or FM peak deviation frequency.

Further, the MODULATION Display is used to display the internally-set, decimal HP-IB address. HP-IB addresses from 0 to 30 (decimal) are valid, all others will be interpreted as 30. (Refer to Section II, Installation when changing the HP-IB address.)

Ten LED annunciators are used to display internal and external modulation source information. The HI EXT and LO EXT annunciators serve as an aid in adjusting the level of the external modulation source. They indicate that the input level is too high or too low for a calibrated display of AM depth or FM peak deviation frequency. The HI EXT annunciator will light if the external modulation signal is greater than 1.02 Vpk (0.721 Vrms), and the LO EXT annunciator light if the signal is less than 0.98 Vpk (0.693 Vrms). Both annunciators will be off when the input level is 1.00 ±0.02 Vpk (0.707 ±0.014 Vrms).

4 Remote Annunciators

Two LED annunciators are used to display remote operation status. The RMT annunciator lights when the instrument is in remote operation. The ADRS annunciator lights when the instrument has been addressed to listen via the bus (regardless of whether or not the instrument is in remote operation).

5 LOCAL Key

The LOCAL key returns the instrument to local operation (full front panel control) from remote operation provided that it is not in Local Lockout.

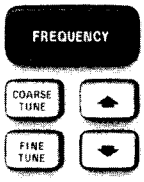
6 HP-IB ADRS Key

The HP-IB ADRS key is used to display the internally-set, decimal HP-IB address in the MODULATION Display.

Figure 3-2. Display and Remote Features (2 of 2)

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CARRIER Keys



The FREQUENCY key is one of the four main function keys. It is used in conjunction with the numeric entry keys, decimal point key, and UNITS entry keys to enter carrier frequency parameters. In addition, it is used in conjunction with the INCR SET key to enter carrier frequency increment values.

The step up and step down keys associated with the frequency function permit the carrier frequency to be changed by the value stored in the internal carrier frequency increment register. The value of the carrier frequency increment initially stored is 10.0000 MHz. Its minimum value is 100 Hz, and its maximum value is ≤989.99 MHz. The carrier frequency will be changed once for each keystroke or repeatedly if either key remains pressed.

The COARSE TUNE and FINE TUNE keys are used in conjunction with the frequency step up and step down keys to tune the carrier frequency. They are used to increase (COARSE TUNE) or decrease (FINE TUNE) the carrier frequency tuning value by a factor of 10. The affect of these keys is disabled and the original carrier frequency increment value is enabled when the INCR SET key is pressed.

If a change in carrier frequency causes the FM peak deviation frequency allowed for that frequency band to be exceeded, the MODULATION Display will flash until a carrier frequency within the correct band is selected or the FM, FM step up , or FM step down key is pressed. In this later case, the maximum FM peak deviation frequency permitted for the currently selected carrier frequency will automatically be selected.



The AMPTD key is one of the four main function keys. It is used in conjunction with all of the Data and UNITS entry keys to enter output amplitude parameters. In addition, it is used in conjunction with the INCR SET key to enter output amplitude increment values. Further, it is used to reset the internal reverse power protection feature once the source of reverse power has been removed.

The step up and step down keys associated with the amplitude function permit the output amplitude to be changed by the value stored in the internal output amplitude increment register. The value of the output amplitude increment initially stored is 10.0 dB. Its minimum value is 0.1 dB (0.001 μV or 0.001 EMF V), and its maximum value is ≤144.0 dB (≤1.57V or ≤ 3.15 EMF V). The output amplitude will be changed once for each keystroke or repeatedly if either key remains pressed.

RF OUTPUT Connector



Female type-N connector (J2) provides access to the RF output signal. Specified output levels are +13 to −127 dBm (+1.00V to +.100 μV) with a minimum resolution of 0.1 dBm. Nominal impedance is 50 ohms. Reverse power protection is provided up to 50W and 25 Vdc. Pressing the AMPTD key restores RF output signal once the source of reverse power has been removed.

Figure 3-3. Carrier Features

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MODULATION Keys



The AM key is one of the four main function keys. It is used in conjunction with the SOURCE keys, numeric entry keys, and UNITS entry keys to enter amplitude modulation parameters. In addition, it is used in conjunction with the INCR SET key to enter AM depth increment values. If the FM peak deviation frequency is being displayed when the AM key is pressed, the MODULATION Display will be updated to show the percentage of AM depth. The default modulation source (internal 1 kHz) will automatically be selected when the AM key is pressed, if no other source has been selected.

The step up and step down keys associated with the AM function permit the percentage of AM depth to be changed by the value stored in the internal AM depth increment register. The value of the AM depth increment initially stored is 1%. This is its minimum value. Its maximum value is ≤99%. The percentage of AM depth will be changed once for each keystroke or repeatedly if either key remains pressed.



The FM key is one of the four main function keys. It is used in conjunction with the SOURCE keys, numeric entry keys, and UNITS entry keys to enter frequency modulation parameters. In addition, it is used in conjunction with the INCR SET key to enter FM peak deviation frequency increment values. If the percentage of AM depth is being displayed when the FM key is pressed, the MODULATION Display will be updated to show the FM peak deviation frequency. The default modulation source (internal 1 kHz) will automatically be selected when the FM key is pressed, if no other source has been selected.

The step up and step down keys associated with the FM function permit the FM peak deviation frequency to be changed by the value stored in the internal FM peak deviation frequency increment register. The value of the FM peak deviation frequency increment initially stored is 1.0 kHz. Its minimum value is 0.1 kHz, and its maximum value is ≤99 kHz. The FM peak deviation frequency will be changed once for each keystroke or repeatedly if either key remains pressed.

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

SOURCE Keys



The INT 400 Hz, INT 1 kHz, EXT, and OFF keys are used to select the internal 400 Hz or 1 kHz modulation source, enable an external source to be applied through the front panel MOD INPUT/OUTPUT connector, or disable one or all selected modulation sources.

The internal modulation signal is available at the MOD INPUT/OUTPUT connector when either the 400 Hz or 1 kHz modulation source is selected and the external source is not selected.

MOD INPUT/OUTPUT Connector

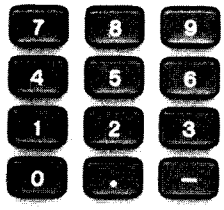


Female BNC connector (J1) accepts either an external modulation signal or a digital unsquelching signal. In addition, it provides access to the 400 Hz or 1 kHz modulation signal from the internal audio oscillator. Source selection is provided by the four MODULATION SOURCE keys. Nominal input impedance is 600 ohms. External input rates are ac coupled with 1 dB of bandwidth. The input signal should be 25 Hz to 25 kHz at 1 Vpk (0.707 Vrms) ±5% minimum into a 600 ohm resistive load to produce calibrated AM depths or FM peak deviations. The HI EXT and LO EXT annunciators provide an indication of the input level available for calibrated modulation. If greater accuracy is required, the signal level should be measured externally.

Figure 3-4. Modulation Features

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Data Entry Keys



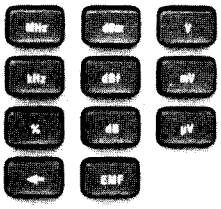
The Data entry keys consist of ten numeric entry keys (0-9), a decimal point key, and a minus sign key.

The ten numeric entry keys are used in conjunction with the four main function keys to enter value-selectable parameters, with the INCR SET key to enter increment values, and with the STORE-RECALL-DISPLAY keys to select one of the ten internal storage registers.

The decimal point key is used to add a decimal point to the numeric entry. A leading zero will be displayed, if the decimal point is added before the numeric entry for carrier frequencies less than 1 MHz and output amplitudes less than ±1 dBm.

The minus sign key is only used when making amplitude Data entries and it can be used at any time before the final UNITS terminator entry is made.

UNITS Entry Keys



The UNITS entry keys consist of ten terminator keys and a backspace (←) key.

The ten terminator keys are used in conjunction with the four main function keys to terminate Data entries. They are also used in conjunction with the INCR SET key to terminate increment value entries.

Frequency entries are always adjusted so that they are displayed in megahertz, even though kHz is a valid terminator.

Fourteen amplitude terminator combinations are possible. They are listed as follows:

dBm
dBf
dB V
dB mV
dB μV
dB EMF V
dB EMF mV
dB EMF μV
V
mV
μV
EMF V
EMF mV
EMF μV

AM entries are always terminated in %, and FM entries are always terminated in kHz.

The backspace key is used to clear the last digit or decimal point visible in a display to permit the entry to be corrected.

Figure 3-5. Data and Units Entry Features

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STORE-RECALL-DISPLAY-SEQUENCE Keys



Four keys used to store up to ten complete front panel setups (exclusive of increment values) for either selectable or sequential recall or display at a later time. When the Signal Generator is powered up or reset, the initialized conditions of the instrument are stored in each of the ten internal storage registers. That is, the parameter values for a carrier frequency of 100 MHz with an output amplitude of -127 dBm and no modulation will be stored in each location.

When the STORE key is used in conjunction with a numeric entry key (a single digit register number 0—9), the current front panel settings (exclusive of increment values) will be stored in an internal storage register.

When the RECALL key is used in conjunction with a numeric entry key (a single digit register number 0—9), the stored contents will be recalled and the output of the Signal Generator will be changed so that it agrees with the recalled parameter values.

When the DISPLAY key is used in conjunction with a numeric entry key (a single digit register number 0—9), the stored contents will be displayed, but the actual output of the Signal Generator will not be affected.

The SEQ key is used to sequence the Signal Generator through each of its ten internal storage registers. As the stored contents are sequentially recalled, the output will be changed so that it agrees with the recalled parameter values.

When the DISPLAY key is used in conjunction with the SEQ key, the stored contents of the internal sequence counter will be displayed in the least significant digit of the AMPLITUDE Display.

INCR SET Key



A single key used in conjunction with any one of the four main function keys to store an increment value for that function. The initialized value of each stored increment is listed as follows:

Carrier Frequency	10.0000 MHz
Output Amplitude	10.0 dB
AM Depth	1%
FM Peak Deviation Frequency	1.0 kHz

The minimum allowable increment value for each of the four main functions is listed as follows:

Carrier Frequency	0.1 kHz
Output Amplitude	0.1 dB
AM Depth	1%
FM Peak Deviation Frequency	0.1 kHz

Figure 3-6. Miscellaneous Features (1 of 2)

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INCR SET Key (Cont'd)

The maximum allowable increment value for each of the four main functions is listed as follows:

Carrier Frequency	≤ 989.99 MHz
Output Amplitude	≤ 144.0 dB
AM Depth	≤ 99%
FM Peak Deviation Frequency	≤ 99 kHz

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

The frequency coarse tune and fine tune feature will be disabled and the original carrier frequency increment value will be restored when the INCR SET key is pressed.

RESET/STBY/ON Switch



Three position rocker switch used to control the operating state of the internal microprocessor. The Signal Generator (and its optional reference oscillator) will remain energized and the fan will continue to operate as long as the power cord is connected to Mains power.

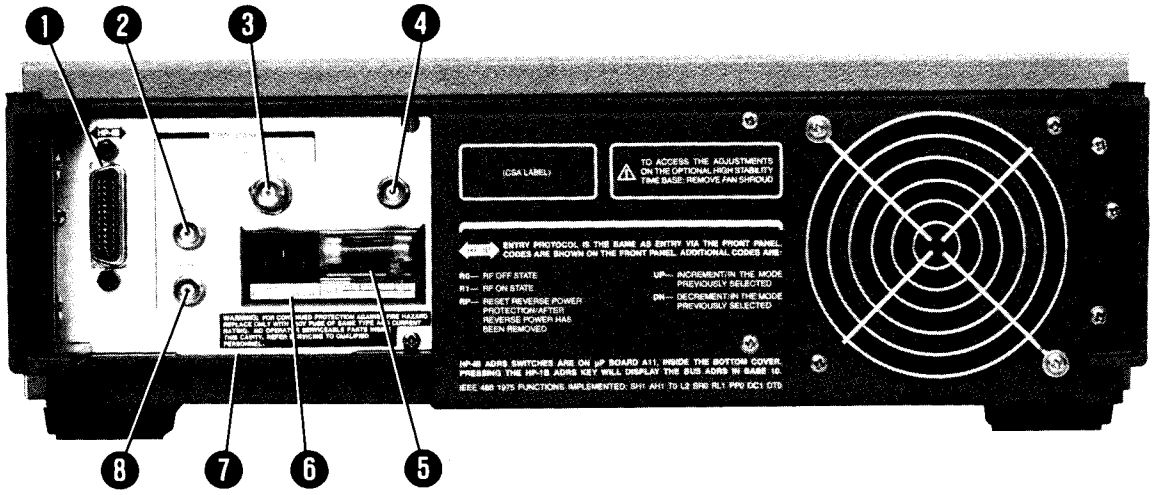
When momentarily set to RESET, the microprocessor will be halted. Upon release, the microprocessor will initiate its restart operation.

When set to STBY, the microprocessor will initiate an RF quieting operation in which all displays are blanked, the high frequency section is turned off, all attenuator sections (120 dB) are switched in, the internal audio oscillator is turned off, and the instrument will not respond to any HP-IB commands.

When set to ON (return from STBY), the operating state of the instrument (prior to entering the standby state) will be restored. Refer to paragraph 3-9 for information regarding the power-on sequence.

Figure 3-6. Miscellaneous Features (2 of 2)

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NOTE

For Option 002 instruments, the RF OUTPUT and MOD INPUT/OUTPUT connectors are located on the rear panel. The RF OUTPUT connector is above (2) *Time Base Input while the MOD INPUT/OUTPUT connector replaces* (4) *SEQ. Refer to Figures 3-3 and 3-4 for detailed information concerning the signals found at these ports.*

(1) HP-IB HP-IB Connector

24-pin female connector used to connect the Signal Generator to the Hewlett-Packard Interface Bus for remote operation. Connection information is presented in Section II, Installation.

(2) TIME BASE INPUT

Female BNC connector (J3) accepts an external 1, 5, or 10 MHz (±0.005%) time base reference input at a level of 0.2 to 0.4 Vrms into 50 ohms. Internal jumper must be installed in the position that corresponds to the external time base reference input used (refer to paragraph 2-7).

(3) TIME BASE HIGH STABILITY OPTION

Female BNC connector (A16J1) provides access to the optional 10 MHz time base reference output. With Option 001 installed and its output connected to the TIME BASE INPUT connector through the supplied cable (not shown), the frequency accuracy and stability of the Signal Generator will be increased. The optional reference oscillator is kept at operating temperature in the STBY mode as long as the Signal Generator remains connected to Mains power.

(4) SEQ

Female BNC connector (J5) accepts external contact closure (from foot pedal, pushbutton switch, etc.) which causes the Signal Generator to sequentially recall the stored contents (exclusive of increment settings) from each of its ten internal storage registers.

(5) Fuse

1.25A, 250V, Slo-Blo for 100/120 Vac operation. 0.6A, 250V, Slo-Blo for 220/240 Vac operation. Ordering information is presented in Section II, Installation.

(6) Line Power Module

Permits operation from 100, 120, 220, or 240 Vac. The number visible in the window indicates nominal line voltage to which the instrument must be connected (see Figure 2-1). Center conductor is safety earth ground.

(7) Serial Number Plate

First four digits and letter constitute the prefix which defines the instrument configuration. The last five digits form a sequential suffix that is unique to each instrument. The plate also indicates any options supplied with the instrument.

(8) TIME BASE OUTPUT

Female BNC connector (J4) provides access to an internal 10 MHz time base reference output at a level greater than 0.2 Vrms into 50 ohms which is derived from the internal reference oscillator. An internal jumper may be repositioned to select either a 1 or 5 MHz reference output (refer to paragraph 2-7).

Figure 3-7. Rear Panel Features

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3-14. OPERATOR'S CHECKS

Operator's checks are simple procedures designed to verify that the main functions of the Signal Generator operate properly. Two procedures are provided, one for basic (front panel) functional checks and the other for HP-IB functional checks.

3-15. Basic Functional Checks

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

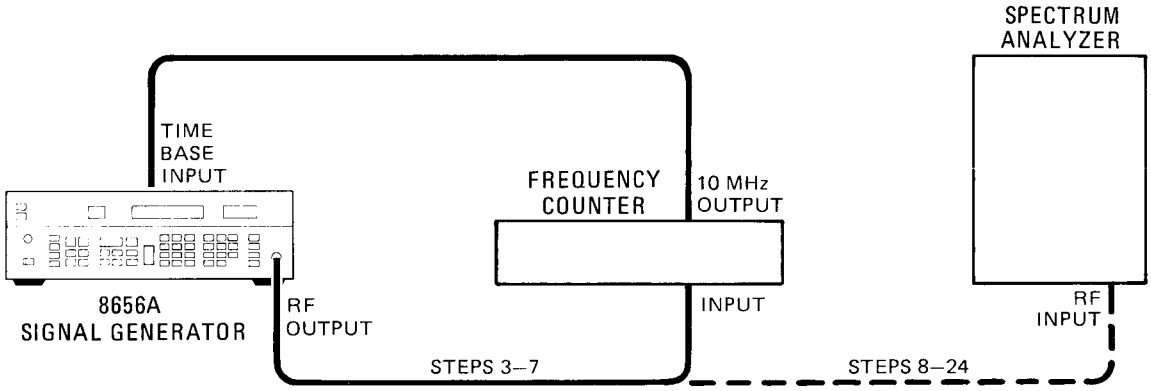


Figure 3-8. Test Setup for Basic Functional Checks

EQUIPMENT: Frequency Counter .....HP 5328A Option 031
Spectrum Analyzer .....HP 8558B/182T

PROCEDURE: **Preliminary Checks**

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

2. Momentarily press and release the left-hand side of the RESET/STBY/ON switch to initialize the Signal Generator, then set the switch back to ON.

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

   If a memory failure is detected, all front panel annunciators and display segments will remain lit until any front panel key is pressed. If the memory check was successful, the front panel indicators will display a carrier frequency of 100.0000 MHz, an output amplitude of −127.0 dBm, and no modulation. Only the dBm annunciator will be lit, all of the others be off.

3. Connect the RF OUTPUT of the Signal Generator to the input of the frequency counter and the 10 MHz reference output from the frequency counter to the TIME BASE INPUT located at the rear of the Signal Generator as shown in Figure 3-8.

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OPERATOR'S CHECKS

3-15. Basic Functional Checks (Cont'd)

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

NOTE

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

Frequency Check

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

Carrier Frequency (MHz)
100.0000
140.0000
200.0000
300.0000
400.0000
600.0000
800.0000
990.0000

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

5. Set the carrier frequency of the Signal Generator to 111.1111 MHz and the frequency increment value to 111.1111 MHz. Leave the output amplitude set at −10.0 dBm.

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

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

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

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3-15. Basic Functional Checks (Cont'd)

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

Carrier Frequency (MHz)
111.1111
222.2222
333.3333
444.4444
555.5555
666.6666
777.7777
888.8888

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

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

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

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

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

Output Level Checks

8. Connect the RF OUTPUT of the Signal Generator to the input of the spectrum analyzer as shown in Figure 3-8.

9. Set the output amplitude of the Signal Generator to 0.0 dBm, carrier frequency to 0.1 MHz, and frequency increment value to 10 MHz.

10. Set the amplitude scale of the spectrum analyzer to display 1 dB/division and make the necessary adjustments to properly display the output signal from the Signal Generator.

NOTE

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

11. Slowly increase the carrier frequency through its entire frequency range (0.1 to 990.0000 MHz) and observe the level displayed on the spectrum analyzer. The level should not vary more than a total of 3 dB (±1.5 dB from 0.0 dBm).

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OPERATOR'S CHECKS

3-15. Basic Functional Checks (Cont'd)

12. Set the carrier frequency of the Signal Generator to 600 MHz, output amplitude to +13 dBm, and output amplitude increment value to 1.0 dB.

13. Adjust the spectrum analyzer as necessary to display the output signal from the Signal Generator. The displayed carrier should be positioned in the center of the graticule with its maximum level positioned near the top of the graticule.

14. Slowly decrease the output amplitude down to −4.0 dBm and observe the level displayed on the spectrum analyzer. The level should decrease in relatively uniform 1 dB steps.

15. Set the output amplitude of the Signal Generator to −10.0 dBm and the output amplitude increment value to 5 dB. Leave the carrier freqeuency set to 600 MHz.

16. Set the amplitude scale of the spectrum analyzer to display 10 dB/division and make the necessary adjustments to properly display the output signal from the Signal Generator. The displayed carrier should be positioned in the center of the graticule with its maximum level positioned near the top of the graticule.

17. Slowly decrease the output amplitude down to −80 dBm and observe the level displayed on the spectrum analyzer. The level should decrease in relatively uniform 5 dB steps.

FM Check

18. Set the output amplitude of the Signal Generator to 0.0 dBm. Leave the carrier frequency set to 600 MHz. Select FM with a peak deviation frequency of 99 kHz using the internal 1 kHz source. Set the FM peak deviation frequency increment value to 1 kHz.

19. Set the spectrum analyzer for a 50 kHz frequency span/division, a resolution bandwidth of 3 kHz, and a reference level of 0 dBm. The waveform displayed should be similar to that shown in Figure 3-9.

20. Slowly decrease the FM peak deviation frequency to zero. The deviation displayed on the spectrum analyzer should decrease in relatively uniform steps.

21. Press FM, then OFF to turn off the FM function.

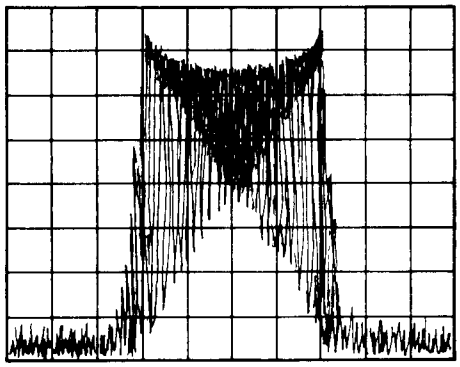


Figure 3-9. FM Functional Check Waveform

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OPERATOR'S CHECKS

3-15. Basic Functional Checks (Cont'd)

AM Check

22. Leave the carrier frequency set to 600 MHz and the output amplitude set to 0.0 dBm. Select AM with a depth of 50% using the internal 400 Hz source.

23. Set the spectrum analyzer to the linear amplitude mode. Set a frequency span/division of zero. Increase the resolution bandwidth, then fine tune for the maximum level of the demodulated signal. The displayed demodulated signal should be a sine wave with a period of 2.5 ms (400 Hz).

24. Press the INT 1 kHz key to change the frequency of the internal modulation source from 400 Hz to 1 kHz. The displayed demodulated signal should be a sine wave with a period of 1 ms (1 kHz).

3-16. HP-IB Functional Checks HP-IB

DESCRIPTION: The following procedures check the Signal Generator's ability to recognize its own HP-IB (listen) address, properly make remote/local transitions, and process all of the applicable HP-IB messages described in Table 3-4. During the process, all of the Signal Generator's HP-IB data input/output bus, control, and handshake lines are checked, except for DIO8 (the most significant data input/output bus line which is not used by the Signal Generator). Only the Signal Generator, a bus controller, and an HP-IB interface with appropriate cabling are required to perform these procedures. These checks are intended to be as independent of one another as possible, since each begins with the instrument being reset to its initialized condition. Nevertheless, it is suggested that the first four checks be performed in order before any other check. Any special initialization steps or requirements for a given check are provided the beginning of the check.

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

- The Signal Generator performs properly when operated via the front panel keys (that is, in local operation). This can be verified by performing the basic functional checks as outlined in paragraph 3-15.
- The bus controller properly executes HP-IB operations.
- The bus controller's HP-IB interface properly transfers the controller's instructions.
- The select code of the bus controller's interface is set to 7.
- The HP-IB address of the Signal Generator is set to 07 (the factory-set address).
- The select code address combination (that is, 707) is not necessary for these checks to be valid; however, the program lines presented in the following procedures would have to be modified for any other combination.

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

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OPERATOR'S CHECKS

3-16. HP-IB Functional Checks (Cont'd)

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

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

EQUIPMENT:

HP-IB Controller	HP 9825A/98213A (General and Extended I/O ROM's) —or— HP 9835A/98332A (I/O ROM) —or— HP 9845A (I/O ROM)
HP-IB Interface	HP 98034A (use "revised" version with HP 9835A and HP 9845A)

Address Recognition

NOTE This check determines whether or not the Signal Generator recognizes when it is being addressed and when it is not. It is assumed that the Signal Generator is in local operation and that it can properly handshake on the bus. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Set the Remote Enable (REN) bus control line false.	lcl 7	LOCAL 7
Send the listen address to the Signal Generator.	wrt 707	OUTPUT 707

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT annunciator remains off and that its ADRS annunciator lights.

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

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT and ADRS annunciators are both off.

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3-16. HP-IB Functional Checks (Cont'd)

Remote and Local Messages and the LOCAL Key

NOTE This check determines whether the Signal Generator properly switches from local to remote operation, switches from remote to local operation, and whether the LOCAL key can return the instrument to local operation. It is assumed that the Signal Generator is able to both handshake and recognize its own address. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the Remote message which sets the Remote Enable (REN) bus control line true and addresses the Signal Generator to listen.	rem 707	REMOTE 707

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT and ADRS annunciators both light.

Send the Local message to the Signal Generator.	lcl 707	LOCAL 707

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT annunciator turns off and that its ADRS annunciator remains on.

Send the Remote message to the Signal Generator.	rem 707	REMOTE 707

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

Data Message

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

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3-16. HP-IB Functional Checks (Cont'd)

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the first part of the Remote message (which enables the Signal Generator to remote).	rem 707	REMOTE 707
Address the Signal Generator to listen (which completes the Remote message) and send the Data message (which tunes the Signal Generator to 990 MHz).	wrt 707, "fr990mz"	OUTPUT 707; "FR990MZ"

OPERATOR'S RESPONSE: Verify that the Signal Generator's RMT and ADRS annunciators both light and that the FREQUENCY Display shows a carrier frequency of 990.0000 MHz.

Local Lockout and Clear Lockout/Set Local Messages

NOTE: This check determines whether or not the Signal Generator properly receives the Local Lockout message which disables all of the front panel keys. In addition, this check determines whether or not the Clear Lockout/Set Local message is properly received and executed by the Signal Generator. It is assumed that the Signal Generator is able to handshake, recognize its own address, and properly make remote/local transitions. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the first part of the Remote message (which enables the Signal Generator to remote).	rem 707	REMOTE 707
Send the Local Lockout message.	llo 7	LOCAL LOCKOUT 7
Address the Signal Generator to listen (which completes the Remote message).	wrt 707	OUTPUT 707

OPERATOR'S RESPONSE: Verify that the Signal Generator's RMT and ADRS annunciators both light. Press the LOCAL key on the front panel of the Signal Generator and verify that its RMT and ADRS annunciators both remain on.

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

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3-16. HP-IB Functional Checks (Cont'd)

OPERATOR'S RESPONSE — Verify that the Signal Generator's RMT annunciator is turned off and that its ADRS annunciator remains on.

Clear Message

NOTE — This check determines whether or not the Signal Generator properly responds to the Clear message. It is assumed that the Signal Generator is able to handshake, recognize its own address, properly make remote/local transitions, and receive Data messages. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the first part of the Remote message (which enables the Signal Generator to remote).	rem 7	REMOTE 7
Address the Signal Generator to listen (which completes the Remote message) and send the Data message (which sets the output amplitude of the Signal Generator to 3.0 dB mV).	wrt 707, "ap3dbmv"	OUTPUT 707; "AP3DBMV"

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

Send the Clear message.	clr 707	RESET 707

OPERATOR'S RESPONSE — Verify that the Signal Generator's RMT and ADRS annunciators remain on and that the AMPLITUDE Display now shows the initialized output amplitude of −127.0 dBm. The dB and mV annunciators will now be off and the dBm annunciator will be on.

Abort Message

NOTE — This check determines whether or not the Signal Generator becomes unaddressed when it receives the Abort message. It is assumed that the Signal Generator is able to handshake, recognize its own address, and properly make remote/local transitions. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the complete Remote message.	rem 707	REMOTE 707

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OPERATOR'S CHECKS

3-16. HP-IB Functional Checks (Cont'd)

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT and ADRS annunciators both light.

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

OPERATOR'S RESPONSE Verify that the ADRS annunciator turns off.

NOTE

The remote annunciator may also turn off when using the 9835A or 9845A.

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3-17. REMOTE OPERATION, HEWLETT-PACKARD INTERFACE BUS

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

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

A quick check of the Signal Generator's HP-IB input/output capability is described in paragraph 3-16, HP-IB Functional Checks. These checks are used to verify that the Signal Generator can respond to each of the applicable HP-IB messages described in Table 3-4.

3-18. HP-IB Compatibility

The Signal Generator has an open-collector, TTL, HP-IB interface which can be used with any HP-IB computing controller or computer for automatic system applications. The Signal Generator is fully programmable via the HP Interface Bus. Its programming capability is described by the twelve HP-IB messages listed in Table 3-4. Foremost among these messages is the Data message. Data messages contain the program codes that control the Signal Generator's output signal. The Signal Generator's complete compatibility with HP-IB is further defined by the following list of interface functions: SH1, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0. A more detailed explanation of these compatibility codes can be found in the IEEE Standard 488 (and the identical ANSI Standard MC1.1). For more information about HP-IB, refer to the Hewlett-Packard Electronic Instruments and Systems catalog and the booklet titled "Improving Measurements in Engineering and Manufacturing" (HP part number 5952-0058).

3-19. Remote Operation

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

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

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

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

3-20. Local Operation

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

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

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

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Table 3-4. HP-IB Message Reference Table

HP-IB Message	Applicable	Response	Related Commands Controls*	Interface Functions*
Data	Yes	All front panel functions, except for DISPLAY, DISPLAY in conjunction with SEQ, Backspace, COARSE TUNE, FINE TUNE,and display HP-IB ADRS are programmable. The front panel ADRS annunciator lights when the Signal Generator is addressed to listen.		T0, L2 AH1, SH0
Trigger	No	The Signal Generator does not have a Device Trigger (DT0) capability.	GET	DT0
Clear	Yes	Resets the Signal Generator to a carrier frequency of 100 MHz, an output amplitude of −127 dBm, and no modulation. Responds equally to Device Clear (DCL) and Selected Device Clear (SDC) bus commands.	DCL, SDC	DC1
Remote	Yes	Remote operation is entered when the Remote Enable (REN) bus control line is true and the Signal Generator is first addressed to listen. The front panel RMT and ADRS annunciators will both light when remote operation is entered, all front panel keys will be disabled (except for the LOCAL key and the RESET/STBY/ON switch), and the output signal will remain unchanged.	REN	RL1
Local	Yes	The Signal Generator will return to local operation (full front panel control) when either the Go to Local (GTL) bus command is received or the front panel LOCAL key is pressed. The output signal will remain unchanged.	GTL	RL1
Local Lockout	Yes	Disables the front panel LOCAL key so that only the controller can return the Signal Generator to local operation.	LLO	RL1
Clear Lockout/ Set Local	Yes	The Signal Generator will return to local operation and local lockout will be cleared when the REN bus control line goes false.	REN	RL1
Pass Control/ Take Control	No	The Signal Generator has no control capability.		C0
Require Service	No	The Signal Generator does not have the capability to request service.		SR0
Status Byte	No	The Signal Generator does not have the capability to respond to a serial poll.		T0
Status Bit	No	The Signal Generator does not have the capability to respond to a parallel poll.		PP0
Abort	Yes	The Signal Generator stops listening.	IFC	T0, L2

*Commands, control lines, and interface functions are defined in IEEE Standard 488 (and the identical ANSI Standard MC1.1). Knowledge of these might not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left-hand column above.

Complete HP-IB compatibility as defined in IEEE Standard 488 (and the identical ANSI Standard MC1.1) is: SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0.

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Local Operation (Cont'd)

ables the LOCAL key and allows return-to-local only under program control.

NOTE

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

- *It defeats the purpose and advantage of local lockout, that is, the system controller will loose control of the Signal Generator.*
- *Some HP-IB conditions are reset to their default state during turn on.*

3-21. Addressing

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

The Signal Generator's listen address is established by five miniature rocker switches located inside the instrument. The address selection procedure is described in Section II, Installation. The decimal equivalent of the listen address can be displayed in the MODULATION Display by pressing the HP-IB ADRS key. Refer to Table 3-5 for a list of the valid decimal (listen address) values and their equivalent ASCII characters.

3-22. Data Messages

The Signal Generator communicates on the interface bus with Data messages. Each Data message consists of one or more bytes of information sent over the Signal Generator's eight data input/output bus lines DIO1 through DIO8 during the data entry mode. The data entry mode is established when the Attention bus control line (ATN) is false. Data messages include the program codes listed in Tables 3-8 and 3-9. These program codes contain the necessary information to program virtually all of the instrument functions available in local operation. The only exceptions are DISPLAY, DISPLAY in conjunction with SEQ, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS.

Table 3-5. Valid Decimal Values vs. Equivalent ASCII Characters

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

Indicates Factory-set address.

3-23. Receiving the Data Message

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

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

Data Message Input Format. Data messages contain the controller's talk address, the Signal Gen-

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Receiving the Data Message (Cont'd)

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

The following paragraphs explain other key elements of the program code strings. Figure 3-10 provides some examples of Data messages.

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

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

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

Table 3-6. Input Data Restrictions

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

NOTES:

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

   A—Z a—z 0—9 LF — . %

   All other characters, including spaces, are ignored.

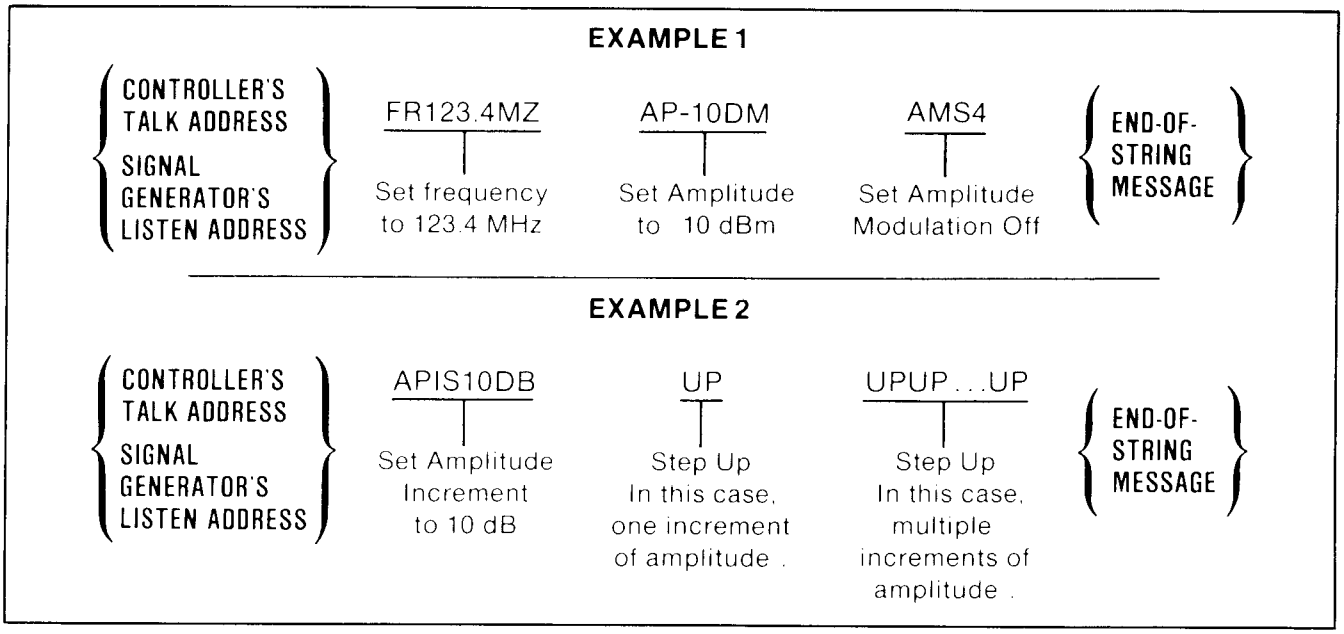


Figure 3-10. Data Message Examples

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Receiving the Data Message (Cont'd)

A complete list of ASCII characters with conversions to binary, octal, decimal, and hexadecimal is provided in Table 3-10.

3-24. Sending the Data Message

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

3-25. Receiving the Trigger Message

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

3-26. Receiving the Clear Message

The Signal Generator will respond to a Clear message by setting each function parameter to the value listed in Table 3-7. The Signal Generator will respond equally to the Selected Device Clear (SDC) bus command when addressed to listen, and to the Device Clear (DCL) bus command whether addressed or not.

Table 3-7. Response to Clear Message

Parameter	Value
Carrier Frequency	100.0000 MHz
Output Amplitude	−127.0 dBm
AM Depth	0%
FM Peak Deviation Frequency	0.0 kHz
Carrier Frequency Increment	10.0000 MHz
Output Amplitude Increment	10.0 dB
AM Depth Increment	1%
FM Peak Deviation Frequency Increment	1.0 kHz
Coarse and Fine Tune Pointer	10.0000 MHz
Sequence Counter	0
All 10 Internal Storage Registers	Remain unchanged.

3-27. Receiving the Remote Message

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

The front panel RMT and ADRS annunciators will both light once the Signal Generator has received the Remote message and is addressed to listen.

3-28. 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 will return to local operation (full front panel control) when it receives the Local message. If the instrument is in local lockout when the Local message is received, full front panel control will be returned, but local lockout will remain in effect. Unless the Signal Generator receives the Clear Lockout/Set Local message, it will return to local lockout the next time it receives a Remote message. All instrument settings remain unchanged when the transition from remote-to-local operation occurs.

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

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

3-29. Receiving the Local Lockout Message

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

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3-30. Receiving the Clear Lockout/Set Local Message

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

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

3-31. Receiving the Pass Control Message

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

3-32. Sending the Require Service Message

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

3-33. Sending the Status Byte Message

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

3-34. Sending the Status Bit Message

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

3-35. Receiving the Abort Message

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

3-36. Switching Characteristics

The Signal Generator's switching characteristics are an important consideration in applications involving a computer controller. For most functions, the Signal Generator has the ability to accept new Data Messages before the hardware can settle to the required output. If the timing requirements are not taken into account in the controller's program, it will be impossible in many situations to make meaningful measurements on a device driven by the Signal Generator.

Switching times for frequency, modulation and amplitude have several characteristics in com-

Table 3-8. HP-IB Program Codes (Alphabetical Order)

Program Code[1]	Parameter	Comments
AM	Amplitude Modulation	Function Entry
AP	Amplitude (carrier)	Function Entry
DB	dB	Units Entry
DF	dBf	Units Entry
DM	dBm	Units Entry
DN	Step Down (↓)	Function Feature
EM	EMF	Units Entry
FM	Frequency Modulation	Function Entry
FR	Frequency (carrier)	Function Entry
HZ	Hz	Units Entry
IS	Increment Set	Function Qualifier
KZ	kHz	Units Entry
MV	mV	Units Entry
MZ	MHz	Units Entry
PC	Percent[2]	Units Entry
RC	Recall	Feature
RP	Reverse Power Protection Reset[3]	Feature
R0	Standby[4]	Feature
R1	On[4]	Feature
SQ	Sequence	Feature
ST	Store	Feature
S1	External Modulation Source	Source Qualifier
S2	Internal 400 Hz Modulation Source	Source Qualifier
S3	Internal 1 kHz Modulation Source	Source Qualifier
S4	Modulation Source Off	Source Qualifier
UP	Step Up (↑)	Function Feature
UV	μV	Units Entry
VL	Volts	Units Entry
0—9	Numerals 0 — 9	Data Entries
-	Minus Sign	Data Entry
.	Decimal Point	Data Entry
%	Percent[2]	Units Entry

[1] Program codes can be either upper or lower case.

[2] Either PC or % can be used.

[3] The source of reverse power must be removed.

[4] The RESET/STBY/ON switch must be set to the ON position.

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Switching Characteristics (Cont'd)

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

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

Frequency Switching. The Signal Generator will typically be within 100 Hz of the final frequency within 2 seconds after receiving the valid units data (terminator). Figure 3-11 shows the sequence of events and the typical error frequency relative to time. Area I shows the software execution time. Areas II through IV make up the hardware execution time.

At times certain events in the frequency switching cycle may be bypassed. For example, small frequency changes will often eliminate event II, the fast slew rate mode or event IV, the FM calibration mode. However, the frequency change that allows these events to be bypassed depends on an involved algorithm that is a function of frequency band and the state of the successive approximation register of the Low Frequency Loop. Therefore, it is best to assume that the entire sequence of

Table 3-9. HP-IB Program Codes (Functional Order)

Parameter	Program Code[1]	Parameter	Program Code[1]
FREQUENCY		UNITS (Cont'd)	
Frequency (carrier)	FR	dBm	DM
		EMF	EM
AMPLITUDE		Volts	VL
Amplitude (carrier)	AP	mV	MV
		μV	UV
MODULATION		Hz	HZ
Amplitude Modulation	AM	kHz	KZ
Frequency Modulation	FM	MHz	MZ
External Modulation Source	S1	Percent[2]	PC
Internal 400 Hz Modulation Source	S2	Percent[2]	%
Internal 1 kHz Modulation Source	S3		
Modulation Source Off	S4	OTHER	
		Step Up (↑)	UP
DATA		Step Down (↓)	DN
Numerals 0 — 9	0 — 9	Increment Set	IS
Minus Sign	−	Standby[3]	R0
Decimal Point	.	On[3]	R1
		Store	ST
UNITS		Recall	RC
dB	DB	Sequence	SQ
dBf	DF	Reverse Power Protection Reset (4)	RP

[1]Program codes can be either upper or lower case.

[2]Either PC or % can be used.

[3]The RESET/STBY/ON switch must be in the ON position.

[4]The source of reverse power must be removed.

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Table 3-10. Commonly Used Code Conversions

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

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

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Switching Characteristics (Cont'd)

events shown in Figure 3-11 occurs every time a frequency change is made.

To minimize the effects of frequency hysteresis (especially near the frequency band edges), switch to the desired frequency from the same direction each time, that is, from either above or below the desired frequency. Ideally, the frequency change should be made from the same preset frequency. The main band frequency hysteresis is 100 kHz at the main band edges, that is, 123.5, 247 and 494 MHz.

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

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

Software correction of amplitude with respect to frequency may cause the amplitude to be uncalibrated while a frequency change occurs. The software correction is implemented after the final frequency is reached.

Software execution time for an amplitude change varies considerably. The basic unit for amplitude in the Signal Generator is dBm. An input in other units requires calculations. This tends to increase the software execution time considerably. For example, an input in dBm generally will take about 160 ms from the terminator to the end of software execution. A change (increment or decrement) in dB will take a little less time, typically 130 ms. Examples of a change with calculations involved are: a preset level in mV with a change in dB, 200 ms; a level and change in mV, 340 ms; a level in dBm and a change in mV, 460 ms.

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

Total time requirements for simple amplitude inputs or changes, that is, minimal software and hardware execution time is 150 ms. A more complex change may take up to 560 ms.

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

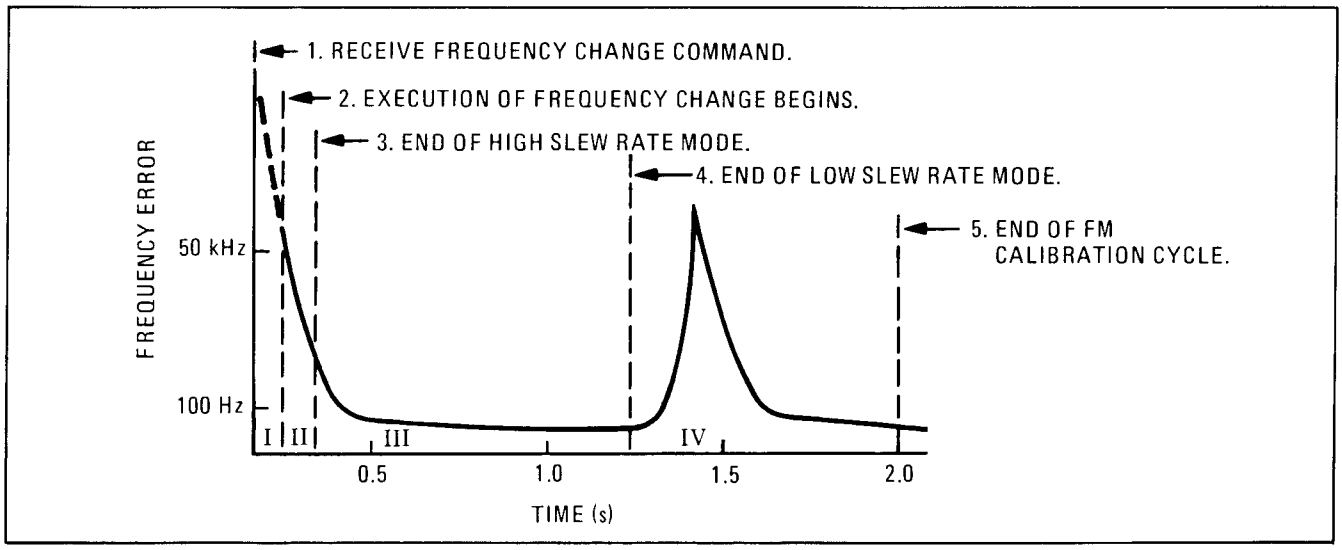


Figure 3-11. Frequency Switching Characteristics

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Amplitude

Description

This instruction details how to set the output amplitude.

Operating Characteristics:
Range: +13 dBm to −127 dBm (+1.00V to +0.100 μV)
Resolution: 0.1 dB

Keystroke Sequence

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

Examples

Set the output amplitude to −12.3 dBm.

LOCAL (keystrokes)	Function: AMPTD — Data: − 1 2 . 3 — Units: dBm
HP-IB (program codes)	AP−12.3DM (Function: AP; Data: 12.3; Units: DM)

Set the output amplitude to −2.0 dB EMF μV.

LOCAL (keystrokes)	Function: AMPTD — Data: − 2 . 0 — Units: dB EMF μV
HP-IB (program codes)	AP−2.0DBEMUV (Function: AP; Data: 2.0; Units: DBEMUV)

Keys and Program Codes

HP-IB

Keys	Program Codes (HP-IB)
AMPTD	AP
dBm	DM
dBf	DF
dB	DB
EMF	EM
V	VL
mV	MV
μV	UV

Indications

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

Comments

Digits selected beyond the specified resolution of the AMPLITUDE Display will be ignored.

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Amplitude (Cont'd)

Comments (Cont'd)

Leading zeros will be blanked.

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

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

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

Amplitude function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

Fourteen valid units entries are possible. They are as follows:

dBm	dB μV	V	EMF mV
dBf	dB EMF V	mV	EMF μV
dB V	dB AMF mV	μV	
dB mV	dB EMF μV	EMF V	

Related Instructions

Amplitude Conversion
Amplitude, Up/Down

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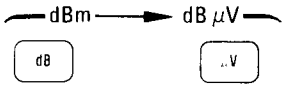
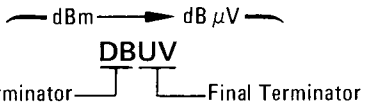
Amplitude Conversion

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

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

Example

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

LOCAL (keystrokes)	
HP-IB (program codes)	

Keys and Program Codes HP-IB

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

[1] Final Terminator.
[2] Prefix Terminator.
[3] Final Terminator for Increment Set Mode.

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

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

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

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

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

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Amplitude Conversion (Cont'd)

Comments (Cont'd)

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

Conversion formulas used are as follows:

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

Related Instructions

Amplitude
Amplitude, Up/Down

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Amplitude, Up/Down

Description

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

Keystroke Sequence

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

Keys and Program Codes HP-IB

Keys	Program Codes (HP-IB)
AMPTD	AP
▲	UP
▼	DN

NOTE

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

Indications

The output amplitude shown in the AMPLITUDE Display and the output of the Signal Generator will change by the value stored in the internal output amplitude increment register.

Comments

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

Places the instrument in the Amplitude Data entry mode and clears any previously selected function.

Continues to change the output amplitude by the value stored in the internal output amplitude increment register if either key remains pressed.

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

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

Related Instructions

Increment Value Change
Increment Value Display

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Display

Description

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

Keystroke Sequence

Press and release the DISPLAY key, then press and hold the Data key (a single digit register number 0—9).

Example

Display the stored contents from register 2.	
LOCAL (keystrokes)	Display Contents of Register 2 DISPLAY 2
HP-IB (program codes)	This feature is not accessible via HP-IB.

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
DISPLAY	None

Indications

The stored contents from the selected register will be displayed as long as the Data key remains pressed.

Comments

Ten internal registers are available (0—9). Each is capable of storing complete front panel setups (exclusive of increment settings).

Does not affect the actual output of the Signal Generator.

Does not change the contents of the internal sequence counter.

Does not affect the current increment settings.

Clears any previously selected function.

Feature is not accessible via HP-IB.

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

Related Instructions

Display Sequence
Recall
Sequence
Store

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Display Sequence

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

Keystroke Sequence Press and release the DISPLAY key, then press and hold the SEQ key.

Example

Display the contents of the internal sequence counter.	
LOCAL (keystrokes)	Display Sequence Counter Contents: DISPLAY SEQ
HP-IB (program codes)	This feature is not accessible via HP-IB.

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
DISLPAY	None
SEQ	None

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

Comments Does not affect the actual output of the Signal Generator.

Does not change the contents of the internal sequence counter.

Clears any previously selected function.

Feature is not accessible via HP-IB.

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

Related Instructions
Display
Sequence

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Frequency

Description

This instruction details how to set the carrier frequency.

Operating Characteristics:
Range: 100 kHz to 990 MHz (990.0000 MHz)
Resolutions: 100 Hz and 250 Hz, depending on the carrier frequency selected.

Keystroke Sequence

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

Example

Set the carrier frequency to 123.45 MHz.

LOCAL (keystrokes)	Function: FREQUENCY; Data: 1 2 3 . 4 5; Units: MHz
HP-IB (program codes)	FR123.45MZ (Function: FR; Data: 123.45; Units: MZ)

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
FREQUENCY	FR
MHz	MZ
kHz	KZ
No key	HZ

Indications

The selected carrier frequency will be displayed in megahertz in the FREQUENCY Display.

Comments

Least significant (eighth) digit will be blanked when the selected carrier frequency is a multiple of 100 Hz.

In cases where the selected carrier frequency is a multiple of 250 Hz, the least significant digit will be a 5.

Digits selected beyond the specified resolution of the FREQUENCY Display will be truncated.

Leading zeros will be blanked.

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

The MODULATION Display will flash if a change in carrier frequency would cause the FM peak deviation frequency allowed for that frequency band to be exceeded. Entering a carrier frequency that would set the instrument in the correct band for the selected deviation frequency will clear the error condition, or pressing one of the following keys will automatically adjust the FM peak deviation frequency to the maximum frequency possible for that frequency band.

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Frequency (Cont'd)

Comments (Cont'd)

Band	Carrier Frequency (MHz)
1	0.1 — 123.5
2	123.5 — 247
3	247 — 494
4	494 — 990



The carrier frequency increment is rejected if it is not a multiple of 100 Hz or 250 Hz.

Frequency function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

Related Instructions

Frequency, Coarse and Fine Tune
Frequency, Up/Down

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Frequency, Coarse and Fine Tune

Description

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

Keystroke Sequence

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

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

Pressing the step up key will then increase the carrier frequency by the newly selected carrier frequency tuning value, while pressing the step down key will decrease the carrier ferquency.

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

Example

Enable a carrier frequency tuning value of 10 kHz (assuming a starting value of 10 MHz).	
LOCAL (keystrokes)	Decrease Tuning Value FINE TUNE ÷10 → FINE TUNE ÷10 → FINE TUNE ÷10
HP-IB (program codes)	This feature is not accessible via HP-IB.

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
FREQUENCY	None
COARSE TUNE	None
FINE TUNE	None
↑	None
↓	None
INCR SET	None

Indications

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

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

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

Comments

Feature only applies to the carrier frequency function.

Feature is not accessible via HP-IB.

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Frequency, Coarse and Fine Tune (Cont'd)

Comments (Cont'd)

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

Places the instrument into the frequency Data entry mode and clears any previously selected function, once either the step up or step down key is pressed.

Enables the last valid carrier frequency increment value when the INCR SET key is pressed.

Related Instructions

Frequency
Frequency, Up/Down
Increment Value Change

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Frequency, Up/Down

Description

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

Keystroke Sequence

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

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
FREQUENCY ▲ ▼	FR UP DN

NOTE

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

Indications

The carrier frequency shown in the FREQUENCY Display and the output of the Signal Generator will change by the value stored in the internal carrier frequency increment register.

Comments

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

Places the instrument in the Frequency Data entry mode and clears any previously selected function.

Continues to change the carrier frequency by the value stored in the internal carrier frequency increment register if either key remains pressed.

The MODULATION Display will flash if a change in carrier frequency would cause the FM peak deviation frequency allowed for that frequency band to be exceeded. Entering a carrier frequency that would set the instrument in the correct band for the selected deviation frequency will clear the error condition, or pressing one of the following keys will automatically adjust the FM peak deviation frequency to the maximum frequency possible for that frequency band.

Band	Carrier Frequency (MHz)
1	0.1—123.5
2	123.5—247
3	247—494
4	494—990



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

Initialized Value	Minimum Value	Maximum Value
10.0000 MHz	0.1 kHz	≤989.99 MHz

Related Instructions

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

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HP-IB Address Display

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

Keystroke Sequence Press and hold the HP-IB ADRS key.

Example

Display the internally-set, decimal HP-IB address.	
LOCAL (keystrokes)	Display HP-IB Address HP-IB ADRS
HP-IB (program codes)	This feature is not accessible via HP-IB.

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
HP-IB ADRS	None

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

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

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

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

To change the HP-IB address, refer to paragraph 2-8, HP-IB Address Selection.

Feature is not accessible via HP-IB.

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

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HP-IB Address Display (Cont'd)

Comments (Cont'd)

Allowable HP-IB Address Codes

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

Indicates factory-set address.

Related Instructions

None

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Increment Value Change

Description

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

Carrier Frequency	10.0000 MHz
Output Amplitude	10.0 dB
AM Depth	1%
FM Peak Deviation Frequency	1.0 kHz

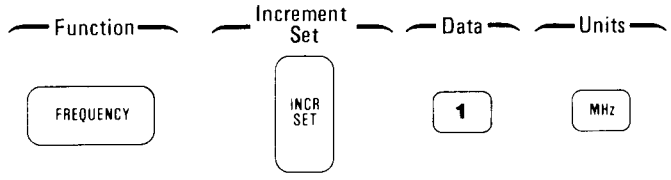
Keystroke Sequence

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

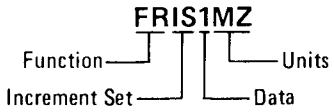
Example

Set a carrier frequency increment of 1 MHz.

LOCAL (keystrokes)



HP-IB (program codes)



Keys and Program Codes HP-IB

Keys	Program Codes HP-IB	Keys	Program Codes HP-IB
INCR SET	IS	%	PC or %
FREQUENCY	FR	dBm	DM
AMPTD	AP	dBf	DF
AM	AM	dB	DB
FM	FM	EMF	EM
MHz	MZ	V	VL
kHz	KZ	mV	MV
No Key	HZ	μV	UV

Indications

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

Comments

The frequency increment is rejected if it is not a multiple of 100 Hz or 250 Hz.

FM peak deviation frequency increments must be selected in units of kHz only.

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Increment Value Change (Cont'd)

Comments (Cont'd)

The minimum allowable increment value for each of the four main functions is listed as follows:

Carrier Frequency	0.1 kHz
Output Amplitude	0.1 dB
	0.01 μV
	0.001 EMF μV
AM Depth	1%
FM Peak Deviation Frequency	0.1 kHz

The maximum allowable increment value for each of the four main functions is listed as follows:

Carrier Frequency	≤989.99 MHz
Output Amplitude	≤144.0 dB
	≤1.57V
	≤3.15 EMFV
AM Depth	≤99%
FM Peak Deviation Frequency	≤99 kHz

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

Related Instructions

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

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Increment Value Display

Description

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

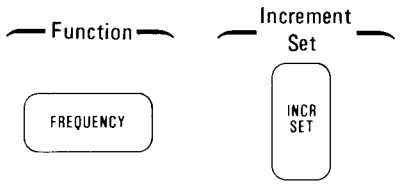
Keystroke Sequence

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

Example

Display the stored carrier frequency increment.

LOCAL (keystrokes)



(program codes)

FRIS

Function — Increment Set

Keys and Program Codes

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

Indications

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

Comments

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

Carrier Frequency	10.0000 MHz
Output Amplitude	10.0 dB
AM Depth	1%
FM Peak Deviation Frequency	1.0 kHz

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

Related Instructions

Increment Value Change

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Modulation, AM

Description

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

Operating Characteristics:

Depth: 0 — 99% to +7 dBm
0 — 30% to +10 dBm
Resolution: 1%
Rate (internal): 400 Hz and 1 kHz, ±3%

Keystroke Sequence

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

Example

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

LOCAL (keystrokes)	Source: INT 400 Hz — Function: AM — Data: 7, 5 — Units: %
HP-IB (program codes)	S2AM75PC or % Source: S2 — Function: AM — Data: 75 — Units: PC or %

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
INT 400 Hz	S2
INT 1 kHz	S3
AM	AM
%	PC or %

Indications

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

Comments

Digits selected beyond the specified resolution for AM depth will be truncated.

Leading zeros will be blanked.

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

AM function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

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

Related Instructions

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

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Modulation, AM Up/Down

Description

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

Keystroke Sequence

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

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
AM	AM
▲	UP
▼	DN

NOTE

During remote operation, repeated UP or DN codes can be sent over the bus once the AM function has been selected.

Indications

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

Comments

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

Places the instrument in the AM Data entry mode and clears any previously selected function.

Selects default modulation source (internal 1 kHz) if no other source is selected.

Continues to change the percentage of AM depth by the value stored in the internal AM depth increment register if either key remains pressed.

Will automatically stop incrementing when the maximum percentage of AM depth permitted for a selected output amplitude is reached.

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

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

Related Instructions

Increment Value Change
Increment Value Display

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Modulation, External Source

Description

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

Operating Characteristics:

Rate (for AM or FM): 25 Hz to 25 kHz; 1 dB bandwidth; ac coupled
Input Impedance: 600 ohms (resistive)
Input Level: 1 Vpk (0.707 Vrms)

Keystroke Sequence

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

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
EXT	S1
AM	AM
%	PC or %
FM	FM
kHz	KZ

Indications

The HI EXT annunciator will light if the external modulation signal is greater than 1.02 Vpk (0.721 Vrms) and the LO EXT annunciator will light if the signal is less than 0.98 Vpk (0.693 Vrms).

NOTE

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

Comments

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

Related Instructions

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

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Modulation, FM

Description

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

Operating Characteristics:

Peak Deviation:

Carrier Frequency (MHz)	Maximum Peak Deviation	
	Rates ≥60 Hz	Rates <60 Hz
0.1 — 123.5	99 kHz	1600 x Rate
123.5 — 247	25 kHz	400 x Rate
247 — 494	50 kHz	800 x Rate
494 — 990	99 kHz	1600 x Rate

Resolution: 0.1 kHz for peak deviations <10 kHz
1 kHz for peak deviations ≥10 kHz

Rate (internal): 400 Hz or 1 kHz, ±3%

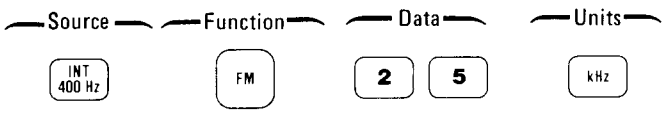
Keystroke Sequence

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

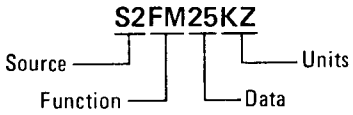
Example

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

LOCAL (keystrokes)



HP-IB (program codes)



Keys and Program Codes HP-IB

Keys	Program Codes (HP-IB)
INT 400 Hz	S2
INT 1 kHz	S3
FM	FM
kHz	KZ

Indications

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

Comments

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

Leading zeros will be blanked.

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Modulation, FM (Cont'd)

Comments (Cont'd)

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

The MODULATION Display will flash if a change in carrier frequency would cause the FM peak deviation frequency allowed for that frequency band to be exceeded. Entering a carrier frequency that would set the instrument in the correct band for the selected deviation frequency will clear the error condition, or pressing one of the following keys will automatically adjust the FM peak deviation frequency to the maximum frequency possible for that frequency band.

Band	Carrier Frequency MHz
1	0.1 — 123.5
2	123.5 — 247
3	247 — 494
4	494 — 990



FM function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

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

Related Instructions

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

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Modulation, FM Up/Down

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

Keystroke Sequence Press and release the step up or step down keys associated with the frequency modulation function.

Keys and Program Codes HP-IB

Keys	Program Codes (HP-IB)
FM	FM
▲	UP
▼	DN

NOTE

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

Indications The FM peak deviation frequency shown in the MODULATION Display and the output of the Signal Generator will change by the value stored in the internal FM peak deviation frequency increment register.

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

Places the instrument in the FM Data entry mode and clears any previously selected function.

Selects default modulation source (internal 1 kHz) if no other source is selected.

Continues to change the FM peak deviation frequency by the value stored in the internal FM peak deviation frequency increment register if either key remains pressed.

Will automatically stop incrementing when the maximum FM peak deviation frequency permitted for a selected carrier frequency is reached.

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

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

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

Related Instructions Increment Value Change
Increment Value Display

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Modulation, Mixed

Description

These instructions detail the selection of mixed modulation. Modulation can be selected in one of four ways.

1. Simultaneous AM and FM may be selected using common or separate modulation sources (rate).

2. Simultaneous AM or FM at two rates may be selected by using internal and external modulation sources. Only one AM depth or one FM deviation can be selected.

3. Three simultaneous modulation signals, AM and FM using a common source (rate) and either AM or FM from a separate source, may be selected.

4. Four simultaneous modulation signals, two AM and two FM, may be selected. Each AM/FM pair must have a common modulation source (rate). Only one AM depth and one FM deviation can be selected.

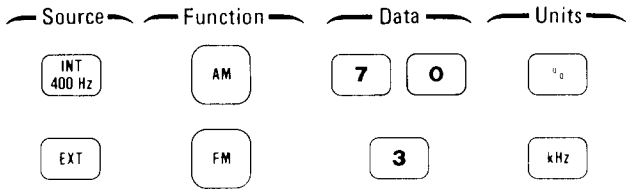
Keystroke Sequence 1

To select simultaneous AM and FM, press and release the Source key to provide the desired AM rate, the AM Function key, the desired Data keys and the % Units key. Then press and release the Source key to provide the desired FM rate, the FM Function key, the desired Data keys and the kHz Units key. (The Source key need not be pressed for FM if the AM and FM rate is the same.)

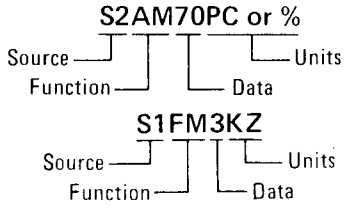
Example 1

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

LOCAL (keystrokes)



HP-IB (program codes)



Keystroke Sequence 2

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

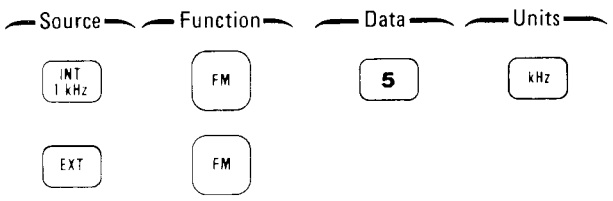
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Modulation, Mixed (Cont'd)

Example 2

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

LOCAL (keystrokes)



(program codes)

S3FM5KZ
Source — Function — Data — Units

S1FM
Source — Function

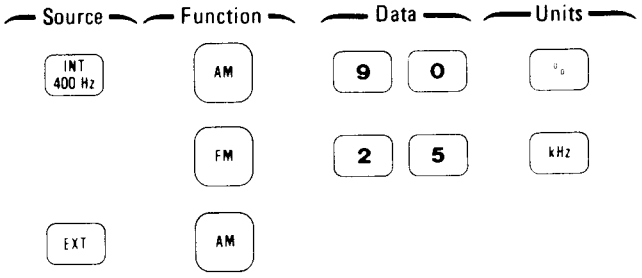
Keystroke Sequence 3

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

Example 3

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

LOCAL (keystrokes)



(program codes)

S2AM90PC or %
Source — Function — Data — Units

FM25KZ
Function — Data — Units

S1AM
Source — Function

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Modulation, Mixed (Cont'd)

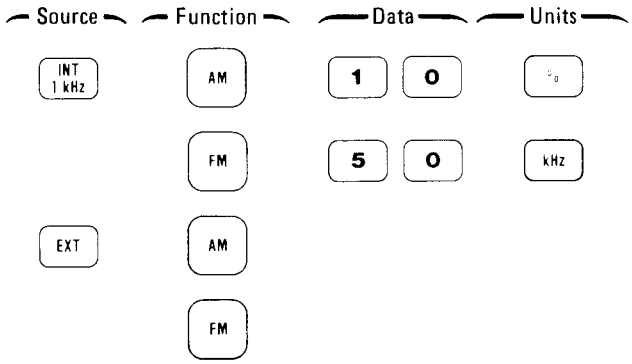
Keystroke Sequence 4

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

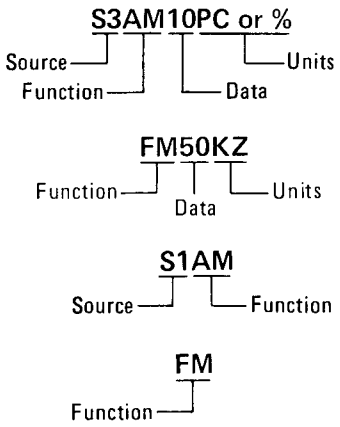
Example 4

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

LOCAL (keystrokes)



HP-IB (program codes)



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Modulation, Mixed (Cont'd)

Keys and Program Codes

HP-IB

Keys	Program Codes HP-IB
AM	AM
FM	FM
EXT	S1
INT 400 Hz	S2
INT 1 kHz	S3

Indications

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

Comments

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

Leading zeros will be blanked.

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

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

The MODULATION Display will flash if a change in carrier frequency would cause the FM peak deviation frequency allowed for that frequency band to be exceeded. Entering a carrier frequency that would set the instrument in the correct band for the selected deviation frequency will clear the error condition, or pressing one of the following keys will automatically adjust the FM peak deviation frequency to the maximum frequency possible for that frequency band.

Band	Carrier Frequency MHz
1	0.1 — 123.5
2	123.5 — 247
3	247 — 494
4	494 — 990



AM or FM function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

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

Related Instructions

Modulation, AM
Modulation, AM Up/Down
Modulation, External Source
Modulation, FM
Modulation, FM Up/Down
Modulation, OFF

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Modulation, OFF

Description

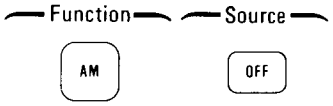
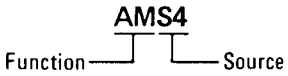
This instruction details how to selectively turn off the AM or FM function. In addition, it details how to selectively turn off a modulation source.

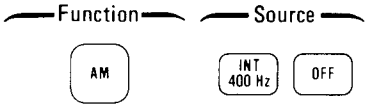
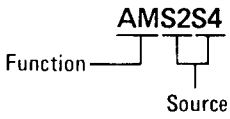
Keystroke Sequences

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

To turn off a modulation source, press and release the associated Function key, Source key, then the OFF key.

Examples

Selectively turn off AM modulation function with only one modulation source in use.	
LOCAL (keystrokes)	
HP-IB (program codes)	

Selectively turn off internal 400 Hz source.	
LOCAL (keystrokes)	
HP-IB (program codes)	

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
AM	AM
FM	FM
EXT	S1
INT 400 Hz	S2
INT 1 kHz	S3
OFF	S4

Indications

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

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Modulation, OFF (Cont'd)

Comments

Currently selected modulation function (AM or FM) will be turned off when the OFF key is pressed provided only one source (internal 400 Hz or 1 kHz or external) has been selected for use.

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

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

Related Instructions

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

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Recall

Description

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

Keystroke Sequence

Press and release the RECALL key, then a Data key (a single digit register number 0—9).

Example

Recall the stored contents from register 2.	
LOCAL (keystrokes)	Recall Contents from Register 2 RECALL 2
(program codes)	RC2 Recall Contents from Register 2

Keys and Program Codes

Keys	Program Codes
RECALL	RC

Indications

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

Comments

Ten internal registers are available (0—9). Each is capable of storing complete front panel setups (exclusive of increment settings).

Clears any previously selected function.

Updates the contents of the internal sequence counter so that it agrees with the numerical location of the recalled register.

Does not affect the current increment settings.

Related Instructions

Display
Store
Sequence

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Sequence

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

Keystroke Sequence Press and release the SEQ key.

Example

Sequentially recall the stored contents from each of the internal storage registers.	
LOCAL (keystrokes)	Recall Contents from Next Sequential Storage Register SEQ
HP-IB (program codes)	SQ Recall Contents from Next Sequential Storage Register

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
SEQ	SQ

Indications The stored contents from each internal storage register will be recalled and the output of the Signal Generator will be changed so that it agrees with the recalled parameter values.

Comments Ten internal registers are available (0—9). Each is capable of storing complete front panel setups (exclusive of increment settings).

Does not clear any previously selected function.

Updates the contents of the internal sequence counter so that it agrees with the numerical location of the recalled register.

Does not affect the current increment settings.

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

Related Instructions

Display
Display Sequence
Recall
Store

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Store

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

Keystroke Sequence Press and release the STORE key, then a Data key (a single digit register number 0—9).

Example

Store the current front panel settings in register 2.	
LOCAL (keystrokes)	Store Settings in Register 2: STORE, 2
HP-IB (program codes)	ST2 — Store Settings in Register 2

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
STORE	ST

Indications No visible front panel change.

Comments Ten internal registers are available (0—9). Each is capable of storing complete front panel setups (exclusive of increment settings).

Clears any previously selected function.

Initialized conditions of the Signal Generator are stored in each of the ten internal storage registers when the instrument is powered up or reset.

Related Instructions
Display
Recall
Sequence

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