OPERATING AND SERVICE MANUAL

HP 8970A
NOISE FIGURE METER
(Including Option 001)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2438A.

With the changes described in Section VII, this manual also applies to instruments with serial numbers 2116A, 2210A, 2222A, 2303A, and 2414A.

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

Operating Manual Part No. 08970-90014
Operating and Service Manual Part No. 08970-90015
Operating and Service Manual Microfiche Part No. 08970-90016

Printed: MAY 1985

SAFETY CONSIDERATIONS

GENERAL

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

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

BEFORE APPLYING POWER

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

SAFETY EARTH GROUND

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

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection). In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

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

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

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

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

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

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

SAFETY SYMBOLS

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

Indicates hazardous voltages.

Indicates earth (ground) terminal.

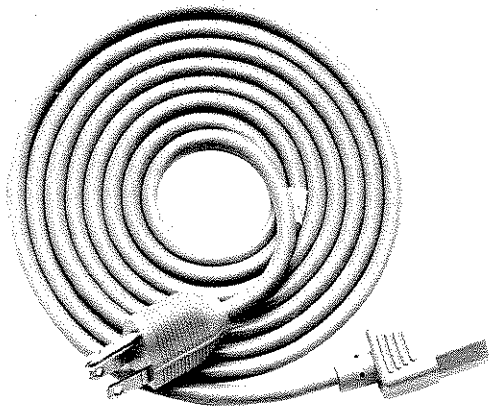
WARNING

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

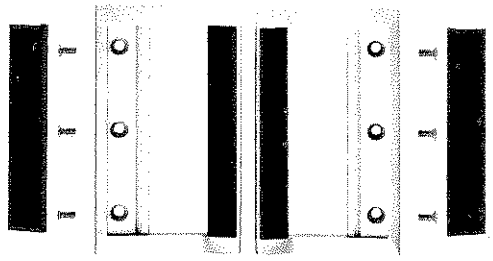
CAUTION

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

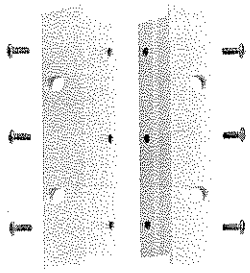
MODEL 8970A



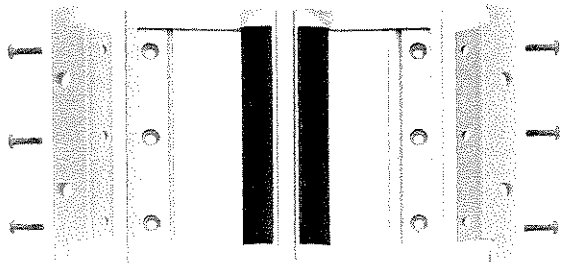
LINE POWER CABLE



OPTION 907
FRONT HANDLE KIT



OPTION 908
RACK FLANGE KIT



OPTION 909
RACK FLANGE AND FRONT
HANDLE COMBINATION KIT

Figure 1-1. HP Model 8970A Accessories Supplied, and Options 907, 908, and 909

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 8970A Noise Figure Meter. Figure 1-1 shows the Noise Figure Meter with all of its externally supplied accessories.

The 8970A Operating and Service manual has eight major sections. They are:

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

Two copies of the operating information are supplied with the Noise Figure Meter. One copy is in the form of an Operating Manual. The Operating Manual is a copy of the first three sections of the Operating and Service Manual. The Operating Manual should stay with the instrument for use by the operator. Additional copies of the Operating Manual can be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

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

1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is 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, provided with a protective earth terminal). The Noise Figure Meter and all related documenatation should be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information for installation, operation, performance testing, adjustment, or service is found in appropriate places throughout this manual.

1-4. INSTRUMENTS COVERED BY MANUAL

Attached to the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. The first four digits and the letter are the serial number prefix. The last five digits are the suffix. The prefix is the same for identical instruments; it changes only when a configuration change is made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

1-5. MANUAL CHANGES SUPPLEMENT

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those documented in this manual. The manual for this newer instrument is accompanied by a Manual Changes supplement. The supplement contains change instructions that explain 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 the manual as current and as accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement is identified with the manual

MANUAL CHANGES SUPPLEMENT (cont'd)

print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-6. DESCRIPTION

The Hewlett-Packard Model 8970A Noise Figure Meter, together with an appropriate noise source, automatically measures the noise figure and gain of the device to which it is attached. The Noise Figure Meter can be tuned between 10 and 1500 MHz. It can also be swept over all or any part of that range. To measure the noise figure of devices with output frequencies greater than 1500 MHz, an external mixer and local oscillator can be used to convert the frequency to the 10—1500 MHz range. Measured noise can be displayed as noise figure, equivalent input noise temperature or Y-Factor. Gain is displayed in dB.

Once calibrated, a single keystroke of the Noise Figure Meter can automatically remove the measurement system noise and gain contribution (called second stage correction). The Noise Figure Meter then displays only the noise figure and gain of the device under test (DUT).

The Excess Noise Ratio (ENR) of the noise source can be entered into the Noise Figure Meter for up to 27 frequencies. The Noise Figure Meter uses this data to correct for ENR versus frequency variations. For measurements made between calibration points, ENR data is interpolated. When the instrument is turned off, the ENR table is stored in continuous memory.

X- and Y-Axis outputs on the rear panel allow for noise figure and gain versus frequency to be displayed on a storage or nonstorage oscilloscope, or output to a recorder. On an oscilloscope, gain can be displayed at a lower intensity than noise figure, to distinguish between the two traces. The Z-Axis output blanks an oscilloscope or lifts a recorder pen. A storage oscilloscope can also be used, but the differences in trace intensity are obscured.

Most functions can be remotely programmed via the Hewlett-Packard Interface Bus (HP-IB) and all measurement data is available to the HP-IB. In addition, the Noise Figure Meter has sufficient HP-IB controller capability to set the output level and to tune a local oscillator across a frequency band.

1-7. OPTIONS

1-8. Electrical Option 001

This option provides a rear panel (instead of front panel) connection for the INPUT jack.

1-9. Mechanical Options

The following options may have been ordered and received with the Noise Figure Meter. If they were not ordered with the original shipment, they can be ordered from the nearest Hewlett-Packard office using the part number included in each of the following paragraphs.

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

Rack Flange Kit (Option 908). The Noise Figure Meter can be solidly mounted to the instrument rack using the flange kit. Order HP part number 5061-9677.

Rack Flange and Front Handle Combination Kit (Option 909). This is not a front handle kit and a rack flange kit packaged together; it is composed of a unique part which combines both functions. Order HP part number 5061-9683.

1-10. HEWLETT-PACKARD INTERFACE BUS HP-IB

1-11. Compatibility

The Noise Figure Meter is compatible with HP-IB to the extent indicated by the following code: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C1, C3, C28, and E1. The Noise Figure Meter interfaces with the bus via open collector TTL circuitry. An explanation of the compatibility code can be found in IEEE Standard 488 (1978), "IEEE Standard Digital Interface for Programmable Instrumentation" or the identical ANSI Standard MC1.1. For more detailed information relating to programmable control of the Noise Figure Meter, refer to Remote Operation, Hewlett-Packard Interface Bus in Section III of this manual.

1-12. Selecting the HP-IB Address

The Noise Figure Meter uses two HP-IB addresses. One is the address of the Noise Figure Meter. The

Selecting the HP-IB Address (cont'd)

second is the HP-IB address of an external local oscillator when the Noise Figure Meter is used as a controller. Refer to HP-IB Addresses in the Detailed Operating Instructions in Section III for additional information.

1-13. ACCESSORIES SUPPLIED

The accessories supplied with the Noise Figure Meter are shown in Figure 1-1.

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

b. Fuses with a 1.5A rating for 100/120 Vac operation and a 1.0A for 220/240 Vac operation are supplied. One fuse is factory installed according to the voltage available in the country of original destination. Refer to paragraph Line Voltage and Fuse Selection in Section II of this manual.

In addition, a product note titled "Applications and Operation of the 8970A Noise Figure Meter" is supplied with each instrument. Order HP part number 5952-8254 for additional copies.

1-14. EQUIPMENT REQUIRED BUT NOT SUPPLIED

To form a noise figure measurement system, a noise source such as HP Model 346B (346A or 346C), must be used with the Noise Figure Meter. The Noise Figure Meter supplies +28.0V pulses to drive the noise source on and off.

1-15. ELECTRICAL EQUIPMENT AVAILABLE

1-16. Performance Test Tape

This tape contains automated versions of all the Performance Tests in Sections IV of this manual. The tape significantly reduces the time normally required to perform the tests. An HP-85B Personal Computer with HP 82936A ROM Drawer, 00085-15005 Advanced Programming ROM, and HP 82937A HP-IB Interface are required to run the programs on the tape. Order HP part number 09870-10001.

1-17. HP-IB Controllers HP-IB

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

1-18. External Mixers and Local Oscillators

An external local oscillator and balanced mixer can be used to extend the frequency range of the Noise Figure Meter. Suitable LO's include the HP 8672A or HP 8673B Synthesized Signal Generator and the HP 8350A Sweep Oscillator. A suitable mixer is the HP HMXR-5001.

1-19. Waveguide/Coax Adapters

The HP 346B/C Noise Source combined with the HP X281C or P281C Waveguide/Coax Adapter makes a very accurate, calibrated waveguide noise source.

1-20. Front-to-Rear-Panel Connector Retrofit Kit

This kit contains all the necessary components and full instructions for converting instruments with a front panel INPUT connector to a rear panel connector. Order HP part number 08970-60100. After installation and calibration, performance will be identical to 8970A Option 001.

1-21. Rear-to-Front-Panel Connector Retrofit Kit

This kit contains all the necessary components and full instructions for converting instruments with a rear panel INPUT connector to a front panel connector. Order HP part number 08970-60101. After installation and calibration, performance will be identical to the standard 8970A.

1-22. MECHANICAL EQUIPMENT AVAILABLE

1-23. Chassis Slide Mount Kit

This kit is extremely useful when the Noise Figure Meter is rack mounted. Access to internal circuits and components or the rear panel is possible without removing the instrument from the rack. Order HP part number 1494-0060 for 430 mm (17 inch) fixed sides and part number 1494-0061 for the correct adapters for non-HP rack enclosures.

1-24. Chassis Tilt Slide Mount Kit

This kit is the same as the Chasis Slide Mount Kit above except that it also allows the tilting of the instrument up or down 90 degrees. Order HP part number 1494-0062 for 430 mm (17 inch) tilting slides and part number 1494-0061 for the correct adapters for non-HP rack enclosures.

1-25. RECOMMENDED TEST EQUIPMENT

Table 1-3 lists the test equipment recommended for use in testing, adjusting, and servicing the

RECOMMENDED TEST EQUIPMENT (cont'd)

Noise Figure Meter. The Critical Specification 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 shown 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.

Table 1-1. Specifications (1 of 2)

Characteristics	Performance Limits	Conditions
NOISE FIGURE MEASUREMENT		
Range	0 to 30 dB	
Resolution	0.01 dB	
Instrumentation Uncertainty	±0.1 dB	For a noise source in a 0 to 55°C environment with an ENR of 14 to 16 dB.
GAIN MEASUREMENT		
Range	−20 to at least +40 dB	For total noise figures <30 dB.
Resolution	0.01 dB 0.1 dB	Gain ≥−9.99 dB Gain <−9.99 dB
Instrumentation Uncertainty	±0.2 dB	
INPUT		
Frequency Range	Tunable from 10 to 1500 MHz	
Frequency Resolution	1 MHz	
Tuning Accuracy	±(1 MHz + 1% of frequency), ±6 MHz maximum	From +10 to +40°
Noise Figure	<7 dB +0.003 dB/MHz	For input power levels below −60 dBm.
Input SWR (Reflection Coefficient)	<1.7 (0.26)	10 to 1500 MHz (50Ω reference impedance).
Maximum Operating Input Power	−10 dBm	
Maximum Net External Gain	>65 dB	Between noise source and 8970A RF Input.
ELECTROMAGNETIC COMPATIBILITY		
EMI	MIL STD 461A CISPR publication 11, and Messempfaenger Postverfuegung 526/527/79	Conducted and radiated interference is in compliance with MIL STD 461A Methods CE03 and RE02, CISPR publication 11 (1975), and Messempfaenger-Postverfuegung 526/527/79 (Kennzeichnung Mit F-Nummer/ Funkschutzzeichen).

Table 1-1. Specifications (2 of 2)

Characteristics	Performance Limits	Conditions
ELECTROMAGNETIC COMPATIBILITY (cont'd)		
Conducted and Radiated Susceptibility	MIL STD 461A-1968	Conducted and radiated susceptibility meets the requirements of methods CS01, CS02, CS06, and CS03 (1 volt/metre) of MIL STD 461A dated 1968.
GENERAL		
Noise Source Drive	28.0 ±0.1V	Noise source ON at up to 60 mA peak.
	<1V	Noise source OFF.
Power Requirements		
Line Voltage:		
100, 120, 220, or 240V	+5, −10%	48 to 66 Hz, single phase.
Power Dissipation	150 VA maximum	
Temperature:		
Operating	0 to 55°C	
Storage	−55 to 75°C	
Remote Operation (HP-IB)	IEEE STD 488-1978 Compatibility Code: H1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C1, C3, C28, E1	The Hewlett-Packard Interface Bus (HP-IB) is Hewlett-Packard's implementation of IEEE Std 488-1978, "Digital Interface for Programmable Instrumentation." Most functions are remotely programmable.
Dimensions:		
Height	146 mm (5.75 in.)	Note: For ordering cabinet accessories, the module sizes are 5¼H, 1 MW (module width, and 17D.
Width	425 mm (16.8 in.)	
Depth	462 mm (18.2 in.)	
Net Weight	15.5 kg (34 lbs)	

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.

All parameters describe performance in automatic operation or properly set manual conditions.

Sensitivity: no external gain required; −100 dBm; able to measure its own noise figure.

Measurement Speed: about 3 to 5 measurements per second.

Maximum Safe Input Level: ±20 Vdc; +20 dBm at RF.

FUNCTIONAL PROPERTIES

Noise Figure Display Units: noise figure in dB or as a ratio, or uncorrected Y-Factor in dB or as a ratio, or effective input noise temperature in kelvins.

External LO Control: frequency control over HP-IB from 10 to 60000 MHz.

Noise Figure Display Jitter: <0.01 dB with appropriate smoothing.

Cold Noise Source Data Range: 0 to 9999K.

Hot Noise Source Data Range: stored table — ENR from −7 to +17 dB; spot frequency — from 0 to 14824K.

Storage Capacity of Hot Noise Source Table: ENR at 27 frequencies.

Smoothing: exponential averaging of gain and noise figure before display according to D=P (F−1)/F+M/F where D is the display result, M is the latest measurement, and F is the averaging factor (1, 2, 4, 8, 16, 32, 64, 128, 256, or 512). Straight averaging is used during swept operation.

Rear Panel Outputs: X-Axis and Y-Axis from 0 to 6V. Z-Axis is TTL for pen lift (on an X-Y recorder) and blanking (on an oscilloscope).

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

Instrument	Specifications	Recommended Model	Use*
Attenuator, 1 dB Steps	Steps: 1 dB from 0 to 11 dB Frequency Range: 10 to 1500 MHz	HP 8494A Option 001	P, A
Attenuator, 10 dB Steps	Steps: 10 dB from 0 to 70 dB Frequency Range: 10 to 1500 MHz	HP 8495A Option 001	P
Attenuator, Fixed 6 dB	Attenuation: 6 dB Frequency Range: 10 to 1500 MHz	HP 8491A Option 006	P, A
Attenuator, Fixed 10 dB (2 required)	Attenuation: 10 dB Frequency Range: 10 to 1500 MHz	HP 8491A Option 010	P
Attenuator, Fixed 20 dB	Attenuation: 20 dB Frequency Range: 10 to 1500 MHz	HP 8491A Option 020	P
Calculator	Functions: Divide, multiply, square root Programmable	HP 41C	P, A
Controller, HP-IB	HP-IB compatibility as defined by IEEE Standard 488 and the identical ANSI Standard MC1.1: SH1, AH1, T2, TE0, L2, LE0, SR0, RL0, PP0, DC0, DT0, C1, 2, 3, 4, 5	HP 85B/82936A (ROM Drawer)/00085-15005 (Advanced Programming ROM) or HP 9835A/98332A/98034A or HP 9826A Option 011 (Basic 2.0 ROM based system) (built-in interface)	C, P,T
Digital Voltmeter	DC Voltage Range: Up to 100V Resolution (in high resolution mode): 1 μV on 1 Vdc range Accuracy (in high resolution mode): ±0.003% of reading +4 counts	HP 3455A or HP 3456A (Systems DVM)	P, A, T
Filter, Low-Pass	Insertion Loss: <1 dB below 0.9 times cut-off frequency Cut-Off Frequency: 1200 MHz Rejection: >50 dB at 1.25 times cut-off frequency	HP 360B	P, A
Frequency Counter	Range: 10 to 4000 MHz Resolution: 1 kHz	HP 5340A or HP 5343A	P, A
Frequency Doubler	Input Frequency Range: 10 to 760 MHz Conversion Loss: <15 dB at +13 dBm input	HP 11721A	P
Interface HP-IB	Required for HP 85B only	HP 82937A	C, P, T
Logic Analyzer	Input Lines: 43 Timing Analysis: 16 lines	HP 1630A or HP 1630D	T

*C = Operator's Checks; P = Performance Tests; A = Adjustments; T = Troubleshooting.

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

Instrument	Specifications	Recommended Model	Use*
Noise Source	Power Required: +28V ENR: 15.2 dB Connector: Type N (male)	HP 346B Option 001 or HP 346A or HP 346C	C, P, T
Oscilloscope	Inputs: Two Channel (A vs B or X vs Y) and Z-Axis	HP 1740A or HP 1980A (Oscilloscope Measuring System) or HP 1980B	C,A,T
Power Meter	Uncertainty: ±0.02 dB Instrumentation: dB Relative	HP 436A	P,A,T
Power Sensor	Frequency Range: 10 to 4000 MHz or Power Range: 0.1 nW to 10 μW SWR 30 to 4000 MHz: 1.15	HP 8484A or HP 8482A or HP 8485A	P,A,T
Power Splitter	Frequency Range: 10 to 1500 MHz	HP 11667A	P,A
Signal Generator (External LO)	Frequency Range: 10 to 760 MHz Frequency Accuracy: ±1 kHz Output Level: +13 dBm	HP 8656A or HP 3335A (Frequency Synthesizer) or HP 8672A (Synthesizer Signal Generator) or HP 8673B	C,T P,A,
Signature Multimeter (Analyzer)	Because the signatures documented are unique to a given signature analyzer, no substitution is recommended	HP 5005A or HP 5005B or HP 5006A	T
Spectrum Analyzer	Frequency Range: 10 to 1500 MHz	HP 8565A or HP 8566A	A
Sweep Oscillator	Frequency Range: 20 to 2400 MHz Attenuation: 70 dB in 10 dB steps	HP 8620C/86222B Option 002 or HP 8340A or HP 8350B	P,A,C
SWR Bridge	Frequency Range: 10 to 1500 MHz Directivity: 40 dB	Wiltron 60N50	P
Wideband Amplifier I	Frequency Range: 0.1 to 1300 MHz Gain: 26 dB Output Power for 1 dB Gain Compression: +7 dBm	HP 8447D Option 010	P
Wideband Amplifier II	Frequency Range: 0.1 to 1300 MHz Gain: 48 dB Output Power for 1 dB Gain Compression: >+15 dBm	HP 8447F Option 010	P

*C = Operator's Checks; P = Performance Tests; A = Adjustments; T = Troubleshooting.

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section provides the information needed to install the Noise Figure Meter. Included is information pertinent to initial inspection, power requirements, line voltage selection, power cables, interconnection, environment, instrument mounting, storage, and shipment.

2-2. INITIAL INSPECTION

WARNING

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

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

2-3. PREPARATION FOR USE

2-4. Power Requirements

The Noise Figure Meter requires a power source of 100, 120, 220 or 240 Vac, +5% to −10%, 48 to 66 Hz single phase. Power consumption is 150 VA maximum.

WARNINGS

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

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

2-5. Line Voltage and Fuse Selection

CAUTION

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

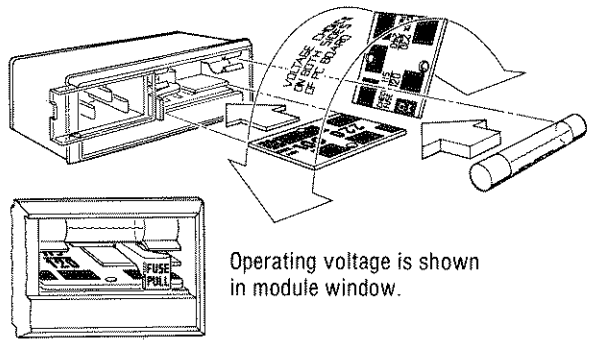
Verify that the line voltage selection card and the fuse are matched to the power source. Refer to Figure 2-1, Line Voltage and Fuse Selection.

Fuses may be ordered under HP part numbers 2110-0043, 1.5A (250V, normal blow) for 100/120 Vac operation and 2110-0001, 1.0A (250V, normal blow) for 220/240 Vac operation.

2-6. Power Cables

WARNING

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



Operating voltage is shown in module window.

SELECTION OF OPERATING VOLTAGE

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

WARNING

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

Figure 2-1. Line Voltage and Fuse Selection

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

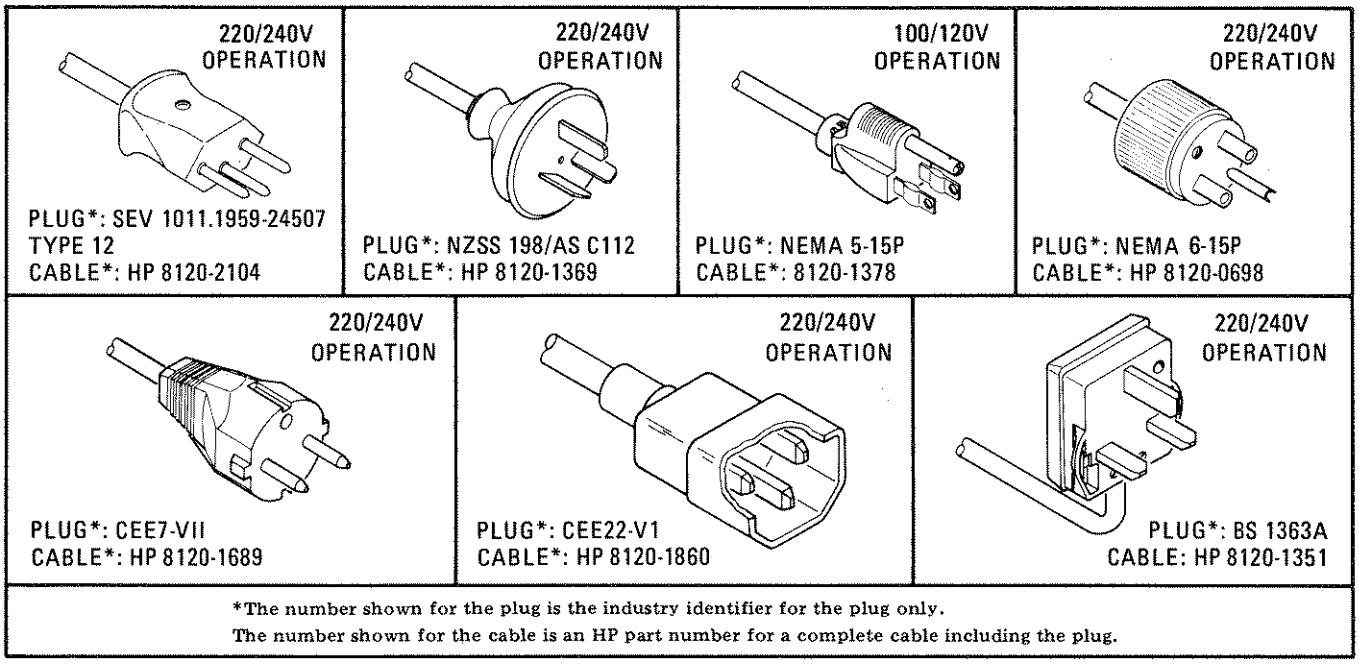
2-7. HP-IB Address Selection HP-IB

The Noise Figure Meter uses two HP-IB addresses. One is the address of the Noise Figure Meter. The second is the HP-IB address for an external local oscillator when the Noise Figure Meter is used as a controller. Both addresses are selectable by Special Function from the front panel. Refer to HP-IB Addresses in the Detailed Operating Instructions in Section III for additional information.

When shipped from the factory, the two addresses are:

a. The Noise Figure Meter HP-IB address is 8 (decimal).

b. The external local oscillator HP-IB address for use when the Noise Figure Meter is the controller is 19 (decimal).



*The number shown for the plug is the industry identifier for the plug only.
The number shown for the cable is an HP part number for a complete cable including the plug.

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

Valid HP-IB addresses are 0 through 30. Refer to Table 2-1 for decimal equivalents of the ASCII Talk and Listen address codes.

Table 2-1. ASCII Address Codes to Decimal Equivalents

ASCII Address Codes		Decimal Equivalents
LISTEN	TALK	
SP	@	00
!	A	01
"	B	02
#	C	03
$	D	04
%	E	05
&	F	06
'	G	07
(	H	08
)	I	09
*	J	10
+	K	11
,	L	12
-	M	13
.	N	14
/	O	15
0	P	16
1	Q	17
2	R	18
3	S	19
4	T	20
5	U	21
6	V	22
7	W	23
8	X	24
9	Y	25
:	Z	26
;	[	27
<	\	28
=	]	29
>	^	30

Decimal 08 is the factory set HP 8970A address.
Decimal 19 is the factory set address for an external LO

2-8. Interconnections

Interconnection data for the Hewlett-Packard Interface Bus is provided in Figure 2-3.

2-9. Mating Connectors

Interface Connector. The HP-IB mating connector is shown in Figure 2-3. Note that two securing screws are metric.

Coaxial Connectors. Coaxial mating connectors used with the Noise Figure Meter should be 50 ohm BNC, or type N male connectors.

2-10. Operating Environment

The operating environment should be within the following limitations:

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

2-11. Bench Operation

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

2-12. Rack Mounting

WARNING

The Noise Figure Meter weighs 15.5 kg (34 lb), therefore, care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting.

Rack mounting information is provided with the rack mounting kits. If the kits were not ordered with the instrument as options, they may be ordered through the nearest Hewlett-Packard office. Refer to the paragraph entitled Mechanical Options in Section I.

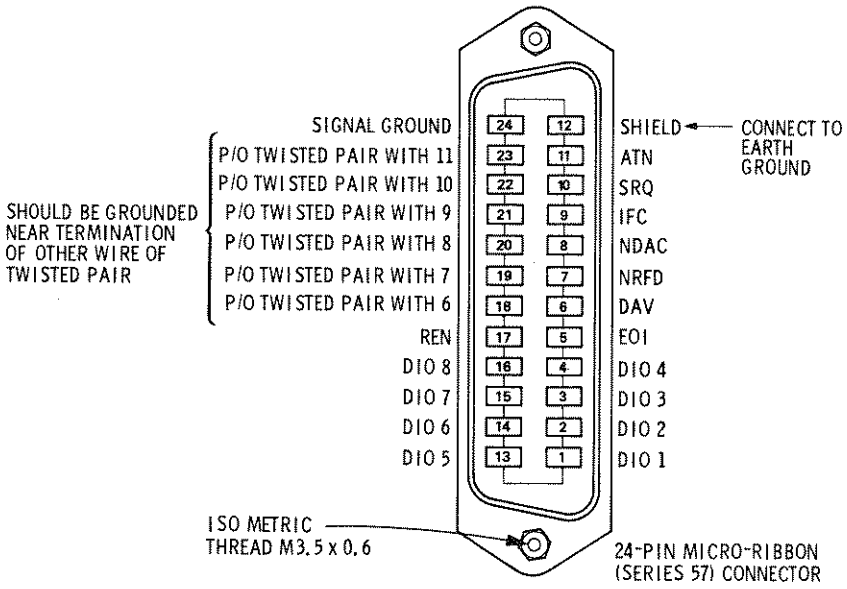
2-13. STORAGE AND SHIPMENT

2-14. Environment

The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:
Temperature .....-55°C to +75°C
Humidity .....<95% relative
Altitude..... <15 300 metres (50 000 feet)

2-15. Packaging

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



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 2-3. Hewlett-Packard Interface Bus Connections

Packaging (cont'd)

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. Mark the container "FRAGILE" to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

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

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

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

d. Seal the shipping container securely.

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

SECTION III
OPERATION

3-1. INTRODUCTION

This section provides complete operating information for the Noise Figure Meter. Included in this section are both general and detailed operating instructions, detailed descriptions of the front and rear panel, local and remote operator's checks, and operator's maintenance procedures.

3-2. Operating Characteristics

Table 3-1 briefly summarizes the major operating characteristics of the Noise Figure Meter. This table is not intended to be an in-depth listing of all operations and ranges but gives a rough idea of the instrument's capabilities. For more information on the Noise Figure Meter's capabilities, refer to Table 1-1, Specifications and Table 1-2, Supplemental Characteristics. For information on HP-IB capabilities, refer to the summary contained in Table 3-3, Message Reference Table.

3-3. Local Operation

Information covering front panel operation of the Noise Figure Meter is given in the sections described below. To rapidly learn the operation of the instrument, begin with Simplified Operation and Operator's Checks. Once familiar with the general operation of the instrument, use the Detailed Operating Instructions for in-depth and complete information in operating the Noise Figure Meter.

General Operating Information. Instructions relating to the Noise Figure Meter turn-on procedure and various keystroke sequences are presented to acquaint the user with the general operation of the instrument.

Simplified Operation. The instructions located on the inside of this fold provide a quick introduction to front panel operation of the Noise Figure Meter. These instructions are designed to rapidly acquaint the new user with basic operating procedures and therefore are not an exhaustive listing of all Noise Figure Meter functions. However, an index to the Detailed Operating Instructions appears opposite the fold to direct the operator to the more complete discussion of the topic of interest.

Panel Features. Front and rear panel features are described in detail in Figures 3-1 through 3-7.

Detailed Operating Instructions. The Detailed Operating Instructions provide the complete operating reference for the Noise Figure Meter user. The instructions are organized alphabetically by subject and are placed at the end of this section for easy reference. They are indexed by function in Table 3-2.

Operating Information Pull-Out Cards. The Operating Information pull-out cards are three flexible plastic reference sheets located in a tray below the front panel. They contain a listing of user special functions, HP-IB output formats, error codes, and measurement modes.

3-4. Remote Operation HP-IB

The Noise Figure Meter is capable of remote operation via the Hewlett-Packard Interface Bus (HP-IB). In remote operation, the Noise Figure Meter operates in one of three modes: normal talker listener mode, talk only mode, or controller mode (where the Noise Figure Meter controls an external LO). The remote operation instructions provide information pertinent to HP-IB operation when the Noise Figure Meter is in the normal talker/listener mode or the talk only mode. Included are discussions on capabilities, addressing, input and output formats, the status byte and service requests. At the end of the discussion is a complete summary of all codes and formats.

In addition to the section described above, information concerning remote operation appears in several other locations. The controller capability of the Noise Figure Meter is described in the Detailed Operating Instructions. A summary of HP-IB codes and output formats appear on one of the Operating Information pull-out cards. Numerous examples of program strings appear throughout the Detailed Operating Instructions.

3-5. Operator's Checks

Operator's Check's are procedures designed to verify the proper operation of the Noise Figure Meter's main functions. Two procedures are described below.

Basic Functional Checks. This procedure requires only a noise source, an oscilloscope, and intercon-

Operator's Checks (cont'd)
necting cables. It assures that most front panel controlled functions are being properly executed by the Noise Figure Meter.

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

3-6. Operator's Maintenance

WARNING

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

Operator's maintenance consists of replacing blown fuses and cleaning the air filter.

The primary power fuse is located within the Line Power Module (A15). Refer to Figure 2-1 for instructions on how to change the fuse.

The rear panel fan has a filter inserted from the outside for ease of cleaning or replacement. To service the filter, disconnect power from the instrument and remove the filter by pulling it from the rear of the fan. To clean the filter, hold it under running water or wash it in warm soapy water and then rinse it in clear water. Dry the filter thoroughly before putting it back into place. The replacement part is listed in Section VI (MP54).

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

3-7. GENERAL OPERATING INSTRUCTIONS

WARNING

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

CAUTION

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

FRONT PANEL FEATURES AND SIMPLIFIED OPERATION

3-8. Turn On

Turn-on Procedure. If the Noise Figure Meter is already plugged in, set the LINE switch to ON.

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

On the rear panel:

1. Check the line voltage selection card for correct voltage selection.
2. Check the fuse for correct current rating. The current rating is printed on the line power module label.
3. Plug in the power cable.

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

Turn-on Sequence. The Noise Figure Meter performs a quick internal check at turn-on. During this check, all front panel indicators light for approximately two seconds to allow a quick visual inspection of each front panel display annunciator and display segment. If a failure is detected, an error code will appear in the NOISE FIGURE display to indicate the nature of the failure. For error codes E10 through E49, and E80, refer to Error Messages and Recovery in the Detailed Operating Instructions. For error codes E50 through E80, refer to Section VIII, Service.

If the memory check was successful, four dashes "– – – –" will appear in the NOISE FIGURE display for approximately five seconds while the Noise Figure Meter performs a frequency calibration.

After the frequency calibration, the instrument powers up to the last front panel configuration prior to being turned off. Refer to Preset Conditions and Power-Up Sequence in the Detailed Operating Instructions for additional information.

NOTE

An internal battery is used to retain data in continuous memory when the Noise Figure Meter is turned off.

At turn-on, the Noise Figure Meter restores the same front panel configuration that was present when last powered down. Nine storage registers, the ENR table and other information are also restored.

3-9. Keystroke Sequences

The Noise Figure Meter's functions can be selected in any order. However, each function selection requires a prescribed sequence of keystrokes. A keystroke sequence can be either a single keystroke or several keystrokes that must be entered in a specific order. Functions requiring only a single keystroke are: PRESET, LOCAL, CALIBRATE, UNCORRECTED NOISE FIGURE, CORRECTED NOISE FIGURE AND GAIN, INCREASE, DECREASE, AUTO, SINGLE, ▲ and ▼.

Frequency parameters are entered in a Function - Data - ENTER format. Data entered following a function will be interpreted for that function only

Key Stroke Sequences (cont'd)
if terminated with the ENTER key. Data previously entered remains unaffected until the new data entry is terminated by pressing the ENTER key. If another function key is pressed before the data entry is terminated, that entry will be rejected and the last valid data for the function will remain active.

STORE and RECALL functions are entered in a Function - Data format. It is not necessary to use the ENTER key to terminate data entry. However, ENTER has no effect if it is used. Data is a single digit register number (0 through 9).

Special Functions are entered in a Code - SPECIAL FUNCTION format. The code consists of a prefix, decimal, and suffix. 7.1 is an example of a special function code where 7 is the prefix and 1 is the suffix. If the suffix is zero, the zero and the decimal point can be omitted when entering the code. For example, 7 SPECIAL FUNCTION is equivalent to 7.0 SPECIAL FUNCTION. A Code -SPECIAL FUNCTION - Data - ENTER format is used to activate and enter data for special functions that require data entry.

Table 3-1. Operating Characteristics

Measurements	Noise Figure (Corrected and Uncorrected Modes) Range: 0 to 30 dB Selectable Display Units: F dB, F, Y dB, Y, Te K Insertion Gain (Corrected Mode Only) Range: –20 to +40 dB Display Units: dB
Tuning	Fixed Frequency Range: 10 to 1500 MHz Resolution: 1 MHz Sweep Linear sweep. Range: 10 to 1500 MHz Resolution: 1 MHz Modes: Automatic, Single
Noise Source Parameters	Drive: +28V (pulsed) Entry Units: ENR in dB, °C, °F, K Hot Temp. Entry Range: 363 to 15000K Cold Temp. Entry Range: 0 to 1000K
Smoothing	Exponential or linear averaging of insertion gain and noise figure data before result is displayed. Selectable units in factors of 2.

ONT PANEL FEATURES

FIXED FREQ keys cause the current tuned frequency and frequency increment values to be displayed, and enable the entry of new values (see Figure 3-4).

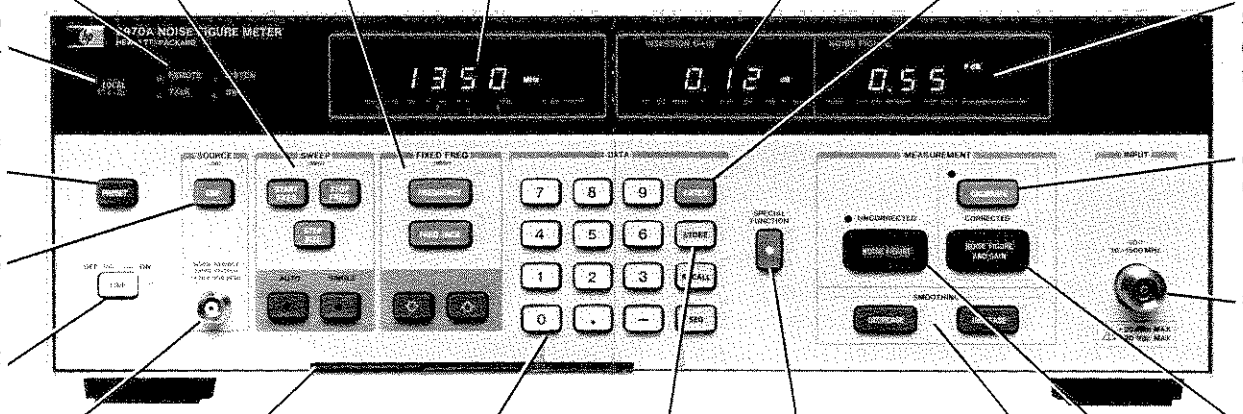
INSERTION GAIN displays the gain of the device under test (for a corrected measurement). Other displays are possible when using Special Functions (see Figure 3-2).

SWEEP keys cause the current sweep parameters to be displayed, enable the entry of new parameters, and initiate or terminate AUTO or SINGLE Sweep (see Figure 3-4).

Left Display indicates frequency, entries in progress, temperature, ENR and Special Function codes (see Figure 3-2).

ENTER key completes a data entry (see Figure 3-5).

HP-IB Annunciators indicate HP-IB status (see Figure 3-2).



NOISE FIGURE displays measured noise (in selectable output units) or error codes. Other displays are possible when using Special Functions (see Figure 3-2).

LOCAL key returns the Noise Figure Meter to local keyboard control from remote control provided the instrument is not in local lockout.

CALIBRATE key initiates a calibration sequence. This sequence measures the noise figure of the measurement system for use in corrected measurements (see Figure 3-6).

PRESET key returns the instrument to the preset conditions shown in Simplified Operation.

INPUT couples the output signal from the measurement setup into the Noise Figure Meter (see Figure 3-6).

ENR key enables entry of the "ENR versus Frequency" calibration data for a specific noise source (see Figure 3-3).

CORRECTED NOISE FIGURE AND GAIN key selects the noise figure and gain measurement. The measurement system noise contribution is automatically removed (see Figure 3-6).

LINE switch applies power to the instrument when set to ON.

UNCORRECTED NOISE FIGURE key selects the noise figure measurement. Displayed values include noise contribution of all parts of the measurement system (see Figure 3-6).

NOISE SOURCE DRIVE OUTPUT drives a noise source on and off with +28V pulses (see Figure 3-3).

DATA keys are used to enter numeric data (see Figure 3-5).

SPECIAL FUNCTION key completes entry of Special Function codes (see Figure 3-5).

Operating Information pull-out cards are quick operating references that show Special Functions, HP-IB codes, error codes and measurement modes.

STORE-RECALL-SEQ keys STORE up to 10 instrument configurations for RECALL at a later time. The SEQ key permits a sequential recall of up to 9 stored instrument configurations (see Figure 3-5).

SMOOTHING keys INCREASE or DECREASE the amount of smoothing (see Figure 3-6).

Figure 3-1. Front Panel Features

SIMPLIFIED OPERATION

PRESET

Press: [PRESET]

This sets the front panel functions to the following:
- FREQUENCY = 30 MHz
- FREQ INCR = 20 MHz
- START FREQ = 10 MHz
- STOP FREQ = 1500 MHz
- SWEEP = off
- STEP SIZE = 20 MHz
- SMOOTHING = 1
- MEASUREMENT = UNCORRECTED NOISE FIGURE
- CALIBRATE = off

In addition, default values are entered for some Special Functions. Refer to Table 3-14, Special Function Summary.

MEASUREMENT MODES

The Noise Figure Meter has five measurement modes. Mode 1.0 is used for RF measurements in the range of 10 to 1500 MHz and requires no external equipment (except a noise source). Modes 1.1 through 1.4 are used for microwave measurements of up to 60 GHz and require an external local oscillator. Modes 1.1 and 1.2 also require an external mixer (the mixer is part of the device under test in Modes 1.3 and 1.4). Refer to the operating information pull-out card and Measurement Modes in the Detailed Operating Instructions for additional information. A Measurement Mode must be selected before performing a calibration or making a measurement. (Measurement Mode 1.0 is selected with PRESET.) Simplified Operation assumes that Measurement Mode 1.0 is selected.

FIXED FREQUENCY TUNING

Fixed frequency parameters are selected in a Function-Data-ENTER format. For example, to set the tuned frequency to 500 MHz and the frequency increment to 100 MHz:

	FIXED FREQ (MHz)	DATA			
press	[FREQUENCY]	[5]	[0]	[0]	[ENTER]
	[FREQ INCR]	[1]	[0]	[0]	[ENTER]

[⇧] or [⇩] steps the frequency up or down by the 100 MHz increment set with the FREQ INCR key.

STORE AND RECALL

The Noise Figure Meter can store instrument configurations for recall at a later time. For example, to store an instrument configuration in storage register 5:

press [STORE] [5]

To recall the stored instrument configuration: press [RECALL] [5]

SWEEP FUNCTIONS

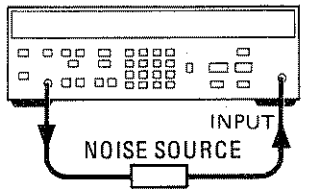
Sweep parameters are selected in a Function-Data-ENTER format. For example, to set the start frequency to 1000 MHz, the stop frequency to 1500 MHz and the step size to 100 MHz:

	SWEEP (MHz)	DATA				
press	START FREQ	1	0	0	0	ENTER
	STOP FREQ	1	5	0	0	ENTER
	STEP SIZE	1	0	0		ENTER

The Noise Figure Meter can sweep the selected frequency range once (SINGLE) or repetitively (AUTO). The sweep can be terminated by pressing the same key again.

MEASUREMENT

Connect a noise source to the Noise Figure Meter as shown:



Uncorrected Noise Figure

To measure uncorrected noise figure: press ● UNCORRECTED NOISE FIGURE
The Noise Figure Meter is measuring its own noise figure.

Calibrate

Calibrate measures and stores the measurement system noise characteristic at each frequency for correction of later measurements. Set START FREQ, STOP FREQ and STEP SIZE parameters. To initiate a calibration:

press ● CALIBRATE

Corrected Noise Figure and Gain

The Noise Figure Meter must be calibrated before a corrected noise figure and gain measurement can be made.

After calibration, to measure corrected noise figure and gain: press ● CORRECTED NOISE FIGURE AND GAIN

Note that the Noise Figure Meter removes its own noise figure from the measurement results.

Smoothing

To change the number of measurements averaged to optimize speed of response and reduce jitter in the INSERTION GAIN and NOISE FIGURE displays: press INCREASE or DECREASE

SPECIAL FUNCTIONS

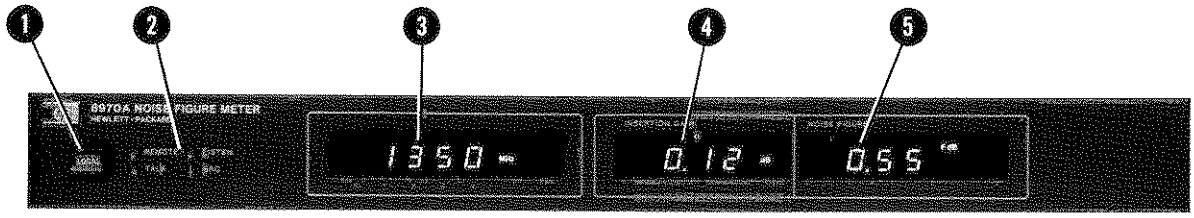
Special Functions access capabilities of the Noise Figure Meter beyond those available with dedicated front panel keys. Special Functions are selected in a Code-SPECIAL FUNCTION format.

For example, to display the ENR entry currently being used: press

CODE			
5	.	2	● SPECIAL FUNCTION

Refer to the Special Functions Detailed Operating Instruction at the end of this section for more information.

Table 3-2. Detailed Operating Instructions Table of Contents (Functional)



1 LOCAL Key. Returns the Noise Figure Meter to local operation (front panel control) from remote HP-IB control provided that the instrument is not in Local Lockout.

2 HP-IB Annunciators. Display the HP-IB status. The REMOTE annunciator lights when the Noise Figure Meter is in the remote mode. The TALK annunciator lights when the Noise Figure Meter is addressed to talk, is in Talk Only mode, or is controlling an external LO. The LISTEN annunciator lights when the Noise Figure Meter is addressed to listen. The SRQ annunciator lights when the Noise Figure Meter is sending a Require Service message to the controller.

3 Left Display. Depending upon the selected functions, the following information is displayed:

Frequency parameters — always displayed in MHz; 1 MHz resolution; 10 to 1500 MHz measurement range without external equipment; displays measurement frequency of up to 60 GHz when an external LO and a mixer are used to extend the frequency range of the Noise Figure Meter.

Special Function codes as they are entered.

Spot ENR — displayed in dB.

Temperature of the noise source — displayed in °C, °F, or K.

Sequence order.

Smoothing factor.

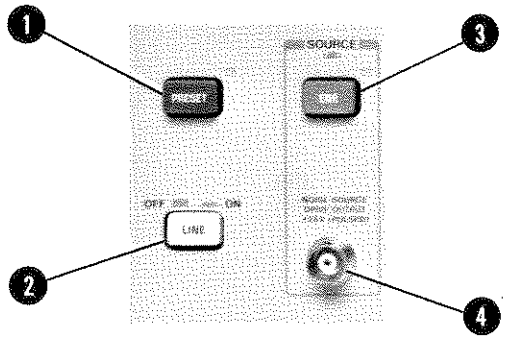
All data as it is being entered (except ENR in the "ENR versus Frequency" table).

EXT MIX (external mixer) annunciator — lights when Measurement Mode 1.1, 1.2, 1.3 or 1.4 is active.

4 INSERTION GAIN Display. Displays (in dB) the gain of the device under test (DUT) to two decimal places. This display also shows ENR in dB when entering the ENR table.

5 NOISE FIGURE Display. Displays measured noise. Five annunciators (F dB, Y dB, F, Te K, and Y) indicate the noise figure display units. This display is also used for power measurements (displayed in dB) and error codes.

Figure 3-2. Display and Remote Features



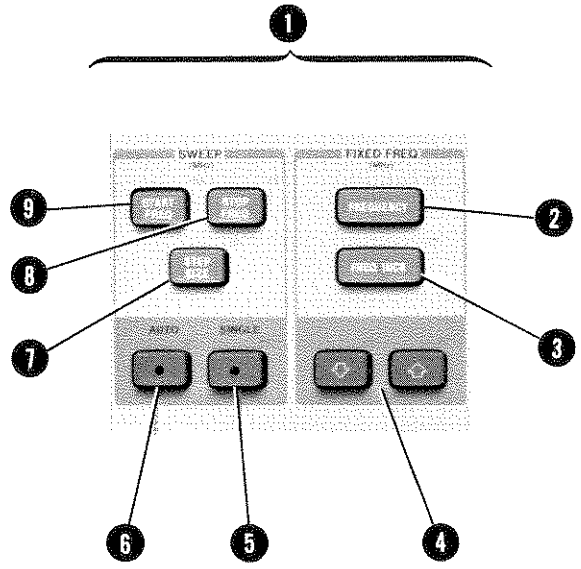
1 PRESET Key. Returns the instrument to a known state. Refer to the Preset Conditions and Power-Up Sequence Detailed Operating Instruction for a list of preset conditions and default values.

2 LINE Switch. Applies power to the Noise Figure Meter when set to the ON position.

3 ENR Key. Used to display and enable entry of the excess noise ratio (ENR) versus frequency table. ENR data for up to 27 frequencies can be stored. Frequency is shown in the left display and the corresponding ENR is shown in the INSERTION GAIN display.

4 NOISE SOURCE DRIVE OUTPUT. This BNC connector provides the output to drive a noise source on and off with +28 volt pulses.

Figure 3-3. LINE Switch, PRESET and SOURCE Features



1 Frequency Function Keys. In addition to the functions described below, the following keys are used to prefix numeric entries for the specified functions: START FREQ, STOP FREQ, STEP SIZE, FREQ, and FREQ INCR. Frequency is entered in MHz from the front panel. Frequency parameters are entered in a Function — Data — ENTER format.

FIXED FREQUENCY Keys

2 FREQUENCY Key. Causes the tuned frequency to appear in the left display. This key also acts as a "clear" key when an error is made during entry; that is, it returns the instrument to the measurement frequency. (Also see Frequency Function Keys.)

3 FREQ INCR Key. Causes the programmed frequency increment to appear in the left display while the key is depressed. (Also see Frequency Function Keys.)

4 ⌃ or ⌄ keys. Increase or decrease the tuned fixed frequency by the programmed frequency increment. Holding either of these keys down causes the tuning to step continuously up or down.

SWEEP Keys

5 SINGLE Key. Starts one sweep from START FREQ to STOP FREQ in increments determined by STEP SIZE. At the end of one sweep the instrument remains tuned to the stop frequency. Single sweep can be terminated by pressing the SINGLE key a second time.

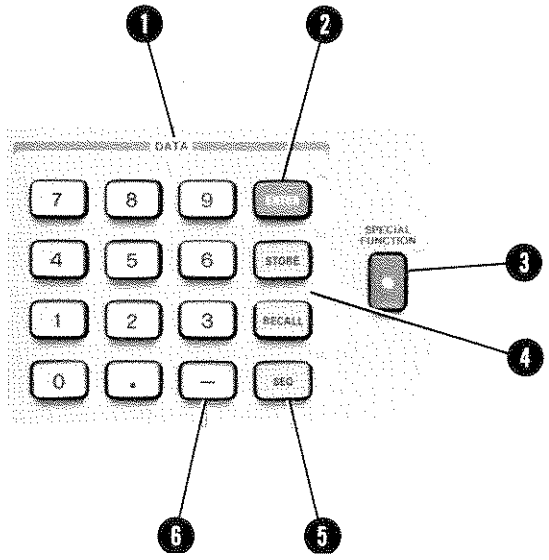
6 AUTO Key. Starts a sweep from the current frequency. The sweep repeats from START FREQ to STOP FREQ in increments determined by STEP SIZE until terminated. Auto sweep is terminated by pressing the AUTO key a second time.

7 STEP SIZE Key. Causes the programmed frequency step size of the sweep to appear in the left display while the key is depressed. (Also see Frequency Function Keys.)

8 STOP FREQ Key. Tunes the Noise Figure Meter to the programmed stop frequency and causes that frequency to appear in the left display. (Also see Frequency Function Keys.)

9 START FREQ Key. Tunes the Noise Figure Meter to the programmed start frequency and causes that frequency to appear in the left display. (Also see Frequency Function Keys.)

Figure 3-4. SWEEP and FIXED FREQ Features



1 DATA Keys. Enter data or Special Function codes. Entries are completed by the ENTER key or the SPECIAL FUNCTION key (except for STORE and RECALL).

2 ENTER Key. Completes keyboard entries other than Special Function codes.

3 SPECIAL FUNCTION Key. Completes the keyboard entry of a Special Function code. Special Functions are instrument operations in addition to those accessible from dedicated front panel keys. Refer to Special Functions in the Detailed Operating Instructions for a complete listing of user special functions.

4 STORE and RECALL Keys. Store and recall up to ten instrument configurations in storage registers 0 through 9. Front panel features that cannot be stored and later recalled are CALIBRATE, SMOOTHING, AUTO or SINGLE SWEEP, UNCORRECTED NOISE FIGURE and CORRECTED NOISE FIGURE AND GAIN.

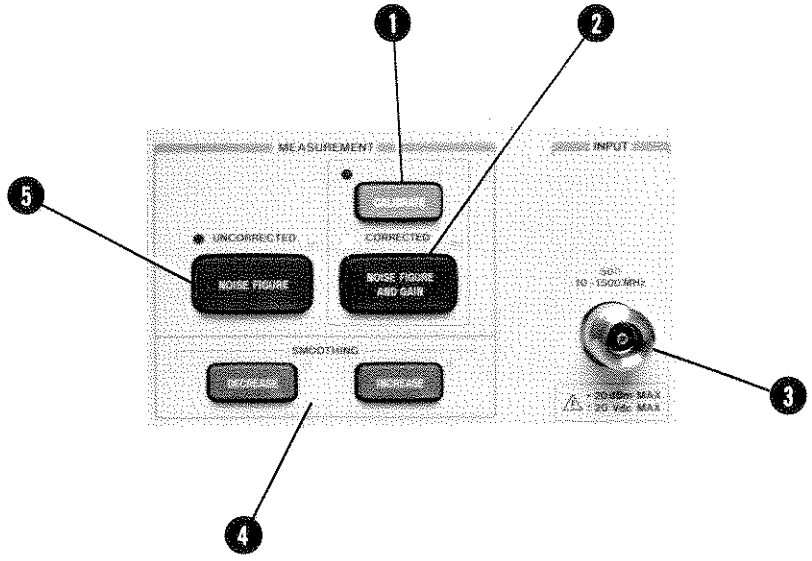
When the STORE key is used as a prefix for a numeric key (a single digit 0 — 9 to identify the register), the current instrument configuration is stored in that internal storage register.

When the RECALL key is used as a prefix to a numeric key (a single digit 0 — 9 to identify the register), the contents stored in that register are recalled and the instrument configuration is changed to the recalled parameter values.

5 SEQ Key. Recalls storage registers 1 through 9 in a preset sequence. Pressing the SEQ key momentarily displays the current storage register number. SEQ is used in conjunction with Special Function 35.

6 –(Minus) Key. Can be used as a prefix for loss, ENR, or temperature. Although the minus key can be used any time before an entry is completed, the minus sign is always inserted to the left of the entered digits. If the minus sign is used incorrectly an error message is displayed when ENTER is pressed.

Figure 3-5. DATA and SPECIAL FUNCTION Features



1 CALIBRATE Key. Initiates the calibration process which measures and stores the measurement system noise figure and gain. This data is used for second stage correction and gain measurements. Calibration is done from START FREQ to STOP FREQ in steps of STEP SIZE (see Figure 3-4). During calibration all front panel keys except PRESET, CALIBRATE and LOCAL are disabled. Pressing CALIBRATE a second time before calibration is complete terminates the calibration.

2 CORRECTED NOISE FIGURE AND GAIN Key. Configures the Noise Figure Meter to measure noise figure and gain with second stage correction (that is, only the noise figure and gain of the device under test is displayed). A calibration must be completed prior to making corrected noise figure and gain measurements.

3 INPUT. This female type-N INPUT connector is used to connect the device under test to the Noise Figure Meter. The nominal input impedance is 50 ohms. Specified operating input level is less than −10 dBm. The frequency range at the INPUT connector is 10 to 1500 MHz.

CAUTION

Damage to the instrument can be caused by connecting signals to INPUT that exceed +20 dBm or +20 Vdc.

4 SMOOTHING Keys. INCREASE and DECREASE the number of measurements averaged (smoothing factor) when displaying measurement results. When pressed, these keys cause the smoothing factor to appear in the left display. The smoothing factor ranges from 1 to 512 and changes in factors of 2. Pressing INCREASE doubles the smoothing factor. Pressing DECREASE halves the smoothing factor. Both INSERTION GAIN and NOISE FIGURE displays are smoothed. Increasing the smoothing reduces the jitter in the display.

5 UNCORRECTED NOISE FIGURE Key. Configures the Noise Figure Meter to measure noise figure without second stage correction (that is, the noise contribution of the measurement system is included in the reading in the NOISE FIGURE display).

Figure 3-6. MEASUREMENT and INPUT Features

GAIN TRACE adjusts the intensity of the gain trace (on an oscilloscope) relative to the noise figure trace.

IF provides a rear panel output for the Noise Figure Meter's last IF (20 MHz) immediately prior to the detector. The power level is -50 to -30 dBm nominal. Output impedance is 50Ω nominal.

INPUT is a rear panel input for coupling the output signal from the device under test into the instrument. This input is supplied on Option 001 instruments instead of the standard front panel connection.

DET provides an output from the noise power detector. Level is 0.1 to 1.0 Vdc nominal, floating.

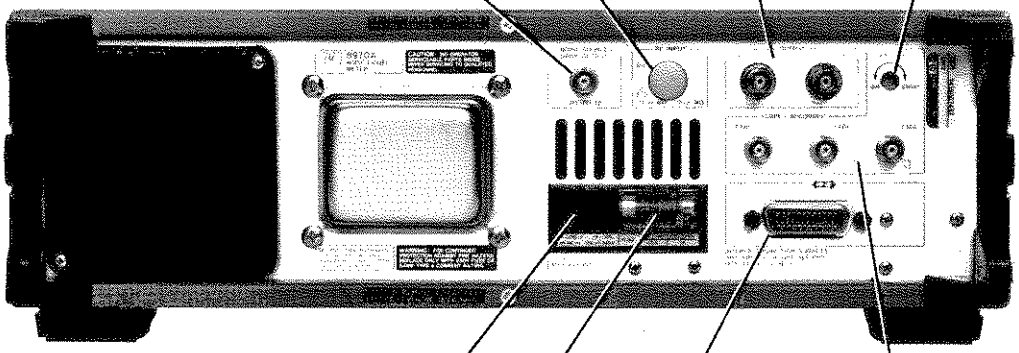
CAUTION

Damage to the instrument can be caused by connecting signals to INPUT that exceed +20 dBm or +20 Vdc.

NOTE

DET is a direct connection to the instrument's detector. Loading or injecting a signal may cause inaccurate readings. Only connect this output to instrumentation with floating inputs. Output impedance is 10 kΩ nominal.

NOISE SOURCE DRIVE OUTPUT drives a noise source on and off with +28V pulses and is in parallel to the front panel NOISE SOURCE DRIVE OUTPUT. (Only one noise source can be connected at a time.)



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 a chassis connection for safety earth ground.

Fuse. 1.5A (250V, Normal Blow) for 100/120 Vac. 1.0 (250V, Normal Blow) for 220/240 Vac.

HP-IB Connector connects the Noise Figure Meter to the Hewlett-Packard Interface Bus for HP-IB operation.

X-AXIS. 0 to +6V output proportional to the measurement frequency when driving an oscilloscope or X-Y recorder. This output can be made proportional to noise figure for driving a strip chart recorder. Output impedance is 100Ω.

Y-AXIS. 0 to +6V output proportional to noise figure when driving an oscilloscope or X-Y recorder. This output can be made proportional to gain when driving a strip chart recorder. Output impedance is 100Ω.

Z-AXIS/PEN LIFT. TTL compatible output. When used with an oscilloscope, the Z-AXIS provides a TTL high signal for retrace blanking. When used with a recorder, the PEN LIFT provides a TTL high signal to lift the pen. Output impedance is 100Ω.

Figure 3-7. Rear Panel Features

3-10. OPERATOR'S CHECKS

3-11. Basic Functional Checks

DESCRIPTION The overall operation of the Noise Figure Meter is checked using a noise source and an oscilloscope. If the Noise Figure Meter is to be used to control an external LO, the optional External LO Check at the end of this procedure verifies that capability. This check should be performed sequentially.

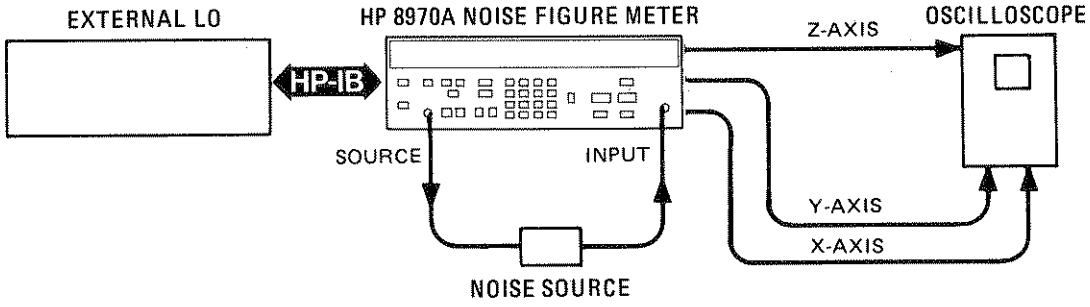


Figure 3-8. Basic Functional Checks Setup

EQUIPMENT

Noise Source	HP 346B Option 001
Oscilloscope	HP 1740A
External LO	HP 8672A

PROCEDURE

Preliminary Check

1. Remove any cables from the Noise Figure Meter's INPUT and SOURCE. Set the LINE switch to OFF, and then back to ON. Verify the front panel LED annunciators, display segments, decimal points, and key lights turn on for approximately two seconds. Then, verify that the NOISE FIGURE display shows " — — — — " for approximately five seconds.

2. Press PRESET. After " — — — — " disappears from the NOISE FIGURE display, verify the following conditions:

   a. Left display shows 30 MHz.
   b. INSERTION GAIN display is blank.
   c. NOISE FIGURE display shows " — — FdB".
   d. UNCORRECTED NOISE FIGURE annunciator is on.

3. Connect the noise source between the Noise Figure Meter's SOURCE and INPUT (See Figure 3-8). Verify the NOISE FIGURE display shows approximately 5 dB.

4. Connect the oscilloscope to the X-,Y-, and Z-AXIS connectors on the rear panel of the Noise Figure Meter. Use the X-AXIS for the horizontal input and the Y-AXIS for the vertical input.

5. On the Noise Figure Meter, press 7 . 1 SPECIAL FUNCTION. Verify that a test pattern is displayed on the oscilloscope. It may be necessary to adjust rear panel GAIN TRACE control to obtain the test pattern. Adjust the oscilloscope until the test pattern fills the grid area (see Figure 3-9). Press 7 . 0 SPECIAL FUNCTION to enable the Noise Figure Meter to output the noise figure and gain data to the oscilloscope.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

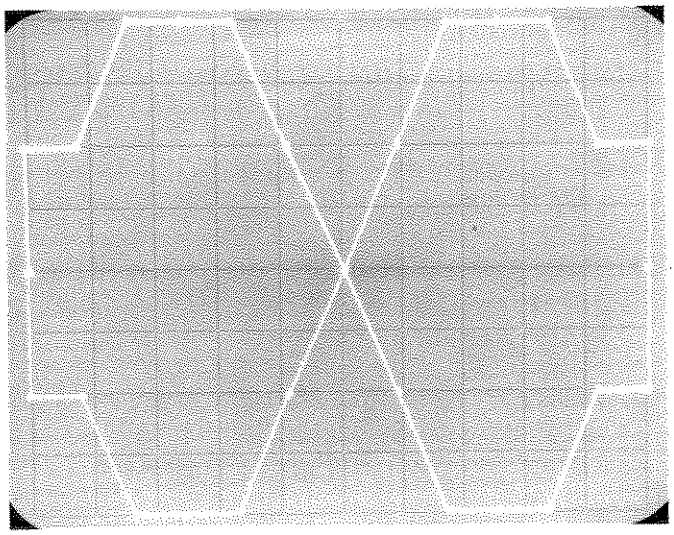


Figure 3-9. Test Pattern on Oscilloscope

Calibration and SWEEP Check

6. Press CORRECTED NOISE FIGURE AND GAIN. Verify the NOISE FIGURE display shows an error message.

NOTE

In step 6, error code E20 (not calibrated) is normally displayed. If error code E26 (IF attenuators not calibrated) is displayed during this check, press 33.0 SPECIAL FUNCTION (IF attenuator calibration). Continue with this check after the IF attenuators are calibrated (approximately 5 seconds).

7. Press UNCORRECTED NOISE FIGURE. Verify that the NOISE FIGURE display shows approximately 5 FdB indicating that the Noise Figure Meter can make uncorrected noise figure measurements prior to being calibrated.
8. Press CORRECTED NOISE FIGURE AND GAIN. Verify the NOISE FIGURE display again shows an error message.

NOTE

All frequency data must be entered in MHz.

9. Press the following keys to enter the SWEEP calibration parameters:
   a. START FREQ 1 2 3 ENTER.
   b. STOP FREQ 7 8 9 ENTER.
   c. STEP SIZE 4 0 ENTER.
10. Press CALIBRATE. Verify the following conditions:
    a. CALIBRATE annunciator lights.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

b. The frequency is swept from the start frequency (123 MHz) to the stop frequency (789 MHz) in 40 MHz steps. This sweep is performed three times.

c. After calibration is complete, the CALIBRATE annunciator turns off and the CORRECTED NOISE FIGURE AND GAIN annunciator lights.

d. The INSERTION GAIN display shows approximately 0 dB and the NOISE FIGURE display shows approximately 0 FdB.

11. Press SWEEP SINGLE. Verify that the key's LED lights. The established frequency range is swept once. After the sweep is completed, the LED turns off and the left display shows 789 MHz.

12. Press SWEEP AUTO. Verify that the key's LED lights and the frequency range is swept repetitively. Press SWEEP AUTO again. Verify the sweep stops at the current frequency and the LED goes off.

13. Press SMOOTHING INCREASE four times to set the smoothing (averaging) factor to 16. Press SWEEP SINGLE. Verify that the INSERTION GAIN and NOISE FIGURE displays are more stable and the time required for each measurement is longer. Press SMOOTHING DECREASE four times to return the smoothing factor to 1.

FIXED FREQUENCY Tuning Check

14. Press the following keys to establish the tuned FIXED FREQUENCY parameters:

    a. FREQUENCY 5 0 0 ENTER.

    b. FREQ INCR 3 0 0 ENTER.

15. Press ▲ . Verify that the left display shows 800 MHz and the NOISE FIGURE display show error code E21 (current frequency is out of calibrated range).

16. Press ▼ . Verify the left display shows 500 MHz and the INSERTION GAIN and NOISE FIGURE displays show approximately 0.

ENR Table Entry Check

NOTE

This check verifies the capability of the ENR and ENTER keys to initiate and sequence through the ENR table. If it is necessary to change the ENR table, refer to the ENR Table Entry Detailed Operating Instruction.

17. Press ENR. Verify the MHz annunciator in the left display is flashing.

18. Press ENTER. Verify that the MHz annunciator remains on and the dB annunciator in the INSERTION GAIN display is flashing.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

19. Press and hold ENTER. Verify the two displays sequence through the ENR table entries. Release ENTER.

NOTE

If ENTER is held down until all 27 frequency vs. ENR pairs have been displayed, both annunciators light and remain lit. When ENTER is relased, the Noise Figure Meter returns to the measurement configuration it was in prior to pressing ENR. If ENTER is released prior to displaying all pairs, press FREQUENCY to return to the previous measurement configuration.

20. Verify that the CORRECTED NOISE FIGURE AND GAIN annunciator lights.

STORE, RECALL, and SEQ Check

21. Press PRESET. Verify the left display shows 30 MHz.

NOTE

During the STORE and RECALL checks the complete instrument configuration is stored and recalled. The frequency change is merely a convenient indication that different setups have been stored and recalled.

22. Press STORE 1.

23. Press ▲ . Verify the left display shows 50 MHz. Press STORE 2.

24. Press RECALL 1. Verify the left display shows 30 MHz. Press RECALL 2. Verify the left display shows 50 MHz.

25. Press and hold SEQ. Verify the left display shows 1. Release SEQ. Verify the left display shows 30 MHz.

26. Press and hold SEQ. Verify the left display shows 2. Release SEQ. Verify the left display shows 50 MHz.

Minus Check

27. Press − . Verify the left display shows − .

External LO Check (Optional)

NOTE

The following steps check the Noise Figure Meter's capability to control an external LO. It is not necessary to perform this check unless the Noise Figure Meter is used for this purpose and a suitable external LO is available. It is assumed in the following check that the HP-IB addresses used by the Noise Figure Meter and the external LO are compatible.

28. Connect the HP-IB cable between the Noise Figure Meter and the external LO (see Figure 3-8).

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

29. Press 1 . 1 SPECIAL FUNCTION. Verify the left display shows 10000 MHz and the EXT MIX annunciator lights.

30. Press one of the following sequences of keys depending upon the external LO used:

    a. For an HP 8350B, press 41.0 SPECIAL FUNCTION.

    b. For an HP 8672A, press 41.2 SPECIAL FUNCTION.

    c. For an HP 8673B, press 41.3 SPECIAL FUNCTION.

31. Press 4 . 1 SPECIAL FUNCTION. Verify the TALK annunciator on the Noise Figure Meter and the remote annunciator on the external LO lights.

32. On the Noise Figure Meter, press SWEEP START FREQ. Verify the left display shows 8000 MHz and the external LO is tuned to the same frequency.

33. On the Noise Figure Meter, press SWEEP STOP FREQ. Verify the left display shows 12000 MHz and the external LO is tuned to the same frequency.

3-12. HP-IB Functional Checks HP-IB

DESCRIPTION The following procedures check the instrument's ability to perform the following functions:

a. Process or send all of the applicable HP-IB messages described in Table 3-3.

b. Recognize its own HP-IB address.

c. Set all of the bus data, handshake, and control lines (except DIO8) to both their true and false states. DIO8 is the most significant data line and is not used by the Noise Figure Meter.

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

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

a. The Noise Figure Meter performs properly when operated via the front panel keys (that is, in local mode). This can be verified with the Basic Functional Checks.

b. The bus controller properly executes HP-IB operations.

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

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

The select code of the controller's HP-IB interface is assumed to be 7. The address of the Noise Figure Meter is assumed to be 8 (its address as set at the factory). This select code address combination (that is, 708) is not necessary for these checks to be valid. However, the program lines presented here have to be modified for any other combination.

These checks are intended to be as independent of each other as possible. Nevertheless, the first four checks should be performed in order before other checks are selected. Any special initialization or requirements for a check are described at its beginning.

INITIAL SETUP The test setup is the same for all of the checks. Connect the Noise Figure Meter to the bus controller via the HP-IB interface. Do not connect any equipment, other than the noise source, to the Noise Figure Meter's INPUT.

EQUIPMENT

HP-IB Controller	HP 85B/82936A (ROM Drawer)/00085-15005 (Advanced Programming ROM)
—or—	HP 9826A Option 011 (Basic 2.0 ROM based system)
HP-IB Interface	HP 82937A (HP 85B only)
Noise Source	HP 346B (Option 001)

HP-IB Functional Checks (cont'd)

Address Recognition

NOTE This check determines if the Noise Figure Meter recognizes when it is being addressed and when it is not. This check assumes only that the Noise Figure Meter can properly handshake on the bus. Before beginning this check, set the Noise Figure Meter's LINE switch to ON, press PRESET, and then 4 . 0 SPECIAL FUNCTION.

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Set the Remote Enable (REN) bus control line false.	LOCAL 7	LOCAL 7
Send the Noise Figure Meter's listen address.	OUTPUT 708	OUTPUT 708

OPERATOR'S RESPONSE Check that the Noise Figure Meter's REMOTE annunciator is off and that its LISTEN annunciator is on.

Unaddress the Noise Figure Meter by sending a different address.	OUTPUT 715	OUTPUT 715

OPERATOR'S RESPONSE Check that both the Noise Figure Meter's REMOTE and LISTEN annunciators are off.

Remote and Local Messages and the LOCAL Key

NOTE This check determines if the Noise Figure Meter properly switches from local to remote control, from remote to local control, and if the LOCAL key returns the instrument to local control. This check assumes that the Noise Figure Meter is able to both handshake and recognize its own address. Before beginning this check, press the Noise Figure Meter's PRESET key. Then press 4 . 0 SPECIAL FUNCTION.

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Send the Remote message (by setting Remote Enable, REN, true and addressing the Noise Figure Meter to listen).	REMOTE 708	REMOTE 708

OPERATOR'S RESPONSE Check that the Noise Figure Meter's REMOTE and LISTEN annunciators are on.

Send the Local message to the Noise Figure Meter	LOCAL 708	LOCAL 708

OPERATOR'S RESPONSE Check that the Noise Figure Meter's REMOTE annunciator is off but its LISTEN annunciator is on.

Send the Remote message to the Noise Figure Meter.	REMOTE 708	REMOTE 708

HP-IB Functional Checks (cont'd)

Remote and Local Messages and the LOCAL Key (cont'd)

OPERATOR'S RESPONSE

Check that both the Noise Figure Meter's RESPONSE and LISTEN annunciators are on. Press the LOCAL key on the Noise Figure Meter. Check that the Noise Figure Meter's REMOTE annunciator is now off, but that its LISTEN annunciator remains on.

Sending the Data Message

NOTE

This check determines if the Noise Figure Meter properly issues Data messages when addressed to talk. This check assumes that the Noise Figure Meter is able to handshake and recognize its own address. Before beginning this check, press the Noise Figure Meter's LINE switch twice (OFF then ON). Then, after the power-up sequence is completed, press CORRECTED NOISE FIGURE AND GAIN and 4 . 0 SPECIAL FUNCTION. (If an HP 9826A controller is used, a short program is required to perform this check.)

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Address the Noise Figure Meter to talk and store its output in variable V. (The output is E20 since the Noise Figure Meter is not calibrated.)	ENTER 708;V	10 V = 0 20 ENTER 708;V 30 DISP V 40 END
Display the value of V.	DISP V	DISP V

OPERATOR'S RESPONSE

Check that the Noise Figure Meter's REMOTE annunciator is off but that its TALK annunciator is on. The controller's display should read 90020000000 (HP 85B) or 9.002E+1 (HP 9826A). The 90020 portion of the display corresponds to the data output for the error code E20 (not calibrated) shown in the Noise Figure Meter's NOISE FIGURE display.

Receiving the Data Message

NOTE

This check determines if the Noise Figure Meter properly receives Data messages. The Data messages sent cause the 7 least significant HP-IB data lines to be placed in both their true and false states. This check assumes the Noise Figure Meter is able to handshake, recognize its own address and properly make the remote/local transitions. Before beginning this check, press the Noise Figure Meter's PRESET key. Then press 4 . 0 SPECIAL FUNCTION.

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Send the first part of the Remote message (enabling the Noise Figure Meter to remote).	REMOTE 7	REMOTE 7
Address the Noise Figure Meter to listen (completing the Remote message), then send a Data message.	OUTPUT 708; "FR15MZ"	OUTPUT 708; "FR15MZ"

OPERATOR'S RESPONSE

Check that both the Noise Figure Meter's REMOTE and RESPONSE LISTEN annunciators are on and that the left display shows 15 MHz.

HP-IB Functional Checks (cont'd)

Local Lockout and Clear Lockout/Set Local Messages

NOTE This check determines if the Noise Figure Meter properly receives the Local Lockout message, disabling the LOCAL key. The check also determines if the Clear Lockout/Set Local message is properly received and executed by the Noise Figure Meter. This check assumes that the Noise Figure Meter is able to handshake, recognize its own address, and properly make the remote/local transitions. Before beginning this check, press the Noise Figure Meter's LINE switch OFF then ON and then press the PRESET key. Then press 4 . 0 SPECIAL FUNCTION.

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Send the first part of the Remote message (enabling the Noise Figure Meter to remote).	REMOTE 7	REMOTE 7
Send the Local Lockout message.	LOCAL LOCKOUT 7	LOCAL LOCKOUT 7
Address the Noise Figure Meter to listen (completing the Remote message).	OUTPUT 708	OUTPUT 708

OPERATOR'S RESPONSE Check that both the Noise Figure Meter's REMOTE and LISTEN annunciators are on. Press the Noise Figure Meter's LOCAL key. Both its REMOTE and LISTEN annunciators should remain on.

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

OPERATOR'S RESPONSE Check that the Noise Figure Meter's REMOTE annunciator is off but its LISTEN annunciator is on.

Clear Message

NOTE This check determines if the Noise Figure Meter properly responds to the Clear message. This check assumes that the Noise Figure Meter is able to handshake, recognize its own address, make the remote/local changes and receive Data messages. Before beginning this check press the Noise Figure Meter's PRESET key. When " - - - - " disappears from the NOISE FIGURE display, press CALIBRATE. Once the LED above the CALIBRATE key turns off, press 4 . 0 SPECIAL FUNCTION.

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Send the first part of the Remote message (enabling the Noise Figure Meter to remote).	REMOTE 7	REMOTE 7
Address the Noise Figure Meter to listen (completing the Remote message), then send a Data message that selects the CORRECTED NOISE FIGURE AND GAIN measurement.	OUTPUT 708; "M2"	OUTPUT 708; "M2"

HP-IB Functional Checks (cont'd)

Clear Message (cont'd)

OPERATOR'S RESPONSE — Check that both the Noise Figure Meter's REMOTE and LISTEN annunciators are on and that the CORRECTED NOISE FIGURE AND GAIN key light is on.

Send the Clear message (setting the Noise Figure Meter's measurement to UNCORRECTED NOISE FIGURE).	CLEAR 708	CLEAR 708

OPERATOR'S RESPONSE — Check that both the Noise Figure Meter's REMOTE and LISTEN annunciators are on and that the UNCORRECTED NOISE FIGURE key light is on.

Abort Message

NOTE — This check determines if the Noise Figure Meter becomes unaddressed when it receives the Abort message. Before beginning this check, enter LOCAL 708 and press the Noise Figure Meter's PRESET key. Then press 4 . 0 SPECIAL FUNCTION.

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Send the Remote message to the Noise Figure Meter.	REMOTE 708	REMOTE 708

OPERATOR'S RESPONSE — Check that both the Noise Figure Meter's REMOTE and LISTEN annunciators are on.

Send the Abort message, unaddressing the Noise Figure Meter from listening.	ABORTIO 7	ABORT 7

OPERATOR'S RESPONSE — Check that the Noise Figure Meter's LISTEN annunciator is off.

Status Byte Message

NOTE — This check determines if the Noise Figure Meter sends the Status Byte message. Before beginning this check, press the Noise Figure Meter's PRESET key. Then press 4 . 0 SPECIAL FUNCTION.

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Place the Noise Figure Meter in serial-poll mode and address it to talk (causing it to send the Status Byte message).	SPOLL (708)	SPOLL (708)

OPERATOR'S RESPONSE — Check that the controller's display reads 0.

OPERATOR'S CHECKS

Require Service Message

NOTE This check determines if the Noise Figure Meter can issue the Require Service message (set the SRQ bus control line true). This check assumes that the Noise Figure Meter is able to handshake, recognize its own address, make the remote/local changes, and receive Data messages. Before beginning this check, press the Noise Figure Meter's PRESET key. Then press 4 . 0 SPECIAL FUNCTION. (If an HP 9826A controller is used, a short program is required to perform the last half of this check.)

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Send the first part of the Remote message (enabling the Noise Figure Meter to remote).	REMOTE 7	REMOTE 7
Address the Noise Figure Meter to listen (completing the Remote message), then send a Data message containing an invalid HP-IB code. This enables a Require Service message to be sent.	OUTPUT 708; "<"	OUTPUT 708; "<"
Make controller wait two seconds to allow time for the Noise Figure Meter to send the Require Service message. (This step is not necessary if sufficient time is allowed.)	WAIT 2000	WAIT 2000
Read the binary status of the controller's HP-IB interface and store the data in variable V (in this step, 7 is the interface's select code).	STATUS 7,2; V	10 V = 0 20 STATUS 7,7; V
Display the value of the SRQ bit (in this step 6 (HP 85B) and 10 (HP 9826) are the SRQ bits for the controller, numbered from 0.	DISP"SRQ="; BIT(V,6)	30 DISP"SRQ="; BIT(V,10) 40 END

OPERATOR'S RESPONSE Check that the SRQ value is 1, indicating the Noise Figure Meter issued the Require Service message.

Trigger Message

NOTE

This check determines if the Noise Figure Meter responds to the Trigger message. This check assumes that the Noise Figure Meter is able to handshake, recognize its own address, make the remote/local changes, and send and receive Data messages. Before beginning this check, enter LOCAL 708 and press the Noise Figure Meter's PRESET key. Then press 4 . 0 SPECIAL FUNCTION (If an HP 9826A controller is used, a short program is required to perform this check.)

Description	HP 85B (BASIC)	HP 9826A (BASIC)
Send the first part of the Remote message (enabling the Noise Figure Meter to remote).	REMOTE 7	10 REMOTE 7
Address the Noise Figure Meter to listen (completing the Remote message), then send a Data message placing the Noise Figure Meter in the Trigger Hold mode).	OUTPUT 708, "T1"	20 OUTPUT 708; "T1"
Send the Trigger message.	TRIGGER 708	30 TRIGGER 708 40 V = 0
Address the Noise Figure Meter to talk and store the data in variable V.	ENTER 708,V	50 ENTER 708; V
Display the value of V.	DISP V	60 DISP V 70 END

OPERATOR'S RESPONSE

Check that both the Noise Figure Meter's REMOTE and TALK annunciators are on. The controller's display should read the same as the NOISE FIGURE display.

HP-IB

3-13. REMOTE OPERATION, HEWLETT-PACKARD INTERFACE BUS

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

The Noise Figure Meter can operate in three mutually exclusive modes on the HP-IB:

1. Normal Talker/Listener Mode. This mode is used when the Noise Figure Meter is under the control of an HP-IB compatible computer or controller.

2. External LO Control Mode. This mode is used when the Noise Figure Meter controls the operation of an external LO.

3. Talk Only Mode. This mode is used to output data to a device that is operating in the Listen Only Mode.

Most front panel functions, special functions and remote-only functions are programmable via HP-IB. Table 3-4 lists the functions that cannot be programmed via HP-IB.

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

3-14. HP-IB Compatibility

The Noise Figure Meter 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 Noise Figure Meter is programmable via the HP Interface Bus. Its programming capability is described by the twelve HP-IB messages listed in Table 3-3. The Noise Figure Meter's compatibility with HP-IB is further defined by the following list of interface functions: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C1, C3, C28 and E1. A more detailed explanation of these compatibility codes can be found in IEEE Standard 488-1978 (and the identical ANSI Standard MC1.1). For more information about HP-IB, refer to the Hewlett-Packard Electonic Instruments and Systems catalog and the booklet titled "Improving Measurements in Engineering and Manufacturing" (HP part number 5952-0058).

3-15. Remote Mode

Remote Capability. The Noise Figure Meter communicates on the bus in both remote and local modes. In remote, most of the Noise Figure Meter's front panel controls are disabled (except for the LINE switch and LOCAL key). However, front panel displays remain active and valid. In remote, the Noise Figure Meter can be addressed to talk or listen. When addressed to listen, the Noise Figure Meter can issue the Data and Status Byte messages. Whether addressed or not, the Noise Figure Meter responds to the Clear (DCL), Local Lockout, Clear Lockout/Set Local, and Abort messages. In addition, the Noise Figure Meter can issue the Require Service Message.

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

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

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

When the Noise Figure Meter switches to remote, the REMOTE annunciator on the front panel turns on.

3-16. Local Mode

Local Capability. In local, the Noise Figure Meter's front panel controls are fully operational and the instrument responds to the Remote message. Whether addressed or not, the Noise Figure Meter also responds to the Clear, Local Lockout, Clear Lockout/Set Local, and the Abort messages. When addressed to talk, the Noise Figure Meter can issue Data messages and the Status Byte message, and whether addressed or not, it can issue the Require Service message.

Remote-to-Local Mode Changes. The Noise Figure Meter always switches to local from remote whenever it receives the Local message (GTL) or the Clear Lockout/Set Local message. (The Clear Lockout/Set Local message sets the Remote Enable control line [REN] false.) The Noise Figure Meter can also be switched to local by pressing the front panel LOCAL key (assuming Local Lockout is not in effect).

3-17. Addressing

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

The Noise Figure Meter's HP-IB address is selected by special function. To change the HP-IB address or to determine the present address setting, refer to the discussion titled HP-IB Addresses in the Detailed Operating Instructions at the end of this section.

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

NOTE

Return-to-local can also be accomplished by turning the Noise Figure Meter's LINE switch to OFF, then back to ON. However, this technique has some disadvantages:

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

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

3-18. Data Messages

The Noise Figure Meter communicates on the interface bus primarily with data messages. Data messages consist of one or more bytes sent over the bus' data lines when the bus is in the data mode (attention control line [ATN] false). Unless it is set to Talk Only or External LO Control, the Noise Figure Meter receives data messages when addressed to listen. Virtually all instrument operations available in local mode can be performed in remote mode via data messages. The major exceptions are changing the LINE switch setting, using the Talk Only capability, using the instrument's capability to control an external LO and changing the HP-IB address of the Noise Figure Meter (refer to Table 3-4).

3-19. Receiving the Data Message

Depending on the status of Special Function 4, the Noise Figure Meter can either talk only, control an external LO, or talk and listen both (normal operation). The instrument responds to Data messages when it is enabled to remote (REN control line true) and it is addressed to listen. The instrument remains addressed to listen until it receives an Abort message or until its talk address or a universal unlisten command is sent by the controller.

Data Input Format. The Data message string, or program string, consists of a series of ASCII codes. Each code is typically equivalent to a front panel keystroke in local mode. Thus, for a given operation, the program string syntax in remote mode is the same as the keystroke sequence in local mode. Example 1 shows a typical program string.

Program Codes. All of the HP-IB codes normally used by the operator to control the Noise Figure Meter are given in Tables 3-8, 3-9, and 3-10. Table

EXAMPLE 1: Typical Program String

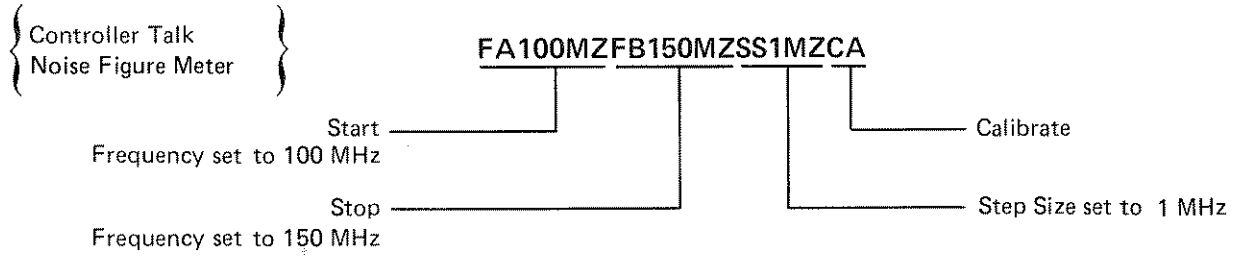


Table 3-3. Message Reference Table (1 of 2)

HP-IB Message	Applicable	Response	Related Commands and Controls	Interface Functions*
Data	Yes	Most Noise Figure Meter operations are bus programmable. All measurement results, special displays, and error outputs are available to the bus.		AH1 SH1 T5 L4
Trigger	Yes	If in remote and addressed to listen, the Noise Figure Meter makes a measurement according to previously programmed setup. It responds equally to bus command GET and program code T2, Trigger Execute (a Data message).	GET	DT1
Clear	Yes	The Noise Figure Meter is set to the same conditions established by pressing PRESET. Refer to Table 3-6.	DCL SDC	DC1
Remote	Yes	Remote mode is enabled when the REN bus control line is true. However, remote mode is not entered until the first time the Noise Figure Meter is addressed to listen. The front panel REMOTE annunciator lights when the instrument is actually in the remote mode. When entering the remote mode, no instrument settings or functions are changed, but all front panel keys except LOCAL are disabled.	REN	RL1
Local	Yes	The Noise Figure Meter returns to local mode (front panel control). It responds equally to the GTL bus command and the front panel LOCAL key. When entering the local mode, no instrument settings or functions are changed.	GTL	RL1
Local Lockout	Yes	Disables all front panel keys including LOCAL. Only the controller can return the Noise Figure Meter to local (front panel control).	LL0	RL1
Clear Lockout/ Set Local	Yes	The Noise Figure Meter returns to local (front panel control) and local lockout is cleared when the REN bus control line goes false. When entering local mode, no instrument settings or functions are changed.	$\overline{\text{REN}}$	RL1
Pass Control/ Take Control	No	The Noise Figure Meter cannot pass or take control of HP-IB. However, it does have limited control capability as indicated in the last column.		C1, 3, 28

*Commands, Control lines, and Interface Functions are defined in IEEE Std 488-1978. Knowledge of these may not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left column.

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

HP-IB Message	Applicable	Response	Related Commands and Controls	Interface Functions*
Require Service	Yes	The Noise Figure Meter sets the SRQ bus control line true if an invalid program code is received (unless disabled). The following conditions also set SRQ true when they occur if they are enabled by the operator to do so: Data Ready, Instrument Error, or Calibration Complete.	SRQ	SR1
Status Byte	Yes	The Noise Figure Meter responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit byte when addressed to talk. If the instrument is holding the SRQ control line true (issuing the Require Service message) bit 7 (RQS bit) in the Status Byte and the bit representing the condition causing the Require Service message to be issued will both be true. The bits in the Status Byte are latched but can be cleared by: 1. removing the causing condition, and 2. reading the Status Byte.	SPE SPD	T5
Status Bit	No	The Noise Figure Meter does not respond to a parallel poll.		PP0
Abort	Yes	The Noise Figure Meter stops talking and listening.	IFC	T5

*Commands, Control lines, and Interface Functions are defined in IEEE Std 488-1978. Knowledge of these may not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left column.

Complete HP-IB capability as defined in IEEE Std 488 and ANSI Std MC1.1 is: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C1, 3, 28, and E1.

Table 3-4. Functions Not Programmable Via HP-IB

Function	Description
Control Function Selection (Special Function 4)	Normal Talker and Listener Enable External LO Control Talk Only
HP-IB Addresses (Special Function 40.0)	Display and Enter Noise Figure Meter Address
LINE Switch	Turns instrument ON and OFF.

Receiving the Data Message (cont'd)

3-8 provides an HP-IB code to parameter summary. Table 3-9 provides a special function to HP-IB code summary. Table 3-10 provides a front panel key to HP-IB code summary. All front panel keys except LOCAL have corresponding program codes. Some functions have an additional code which terminates the numeric data entry in Hz rather than MHz as indicated on the front panel. Where more than one code is given for a function, either code will serve equally. However, the mnemonic code given is recommended since it is shorter and more closely represents the function selected. Also, the mnemonic code will make deciphering program code strings easier. The first codes given are the codes used in all programming examples in this manual.

The Noise Figure Meter's response to the ASCII character set is as follows:

a. The ASCII characters used for the program codes are the alphabet (A through Z, except O), the numbers 0 through 9, the period (.), and the minus (–).

b. Lower case letters are treated the same as upper case letters.

c. The letter O is treated the same as the number 0.

d. All other characters are ignored (however, they can not be used as the second character of a two-character HP-IB program code). If any of these other characters are used as a second character or if an undefined combination of valid characters is sent, SRQ is set if the HP-IB error condition has been enabled.

Turning Off Functions. When operating in local mode, CALIBRATE, and SINGLE and AUTO Sweep toggle on and off with successive keystrokes. In remote mode, these functions do not toggle on and off. Instead, both require that the HP-IB code W0 be used to turn off the function.

Programming Numeric Data. When programming tuned frequency or issuing any numeric data (other than specific HP-IB codes) to the Noise Figure Meter, certain precautions should be observed. Numeric data may consist of up to five digits, one decimal point, and a one-digit signed exponent.

Triggering Measurements with the Data Message. A feature that is available from both the front panel and via remote programming is the selection of free run, standby, or triggered operation of the Noise Figure Meter. The HP-IB codes and related Special Functions are discussed in detail in the Trigger Selection Detailed Operating Instruction later in this section.

3-20. Sending The Data Message

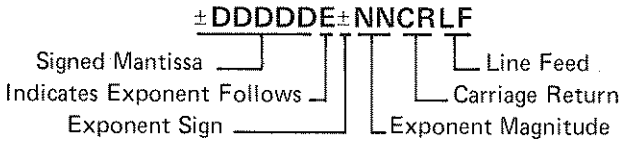
Depending on how the control functions are set, the Noise Figure Meter can either talk only, control an external LO, or talk and listen both (normal operation). If set to both talk and listen, the instrument sends Data messages when addressed to talk. The instrument then remains configured to talk until it is unaddressed to talk by the controller. To unaddress the Noise Figure Meter, the controller must send either an Abort message, a new talk address, or a universal untalk command.

Talk Only Mode. If the Noise Figure Meter's Talk address is valid and Special Function 4.2 is selected, the Noise Figure Meter is placed in the Talk Only mode. In this mode the instrument is configured to send Data messages whenever the bus is in the data mode. Each time the measurement is completed, the measurement result will be output to the bus unless the listening device is not ready for data. If the listener is not ready for data, another measurement cycle is executed.

Data Output Format. As shown below, the output data is always formatted as a real constant: first the sign, then five digits (leading zeros not suppressed) followed by the letter E and a signed power-of-ten multiplier. The string is terminated by a carriage return (CR) and a line feed (LF), string positions 11 and 12. Data is always output in fundamental units (that is Hz, dB, etc.), and the decimal point (not sent) is assumed to be to the right of the fifth digit of the mantissa. Data values never exceed 1×10^5. The one exception to this format is the voltmeter mode as shown in Table 3-5, HP-IB Data Output Summary.

The general data output format is as follows:

Sending the Data Message (cont'd)



A summary of the different data outputs is listed in Table 3-5.

Table 3-5. HP-IB Data Output Summary

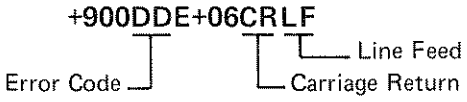
Front Panel Display[1]	HP-IB Output Format	Conditions
Left Display	+DDDDDE+06	Frequency
	±DDDDDE±NN	Data other than frequency
	+90000E+06	Display is blank
INSERTION GAIN[2]	±DDDDDE±NN	Gain is displayed
	+90000E+06	Display is blank
NOISE FIGURE[2]	±DDDDDE±NN	Normal display
	+DDDDDDE−05	Voltmeter mode
	+900DDE+06	Error codes where DD is the error code)
	+90000E+06	Data not ready. Sent when the instrument receives a read command while "- - - -" is displayed in Trigger Hold mode. Also sent when display is blank.

[1]The HP-IB data output for mode H0 is NOISE FIGURE CR/LF. The HP-IB data output for mode H1 is Left Display, INSERTION GAIN, NOISE FIGURE CR/LF. EOI is set each time LF is sent.

[2]The HP-IB output has one more digit of resolution than the front panel display (except for the voltmeter mode which has two more digits of resolution than the front panel NOISE FIGURE display).

When an error is output to the bus, it follows the same 12-byte format described above except most of the numeric digits have predetermined values as shown below. Error outputs always exceed 90 000 000 000. The two-digit error code is represented by the last two digits of the five-digit mantissa. The error code can be derived from the string by subtracting 9 x 10^{10}, then dividing the result by 1 000 000.

Error Output Format:



3-21. Receiving the Clear Message

The Noise Figure Meter responds to the Clear message by assuming the settings detailed in Table 3-6. The Noise Figure Meter responds equally to the Selected Device Clear (SDC) bus command when addressed to listen, and the Device Clear (DCL) bus command whether addressed or not. The Clear message clears any pending Require Service message and resets the Service Request Condition (Special Function 44) such that the Require Service message will be issued on HP-IB code errors only (Special Function 44.3).

Refer to Table 3-14 in the Special Functions Detailed Operating Instruction for a list of the Special Functions that are turned off or not affected by the Clear Message.

3-22. Receiving the Trigger Message

When in remote and addressed to listen, the Noise Figure Meter responds to a Trigger message by executing one measurement cycle. The Noise Figure Meter responds equally to a Trigger message (the Group Execute Trigger bus command [GET]) and a Data message, program code T2 (execute a measurement).

3-23. Receiving the Remote Message

The Remote message has two parts. First, the remote enable bus control line (REN) is held true; second, the device listen address is sent by the controller. These two actions combine to place the Noise Figure Meter in remote mode. Thus, the Noise Figure Meter is enabled to go into remote when the controller begins the Remote message, but it does not actually switch to remote until addressed to listen the first time. No instrument settings are changed by the transition from local to remote. When actually in remote, the Noise Figure Meter's front panel REMOTE annunciator lights. When the Noise Figure Meter is being addressed (whether in remote or local), its front panel LISTEN or TALK annunciator turns on.

Table 3-6. Response to a Clear Message (or Pressing PRESET)

Parameter	Condition
START FREQ	10 MHz
STOP FREQ	1500 MHz
STEP SIZE	20 MHz
SWEEP	Off
FREQUENCY	30 MHz
FREQ INCR	20 MHz
SMOOTHING	1
CALIBRATE	Off
MEASUREMENT	UNCORRECTED NOISE FIGURE
SPECIAL FUNCTION	**NOTE** *Most Special Functions are set to their zero suffix state (for example, Measurement Mode Selection is set to 1.0). Some are turned off (for example, Power Measurements). The following four Special Functions are not affected by either the Clear message or by pressing PRESET.* *a. Control Function Selection (Special Function 4).* *b. HP-B Addresses (Special Function 40).* *c. External LO Programs (Special Funtion 41).* *d. External LO Commands (Special Function 42).* *In addition, Service Request (Special Function 44) is set to enable HP-IB Code Error (Special Function 44.3).* The following Special Functions are set to the indicated default values:
IF (Special Function 3.0)	30 MHz
LO Frequency (Special Function 3.1)	10000 MHz
Smoothing Factor (Special Function 13.2)	1
Spot ENR (Special Function 5.3)	15.2 dB
T_{hot} (Special Function 5.4)	9893K
T_{cold} (Special Function 6)	296.5K
Oscilloscope Limits (Special Function 8)	
Noise Figure Lower Limit	0
Noise Figure Upper Limit	8
Gain Lower Limit	0
Gain Upper Limit	40
Loss Compensation (Special Function 34)	
Before DUT	0 dB
Temperature of Losses	0K
After DUT	0 dB
Set Sequence (Special Function 35.2)	1 through 9

3-24. 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 Noise Figure Meter returns to front panel control when it receives the Local message. If the instrument was in local lockout when the Local message was received, front panel control is returned, but lockout is not cleared. Unless it receives the Clear Lockout/Set Local message, the Noise Figure Meter will return to local lockout the next time it goes to remote. No instrument settings are changed by the transition from remote to local.

When the Noise Figure Meter goes to local mode, the front panel REMOTE annunciator turns off. However, when the Noise Figure Meter is being addressed (whether in remote or local), its front panel LISTEN or TALK annunciator lights.

If the Noise Figure Meter is not in local lockout mode, pressing the front panel LOCAL key might interrupt a Data message being sent to the instrument, leaving the instrument in a state unknown to the controller. This can be prevented by disabling the Noise Figure Meter's front panel keys entirely, using the Local Lockout message.

3-25. Receiving the Local Lockout Message

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

3-26. Receiving the Clear Lockout/Set Local Message

The Clear Lockout/Set Local message is the means by which the controller sets the Remote Enable (REN) bus control line false. The Noise Figure Meter returns to local mode (full front panel control) when it receives the Clear Lockout/Set Local message. No instrument settings are changed by the transition from remote with local lockout to local. When the Noise Figure Meter goes to local mode, the front panel REMOTE annunciator turns off.

3-27. Receiving the Pass Control Message

The Noise Figure Meter does not respond to the Pass Control message because it does not have this control capability.

3-28. Sending the Require Service Message

The Noise Figure Meter sends the Require Service message by setting the Service Request (SRQ) bus control line true. The instrument can send the Require Service message in either local or remote mode. The Require Service message is cleared when a serial poll is executed by the controller or if a Clear message is received by the Noise Figure Meter. (During serial poll, the Require Service message is cleared immediately before the Noise Figure Meter places the Status Byte message on the bus.) There are four conditions that can be enabled to cause the Require Service message to be sent when they occur. All four conditions are described below.

1. Data Ready: When the Noise Figure Meter is ready to send any information except error codes.

2. HP-IB Code Error: When the Noise Figure Meter receives an invalid Data message. (Unless specifically disabled, this condition causes a Require Service message to be sent.)

3. Instrument Error: When any operator error (E10 through E49, and E99) is displayed by the Noise Figure Meter.

4. Calibration Complete: When a calibration cycle is complete.

3-29. Enabling the Service Request Condition

Use Special Function 44 (or the related Service Request Condition HP-IB codes) to enable the Noise Figure Meter to issue the Require Service message on any of the conditions above. The Service Request Condition Special Function is entered from either the front panel or via the HP-IB. A description of the Service Request Condition Special Function and the procedure for enabling the various conditions are given on the following page:

Enabling the Service Request Condition (cont'd)

NOTE

Each condition must be enabled separately. If the enabled conditions are changed, it is a good practice to first disable the SRQ capability and then enter the required enabled conditions.

a. Send the HP-IB Code Q0 to clear all enabled conditions.

b. Send the applicable HP-IB Codes from Table 3-7 to establish the required enabled conditions.

Table 3-7. Service Request Enabled Conditions Summary

HP-IB Code	Special Function	Description
Q0	44.0	Disables the SRQ capability (clears all enabled conditions)
Q1	44.1	Enable Data Ready
Q2	44.2	Enable RF Calibration Complete (not for Zero Frequency or IF Calibration)
Q3	44.3	Enable HP-IB Code Error
Q6	44.6	Enable Instrument Error

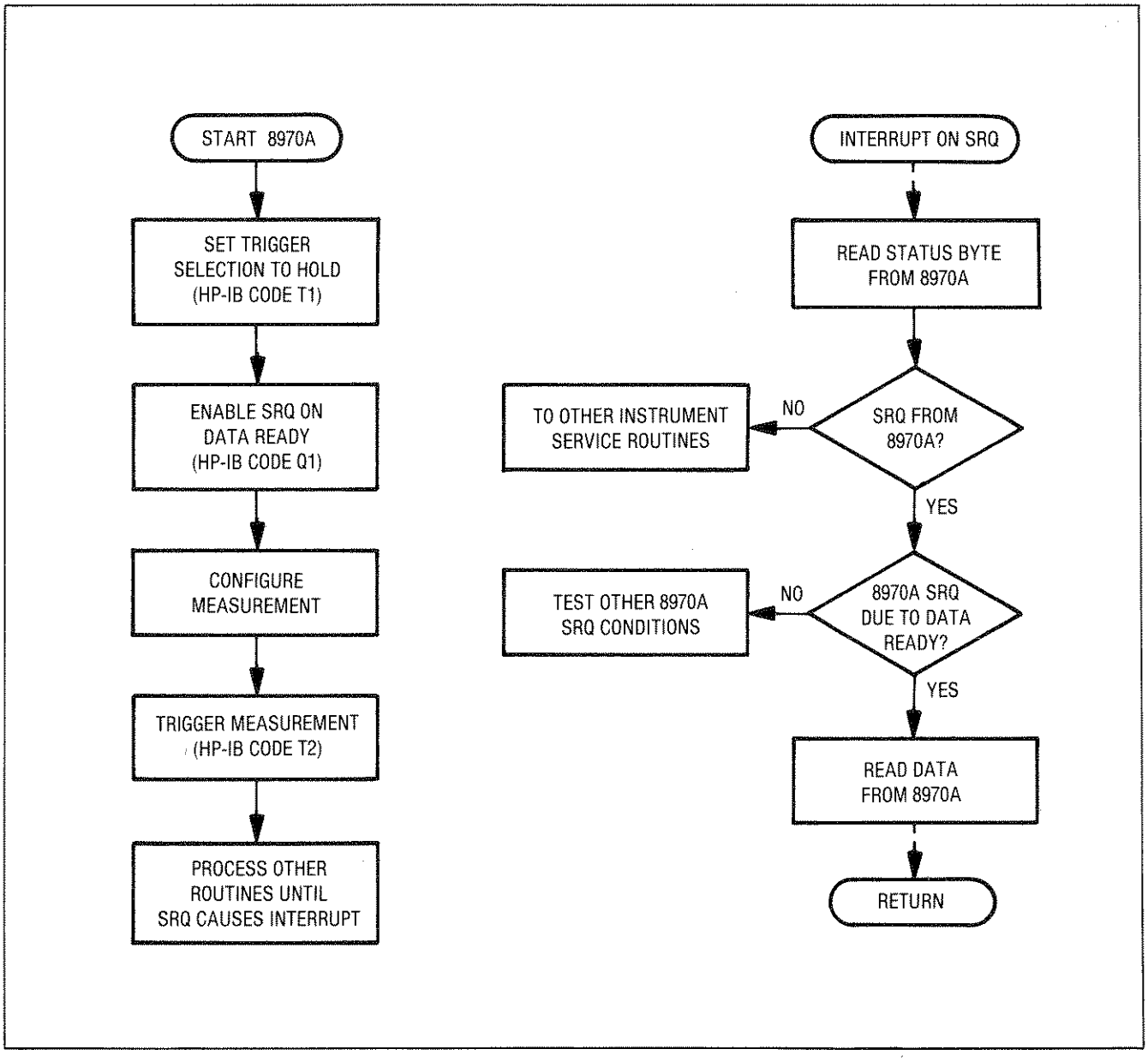


Figure 3.10 Example Flow Chart for Driving the Noise Figure Meter Using the Require Service Message (SRQ)

Enabling the Service Request Condition (cont'd)

Normally, device subroutines for the Noise Figure Meter can be implemented simply by triggering measurements and then reading the output data. In certain applications, the controller must perform other tasks while controlling the Noise Figure Meter. Figure 3-10 illustrates a flow chart for developing device subroutines using the instrument's ability to issue the Require Service message when data is ready. This subroutine structure frees the controller to process other routines until the Noise Figure Meter is ready with data.

3-30. Sending the Status Byte Message

The Status Byte message consists of one 8-bit byte in which 4 of the bits are set according to the enabled conditions described above under Sending the Require Service Message. If one or more of the four conditions are enabled and present, all the bits corresponding to the conditions and also bit 7, the RQS bit, will be set true (and the Require Service message is sent). If one of the above conditions occurs but has not been enabled by Special Function 44 or the HP-IB codes, neither the bit corresponding to the condition nor the RQS bit will be set (and the Require Service message will not be sent). The bit patten of the Status Byte is shown in the HP-IB Syntax and Characteristics Summary.

Once the Noise Figure Meter receives the Serial Poll Enable bus command (SPE), it is no longer allowed to clear the Status Byte. However, it can add additional bits to the status byte if the bit has been enabled and the condition occurs. When addressed to talk (following SPE), the Noise Figure Meter sends the Status Byte message.

After the Status Byte message has been sent it will be cleared if the Serial Poll Disable (SPD) bus command is received, if the Abort message is received, or if the Noise Figure Meter is unaddressed to talk. Nonvolatile error messages are also cleared when the Status Byte message is sent. Thus, some error messages which may have caused the Require Service Message to be issued disappear when a serial poll is performed. Refer to the Error Messages and Recovery Detailed Operating Instruction for a listing of volatile and nonvolatile errors. Regardless of whether or not the Status Byte message has been sent, the Status Byte and any Require Service message pending will be cleared if a Clear message is received.

3-31. Sending the Status Bit Message

The Noise Figure Meter does not respond to a Parallel Poll Enable (PPE) bus command and thus cannot send the Status Bit message.

3-32. Receiving the Abort Message

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

HP-IB SYNTAX AND CHARACTERISTICS SUMMARY

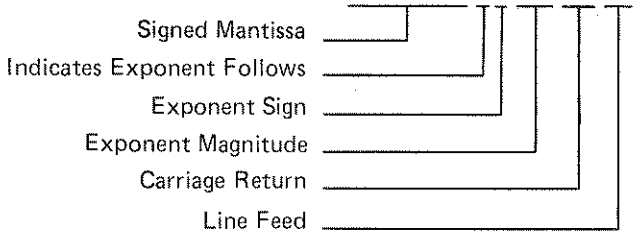
Address:

Selected and displayed on front panel using Special Function 44.0, Noise Figure Meter HP-IB Address. Factory set to 8 decimal.

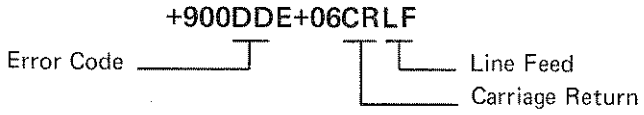
Numeric Data Input Format: (Except in Voltmeter mode).*

Output Formats: (Except in Voltmeter mode).*

HP-IB code H0 (43.0 SP): ±DDDDDE±NNCRLF
HP-IB code H1 (43.1 SP): ±DDDDDE±NN, ±DDDDDE±NN, ±DDDDDE±NNCRLF



Errors:



Reserved Number (used for the "— — — —" special display or a blank display):

+90000E+06CRLF

Return to Local:

Front panel LOCAL key if not locked out.

Status Byte:

Bit	8	7	6	5	4	3	2	1
Weight	128	64	32	16	8	4	2	1
Service Request Condition	0 (always)	RQS Bit Require Service	Instrument Error	0 (always)	0 (always)	HP-IB Code Error	Calibration Complete	Data Ready

Notes:
1. The condition indicated in bits 1, 2, 3 and 6 must be enabled to cause a Service Request by Special Function 44. Each condition must be enabled separately.
2. The RQS bit (bit 7) is set true whenever any of the conditions of bits 1, 2, 3 or 6 are enabled and occurr.

Complete HP-IB Capability (as described in IEEE Std 488-1978, and ANSI Std MC1.1):
SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C1, C3, C28, E1..

*For information on the Voltmeter mode refer to Section VIII, Service.

Table 3-8. Noise Figure Meter HP-IB Code to Parameter Summary (1 of 2)

Program Code	Parameter	Program Code	Parameter
AC	External LO Auxiliary Commands	F7	Smoothing Factor = 128
AF	Enable Smoothing Factor	F8	Smoothing Factor = 256
	Output to Oscilloscope	F9	Smoothing Factor = 512
A0	Noise Figure and Gain	GL	Gain Lower Limit (for Oscilloscope)
A1	Test Pattern	GU	Gain Upper Limit (for Oscilloscope)
A2	Noise Figure Only		Special Function Catalog
A3	Gain Only	G0	Scan Catalog Lines
A4	Plot Noise Figure (for X-Y Recorder)	G1	Line 1 Status
A5	Plot Gain (for X-Y Recorder)	G2	Line 2 Status
A6	X Axis is Noise Figure and Y Axis is Gain	G3	Line 3 Status
	(Strip Chart Mode)	G4	Line 4 Status
B0	Double Sideband	G5	Line 5 Status
B1	Lower Single Sideband	G6	Line 6 Status
B2	Upper Single Sideband	HZ	Hz
CA	CALIBRATE		HP-IB Data Output
CC	Cold Calibration (Manual Measurement)	H0	NOISE FIGURE Display Only
CH	Hot Calibration (Manual Measurement)	H1	Left, INSERTION GAIN, and NOISE
CS	Initialize Special Functions		FIGURE Displays
	Input Gain Calibration	IC	Calibrate IF Attenuators
C0	+20, +10, and 0 dB	IF	IF (for Modes 1.1 and 1.3)
C1	+10, 0, and −10 dB	IH	IF Attenuator Hold
C2	0, −10, and −20	IN	INCREASE Smoothing
C3	−10, −20, and −30 dB		IF Attenuation Selection
DB	dB	I0	Auto
DE	DECREASE Smoothing	I1	0 dB
DN	↓ (Step down)	I2	5 dB
	Noise Source Temperature Units for Data	I3	10 dB
	Input	I4	15 dB
D0	K	I5	20 dB
D1	°C	I6	25 dB
D2	°F	I7	30 dB
EA	Display and Enter Ext LO HP-IB Address	I8	35 dB
EN	ENTER		External LO Programs
	Measurement Modes	J0	HP 8350B Sweep Oscillator
E0	Mode 1.0	J2	HP 8672A Syn. Signal Generator
E1	Mode 1.1	J3	HP 8673B Syn. Signal Generator
E2	Mode 1.2	LA	Loss Compensation before DUT
E3	Mode 1.3	LB	Loss Compensation after DUT
E4	Mode 1.4	LF	LO Frequency (for Modes 1.2 and 1.4)
FA	START FREQ	LL	Go to Lower Left (for X-Y Recorder)
FB	STOP FREQ	LT	Temperature of Losses
FN	FREQ INCR	L0	Loss Compensation Off
FN	FREQUENCY	L1	Loss Compensation On
F0	Smoothing Factor = 1	MC	Cold Manual Measurement
F1	Smoothing Factor = 2	MH	Hot Manual Measurement
F2	Smoothing Factor = 4	MN	External LO Minimum Frequency in MHz
F3	Smoothing Factor = 8	MX	External LO Maximum Frequency in MHz
F4	Smoothing Factor = 16	MZ	MHz
F5	Smoothing Factor = 32	M1	UNCORRECTED NOISE FIGURE
F6	Smoothing Factor = 64	M2	CORRECTED NOISE FIGURE AND GAIN

Table 3-8. Noise Figure Meter HP-IB Code to Parameter Summary (2 of 2)

Program Code	Parameter	Program Code	Parameter
NE	Enter and Use ENR	SE	Display Current ENR
NL	Noise Figure Lower Limit (for Oscilloscope)	SI	Display IF Attenuator Setting
NR	Enter ENR Table	SN	Enter Noise Source Identifier
NU	Noise Figure Upper Limit (for Oscilloscope)	SP	SPECIAL FUNCTION
	Noise Figure Display Units	SQ	SEQ
N0	F dB	SR	Display RF Attenuator Setting
N1	F	SS	STEP SIZE
N2	Y dB	ST	STORE
N3	Y	S0	Use ENR Table
N4	Te K	S1	Use Spot ENR
	Power Measurements	TC	T_{cold}
N5	SOURCE Off (Uncal)	TH	T_{hot}
N6	SOURCE On (Uncal)	TM	External LO Settling Time
N7	SOURCE Off (Cal)		Trigger Selection
N8	SOURCE On (Cal)	T0	Free Run
PR	PRESET	T1	Hold
PS	External LO CW Prefix and Suffix	T2	Execute
P0	Normal Display (to return from displaying manual measurement results)	UP	↑ (Step up)
		UR	Go to Upper Right (for X-Y Recorder)
P1	Display Manual Measurement Results	V0	Exponential Smoothing
	Sequence Functions	V1	Arithmetic Smoothing
QA	Automatic	W0	Sweep off
QC	Clear	W1	AUTO Sweep
QM	Manual	W2	SINGLE Sweep
QS	Set		Display Resolution
	Service Request	X0	Maximum Resolution
Q0	Disable SRQ Capability	X1	Less Resolution on Noise Figure
Q1	Enable Data Ready to Cause SRQ	X2	Less Resolution on Gain
Q2	Enable Cal Complete to Cause SRQ		Frequency Calibration
Q3	Enable HP-IB Code Error to Cause SRQ	Y0	Automatic
Q6	Enable Instrument Error to cause SRQ	Y1	Disable Frequency Cal
RC	RECALL	Y2	Perform 1 Frequency Cal
RH	RF Attenuator Hold		Individual RF Attenuator Selection
	RF Attenuation Selection	Z0	Select RF Thru Path
R0	Auto	Z1	Select 10 dB Pad No. 1
R1	+20 dB	Z2	Select 20 dB Input Amplifier
R2	+10 dB	Z4	Select 10 dB Pad No. 2
R3	0 dB	Z5	Select 10 dB Pad No. 3
R4	−10 dB		
R5	−20 dB		
R6	−30 dB		

Table 3-9. Special Function to HP-IB Code (1 of 5)

Special Function		HP-IB Code HP-IB	Description
Name	Code*		
Initialize Special Functions	0.0	CS	Initializes many Special Functions
Measurement Mode Selection	1.0	E0	Mode 1.0 (10—1500 MHz measurement)
	1.1	E1	Mode 1.1 (fixed IF; variable freq. ext LO)
	1.2	E2	Mode 1.2 (variable IF; fixed freq. ext LO; SSB)
	1.3	E3	Mode 1.3 (fixed IF; variable freq. ext LO; mixer is DUT)
	1.4	E4	Mode 1.4 (variable IF; fixed freq. ext LO; mixer is DUT)
Sideband Frequency Offset	2.0	B0	Double Sideband (no offset)
	2.1	B1	Lower Single Sideband ($F_{signal} < F_{LO}$)
	2.2	B2	Upper Single Sideband ($F_{signal} > F_{LO}$)
Enter IF and LO Frequencies	3.0	IF	IF (for Modes 1.1 and 1.3)
	3.1	LF	LO (for Modes 1.2 and 1.4)
Control Function Selection	4.0	none	Normal Talker and Listener
	4.1	none	Enable Ext LO Control
	4.2	none	Talk Only
ENR and T_{hot} Settings	5.0	S0	Use ENR Table
	5.1	S1	Use Spot ENR
	5.2	SE	Display Current ENR in dB
	5.3	NE	Enter and Use Spot ENR
	5.4	TH	Enter and Use T_{hot}
	5.5	SN	Enter Noise Source Identifier
T_{cold} Setting	6.0	TC	Enter T_{cold}
Output to Oscilloscope	7.0	A0	Noise Figure and Gain
	7.1	A1	Test Pattern
	7.2	A2	Noise Figure Only
	7.3	A3	Gain Only
Enter Oscilloscope Limits	8.1	NL	Noise Figure Lower Limit
	8.2	NU	Noise Figure Upper Limit
	8.3	GL	Gain Lower Limit
	8.4	GU	Gain Upper Limit

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.

Table 3-9. Special Function to HP-IB Code (2 of 5)

Special Function		HP-IB Code HP-IB	Description
Name	Code*		
Power Measurements	9.1	N5	SOURCE Off (uncal)
	9.2	N6	SOURCE On (uncal)
	9.3	N7	SOURCE Off (cal)
	9.4	N8	SOURCE On (cal)
Noise Figure Display Units	10.0	N0	F dB
	10.1	N1	F
	10.2	N2	Y dB
	10.3	N3	Y
	10.4	N4	Te K
Select Noise Source Temperature Units for Data Input	11.0	D0	K
	11.1	D1	°C
	11.2	D2	°F
Display Resolution	12.0	X0	Maximum Resolution
	12.1	X1	Less Resolution on Noise Figure
	12.2	X2	Less Resolution on Gain
Smoothing (Averaging)	13.0	V0	Exponential Smoothing
	13.1	V1	Arithmetic Smoothing
	13.2	AF	Smoothing Factor
Manual Measurement Functions	14.1	MC	Cold Measurement (SOURCE-off)
	14.2	MH	Hot Measurement (SOURCE-on)
	14.3	CC	Cold Calibration (SOURCE-off)
	14.4	CH	Hot Calibration (SOURCE-on)
	15.0	P0	Display Current Measurement
	15.1	P1	Display Manual Measurement Results
Recorder Functions	20.0	LL	Go to Lower Left
	21.0	UR	Go to Upper Right
	22.0	A4	Plot Noise Figure
	23.0	A5	Plot Gain
	24.0	A6	X-AXIS Output is Noise Figure and Y-AXIS Output is Gain (Strip Chart mode)

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.

Table 3-9. Special Function to HP-IB Code (3 of 5)

Special Function		HP-IB Code HP-IB	Description
Name	Code*		
Trigger Selection	30.0	T0	Free Run
	30.1	T1	Hold
	30.2	T2	Execute
Frequency Calibration	31.0	Y0	Automatic
	31.1	Y1	Disable Frequency Cal
	31.2	Y2	Perform 1 Frequency Cal
Input Gain Calibration	32.0	C0	+20, +10 and 0 dB
	32.1	C1	+10, 0 and −10 dB
	32.2	C2	0, −10 and −20 dB
	32.3	C3	−10, −20 and −30 dB
IF Attenuators Calibration	33.0	IC	Calibrate IF Attenuators
Loss Compensation	34.0	L0	Off
	34.1	L1	On
	34.2	LA	Enter Loss before DUT in dB
	34.3	LT	Enter Temperature of Losses
	34.4	LB	Enter Loss after DUT in dB
Sequence Functions	35.0	QM	Manual
	35.1	QA	Automatic
	35.2	QS	Set
	35.3	QC	Clear
HP-IB Addresses	40.0	none	Display and Enter 8970A Address
	40.1	EA	Display and Enter Ext LO Address
External LO Programs	41.0	J0	HP 8350B Sweep Oscillator
	41.2	J2	HP 8672A Syn. Signal Generator
	41.3	J3	HP 8673B Syn. Signal Generator
External LO Commands	42.0	AC	Auxiliary Commands
	42.1	PS	CW Prefix and Suffix
	42.2	TM	Settling Time in ms
	42.3	MN	Minimum Frequency in MHz
	42.4	MX	Maximum Frequency in MHz
HP-IB Data Output Selection	43.0	H0	NOISE FIGURE Only
	43.1	H1	Frequency (left display), INSERTION GAIN, NOISE FIGURE

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.

Table 3-9. Special Function to HP-IB Code (4 of 5)

Special Function		HP-IB Code HP-IB	Description
Name	Code*		
Service Request	44.0	Q0	Disable SRQ Capability (clears all enabled conditions)
	44.1	Q1	Enable Data Ready to cause an SRQ
	44.2	Q2	Enable Cal Complete to cause an SRQ
	44.3	Q3	Enable HP-IB Code Error to cause an SRQ
	44.6	Q6	Enable Instrument Error to cause an SRQ
Special Function Catalog	50.0	G0	Scan Special Function Catalog Lines
	50.1	G1	Line 1 Status
	50.2	G2	Line 2 Status
	50.3	G3	Line 3 Status
	50.4	G4	Line 4 Status
	50.5	G5	Line 5 Status
	50.6	G6	Line 6 Status
RF Attenuation Selection	60.0	R0	Auto
	60.1	R1	+20 dB
	60.2	R2	+10 dB
	60.3	R3	0 dB
	60.4	R4	−10 dB
	60.5	R5	−20 dB
	60.6	R6	−30 dB
Display RF Attenuator Settings	61.0	SR	Display RF Attenuators
RF Attenuator Hold	62.0	RH	RF Attenuators are held in the configuration that exists when Special Function 62.0 is activated.
Individual RF Attenuator Selection	63.0	Z0	Select RF Thru Path
	63.1	Z1	Select 10 dB Pad No. 1
	63.2	Z2	Select 20 dB Input Amplifier
	63.4	Z4	Select 10 dB Pad No. 2
	63.5	Z5	Select 10 dB Pad No. 3
IF Attenuation Selection	70.0	I0	Auto
	70.1	I1	0 dB
	70.2	I2	5 dB
	70.3	I3	10 dB

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.

Table 3-9. Special Function to HP-IB Code (5 of 5)

Special Function		HP-IB Code HP-IB	Description
Name	Code*		
IF Attenuation Selection (cont'd)	70.4	I4	15 dB
	70.5	I5	20 dB
	70.6	I6	25 dB
	70.7	I7	30 dB
	70.8	I8	35 dB
Display IF Attenuator Settings	71.0	SI	Display IF Attenuators
IF Attenuator Hold	72.0	IH	IF Attenuators are held in the configuration that exists when Special Function 72.0 is activated.

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.

Table 3-10. Front Panel Keys to HP-IB Code Summary

Front Panel Key	HP-IB Code	Front Panel Key	HP-IB Code
AUTO	W1	PRESET	PR
CALIBRATE	CA	RECALL	RC
DECREASE	DE	SEQ	SQ
ENR	NR	SINGLE	W2
ENTER	EN	SPECIAL FUNCTION	SP
FREQ INCR	FN	START FREQ	FA
▼	DN	STEP SIZE	SS
▲	UP	STOP FREQ	FB
FREQUENCY	FR	STORE	ST
INCREASE	IN	Sweep and Calibrate Off (must be used to	W0
NOISE FIGURE (UNCORRECTED)	M1	turn these functions off over the HP-IB)	
NOISE FIGURE AND GAIN (CORRECTED)	M2		

Table 3-11. 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

Calibrate

Description

Pressing the CALIBRATE key initiates a calibration of the instrument and any equipment that is currently connected to the INPUT. First a frequency calibration is performed and then the noise figure is measured at each selected calibration point. The calibration data obtained is used to measure gain and to perform the "second stage correction" computations needed to make a CORRECTED NOISE FIGURE AND GAIN measurement. The calibration points are the START FREQ setting, the STOP FREQ setting, and the frequency steps determined by the setting of STEP SIZE. Refer to the Sweep Detailed Operating Instruction for additional information on these keys. During calibration, each specified frequency in the selected range is calibrated at three input gain settings as selected by Special Function 32. The default gain settings are +20, +10 and 0 dB. The calibration data is interpolated between the measured points when it is used for a gain measurement and second stage correction. Therefore, it is not necessary to calibrate at every frequency that is to be measured. However, the data is not extrapolated. If a corrected measurement is attempted at a frequency less than the START FREQ setting or more than the STOP FREQ setting of the calibration run, error code E21 (Frequency Out of Calibrated Range) is displayed.

Specific calibration setups and procedures are contained in the Detailed Operating Instructions for Measurement Modes 1.0 through 1.4.

Procedure

To initiate a calibration sequence, press CALIBRATE. To terminate calibration before it is complete, press CALIBRATE again. The CALIBRATE key toggles the calibration function on and off. Pressing PRESET also terminates the calibration sequence.

Front Panel Key	Program Code HP-IB	Stored in Continuous Memory	Can Be Stored and Recalled	Preset (and HP-IB Clear) Conditions
CALIBRATE	CA	N	N	Off

Table categories are described in the Preset Conditions and Power-Up Sequence Detailed Operating Instruction.

Example

To initiate calibration at the existing SWEEP function settings:

LOCAL (keystrokes)	Function → CALIBRATE
HP-IB (program codes)	CA

Program Codes HP-IB

CA is the program code for the CALIBRATE key. The calibration sequence can not be toggled on and off over the HP-IB. Instead, successive CA codes cause the calibration to be restarted. To terminate calibration prior to completion, use the Sweep Stop command (W0).

Indications

The CALIBRATE LED lights and remains lit until the calibration is complete. During frequency calibration, the NOISE FIGURE display shows four dashes " — — — — ".

Calibrate (cont'd)

Indications (cont'd)

During second stage calibration, the left display indicates each tuned frequency and the NOISE FIGURE display indicates the noise figure at that frequency. The frequency range and step size are controled by the SWEEP keys.

When calibration is completed, the instrument resumes making the measurement that was active when CALIBRATE was pressed. However, if the instrument was sweeping (either in AUTO or SINGLE) it does not resume sweeping. Instead, it performs the previously selected measurement at the frequency it was tuned to when CALIBRATE was pressed.

Comments

The maximum number of frequency points that can be calibrated is 81 (that is, approximately 19 MHz steps for the full frequency range of 10 MHz to 1500 MHz).

During calibration, all of the front panel keys except LOCAL, PRESET, and CALIBRATE are disabled.

If LOCAL is pressed during calibration, the instrument returns to local control (if it was in remote, and the Local Lockout command was not in effect). Calibration is not interrupted by the LOCAL command.

Pressing PRESET or CALIBRATE terminates the calibration function. However, PRESET also resets the entire instrument to a specified set of conditions (refer to the Preset Conditions and Power-Up Sequence Detailed Operating Instruction). If either of these keys are pressed during the frequency calibration portion of the sequence (that is, the NOISE FIGURE display is " — — — — ", calibration is not terminated. These commands cannot be used until the frequency calibration is completed.

The calibration data cannot be stored using the STORE key and it is not retained when the instrument is turned off. Therefore, it is necessary to calibrate the instrument each time power is turned on.

If smoothing (averaging) is used during calibration, the arithmetic averaging algorithm is used. Refer to the Smoothing (Averaging) Detailed Operating Instruction for a detailed discussion of the averaging techniques used by the instrument. Note that once calibration is initiated, the SMOOTHING keys are disabled and the averaging factor cannot be changed during the calibration sequence.

If an external controller is used to control both the Noise Figure Meter and the external LO, the calibration sequence must be stepped using the HP-IB command T2 after the LO has been moved to each new frequency. Once the HP-IB command for calibration (CA) is issued, the T2 mnemonic for trigger execute must be used. The Noise Figure Meter will ignore the alternate HP-IB code of 30.2SP. Refer to the Trigger Selection Detailed Operating Instruction for additional triggering information.

It is assumed that the triggered calibration is being performed as a part of the procedure in the Comments section of the Detailed Operating Instructions for Measurement Modes 1.1 and 1.3. Step d of both these procedures requires a triggered calibration sequence. Therefore, the preliminary steps such as selecting Special Function 4.0 will have already been performed. The following general conditions must be observed when using an external controller to perform a triggered calibration:

a. Remove the device under test (DUT) from the measurement system.

b. Set the Noise Figure Meter's calibrate function on (HP-IB code is CA).

Calibrate (cont'd)

Comments (cont'd)

c. Set the external LO to the appropriate frequency. Refer to the LO's operating manual for the required HP-IB codes. Allow sufficient settling time for the output of the external LO to stabilize.

d. Trigger a measurement using the HP-IB code T2. Do not use the alternate HP-IB code 30.2SP for it will be ignored.

e. To determine when to step to a new frequency, read the noise figure results. This read operation cannot be completed until the new data is ready. It is also possible to write an SRQ interrupt routine on the Data Ready status bit. Refer to Enabling the Service Request Condition, paragraph 3-29.

f. Continue to loop through steps c, d, and e. A method for determining when the calibration is complete must be programmed into the external controller. One method is to compare the frequency that is sent to the exernal LO with the stop frequency programmed into the Noise Figure Meter and terminate the program after the third measurement in which they are equal. It is also possible to write an SRQ interrupt routine on the Calibration Complete SRQ. Refer to Enabling the Service Request Condition, paragraph 3-29.

If any of the 60 or 70 series of Special Functions (except 60.0 and 70.0) are active, the calibration sequence does not override them. Therefore, to calibrate on one range only, use any of these Special Functions except 60.0 or 70.0. If any of these Special Functions are inadvertently left active the calibration sequence will not cover the expected gain range.

The calibration sequence always uses the 10 to 1500 MHz portion of the ENR table.

Any loss compensation entered by Special Function 34 is ignored during the calibration sequence.

Related Sections

Calibration, Frequency
Calibration, Input Gain Selection
Measurement Modes 1.0 through 1.4
Noise Figure (Uncorrected) and Noise Figure and Gain (Corrected)
Sweep
Trigger Selection

Calibration, Frequency
(Special Funtion 31)

Description

Frequency Calibration is performed to ensure the accuracy of the displayed tuned frequency. During frequency calibration, the instrument's first local oscillator (the YIG oscillator) is tuned to the first IF (2050 MHz). Since the first mixer is not perfectly balanced, some of the first local oscillator power is fed through to the first IF. This signal is mixed down to the third IF. It is then detected by a special narrow-band detector (approximately 100 kHz wide).

The YIG oscillator is then stepped through the narrow-band detectors's pass band using a special fine tune digital-to-analog converter (DAC). When the peak output is detected, the YIG oscillator is tuned to 2050 MHz (first IF). This IF corresponds to 0 MHz on the front-panel frequency display. The fine tune DAC is held at this value. This correction value is then used when the YIG oscillator is tuned in response to subsequent tuning changes.

Frequency calibration is initiated by the following:

a. The LINE switch is pressed to apply power to the instrument.
b. Either the PRESET or the CALIBRATE key is pressed.

c. Special Function 31 is used to initiate and control frequency calibration.

Completion of Frequency Calibration does not set the CALIBRATION COMPLETE bit of the HP-IB statue byte. That bit is used only for RF calibration.

Special Function 31 is defined as follows:

a. 31.0—Selects the automatic frequency calibration mode. In addition to the initial frequency calibration described previously, a frequency calibration is automatically initiated 15 minutes after power on, 30 minutes later, 1 hour later, 2 hours later, and then every 2 hours until the instrument is turned off or a different 31 Special Function is entered. This mode is the default condition.

b. 31.1—Disables the frequency calibration. In this mode, frequency calibration is still done if the PRESET or CALIBRATE keys are pressed. However, frequency calibration is not initiated periodically as described in 31.0.

c. 31.2—Initiates a frequency calibration immediately. After that frequency calibration, the operation returns to the mode active when 31.2 was entered. If 31.1 was active, it remains active after the frequency calibration is done.

Procedure

Frequency calibration is performed as a part of the PRESET and CALIBRATE functions. In addition, the frequency calibration can be performed or disabled by keying in the corresponding Special Function code and then pressing the SPECIAL FUNCTION key.

Calibration Frequency (cont'd)
(Special Function 31)

Procedure (cont'd)

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Automatic Frequency Calibration	31.0	Y0 or 31.0SP	N	N	N	On	On
Disable Frequency Calibration	31.1	Y1 or 31.1SP	N	N	N	Off	Off
Perform One Frequency Calibration	31.2	Y2 or 31.2SP	N	N	N	Off	Off
Table categories are explained in the Special Functions Detailed Operation Instruction.							

Example To select the Disable Frequency Calibration Mode:

LOCAL (keystrokes)	Code: 3 1 . 1 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	Y1

Program Codes HP-IB

For HP-IB codes, refer to Procedure above.

Indications

The INSERTION GAIN and NOISE FIGURE displays are not affected by 31.0 and 31.1. If 31.2 is entered, the Noise Figure Display shows " — — — — " until the frequency calibration is completed.

Related Sections

Calibrate
Preset Conditions and Power-Up Sequence
Special Functions

Calibration, IF Attenuators
(Special Function 33)

Description

Special Function 33 is used to calibrate the IF Attenuators. This calibration should be performed approximately every six months or if there are wide changes in the ambient temperature. The noise source MUST be connected to the instrument. The Noise Figure Meter turns on the noise source and uses its own internal noise power detector to measure each IF attenuator. This data is used to correct the gain readings during gain measurement. After the IF attenuation calibration is completed, this data is stored in the instrument's continuous memory and is retained when power is removed. Completion of IF calibration does not set the CALIBRATION COMPLETE bit of the HP-IB status byte.

Procedure

To calibrate the IF Attenuators, connect the noise source to the instrument's INPUT connector, enter 33.0, and then press SPECIAL FUNCTION.

Special Function		Program Code (HP-IB)	Description	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Name	Code							
IF Attenuators Calibration	33.0	IC	Calibrate IF Attenuators	N	Y	N	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example

LOCAL (keystrokes)	Code: 3 3 . 0 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	IC

Program Codes (HP-IB)

The HP-IB code for IF Attenuator Calibration is IC (or 33.0SP).

Indications

During calibration, the NOISE FIGURE display shows four dashes " — — — — ". IF Attenuator Calibration takes only a few seconds. If for any reason the IF Attenuator Calibration is not successfully completed, error E13 (IF Attenuator Calibration failed) is displayed.

Comments

Error code E26 is displayed if the IF Attenuator calibration data is not stored in the continuous memory. Error E26 always occurs after an error E80 (continuous memory failure). Therefore, an IF Attenuator calibration must always be performed after an error E80 has been cleared. Either an HP 346B or HP 346C Noise Source is needed for calibrating the IF attenuators. The HP 346A will work only with the addition of approximately 10 dB of gain between the Noise Source and the HP 8970A INPUT connector.

Related Sections

Error Messages and Recovery
Special Functions

Calibration, Input Gain Selection
(Special Function 32)

Description

The gain setting for calibration can be selected using Special Function 32. Calibration is performed from the start frequency to the stop frequency in steps of the specified step size. At each frequency, calibration is done at the three most sensitive RF attenuator gain settings (that is, +20, +10, and 0 dB). These settings are the default value for Special Function 32. Three other sets of gain settings can be selected using the special functions shown below. Selection of the gain settings to be calibrated depends upon the specific application. Selecting a calibration gain setting does not initiate a calibration sequence.

Procedure

To select an alternate gain setting for calibration, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
+20, +10, and 0 dB	32.0	C0 or 32.0SP	N	N	N	On	On
+10, 0, and −10 dB	32.1	C1 or 32.1SP	Y	N	N	Off	Off
0, −10, and −20 dB	32.2	C2 or 32.2SP	Y	N	N	Off	Off
−10, −20, and −30 dB	32.3	C3 or 32.3SP	Y	N	N	Off	Off

Table categories are explained in the Special Function Detailed Operation Instruction.

Example

To select +10, 0 and −10 dB as the gain settings for calibration:

LOCAL (keystrokes)	Code: 3 2 . 1 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	C1

Program Codes HP-IB

For HP-IB codes, refer to Procedure above.

Comments

The gain settings, other than the default values, are used primarily when the instrument is calibrated for use with a high gain device under test (DUT).

DUTs in the specified range of −20 to +40 dB can be measured using Special Function 32.0.

Related Sections

Calibrate
Special Functions

Controller Capability of the Noise Figure Meter
(Special Function 4)

Description

The Noise Figure Meter can be used as a limited controller for an external device. This capability is limited to acting as a controller for an external LO or operating in the Talk Only Mode (outputting data to a recording device). The Noise Figure Meter can also be controlled by an external controller when Special Function 4.0 is active. Only one of the three capabilities can be active at any one time.

If the Controller Mode is selected, one of the stored programs described in the Programs Available To Control an External LO Detailed Operating Instruction can be selected. Stored programs are available for the HP 8350A Sweep Oscillator and the HP 8672A Synthesized Signal Generator. In addition to the stored programs, the capability to modify and generate programs for unspecified local oscillators is available. Refer to the Programming an External LO Detailed Operating Instruction for additional information.

Procedure

To select an HP-IB control capability, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Normal Talker and Listener Mode	4.0	None	N	Y	N	NC	NC
Controller Mode (for External LO)	4.1	None	N	Y	N	NC	NC
Talk Only Mode	4.2	None	N	Y	N	NC	NC

Table categories are explained in the Special Functions Detailed Operation Instruction.

Example

To select the Controller Mode (for an external LO).

LOCAL (keystrokes)	Data: 4 . 1 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	Cannot be selected via HP-IB

Indications

When Special Function 4.2 is active, the HP-IB TALK annunciator lights.

Comments

In the Talk Only Mode, the instrument continuously outputs data to a recording device that is in the Listen Only Mode. The data output format and content is controlled by Special Function 43. Refer to the HP-IB portion of this section for additional information on this Special Function.

Controller Capability of the Noise Figure Meter (cont'd)

(Special Function 4)

Comments (cont'd)

In the Controller Mode, the instrument is used to control the frequency and level of the external local oscillator. Note that the instrument does not have full controller capability. For example, it cannot pass or receive control of the HP-IB. The instrument's controller capabilities are defined as C1, C3, and C28. These capabilities are explained in the HP-IB portion of this section.

An external controller cannot be used when Special Function 4.1 or 4.2 is active.

The active function of Special Function 4 is not affected by PRESET, Special Function 0.0, or the LINE switch.

Related Sections

Programming an External LO
Programs Available to Control an External LO
Special Functions

Data Output to Oscilloscopes and Recorders

(Special Functions 7, 8, and 20 through 24)

Description

The Noise Figure Meter can output analog data to an oscilloscope, an X-Y recorder, or a strip chart recorder. However, only one of these devices can be used at a time. Since the setup procedures and operation are similar for all three devices, the operating information for all are covered in this operating instruction.

Normally it is simpler to perform a setup procedure using the oscilloscope and then switch to a recorder mode (or use an oscilloscope camera) if a permanent record is required. In the example following the general procedure, this type of setup will be shown.

Procedure

To select one of the oscilloscope or recorder output functions, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code (HP-IB)	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Output to Oscilloscope							
Noise Figure and Gain	7.0	A0 or 7.0SP	N	Y	N	On	On
Test Pattern	7.1	A1 or 7.1SP	N	Y	N	Off	Off
Noise Figure Only	7.2	A2 or 7.2SP	N	Y	N	Off	Off
Gain Only	7.3	A3 or 7.3SP	N	Y	N	Off	Off
Enter Oscilloscope Limits							
Noise Figure Lower Limit	8.1	NL or 8.1SP	N	Y	Y	NC	0
Noise Figure Upper Limit	8.2	NU or 8.2SP	N	Y	Y	NC	8
Gain Lower Limit	8.3	GL or 8.3SP	N	Y	Y	NC	0
Gain Upper Limit	8.4	GU or 8.4SP	N	Y	Y	NC	40
Recorder Functions							
Go to Lower Left	20.0	LL or 20.0SP	N	N	N	Off	Off
Go to Upper Right	21.0	UR or 21.0SP	N	N	N	Off	Off
Plot Noise Figure	22.0	A4 or 22.0SP	N	Y	N	Off	Off
Plot Gain	23.0	A5 or 23.0SP	N	Y	N	Off	Off
Strip Chart Mode (X = Noise Figure; Y = Gain)	24.0	A6 or 24.0SP	N	Y	N	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example

The following example shows how to set up the Noise Figure Meter to ouput a swept CORRECTED NOISE FIGURE AND GAIN measurement result to an oscilloscope and then to plot noise figure and gain results independently. It is assumed that the Noise Figure Meter is already making this type of measurement in one of the Measurement Modes. It is also assumed that the oscilloscope has A vs B (or X/Y) capability.

Data Output to Oscilloscopes and Recorders (cont'd)

(Special Functions 7, 8, and 20 through 24)

Example (cont'd)

Data Output to an Oscilloscope

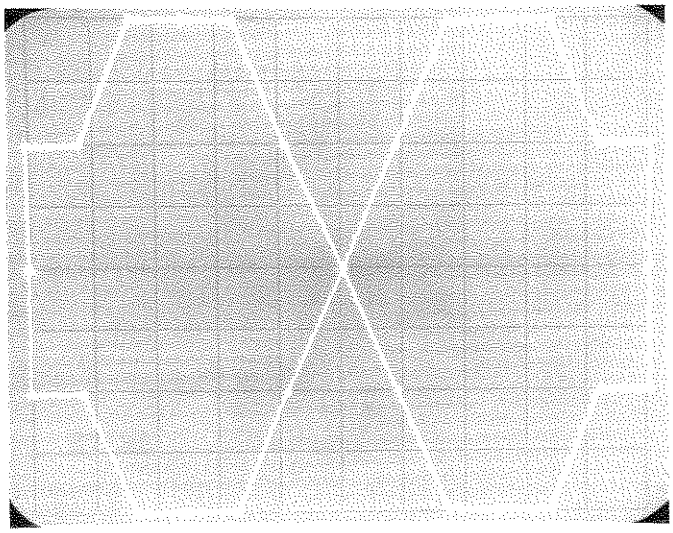
a. Connect the X-AXIS, Y-AXIS, and Z-AXIS outputs on the rear panel of the Noise Figure Meter to the A, B, and Z (or horizontal, vertical, and Z) inputs of the oscilloscope as appropriate. Select the DC mode for all oscilloscope inputs.

b. To display the test pattern on the oscilloscope screen press 7 . 1 SPECIAL FUNCTION (or send HP-IB code A1).

NOTE

In the following step, first adjust the position controls on the oscilloscope to place the test pattern on the left side and the bottom. Then, adjust the gain controls to position the right side and top.

c. Adjust the oscilloscope controls until the test pattern just fills the screen (touching the outer lines on all four sides). See figure below. Verify that the diagonal lines cross near the center of the screen.



Test Pattern on Oscilloscope

NOTE

In the following steps it is assumed that the DUT has a noise figure range of 0.5 to 4 dB and a gain range of 0 to 25 dB over the specified frequency range.

d. To display the noise figure and gain traces on the oscilloscope screen, press 7 . 0 SPECIAL FUNCTION (or send HP-IB code A0).

e. To display the noise figure lower limit in the left display, press 8 . 1 SPECIAL FUNCTION (or send HP-IB code NL). If the left display shows the default value of 0.000 dB, continue with the next step. If the display shows a different value, press 0 and ENTER (or send HP-IB codes 0EN).

f. To display the noise figure upper limit in the left display, press 8 . 2 SPECIAL FUNCTION (or send HP-IB code NU). The default value is 8.000 dB. To change the upper limit to 4 dB, press 4 and ENTER (or send HP-IB codes 4EN).

Data Output to Oscilloscopes and Recorders (cont'd)

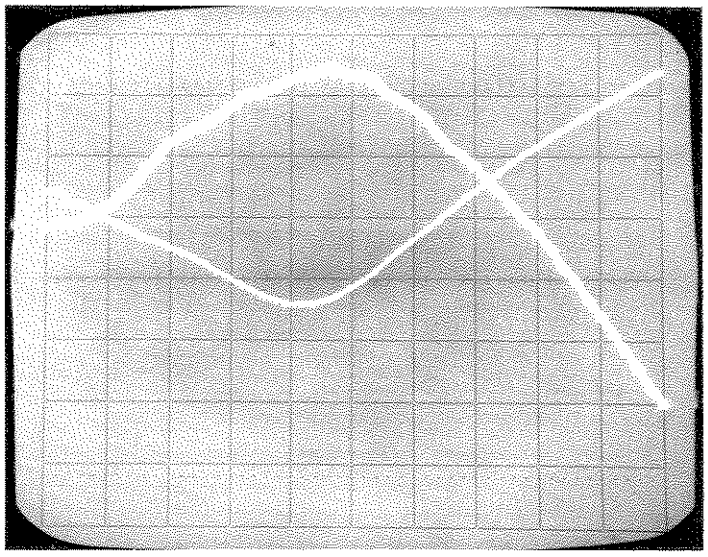
(Special Functions 7, 8, and 20 through 24)

Example (cont'd)

g. In a similar manner, use Special Functions 8.3 and 8.4 (HP-IB codes GL and GU) to display and change the lower and upper limits of the gain trace. The default values of 0.000 and 40.00 are satisfactory for this example.

h. To display the corrected swept measurement, press CORRECTED NOISE FIGURE AND GAIN (or send HP-IB code M2).

i. For a repetitive swept measurement beginning at the start frequency, press START FREQ and then AUTO (or send HP-IB codes FAW1). Verify the display is similar to that shown below.



Swept Measurement on Oscilloscope

NOTE

If desired, the intensity of the gain trace can be adjusted relative to the noise figure trace. This can be done by turning the GAIN TRACE adustment on the rear panel of the Noise Figure Meter (see Figure 3-7).

j. To stop the sweep press AUTO again (or send HP-IB code W0). Note that a different HP-IB code is required to turn off the sweep since this function cannot be toggled over the HP-IB.

NOTE

Step j completes the procedure for setting up the Noise Figure Meter for an oscilloscope display. If a permanent record of the measurement results is required, use an oscilloscope camera or perform the remaining steps, which provide a typical procedure for plotting the data on an X-Y recorder.

Plotting Data on an X-Y Recorder

k. Connect the X-AXIS, Y-AXIS, and Z-AXIS outputs from the Noise Figure Meter to the X, Y, and pen lift inputs of the X-Y recorder. Select DC mode on all recoder inputs.

Data Output to Oscilloscopes and Recorders (cont'd)

(Special Functions 7, 8, and 20 through 24)

Example (cont'd)

l. To adjust the lower left point on the recorder, press 2 0 . 0 SPECIAL FUNCTION (or send HP-IB code LL) and adjust the X and Y zero-set controls on the recorder.

m. To adjust the upper right point on the recorder, press 2 1 . 0 SPECIAL FUNCTION (or send HP-IB code UR) and adjust the X and Y vernier controls on the recorder.

NOTE

The X-AXIS and Y-AXIS output voltages from the Noise Figure Meter vary from 0 to 6V. Therefore, it may be necessary to adjust the recorder to accommodate this range of voltages.

n. Check both the upper and lower limits on the recorder and readjust as required.

o. To plot a single sweep of the noise figure results, press 2 2 . 0 SPECIAL FUNCTION and then SINGLE (or send HP-IB codes A4W2). When the single sweep is complete, the Noise Figure Meter remains tuned to the stop frequency.

p. To plot a single sweep of the gain results, press 2 3 . 0 SPECIAL FUNCTION and then SINGLE (or send HP-IB codes A5W2). When the single sweep is complete, the Noise Figure Meter remains tuned to the stop frequency.

q. The plotted traces should be similar to the traces that were displayed on the oscilloscope.

Program Codes

HP-IB

For HP-IB codes, refer to Procedure above.

Comments

For the oscilloscope and recorder modes, whatever is displayed in the NOISE FIGURE display is treated as a noise figure trace. For example, if Special Function 9 is active, the power measurement information displayed is output to the oscilloscope or recorder as if it were noise figure information. Noise figure is displayed in the units selected by Special Function 10 and gain is displayed in dB.

Special Function 8 is used to set both noise figure and gain limits.

Special Function 24 selects the strip chart mode. This mode is useful in plotting noise figure and gain versus time. For example, it can be used to plot noise figure versus emitter current on an X-Y recorder or to drive an external meter. The X-AXIS output is the noise figure information and the Y-AXIS output is the gain information.

Related Sections

Display Units Selection
Measurement Modes 1.0 through 1.4
Special Functions

Display Resolution

(Special Function 12)

Description The Noise Figure Meter can vary the resolution of the INSERTION GAIN and NOISE FIGURE displays.

The table below shows the maximum resolution (to the right of the decimal point) allowed by Special Function 12.

Display	12.0SP Maximum Resolution	12.1SP Less Resolution on NOISE FIGURE	12.2SP Less Resolution on GAIN
NOISE FIGURE			
F dB	dd.dd	dd.d	
F	d.ddd	d.dd	
Y dB	dd.dd	dd.d	
Y	d.ddd	d.dd	
Te K	ddd.d	ddd	
INSERTION GAIN			
dB	dd.dd		dd.d

Procedure To select the desired display resolution, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code (HP-IB)	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Maximum resolution for both INSERTION GAIN and NOISE FIGURE displays	12.0	X0 or 12.0SP	N	Y	N	On	On
Less resolution on NOISE FIGURE display	12.1	X1 or 12.1 SP	N	Y	N	Off	Off
Less resolution on INSERTION GAIN display	12.2	X2 or 12.2SP	N	Y	N	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

Display Resolution (cont'd)

(Special Function 12)

Example To have less resolution in the NOISE FIGURE display:

LOCAL (keystrokes)	Code: 1 2 . 1 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	X1

Program Codes

HP-IB

For HP-IB program codes, refer to Procedure above.

Indications The NOISE FIGURE and INSERTION GAIN displays reflect the resolution corresponding to the selected Special Function.

Comments Special Function 12 also affects the resolution of the HP-IB output. The HP-IB output always has one digit more of resolution than the front panel displays.

Related Sections

Display Units Selection
Special Functions

Display Units Selection
(Special Function 10)

Description

Noise measurements can be output in the following display units:

a. noise figure in dB (F dB)
b. noise figure as a ratio (F)
c. Y factor in dB (Y dB)
d. Y factor as a ratio (Y)
e. equivalent input noise temperature in kelvins (Te K)

Procedure

To select a NOISE FIGURE display unit, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
F dB	10.0	N0 or 10.0SP	N	Y	Y	On	On
F	10.1	N1 or 10.1SP	N	Y	Y	Off	Off
Y dB	10.2	N2 or 10.2SP	N	Y	Y	Off	Off
Y	10.3	N3 or 10.3SP	N	Y	Y	Off	Off
Te K	10.4	N4 or 10.4SP	N	Y	Y	Off	Off

Table format is explained in the Special Functions Detailed Operating Instructions.

Example

To have measured noise displayed as Y factor in dB:

LOCAL (keystrokes)	Code: 1 0 . 2 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	N2

Program Codes HP-IB

For HP-IB program codes, refer to Procedure above.

Indications

The selected display unit appears on the right side of the NOISE FIGURE display. Special Function 10 has no effect on the INSERTION GAIN display.

Comments

32 dB is the maximum value that can be displayed in units of F dB. Readings above this value cause the NOISE FIGURE display to show two dashes " — — ". The smoothed number is the value that is checked against 32 dB. Therefore, if the display is flashing between approximately 30 dB and " — — ", increasing the smoothing may provide a stable display if the noise figure is less than 32 dB.

The maximum value allowable for Te K is 9999K (noise figure of 15.5 dB).

Display Units Selection (cont'd)
(Special Function 10)

Comments (cont'd)

The maximum value allowable for F is 9999 (noise figure of approximately 40 dB).

Equations for the display units are as follows:

$$F = \frac{\text{noise power added by DUT + noise power out due to source}}{\text{noise power out due to source}}$$

(when the source is at 290K)

$$F(dB) = 10 \log F$$

$$Y = \frac{\text{power measured with noise source On}}{\text{power measured with noise source Off}}$$

$$Y(dB) = 10 \log Y$$

$$Te = \frac{T_{hot} - Y \times T_{cold}}{Y - 1}$$

where: T_{hot} is the equivalent temperature of the noise source when it is On
and
T_{cold} is the equivalent temperature of the noise source when it is Off.

Related Sections

Display Resolution
Noise Figure (Uncorrected) and Noise Figure and Gain (Corrected)
Smoothing
Special Functions

ENR Table Entry

Description

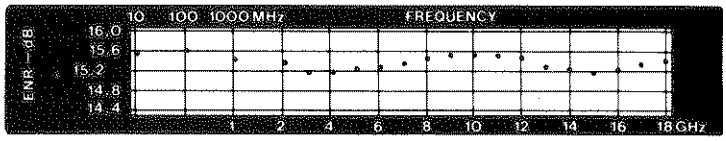
The ENR key allows display and entry of the noise source's calibration factors. This information is used to improve the accuracy of the noise figure and gain calculations made by the Noise Figure Meter. The information entered is the actual Excess Noise Ratio (ENR) value at the specified frequency. All ENR noise sources have this calibration information available. In the case of the HP 346A, B and C Noise Sources, a separate printout is supplied, and a graph or table is printed on its side showing the ENR versus Frequency data. The frequency points shown on the printout and graph are the default frequency values displayed when the table is entered. The ENR table can hold a maximum of 27 frequency points. The valid frequency range for entries is from 10 MHz to 60 GHz. The valid power range for the ENR entries is from −6 to +17 dB.

HEWLETT PACKARD
CALIBRATION REPORT

MODEL 346B OPT 004 SER NO: 2037A01199
DATE: 01/21/82 TECHNICIAN: 10648

FREQ MHz	ENR dB	REFL ON MAG	REFL ON ANG	REFL OFF MAG	REFL OFF ANG
10	15.53	.032	-122.0	.035	-44.0
101	15.60	.028	164.9	.021	-14.7
1000	15.40	.036	29.5	.013	-140.0
2000	15.34	.039	-91.1	.022	4.7
3000	15.15	.030	152.5	.039	-128.7
4000	15.15	.008	-58.4	.034	128.3
5000	15.22	.046	169.0	.008	-154.5
6000	15.26	.053	77.4	.047	121.3
7000	15.33	.035	-34.8	.051	11.1
8000	15.44	.026	-130.6	.055	-109.1
9000	15.50	.021	-143.5	.041	158.7
10000	15.51	.043	173.0	.010	-157.1
11000	15.49	.032	88.0	.036	146.9
12000	15.45	.020	-32.2	.038	25.6
13000	15.27	.016	-54.3	.045	-76.4
14000	15.21	.051	-76.4	.026	-103.2
15000	15.14	.069	-136.6	.061	-112.1
16000	15.21	.064	140.8	.083	156.9
17000	15.31	.055	28.4	.079	37.2
18000	15.39	.053	-35.0	.072	-50.0

Example of Printout of ENR versus Frequency Data



Example of ENR Versus Frequency Data on HP 346B Noise Source

The instrument uses the noise source's calibration information starting at the first stored pair (frequency and ENR) and uses subsequent pairs until a lower frequency entry is encountered. When power is initially applied to the instrument, the ENR table contains the default value of 15.20 dB at all frequency points. After an ENR table is entered for a specific noise source, this information is retained in the continuous memory and need not be re-entered each time power is turned off and on.

ENR Table Entry (cont'd)

Procedure To enter a specific set of values into the ENR table perform the following steps:

NOTE

Entering the ENR table values is simply a matter of pressing the ENR key and entering the required data. The flashing annunciators indicate the type of data required. The following detailed procedure is only necessary if this is the first time the procedure has been performed.

a. Press the ENR key and verify that the MHz indicator in the left display is flashing.

NOTE

If an error is made while entering numeric data and the error is noted before ENTER is pressed the entry can be cleared by pressing the UNCORRECTED NOISE FIGURE key. However, once ENTER is pressed, the number cannot readily be changed. Therefore, be very careful when making entries. If an incorrect entry is made and ENTER has been pressed, two possible recovery procedures are recommended:

1. If it is early in the entry procedure, press FREQUENCY to terminate the ENR table entry mode and start over.

2. If several entries have been made, ignore the incorrect input and continue with the entry procedure. After all entries have been made, use the ENTER key to sequence to the incorrect entry and make the required change. Step h. explains the use of ENTER for this purpose.

b. The frequency displayed is either the first calibrated frequency for the HP 346B (default value) or the last entered frequency for this point. If this is the frequency at which ENR calibration data is to be entered, just press ENTER. To change the frequency, use the numeric keyboard to enter the desired value in MHz. Note that all frequency entries must be made in MHz. If a non-interger value is entered, the instrument converts the number to the nearest MHz.

c. After ENTER is pressed for the frequency entry, verify that the MHz indicator is on and not flashing and the indicated frequency value is correct. Verify the dB indicator in the INSERTION GAIN display is flashing.

d. The dB value displayed is either the default value (15.20 dB) or the last entered value for this point. If this is the value to be entered, just press ENTER. To change this value, use the numeric keyboard to enter the new value and then press ENTER. Up to two significant digits after the decimal point can be entered.

e. After ENTER is pressed for the dB value entry, verify that the dB indicator is on and not flashing and that the indicated dB value is correct. Verify the MHz indicator is flashing.

f. Repeat steps a through e until all of the required calibration information is entered.

NOTE

If less than a full table is entered, the frequency following the last entry to be used must be lower than that entry. When the ENR table is used by the instrument, only the values that are in ascending frequency order are used. The first descending frequency value terminates the table.

ENR Table Entry (cont'd)

Procedure (cont'd)

g. After all required entries are complete, press FREQUENCY. The instrument exits the ENR table entry mode and returns to the measurement that was active when the ENR key was pressed.

h. Press the ENR key to reinitiate the ENR table entry mode. Verify that the calibration data is correct by pressing the ENTER key to cycle through the ENR table. Each time the ENTER key is pressed, the table is alternately stepped to the following frequency or dB point in the table. Holding the ENTER key down causes the table entries to be automatically displayed in sequential order. With the ENTER key held down, each frequency and dB entry is displayed for approximately one second. Releasing the key stops the table at the displayed point. If required, changes can be made to the displayed data. Note that the displays cannot be sequenced back. Therefore, if a known error exists, release the ENTER key one or two entries prior to the one that must be changed. Then, single step the table using the ENTER key until the incorrect information is displayed. Make the necessary correction and then check the rest of the table as explained previously.

Program Code

HP-IB

The HP-IB code to enable ENR table entry is NR.

Comments

The ENR table is used during both UNCORRECTED NOISE FIGURE measurements and CORRECTED NOISE FIGURE AND GAIN measurements.

The specific ENR vs. frequency data that is used is determined by the stimulus frequency and the measurement mode that has been selected. Refer to Measurement Modes 1.0 through 1.4 Detailed Operating Instructions for additional information.

PRESET has no effect on data stored in the ENR table.

Related Sections

Measurement Modes 1.0 through 1.4
Spot ENR, T_{hot}, and T_{cold}

Error Messages and Recovery

Description

The instrument generates error messages to indicate operating problems, incorrect keyboard entries, or service-related problems. The error message is cleared when the error condition is removed. The error messages are grouped by error code as follows:

Error 10 through Error 49. These are operating and entry errors which indicate that not all conditions have been met to assure a calibrated measurement, or that an invalid keyboard or HP-IB entry has been made. Operating errors can usually be cleared by using the front panel controls, changing the equipment setup, or correcting the HP-IB code. Entry errors require that a new keyboard entry or function selection be made. A number of errors in this group may represent instrument malfunctions. The operator should try to clear the error condition using the corrective actions shown in the table below before referring the unit for service.

Error 50 through Error 80. These are service errors which provide service-related information. Service errors are discussed in the Service Section (VIII).

Errors may also be classified as volatile or nonvolatile.

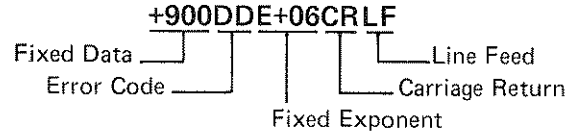
Nonvolatile errors typically occur when the instrument has received conflicting commands from the operator. The instrument stops making measurements and waits for the conflict to be resolved by the operator. An example of this type of conflict is selecting a corrected measurement when a calibration has not been performed. All hardware errors are also nonvolatile.

Volatile errors typically represent invalid entries of either frequency, special function codes, numerical data, or HP-IB characters. Volatile errors are cleared when a front panel key is pressed or when a serial poll is performed over the HP-IB. Unlike nonvolatile errors, after a serial poll has been performed, it is not possible to determine the error code of a volatile error that may have generated the Require Service message. Upon clearing a volatile error, the invalid entry is ignored by the instrument and measurements resume as if the entry was never received.

HP-IB Output Format

HP-IB

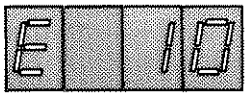
The HP-IB output format for errors is:



For example, Error 10 is output to the HP-IB as +90010E+06CRLF. This format differs from normal data outputs since normal data outputs will never exceed 1 x 10^5. Once an error has been input to the computing controller, the error code is simply derived by subtracting 9 x 10^{10} from the input number, and then dividing the result by 1 000 000.

Error Displays

There are three types of error displays. All three use the format shown above to output the error message to the HP-IB. The following examples illustrate each type:



The display above shows the general error display format. E means error while the number is the error code.

Error Messages and Recovery (cont'd)

Error Displays (cont'd)

This display indicates that a measurement overflow has occurred or that the measured noise figure exceeds 32 dB. This display is output to the HP-IB as E99 using the HP-IB output format above.

The display above indicates that the data is not ready. For example, this display occurs during a frequency calibration of the instrument. This display is output to the HP-IB as a special reserved number (90000E+06CRLF).

Error Messages

The table below describes all operating and entry errors. The error code, message, and the action typically required to remove the error-causing condition are given. Additional information pertaining to particular errors is also given.

Error Code	Volatile (V) or Nonvolatile (NV)	Message	Recommended Action/Comments
Hardware Error			
General Remedy: Press PRESET and check that input signal is within the specified amplitude and frequency range.			
10	NV	A/D conversion failed.	Refer to Service-Related Errors in Section VIII, Service.
11	NV	A/D converter overflow.	Set IF and RF attenuators to autorange (Special Functions 70.0 and 60.0). If error persists, refer to Service-Related Errors in Section VIII, Service. Also check for proper operation of the Noise Source.
12	NV	Input overflow.	Set RF attenuators to autorange (Special Function 60.0). If error persists, refer to Service-Related Errors in Section VIII, Service.
13	NV	IF attenuator calibration failed.	Check that IF attenuator calibration (Special Function 33.0) was properly executed by operator. If error persists, refer to Service-Related Errors in Section VIII, Service.
14	NV	Proper IF or RF attenuators cannot be selected.	Refer to Service-Related Errors in Section VIII, Service.
18	NV	Frequency calibration failed.	Refer to Service-Related Errors in Section VIII, Service.

Error Messages and Recovery (cont'd)

Error Messages (cont'd)

Error Code	Volatile (V) or Nonvolatile (NV)	Message	Recommended Action/Comments
Not Properly Calibrated For Corrected Measurement			
General Remedy: Repeat calibration.			
20	NV	Not calibrated.	Perform calibration prior to selecting CORRECTED NOISE FIGURE AND GAIN measurement.
21	NV	Current frequency is out of calibrated range.	Select frequency within calibrated range or calibrate over a new frequency range.
22	NV	Current RF attenuation not calibrated.	Select appropriate input gain calibration range (Special Function 32).
23	NV	Not calibrated in the current measurement and sideband modes.	Perform calibration in current measurement and sideband modes.
24	NV	Not calibrated for the current IF (Measurement Modes 1.1 and 1.3).	Perform calibration. (Changing the IF requires recalibration.)
25	NV	Not calibrated for the current LO frequency (Measurement Mode 1.2).	Perform calibration. (Changing the LO frequency requires recalibration)
26	NV	Internal IF attenuators not calibrated.	Perform IF attenuator calibration (Special Function 33.0). Refer to the Calibration, IF Attenuators Detailed Operating Instruction.
27	NV	Overflow while calibrating.	Too much loss in calibration system. Check input gain calibration setting (Special Function 32). Check for proper Noise Source operation. Refer to comments.
Invalid Frequency Error			
General Remedy: Change frequency parameter and repeat measurement.			
30	V	Start frequency is greater than stop frequency during calibration or plot. Or, the lower limit is greater than the upper limit (noise or gain) during sweep.	Set start frequency (or lower limit) to a value less than the stop frequency (or upper limit).
31	V	Number of calibration points exceeds 81.	Reduce the number of calibration points. (Reduce calibration range or increase step size.)

Error Messages and Recovery (cont'd)

Error Messages (cont'd)

Error Code	Volatile (V) or Nonvolatile (NV)	Message	Recommended Action/Comments
Invalid Frequency Error (cont'd)			
32	V	LO frequency will be out range.	Change IF, START FREQ, STOP FREQ, or sideband selection so that LO does not tune through 0 MHz.
33	V	IF will be out of range.	Change START FREQ, STOP FREQ, or LO frequency so that the difference between the LO frequency and the start or stop frequency is greater than 10 MHz and less than 1500 MHz.
34	NV	Double sideband is not allowed in Measurement Mode 1.2	Use single sideband (Special Function 2.1 or 2.2) with Measurement Mode 1.2.
Entry Error			
General Remedy: Check and repeat entry.			
35	V	Entered value is out of range.	Re-enter new value.
36	V	Undefined special function.	Check, then re-enter correct special function code.
37	V	Cannot enter specified parameter.	Select proper function that allows entry of this parameter.
HP-IB Errors			
General Remedy: Check and repeat entry.			
40	V	Undefined HP-IB code.	Check, then re-enter correct HP-IB code.
41	V	Invalid HP-IB characters.	Check, then re-enter valid HP-IB characters.
42	NV	No external LO is connected when in controller mode (4.1SP).	Connect an external LO or select another control function (Special Function 4).
43	V	Codes received while in Talk Only Mode (4.2SP).	Only send codes when the instrument is addressed to listen.

Error Messages and Recovery (cont'd)

Error Messages (cont'd)

Error Code	Volatile (V) or Nonvolatile (NV)	Message	Recommended Action/Comments
		Service Errors	
50-79	NV	Service-related errors.	Refer to Service-Related Errors in Section VIII, Service.
80	NV	Continuous memory failure.	Refer to Comments below.

Comments

Error code E27 usually occurs because the noise figure of the measurement system is too high during the calibration of the third input gain setting. Consider the error code as only a warning, and that the ability of the instrument to make valid measurements is most likely not impaired. But, if error code E22 occurs during the actual measurement, do one of the following:

1. Decrease the instrument's smoothing factor and try to recalibrate.

2. The DUT probably has 30 dB or more of gain, causing the Noise Figure Meter to use the attenuator setting of the third calibration setting. Attach a 10 dB attenuator to the output of the DUT and use special functions 34.3, 34.4, and 34.1 to correct for the loss.

3. Add a preamp to the measurement system and recalibrate.

Error code E80 indicates a continuous memory failure. The instrument may not retain data when powered down. However, the ability of the instrument to make valid measurements may not be impaired. If E80 occurs, press PRESET and proceed. The occurrence of E80 implies that stored information such as the IF attenuator calibration was not retained. Therefore, error code E26 will appear. Perform an IF attenuator calibration (refer to the Calibration, IF Attenuators Detailed Operating Instruction). If E80 persists, service should be performed on the internal battery and related circuits. Refer to Service-Related Errors in Section VIII, Service.

Related Sections

Calibrate
Calibration, IF Attenuators
Calibration, Input Gain Selection
IF Attenuation Selection
Measurement Modes 1.1 through 1.4
Remote Operation, HP-IB
RF Attenuation Selection
Service-Related Errors, Section VIII
Special Functions

Fixed Frequency Increment

Description

The tuned frequency of the instrument can be changed by using a combination of the FREQ INCR, ▲, and ▼ keys. The FREQ INCR key is used to set the fixed increment size. The ▲ and ▼ keys step the fixed frequency up or down by the value of the current frequency increment. These keys provide a convenient method of controlling the fixed frequency of the instrument for applications such as locating the minimum noise figure of an amplifier.

The allowable range of values for a frequency increment is 1 to 1490 MHz for Measurement Modes 1.0 and 1.4, and 1 MHz to 60 GHz for Measurement Modes 1.1, 1.2, and 1.3. If an attempt is made to enter an illegal frequency increment, error code E35 is displayed and the entry is not made.

Procedure

To change the size of the frequency increment, press the FREQ INCR key, enter a value for frequency in MHz, and then press the ENTER key.

Use ▲ or ▼ to step the frequency up or down by the current frequency increment.

Front Panel Key	Program Code (HP-IB)	Stored in Continuous Memory	Can be Stored and Recalled	Preset (and HP-IB Clear) Conditions
FREQ INCR	FN	Y	Y	20 MHz
▲	UP	—	—	—
▼	DN	—	—	—

Table categories are explained in the Preset Conditions and Power-Up Sequence Detailed Operating Instruction.

Example

To set the frequency increment to 50 MHz:

LOCAL (keystrokes)	Function: FREQUENCY; Data: 5, 0; Function: ENTER
(HP-IB) (program codes)	FN50MZ (Code: FN; Data: 50; Function: MZ)

To decrease the tuned frequency by the current frequency increment:

LOCAL (keystrokes)	Function: ▼
(HP-IB) (program codes)	DN

Fixed Frequency Increment (cont'd)

Example (cont'd)

Holding either the ▲ or ▼ key down causes the frequency to step continuously. However, the frequency is slower to change when stepped downward.

Program Codes

HP-IB

In addition to the HP-IB program codes given in Procedure above, HZ and MZ are the program codes for Hz and MHz, respectively.

Indications

The currently programmed frequency increment is displayed in the left display for as long as the FREQ INCR key is depressed. After FREQ INCR is pressed, the new frequency increment data can be entered. This data is displayed in the left display until the ENTER key is pressed. The function is then implemented and the instrument returns to the last selected measurement.

When either ▲ or ▼ is pressed, the tuned frequency is changed in the selected direction. The new tuned frequency is displayed in the left display and the instrument continues with the selected measurement.

Comments

Front panel frequency increment values should be entered in integer MHz units. If a decimal MHz entry is made, the instrument rounds the entry to the nearest integer (0.5 MHz and above is rounded up).

The Hz unit, provided for HP-IB, is for programmer convenience. The instrument rounds all HP-IB tuned frequency inputs to the nearest MHz.

If ▲ or ▼ is pressed rapidly in succession, the left display updates the frequency each time the key is pressed. The noise measurement may be delayed (— — — — will appear in the NOISE FIGURE display), especially if smoothing is used.

Related Sections

Fixed Frequency Tuning
Measurement Modes 1.0 through 1.4
Preset Conditions and Power-Up Sequence

Fixed Frequency Tuning

Description

The FREQUENCY key is used to display the frequency to which the instrument is tuned and to enter a new fixed frequency value. The allowable frequency range is 10 to 1510 MHz in Measurement Modes 1.0 and 1.4, and 1 MHz to 60 GHz in Measurement Modes 1.1, 1.2, and 1.3.

The tuned fixed frequency of the instrument can also be changed by using a combination of the FREQ INCR key to set the increment size, and the ▲ and ▼ keys to step the fixed frequency in the selected direction.

The FREQUENCY key acts as a "clear entry" key. It clears entries in progress, returns the instrument to the last selected measurement with the left display showing the current tuned frequency, and halts the sweep if it is in progress.

Procedure

To display the current tuned frequency and enter a new tuned frequency, press FREQUENCY, enter the value of the new frequency in MHz, and press ENTER.

Front Panel Key	Program Code HP-IB	Stored in Continuous Memory	Can be Stored and Recalled	Preset (and HP-IB Clear) Conditions
FREQUENCY	FR	Y	Y	30 MHz

Table categories are explained in the Preset Conditions and Power-Up Sequence Detailed Operating Instruction.

Example

To tune the instrument to a new frequency of 100 MHz:

LOCAL (keystrokes)	Function: FREQUENCY — Data: 1 0 0 — Function: ENTER
HP-IB (program codes)	FR100MZ (Code: FR; Data: 100; Function: MZ)

Program Codes HP-IB

The HP-IB program code for FREQUENCY is FR. The program codes for Hz and MHz are HZ and MZ.

Indications

Pressing the FREQUENCY key clears an incomplete entry, displays the current tuned frequency, and enables the entry of a new tuned frequency. As the entry numbers are pressed, the specific numbers appear in the left display. When ENTER is pressed, the instrument is tuned to the specified frequency and the instrument continues to make the the last selected measurement.

Comments

Front panel frequency entries should be made in integer MHz units. If a decimal MHz entry is made, the instrument rounds the entry to the nearest integer (0.5 MHz and above is rounded up).

Fixed Frequency Tuning (cont'd)

Comments (cont'd)

The Hz unit, provided for HP-IB, is for programmer convenience. The instrument rounds all HP-IB tuned frequency inputs to the nearest MHz.

If no other prefix key has been pressed, any digits entered followed by ENTER will be interpreted as if the FREQUENCY key were the prefix.

Related Sections

Fixed Frequency Increment
Measurement Modes 1.0 through 1.4
Preset Conditions and Power-Up Sequence

Fixed IF or LO Frequency Selection
(Special Function 3)

Description

Special Function 3 displays and allows entry of the fixed IF and LO frequencies for the external mixer measurement modes.

Special Function 3.0 is used to display and enter the fixed IF for Measurement Modes 1.1 and 1.3. If no entry is made, the Noise Figure Meter uses the last entered value. The fixed IF value is ignored when the instrument is operated in Measurement Modes 1.0, 1.2, or 1.4. The allowable range of values for IF entries is 10 to 1510 MHz.

Special Function 3.1 is used to display and enter the fixed LO frequency for Measurement Modes 1.2 and 1.4. If no entry is made, the Noise Figure Meter uses the last entered value. If the instrument is operated in Measurement Modes 1.0, 1.1, or 1.3, the fixed LO frequency is ignored. The allowable range of values for LO frequency entries is 0 to 60 GHz.

Front panel frequency entries should be made in integer MHz units. If a decimal MHz entry is made, the instrument rounds the entry to the nearest integer (0.5 MHz and above are rounded up).

Procedure

To select a fixed IF or LO frequency, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key. Next, enter the appropriate value using the DATA keys and press ENTER.

Special Function		Program Code (HP-IB)	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Fixed IF (for modes 1.1 and 1.3)	3.0	IF or 3.0SP	N	Y	Y	NC	30 MHz
Fixed LO Frequency (for modes 1.2 and 1.4)	3.1	LF or 3.1SP	N	Y	Y	NC	10 000 MHz

Table categories are explained in the Special Functions Detailed Operating Instruction.

Fixed IF or LO Frequency Selection (cont'd)

(Special Function 3)

Example

To select a fixed IF of 70 MHz:

LOCAL (keystrokes)	Code: 3 . 0 — Function: • SPECIAL FUNCTION — Data: 7 0 — Function: ENTER
HP-IB (program codes)	IF70MZ — Function: IF — Data: 70 — Function: MZ

Program Codes

HP-IB

The HP-IB codes for Hz and MHz are HZ and MZ, respectively. For Special Function 3 program codes, refer to Procedure.

Indications

When Special Function 3.0 or 3.1 is selected, the left display shows the current IF or LO frequency. When a new frequency value is entered, it appears in the left display only for as long as the ENTER key is depressed. When the ENTER key is released, the left display returns to the display that was present when the special function was entered.

Comments

If error code E32 is displayed when attempting to enter a fixed LO frequency, the entered frequency is outside the range specified for the external LO. If the entered frequency was incorrect, re-enter the correct frequency. If the external LO frequencies are incorrect, they can be changed using either Special Function 42.3 or 42.4 (refer to the Programming an External LO Detailed Operating Instruction).

The Hz unit, provided for HP-IB, is for programmer convenience. The instrument rounds all HP-IB tuned frequency inputs to the nearest MHz.

Related Sections

Error Messages and Recovery
Measurement Modes 1.1 through 1.4
Programming an External LO
Special Functions

HP-IB Addresses

Noise Figure Meter and External LO (Special Function 40)

Description

HP-IB

The Noise Figure Meter has two HP-IB addresses. One is the address of the Noise Figure Meter when it is being used over the HP-IB. The second is the HP-IB address of an external local oscillator (LO) for use when the LO is being controlled by the Noise Figure Meter (that is, Special Function 4.1 is active and Measurement Mode 1.1, 1.2, 1.3, or 1.4 is selected).

The HP-IB addresses for the Noise Figure Meter and an external LO can be displayed and changed by Special Function 40. The selected address is displayed in decimal in the left display. The decimal value of the factory set addresses are:

a. Noise Figure Meter = 8

b. External LO = 19

A list of allowable addresses for the Noise Figure Meter and an external LO is given below.

ASCII Address Codes		Decimal Equivalents
LISTEN	TALK	
SP	@	00
!	A	01
"	B	02
#	C	03
$	D	04
%	E	05
&	F	06
'	G	07
(	H	08
)	I	09
*	J	10
+	K	11
,	L	12
-	M	13
.	N	14
/	O	15
0	P	16
1	Q	17
2	R	18
3	S	19
4	T	20
5	U	21
6	V	22
7	W	23
8	X	24
9	Y	25
:	Z	26
;	[	27
<	\	28
=	]	29
>	^	30

HP-IB Addresses (cont'd)

Noise Figure Meter and External LO (Special Function 40)

Procedure

To display the current HP-IB address of either the the Noise Figure Meter or an external LO, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

To change an HP-IB address, first display the current address. Then, enter a decimal number from 0 to 30 for the new address and press the ENTER key.

Special Function		Program Code (HP-IB)	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Descripton	Code						
Noise Figure Meter HP-IB Address	40.0	None	N	Y	N	NC	NC
External LO HP-IB Address	40.1	EA or 40.1SP	N	Y	N	NC	NC

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example

To display the external LO address and change it to 20:

LOCAL (keystrokes)	Code				Function	Data		Function		
	4	0	.	1	• SPECIAL FUNCTION	2	0	ENTER		
(HP-IB) (program codes)	EA20EN Code — Function Data									

Program Codes (HP-IB)

The program code to display the HP-IB address of the external LO is EA. The external LO address can be changed by entering a decimal number from 0 to 30 and then EN (the program code for ENTER). The HP-IB address of the Noise Figure Meter cannot be read or changed over the HP-IB.

Indications

The HP-IB address of the corresponding special function appears in the left display when either Special Function 40.0 or 40.1 is selected. When an HP-IB address is changed, the new address appears in the left display for as long as the ENTER key is depressed. When the ENTER key is released, the instrument returns to the last selected measurement.

Comments

Do not set the Noise Figure Meter HP-IB address equal to the external LO HP-IB address.

Related Sections

Controller Capability of the Noise Figure Meter
Remote Operation, HP-IB
Special Functions

IF Attenuation Selection

(Special Functions 70, 71, and 72)

Description

IF attenuation selection, display, and hold are available in all measurement modes. It should be noted, however, that only the hold capability (Special Function 72.0) is normally used by most operators. The hold is required during manual measurements (refer to the Manual Measurements Detailed Operating Instruction for additional information). The selection and display of specific IF attenuation settings are more likely to be used during adjustment procedures, performance tests, or troubleshooting procedures. In some specialized applications these capabilities can be helpful, but care must be exercised when using them. It is possible to introduce some very subtle errors in the measurements that the Noise Figure Meter may not be able to guard against. Additional information on how to use and interpret these Special Functions is contained in Section VIII, Service.

Procedure

To select a specific IF attenuation setting, display, or hold, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code (HP-IB)	Lights Special Function Key	Stored in Continuous	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
IF Attenuation Selection							
Auto	70.0	I0 or 70.0SP	N	N	N	On	On
0 dB	70.1	I1 or 70.1SP	Y	N	N	Off	Off
5 dB	70.2	I2 or 70.2SP	Y	N	N	Off	Off
10 dB	70.3	I3 or 70.3SP	Y	N	N	Off	Off
15 dB	70.4	I4 or 70.4SP	Y	N	N	Off	Off
20 dB	70.5	I5 or 70.5SP	Y	N	N	Off	Off
25 dB	70.6	I6 or 70.6SP	Y	N	N	Off	Off
30 dB	70.7	I7 or 70.7SP	Y	N	N	Off	Off
35 dB	70.8	I8 or 70.8SP	Y	N	N	Off	Off
Display IF Attenuator Settings							
Display IF Attenuator	71.0	SI or 71.0SP	N	N	N	Off	Off
IF Attenuator Hold							
IF Attenuator Hold	72.0	IH or 72.0SP	Y	N	N	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

IF Attenuation Selection (cont'd)

(Special Functions 70, 71, and 72)

Example

To select the IF attenuator hold function:

LOCAL (keystrokes)	Code: 7 2 . 0 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	IH

Program Codes

HP-IB

For HP-IB codes, refer to Procedure.

Indications

When Special Function 71 is implemented, three digits appear in the left display. The digits are either "1" (yes) or "0" (no) to indicate whether or not the corresponding attenuator is switched into the 20 MHz IF Assembly circuits (see Service Sheets 3 and 4 in Section VIII, Service). The first (most significant) digit represents 20 dB. The second digit represents 10 dB. The third (least significant) digit represents 5 dB. To obtain the IF attenuator setting, add the attenuation that is represented by each digit. For example, a display of "1 0 1" indicates an IF attenuator setting of 25 dB.

Comments

If any of the 60 or 70 series of Special Functions (except 60.0 and 70.0) are active, the calibration sequence does not override them. Therefore, to calibrate on one range only, use any of these Special Functions except 60.0 or 70.0. It is also true that if any of these Special Functions are inadvertently active, the calibration sequence will not cover the expected gain range.

Related Sections

Calibrate
Manual Measurements
RF Attenuation Selection
Special Functions

Loss Compensation
(Special Function 34)

Description Special Function 34 corrects for loss between the noise source and the device under test (DUT), and the DUT and the Noise Figure Meter. The loss in dB and the temperature of the loss must be entered prior to enabling loss compensation (Special Function 34.1) or else the default values of 0 dB and 0K are used.

The temperature of the loss is the ambient temperature. Therefore, both the loss before the DUT and the loss after the DUT are assumed to be at the same temperature. Only one temperature can be entered for both losses. The temperature of the loss can be entered in Kelvins, degrees Fahrenheit, or degrees Celsius. Temperature units are selected by Special Function 11.

The allowable range of loss in Kelvins is 0 to 9999. The allowable range of loss in dB is −100 to +100.

Procedure To display, enter, or enable loss compensation, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code (HP-IB)	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Turn loss compensation off.	34.0	L0 or 34.0SP	N	Y	N	On	On
Turn loss compensation on.	34.1	L1 or 34.1SP	Y	Y	N	Off	Off
Display and enter the amount of loss between the noise source and the DUT in dB.	34.2	LA or 34.2SP	N	Y	N	NC	0 dB
Display and enter the temperature of losses (units are determined by Special Function 11).	34.3	LT or 34.3SP	N	Y	N	NC	0K
Display and enter the amount of loss between the DUT and the Noise Figure Meter in dB.	34.4	LB or 34.3SP	N	Y	N	NC	0 dB

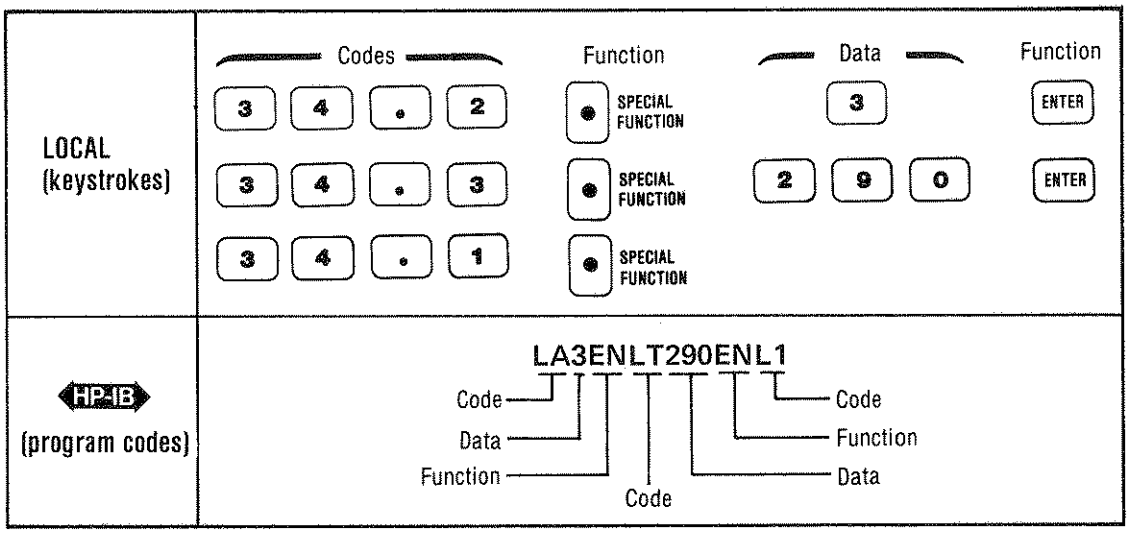
Table categories are explained in the Special Functions Detailed Operating Instruction.

Loss Compensation (cont'd)

(Special Function 34)

Example

To compensate for a loss of 3 dB between the noise source and the DUT at a temperature of 290K (assume Special Function 11.0 is active — temperature in K) and to enable the loss compensation function:



Program Codes HP-IB

For HP-IB codes, refer to Procedure above.

Indications

If Special Function 34.0 or 34.1 is selected, the left display returns to the previously selected display. The INSERTION GAIN and NOISE FIGURE displays are not affected by this function.

Comments

When a loss compensation entry is made in dB, the temperature of the loss should also be entered.

The Noise Figure Meter assumes that the loss was not present during calibration.

Related Sections

Special Functions
Temperature Units Selection

Manual Measurement Functions
(Special Functions 14 and 15)

Description

The manual measurement functions calibrate and measure noise figure using a thermal (hot/cold) noise source. They also can be used to display either the current measurement or the result of the manual measurement. Manual measurement functions are used for fixed frequency measurements only.

Three general requirements must be understood when performing manual measurements:

1. A stable reading must be stored in the Noise Figure Meter's memory prior to disconnecting the noise source. This stable reading can be obtained by either activating the next manual measurement special function or by using the Trigger Selection Special Function (30). Since activating the next special function requires fewer keystrokes, that is the method used in the example shown in this instruction.

2. The device under test (DUT) must first be connected to the measurement system and the proper RF attenuation level determined. The RF attenuators must then be held fixed (Special Function 62) for the entire manual measurement.

3. The IF attenuators must be held fixed (Special Function 72) during the two measurement readings (noise source off and on) and again during the two calibration readings (noise source off and on). However, the IF attenuators must be allowed to autorange when switching between calibration and measurements, and vice versa.

Procedure

To measure, calibrate, or display manual measurements, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Make cold measurements (source off).	14.1	MC or 14.1SP	N	Y	Y	Off	Off
Make hot measurements (source on).	14.2	MH or 14.2SP	N	Y	Y	Off	Off
Perform cold calibration (source off).	14.3	CC or 14.3SP	N	Y	Y	Off	Off
Perform hot calibration (source on).	14.4	CH or 14.4SP	N	Y	Y	Off	Off
Normal display mode.	15.0	P0 or 15.0SP	N	N	Y	On	On
Display manual measurement results	15.1	P1 or 15.1SP	Y	N	Y	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

Manual Measurement Functions (cont'd)

(Special Functions 14 and 15)

Example

The following example is a general procedure for making manual measurements. It may be necessary to determine the requirements of a specific application and make the necessary changes to obtain the best measurement results. For example, it is possible to make manual measurements using an external controller. Additional information on this method is contained in the Comments section of this instruction.

Find and Hold the RF Attenuation

a. Enter the required parameters for the Measurement Mode that is going to be used.

b. Connect the hot noise source to the DUT input. Connect the DUT output to the measurement system setup.

c. Press 1 4 . 2 SPECIAL FUNCTION to obtain the noise power.

d. Press 6 2 . 0 SPECIAL FUNCTION to hold the RF attenuation setting. The RF attenuation is held at this setting for the entire measurement.

Calibrate

e. Remove the DUT and connect the hot noise source to the measurement system setup.

f. Press 1 4 . 4 SPECIAL FUNCTION to calibrate the measurement system for the hot noise source.

g. Press 7 2 . 0 SPECIAL FUNCTION to hold the IF attenuation setting.

h. Press 1 4 . 3 SPECIAL FUNCTION to store the hot noise source calibration reading and to select the cold noise source calibration. Note that while the cold noise source calibration is selected, the results are not stored until after the cold noise source is connected and Special Function 14.2 is activated in step j.

i. Remove the hot noise source and connect the cold noise source to the measurement system setup.

j. Press 1 4 . 2 SPECIAL FUNCTION to select the hot noise source measurement and to store the cold noise source calibration reading.

Measure, then Calculate and Display Noise Figure

k. Connect the hot noise source to the DUT and the DUT to the measurement system setup.

l. Press 7 0 . 0 SPECIAL FUNCTION to allow the IF attenuators to autorange.

m. Press 7 2 . 0 SPECIAL FUNCTION to hold the IF attenuation fixed at the new value.

n. Press 1 4 . 1 SPECIAL FUNCTION to select the cold noise source measurement and to store the hot noise measurement reading.

o. Disconnect the hot noise source from the DUT and connect the cold noise source to the DUT.

Manual Measurement Functions (cont'd)

(Special Functions 14 and 15)

Example (cont'd)

p. Press 1 5 . 1 SPECIAL FUNCTION to calculate and display the manual measurement noise figure result. Verify that the LED in the SPECIAL FUNCTION key lights when this special function is activated. The Noise Figure Meter continues to make cold noise source measurements and update the display.

NOTE

The calibration data remains stored. Therefore, if another DUT is to be tested immediately, it is only necessary to press 1 4 . 2 SPECIAL FUNCTION and repeat steps k through p. To exit manual measurements and return to the normal display, press 1 5 . 0 SPECIAL FUNCTION and then press UNCORRECTED NOISE FIGURE.

Program Codes

HP-IB

For HP-IB codes, refer to Procedure above.

Indications

When Special Functions 15.0 and any 14.N are selected, no unit annunciators are lit in the NOISE FIGURE display. The number displayed is the power into the detector in mW.

Comments

When Special Function 15.1 is selected, UNCORRECTED NOISE FIGURE, CORRECTED NOISE FIGURE AND GAIN, or any noise figure display unit (Special Function 10) can be selected.

Another way to ensure that stable readings are stored in the Noise Figure Meter's memory during Manual Measurements is to use the Trigger Hold Special Function (30.1) and Trigger Execute Special Function (30.2). In this type of operation only one measurement is taken and stored. Therefore, it is not critical if the equipment is disconnected prior to switching Manual Measurement Special Functions.

Related Sections

IF Attenuation Selection
RF Attenuation Selection
Special Functions
Trigger Selection

Measurement Modes
(Special Function 1)

Description The Noise Figure Meter has five Measurement Modes available. Each Measurement Mode, 1.0 through 1.4, is described individually in a separate Detailed Operating Instruction. This discussion covers the capabilities and differences of the individual modes. The following table lists the modes and shows their status in different instrument operations.

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Measurement Mode 1.0—10 to 1500 MHz	1.0	E0	N	Y	Y	On	On
Measurement Mode 1.1—variable frequency external LO; fixed IF	1.1	E1	N	Y	Y	Off	Off
Measurement Mode 1.2—fixed frequency external LO; variable IF	1.2	E2	N	Y	Y	Off	Off
Measurement Mode 1.3—variable frequency external LO; fixed IF; mixer in DUT	1.3	E3	N	Y	Y	Off	Off
Measurement Mode 1.4—fixed frequency external LO; variable IF; mixer in DUT	1.4	E4	N	Y	Y	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

The five Measurement Modes can be divided into the following three subsets:

a. Measurement Mode 1.0 is a stand alone mode with no external mixer or LO required and no frequency conversion in the device under test. The frequency range in this mode is 10 to 1500 MHz.

b. Measurement Modes 1.1 and 1.3 both require a variable frequency LO and an external mixer. In either of these modes the Noise Figure Meter can be used to control the external LO and vary the LO frequency as directed by the external LO program (Special Function 41 or 42). Both modes down convert the measurement frequency to the 10 to 1500 MHz range of the Noise Figure Meter. Measurement Mode 1.1 has no down conversion in the DUT (for example, an amplifier or transistor). Measurement Mode 1.3 does down convert in the DUT (for example, a mixer or receiver).

c. Measurement Modes 1.2 and 1.4 both require a fixed frequency LO and a variable IF. As stated for the previous subset, Measurement Mode 1.2 has frequency conversion in the measurement system but not in the DUT and Measurement Mode 1.4 has frequency conversion in the DUT. Mode 1.2 must be a single sideband measurement. Additional information on sideband selection is covered later in this instruction and in the Sideband Selection Detailed Operating Instruction.

The calibration and measurement setups and procedures are illustrated and specific examples are provided in the Detailed Operating Instructions for Measurement Modes 1.0 through 1.4.

Measurement Modes (cont'd)

(Special Function 1)

Signal Comparison

In the following discussion, signals present at different points in the measurement system are compared for the different measurement modes. The following signal points are covered:

a. The output of the noise source (for example the HP 346B).

b. The output of the external LO.

c. The measurement bandwidth of the Noise Figure Meter as seen looking back into the mixer (translated to the frequency range of the external LO).

d. The input to the Noise Figure Meter.

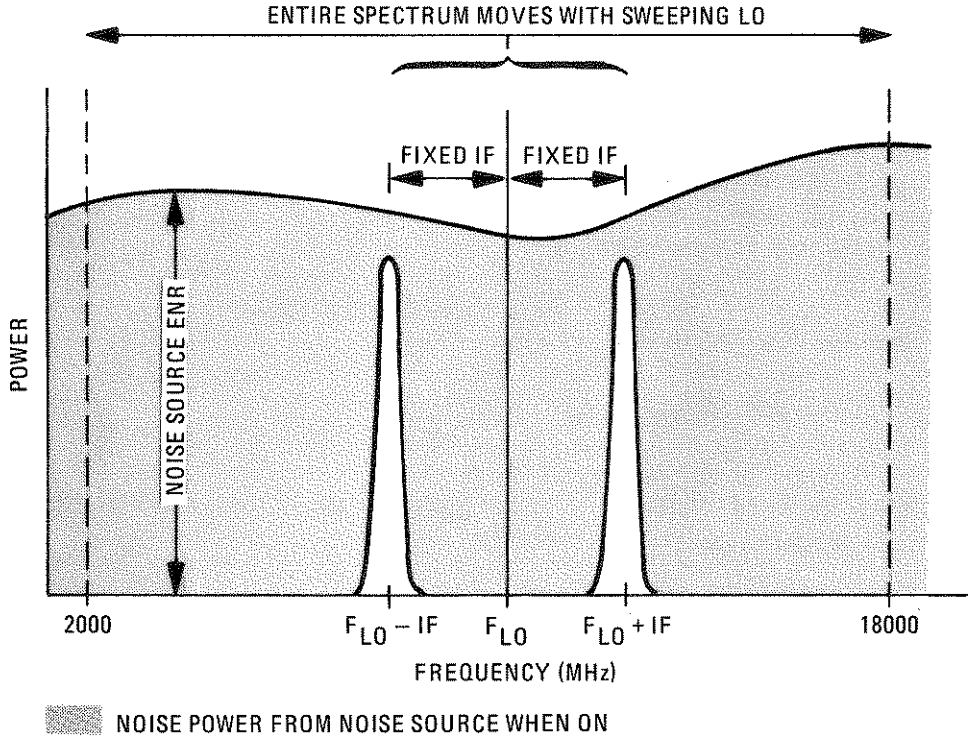
The noise source output is the same for all modes. For a noise source with a nominal Excess Noise Ratio (ENR) of 15.2 dB, the output is broadband random noise varying between approximately −158.8 dBm/Hz when on (hot) and −174 dBm/Hz when off (cold). The ENR of the noise source varies slightly over the frequency range of 10 to 18000 MHz. This variation in power level is compensated for in the Noise Figure Meter using the specific information entered into the ENR table. Refer to the ENR Table Entry Detailed Operating Instruction for additional information on the ENR table.

There is no external LO used in Measurement Mode 1.0. In Measurement Modes 1.1 and 1.3, the external LO can be swept over any range in the 2 to 18 GHz range using the existing external LO programs. The Noise Figure Meter's programs can be modified to sweep the LO up to 60 GHz. In Measurement Modes 1.2 and 1.4, the fixed LO frequency can be set to any point within the 10 MHz to 60 GHz range. The limiting factors within this range are the frequency ranges of the external LO and the noise source.

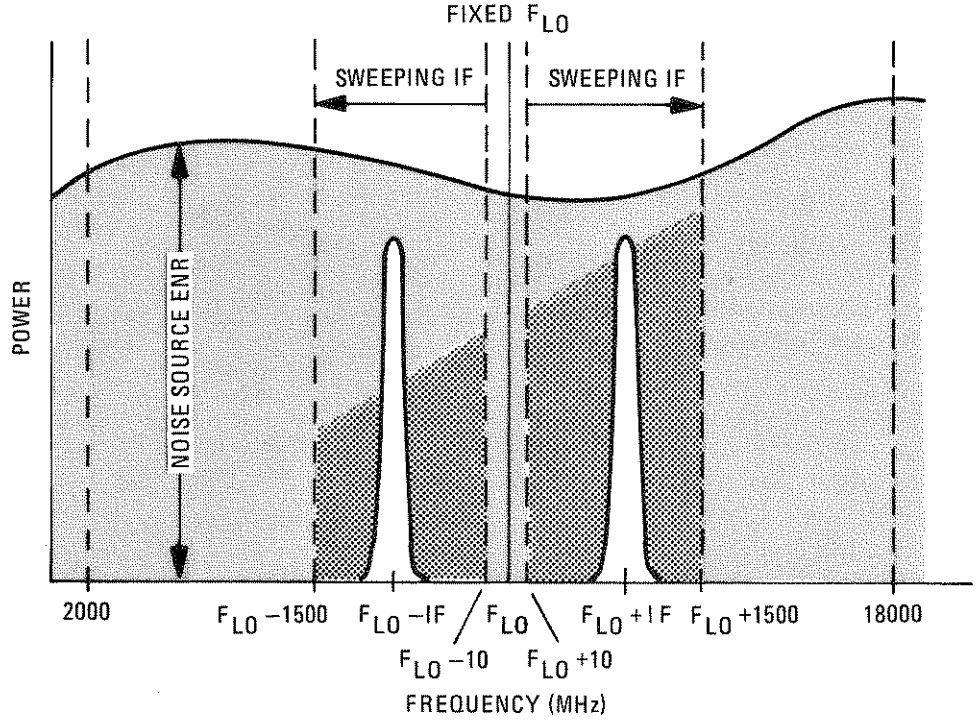
There is no mixer used in Measurement Mode 1.0. Looking back into the mixer in Measurement Modes 1.1 and 1.3, the Noise Figure Meter passband translates into two sidebands. Each sideband is separated from the LO frequency by a fixed IF (the receiving frequency of the Noise Figure Meter). As the LO frequency sweeps, the sidebands move with it. The frequency can be increased or decreased within the allowable frequency range. In Measurement Modes 1.2 and 1.4 the LO frequency is held fixed. As the variable IF sweeps, the sidebands move away from the LO frequency in opposite directions for an increasing IF sweep and toward the LO frequency for a decreasing IF sweep. Examples of both a fixed IF and a variable LO, and a variable IF and fixed LO are shown in the Noise Figure Meter Measurement Passband figure.

The Noise Figure Meter's input frequency range is 10 to 1500 MHz. In Measurement Mode 1.0 a swept measurement can sweep the Noise Figure Meter's 4 MHz passband over the 10 to 1500 MHz range. In Modes 1.1 and 1.3, the IF is fixed and the LO frequency is swept within the frequency ranges previously explained. In Modes 1.2 and 1.4, the LO frequency is fixed and the IF is swept across the 10 to 1500 MHz range. In Modes 1.1, 1.3, and 1.4 (because of the frequency conversion) either upper, lower, or both sidebands can be accepted by the Noise Figure Meter. However, in Mode 1.2, a double sideband measurement cannot be made (the Noise Figure Meter will display error E34). In this mode, a double sideband measurement is meaningless because the average measurement frequency is the LO frequency and it does not change as the IF is swept.

For Measurement Modes 1.1 and 1.3:



For Measurement Modes 1.2 and 1.4:



Noise Figure Meter Measurement Passband

Measurement Modes (cont'd)

(Special Function 1)

Indications

The frequencies displayed in the left display for various measurement conditions are shown in the following table. The displayed frequency depends upon the measurement mode used and the sideband selected (Special Function 2). In Measurement Mode 1.0, no external conversion is performed so the left display represents the measurement signal (F_{signal}). In Measurement Modes 1.1, 1.2, 1.3, and 1.4 conversion is performed, thus creating an external IF. The Noise Figure Meter is tuned to this IF while the external local oscillator is tuned to F_{LO}.

Noise Figure Meter Left Display

Selected Sideband	Measurement Mode				
	1.0	1.1	1.2	1.3	1.4
Double Sideband (2.0SP)	F_{signal}	F_{LO}	not allowed	F_{LO}	IF
Lower Single Sideband (2.1SP)	F_{signal}	$F_{LO} - IF$	$F_{LO} - IF$	$F_{LO} - IF$	IF
Upper Single Sideband (2.2SP)	F_{signal}	$F_{LO} + IF$	$F_{LO} + IF$	$F_{LO} + IF$	IF

Measurement Mode and Sideband Selection

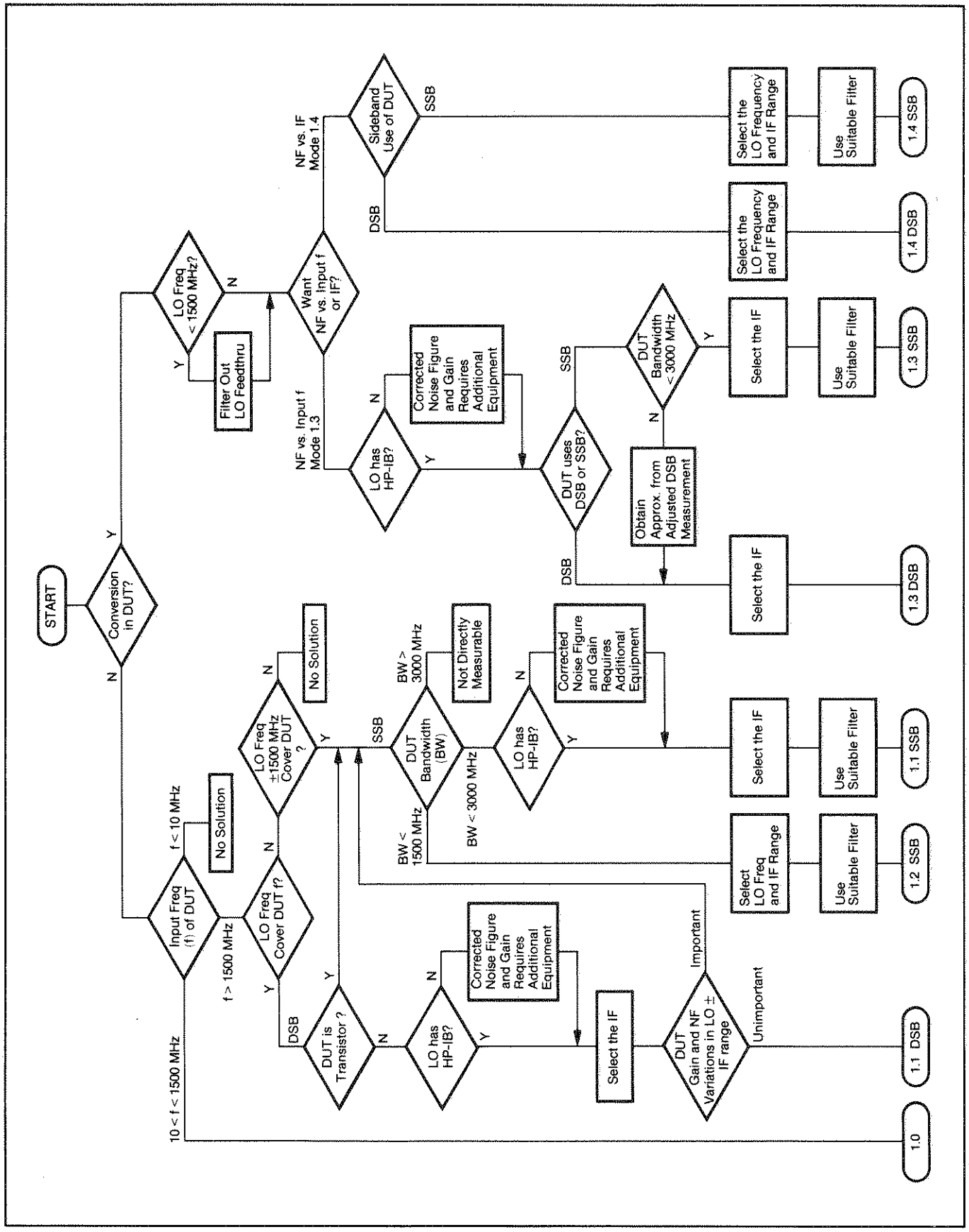
Prior to making any measurement, the Measurement Mode and sideband operation that are best suited to that specific measurement must be chosen.

The Measurement Mode and Sideband Selection Flowchart provides a means of determining which Measurement Mode will best suit a specific application and which type of sideband operation will give the best results.

Each of the Detailed Operating Instructions for Measurement Modes 1.0 through 1.4 has valid examples of the type of measurements that are made in each mode. Apply the flowchart instructions to each Measurement Mode example to illustrate the decision-making process for selecting that mode.

Related Sections

Calibrate
ENR Table Entry
Fixed IF or LO Frequency Selection
Measurement Modes 1.0 through 1.4
Sideband Selection



Measurement Mode and Sideband Selection Flowchart

Measurement Mode 1.0

(Special Function 1.0)

Description

Measurement Mode 1.0 provides direct noise figure and gain measurements in the frequency range of 10 to 1500 MHz. No external mixer or LO is required. All of the Measurement Modes can be set up to use many of the other capabilities of the Noise Figure Meter. For example, each mode can make either UNCORRECTED NOISE FIGURE or CORRECTED NOISE FIGURE AND GAIN measurements. In addition, the measurement results for each mode can be displayed on an oscilloscope. For an explanation and comparison of the five Measurement Modes and instructions on how to choose the appropriate Measurement Mode and sideband operation, refer to the Measurement Modes Detailed Operating Instruction.

Procedure

There are many possible measurement procedures. However, the following general procedure applies to all cases:

a. Set frequency parameters.

b. Calibrate in Mode 1.0 (this is only required for a CORRECTED NOISE FIGURE AND GAIN measurement).

c. Insert DUT and measure.

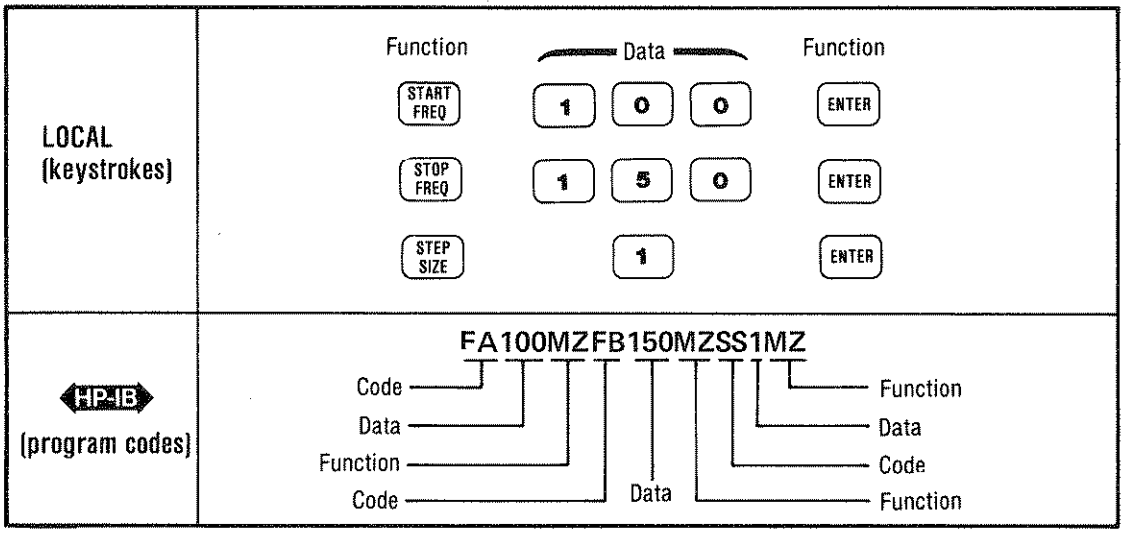
Example

To make a swept CORRECTED NOISE FIGURE AND GAIN measurement in the 100 to 150 MHz range in 1 MHz steps:

a. Press PRESET (or send HP-IB code PR) to establish initial conditions. This sets the the Noise Figure Meter to Measurement Mode 1.0.

b. Set the frequency parameters for both the calibration and measurement.

c. Enter actual ENR for the Noise Source, if this has not previously been done.

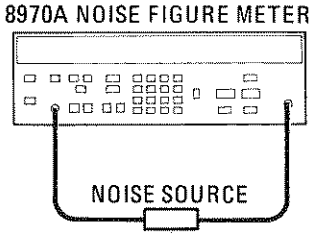


Measurement Mode 1.0 (cont'd)

(Special Function 1.0)

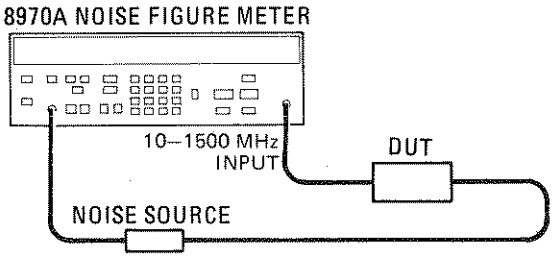
Example (cont'd)

d. To calibrate the Noise Figure Meter, set up the equipment as shown below.



e. Calibrate the equipment in Measurement Mode 1.0 by pressing CALIBRATE (or send HP-IB code CA). The Noise Figure Meter was set to Measurement Mode 1.0 when PRESET was pressed.

f. To make the measurement, set up the equipment as shown below.



g. Press CORRECTED NOISE FIGURE AND GAIN (or send HP-IB code M2).

h. Press SINGLE (or send HP-IB code W2). The Noise Figure Meter will sweep from 100 MHz to 150 MHz in 1 MHz steps and halt.

Program Codes

HP-IB

The HP-IB code for Measurement Mode 1.0 is E0 (or 1.0SP).

Indications

The left display shows each frequency at which a measurement is made. The INSERTION GAIN display shows the gain of the DUT at the displayed frequency. The NOISE FIGURE display shows the noise figure of the DUT at the displayed frequency.

Comments

Measurement Mode 1.0 is often referred to as an RF measurement. The other four Measurement Modes are often referred to as microwave measurements.

Related Sections

Calibrate
Measurement Modes
Special Functions

Measurement Mode 1.1

(Special Function 1.1)

Description

Measurement Mode 1.1 provides a means of controlling an external LO to obtain a measurement frequency higher than 1500 MHz. This mode allows for down conversion in the measurement system but not in the device under test (DUT). Although the signal measured at the Noise Figure Meter INPUT is always in the range of 10 to 1500 MHz, the Noise Figure Meter uses the Excess Noise Ratio (ENR) of the noise source at the measurement frequency. A typical DUT is an amplifier or transistor. An external LO and a mixer are required. All of the Measurement Modes can be set up to use many of the other capabilities of the Noise Figure Meter. For example, each mode can make either UNCORRECTED NOISE FIGURE or CORRECTED NOISE FIGURE AND GAIN measurements, plus the measurement results for each mode can be displayed on an oscilloscope. For an explanation and comparison of the five Measurement Modes and instructions on how to choose the appropriate Measurement Mode and sideband operation, refer to the Measurement Modes Detailed Operating Instruction.

The following minimum requirements are necessary for the Noise Figure Meter to act as a controller in Measurement Mode 1.1:

a. HP-IB cable connected between the Noise Figure Meter and the external LO.

b. Special Function 4.1 (external LO control) active. If Special Function 4.1 is selected, no other controller can communicate with the Noise Figure Meter. However, it is possible to perform this function using an external controller to control both the Noise Figure Meter and the external LO. For additional information refer to Comments at the end of this instruction.

c. The HP-IB address of the external LO must match the external LO address that is stored in the Noise Figure Meter. Use Special Function 40.1 (external LO HP-IB address) to display and change this address if necessary.

d. The correct external LO program must be active if the Noise Figure Meter is going to control the external LO. Use Special Function 41.0 for the HP 8350B Sweep Oscillator or Special Function 41.2 for the HP 8672A Synthesized Signal Generator or Special Function 41.3 for the HP 8673B Synthesized Signal Generator. Use Special Function 42 to define a new program for other external LOs.

Procedure

There are many possible measurement procedures. However, the following general procedure applies to all cases:

a. Verify that the minimum requirements specified in the description are satisfied.

b. Press 1 . 1 SPECIAL FUNCTION to set the Noise Figure Meter to Measurement Mode 1.1.

c. Set frequency parameters (including the fixed IF, Special Function 3.0).

d. Calibrate in Mode 1.1.

e. Insert DUT and measure.

Example

To make a swept double sideband CORRECTED NOISE FIGURE AND GAIN measurement in the 6 to 12 GHz range in 200 MHz steps with a fixed IF of 70 MHz:

Measurement Modes (cont'd)

(Special Function 1.1)

Example (cont'd)

NOTE

This example assumes that the Noise Figure Meter is acting as a controller and the minimum requirements specified in the description are satisfied. Since no external controller can be be used, no HP-IB codes are given in the example. Refer to Comments for a brief description of using an external controller when in Measurement Mode 1.1.

a. Press PRESET to establish initial conditions.

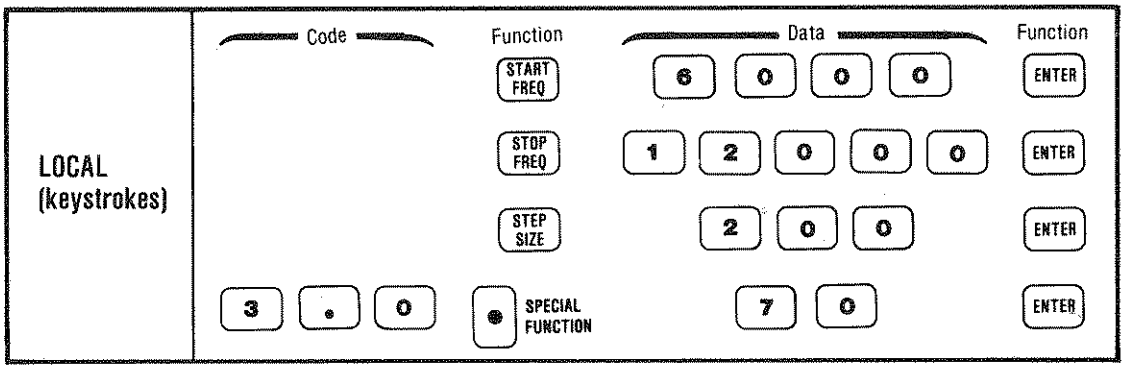
NOTE

Measurement Mode 1.1 must be activated prior to entering the frequency parameters to avoid error E35 (entered value is out of range).

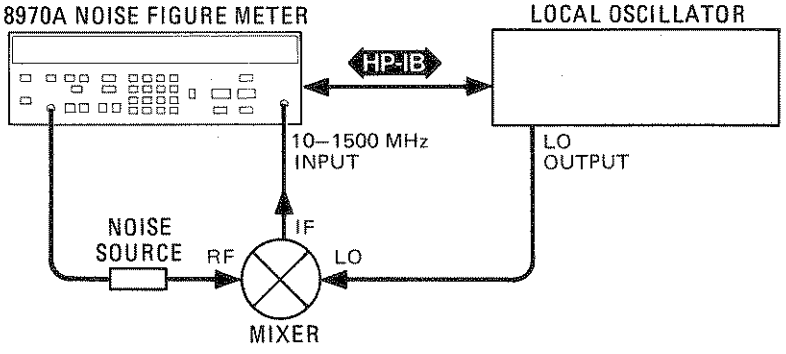
b. Press 1 . 1 SPECIAL FUNCTION to activate Measurement Mode 1.1.

c. Set the frequency parameters for both the calibration and measurement.

d. Enter actual ENR for the Noise Source, if this has not previously been done.



e. To calibrate the Noise Figure Meter, set up the equipment as shown below.



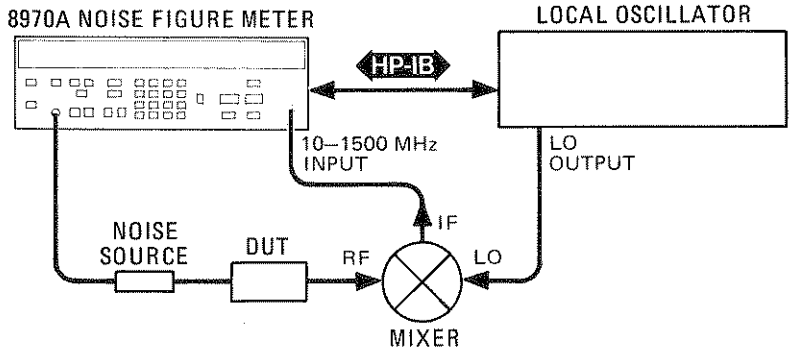
f. Calibrate the equipment in Measurement Mode 1.1 by pressing CALIBRATE.

Measurement Mode 1.1 (cont'd)

(Special Function 1.1)

Example (cont'd)

g. To make the measurement, set up the equipment as shown below.



h. Press CORRECTED NOISE FIGURE AND GAIN.

i. Press SINGLE. The Noise Figure Meter will sweep the external LO from 6 GHz to 12 GHz in 200 MHz steps and halt.

Program Codes

HP-IB

The HP-IB code for Measurement Mode 1.1 is E1 (or 1.1SP). Refer to Comments for additional information on using HP-IB program codes in Measurement Mode 1.1.

Indications

The left display shows each frequency at which a measurement is made and the EXT MIX annunciator lights. The INSERTION GAIN display shows the gain of the DUT at the displayed frequency. The NOISE FIGURE display shows the noise figure of the DUT at the displayed frequency.

Comments

An external controller can be used in place of the Noise Figure Meter to control the external LO and the Noise Figure Meter in Measurement Mode 1.1. The following general conditions must be observed when using an external controller:

a. Special Function 4.0 (normal talker and listener) must be active. Note that there is no HP-IB code for this special function.

b. Special Function 30.1 (trigger hold) must be active (HP-IB code is T1).

c. The correct measurement parameters (for example, Measurement Mode, frequencies, etc.) must be established. Refer to Table 3-9, Special Function to HP-IB Code Summary, and Table 3-10, Front Panel Keys to HP-IB Code Summary, for applicable HP-IB codes.

d. Perform a triggered calibration with the DUT out of the measurement system (refer to the Calibrate Detailed Operating Instruction)

e. Insert the DUT into the measurement system.

f. Set the Noise Figure Meter's SINGLE sweep on (HP-IB code is W2) or AUTO sweep on (HP-IB code is W1).

Measurement Mode 1.1 (cont'd)

(Special Function 1.1)

Comments (cont'd)

HP-IB

g. Set the external LO to the appropriate frequency. Refer to the LO's operating manual for the required HP-IB codes. Allow sufficient time for the output of the external LO to stabilize.

h. Trigger a measurement using the HP-IB code T2. Do not use the alternate HP-IB code 30.2SP for Special Function 30.2 as it will reset the sweep.

i. To determine when to step to a new frequency, read the noise figure results. This read operation cannot be completed until the new data is ready. It is also possible to write an SRQ interrupt routine on the Data Ready SRQ. Refer to Enabling the Service Request Condition, paragraph 3-29.

j. Continue to loop through steps g, h, and i. A method for determining when the measurements are complete must be programmed into the external controller. One method is to compare the frequency that is sent to the exernal LO with the stop frequency programmed into the Noise Figure Meter and terminate the program after the measurement in which they are equal.

Related Sections

Calibrate
Controller Capability of the Noise Figure Meter
Fixed IF or LO Frequency Selection
Measurement Modes
Sideband Selection
Special Functions
Trigger Selection

Measurement Mode 1.2

(Special Function 1.2)

Description

Measurement Mode 1.2 provides a means of using a fixed-frequency external LO with a variable IF in order to measure over a band of frequencies less than 1500 MHz wide. This mode allows for down conversion in the measurement sytem but not in the device under test (DUT). Single sideband operation and external filtering of the unwanted sideband are required. A typical DUT is an amplifier with a bandwidth of less than 1500 MHz. An external LO, an external filter and a mixer are required. Although the signal measured at the Noise Figure Meter INPUT is always in the range of 10 to 1500 MHz, the Noise Figure Meter uses the Excess Noise Ratio (ENR) of the noise source at the measurement frequency. All of the Measurement Modes can be set up to use many of the other capabilities of the Noise Figure Meter. For example, each mode can make either UNCORRECTED NOISE FIGURE or CORRECTED NOISE FIGURE AND GAIN measurements. Or, the measurement results for each mode can be displayed on an oscilloscope. For an explanation and comparison of the five Measurement Modes and instructions on how to choose the appropriate Measurement Mode and sideband operation, refer to the Measurement Modes Detailed Operating Instruction.

Procedure

There are many possible measurement procedures. However, the following general procedure applies to all cases:

a. Select single sideband offset (use either Special Function 2.1 or 2.2).

b. Press 1 . 2 SPECIAL FUNCTION to set the Noise Figure Meter to Measurement Mode 1.2.

c. Set frequency parameters (including the fixed frequency for the external LO, Special Function 3.1).

d. Calibrate in Mode 1.2 (this is only required for a CORRECTED NOISE FIGURE AND GAIN measurement). External filtering is required during both the calibration and the measurement.

e. Insert DUT and measure.

Example

To make a swept CORRECTED NOISE FIGURE AND GAIN measurement of a wideband amplifier in the 3.5 to 4.5 GHz range in 20 MHz steps:

a. Press PRESET (or send HP-IB code PR) to establish initial conditions.

b. Press 2 . 1 (or send HP-IB code B1) to select a lower sideband measurement.

NOTE

Measurement Mode 1.2 must be activated prior to entering the frequency parameters to avoid error E35 (entered value is out of range).

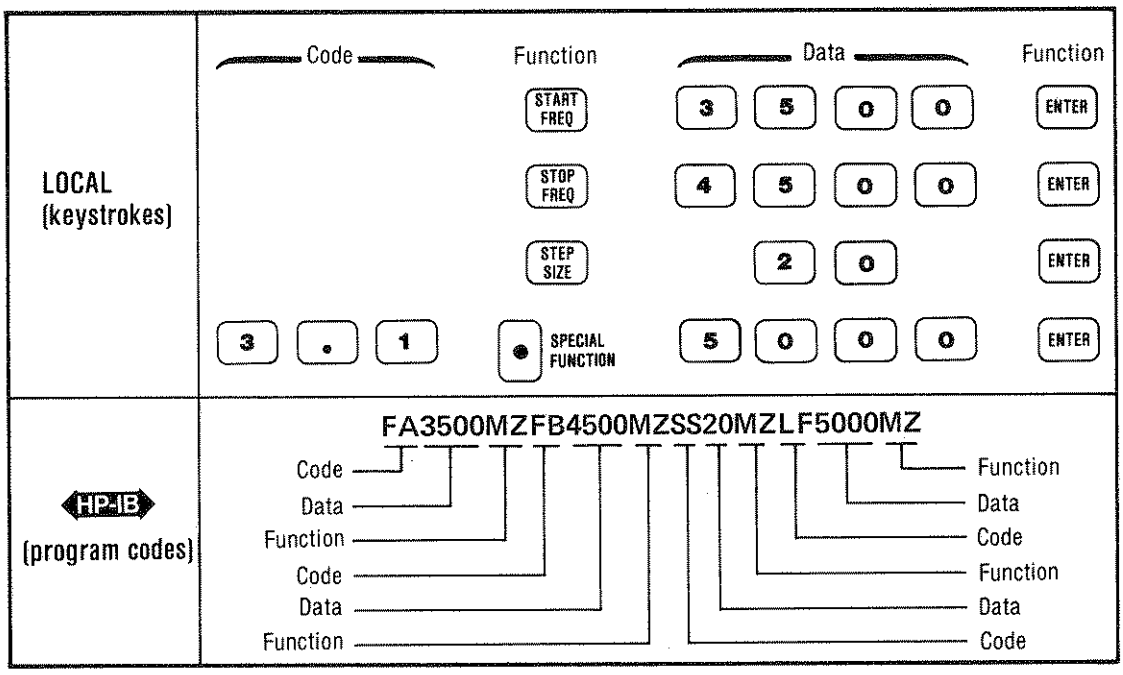
c. Press 1 . 2 SPECIAL FUNCTION (or send HP-IB code E2) to activate Mode 1.2. Note that error E33 (IF will be out of range) is displayed. This error is cleared when the correct frequency parameters are entered in step d.

d. Set the frequency parameters for both the calibration and measurement.

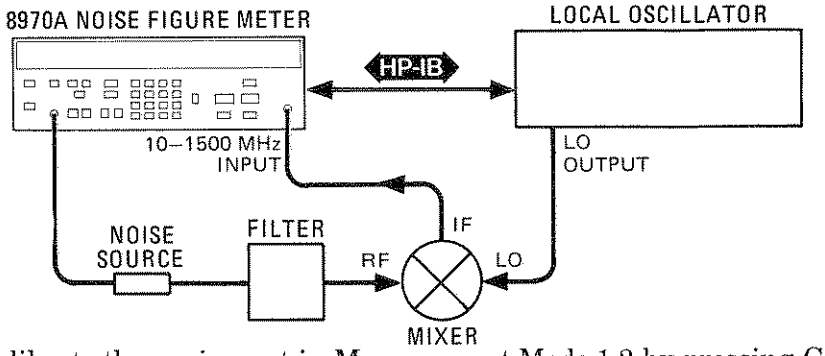
Measurement Mode 1.2 (cont'd)

(Special Function 1.2)

Example (cont'd)

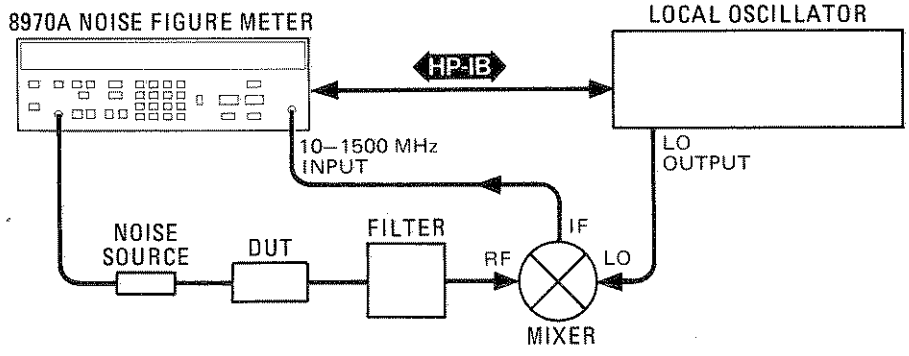


e. To calibrate the Noise Figure Meter, set up the equipment as shown below.



f. Calibrate the equipment in Measurement Mode 1.2 by pressing CALIBRATE (or sending HP-IB code CA).

g. To make the measurement, set up the equipment as shown below.



Measurement Mode 1.2 (cont'd)

(Special Function 1.2)

Example (cont'd)

NOTE

This example assumes that the external LO is tuned to the specified frequency (5 GHz). If the Noise Figure Meter is controlling the LO, the LO tunes to 5 GHz when entered with Special Function 3.1 in step d. If the external LO is not controlled by the Noise Figure Meter, the LO must be separately tuned to 5 GHz. If the Enable External LO Control Special Function (4.1) is active, an external controller cannot be used with the Noise Figure Meter.

h. Press CORRECTED NOISE FIGURE AND GAIN (or send HP-IB code M2).

i. Press SINGLE (or send HP-IB code W2). The Noise Figure Meter will sweep from 1500 to 500 MHz in 20 MHz steps but will display the microwave measurement frequency of 3500 to 4500 MHz. After the single sweep is completed, the instrument halts.

Program Codes

HP-IB

The HP-IB code for Measurement Mode 1.2 is E2 (or 1.2SP).

Indications

The left display shows each frequency at which a measurement is made and the EXT MIX annunciator lights. The INSERTION GAIN display shows the gain of the DUT at the displayed frequency. The NOISE FIGURE display shows the noise figure of the DUT at the displayed frequency.

Related Sections

Calibrate
Controller Capability of the Noise Figure Meter
Fixed IF or LO Frequency Selection
Measurement Modes
Sideband Selection
Special Functions

Measurement Mode 1.3
(Special Function 1.3)

Description

Measurement Mode 1.3 provides a means of controlling an external LO to measure a frequency conversion device. This mode uses a fixed IF and allows for frequency conversion in the device under test (DUT). Although the signal measured at the Noise Figure Meter INPUT is always in the range of 10 to 1500 MHz, the Noise Figure Meter uses the Excess Noise Ratio (ENR) of the noise source at the measurement frequency. However, the correct 10 to 1500 MHz ENR is used during calibration. A typical DUT is a mixer or receiver. All of the Measurement Modes can be set to use many of the other capabilities of the Noise Figure Meter. For example, each mode can make either UNCORRECTED NOISE FIGURE or CORRECTED NOISE FIGURE AND GAIN measurements. Or, the measurement results for each mode can be displayed on an oscilloscope. For an explanation and comparison of the five Measurement Modes and instructions on how to choose the appropriate Measurement Mode and sideband operation, refer to the Measurement Modes Detailed Operating Instruction.

The following minimum requirements are necessary for the Noise Figure Meter to act as a controller in Measurement Mode 1.3:

a. HP-IB cable connected between the Noise Figure Meter and the external LO.

b. Special Function 4.1 (external LO control) active. If Special Function 4.1 is selected, no other controller can communicate with the Noise Figure Meter. Therefore, the HP-IB codes shown in the example cannot be used. However, it is possible to perform this function using an external controller to control both the Noise Figure Meter and the external LO. For additional information refer to Comments at the end of this instruction.

c. The HP-IB address of the external LO must match the external LO address that is stored in the Noise Figure Meter. Use Special Function 40.1 to display and change this address if necessary.

d. The correct external LO program must be active if the Noise Figure Meter is going to control the external LO. Use Special Function 41.0 for the HP 8350B Sweep Oscillator or Special Function 41.2 for the HP 8672A Synthesized Signal Generator or Special Function 41.3 for the HP 8673B Synthesized Signal Generator. Use Special Function 42 to define a new program for other external LOs.

Procedure

There are many possible measurement procedures. However, the following general procedure applies to all cases:

a. Verify that the minimum requirements specified in the description are satisfied.

b. Press 1 . 3 SPECIAL FUNCTION to set the Noise Figure Meter to Measurement Mode 1.3.

c. Set frequency parameters (including the fixed IF, Special Function 3.0).

d. Calibrate in Mode 1.3.

e. Insert DUT and initiate sweep.

Example

To make a swept CORRECTED NOISE FIGURE AND GAIN measurement in the 3.0 to 4.5 GHz range in 20 MHz steps with a fixed IF of 70 MHz:

Measurement Mode 1.3 (cont'd)

(Special Function 1.3)

Example (cont'd)

NOTE

This example assumes that the Noise Figure Meter is acting as a controller and the minimum requirements specified in the description are satisfied. Since no external controller can be be used, no HP-IB codes are given in the example. Refer to Comments for a brief description of using an external controller when in Measurement Mode 1.3.

a. Press PRESET (or send HP-IB code PR) to establish initial conditions.

NOTE

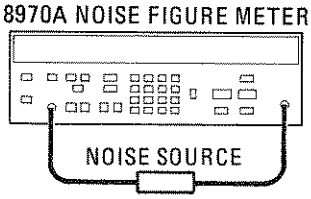
Measurement Mode 1.3 must be activated prior to entering the frequency parameters to avoid error E35 (entered value is out of range).

b. Press 1 . 3 SPECIAL FUNCTION to activate Measurement Mode 1.3.

c. Set the frequency parameters for both the calibration and measurement.

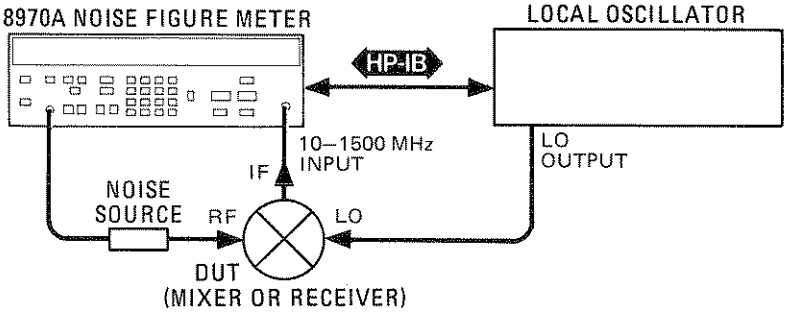
	Code	Function	Data	Function
LOCAL (keystrokes)		START FREQ	3 0 0 0	ENTER
		STOP FREQ	4 5 0 0	ENTER
		STEP SIZE	2 0	ENTER
	3 . 0	• SPECIAL FUNCTION	7 0	ENTER

d. To calibrate the Noise Figure Meter, set up the equipment as shown below.



e. Calibrate the equipment in Measurement Mode 1.3 by pressing CALIBRATE.

f. To make the measurement, set up the equipment as shown below.



Measurement Mode 1.3 (cont'd)

(Special Function 1.3)

Example (cont'd)

g. Press CORRECTED NOISE FIGURE AND GAIN.

h. Press SINGLE. The Noise Figure Meter will sweep the external LO from 3 GHz to 4.5 GHz in 20 MHz steps and halt.

Program Codes

HP-IB

The HP-IB code for Measurement Mode 1.3 is E3 (or 1.3SP). Refer to Comments for additional information on using HP-IB program codes in Measurement Mode 1.3

Indications

The left display shows each frequency at which a measurement is made and the EXT MIX annunciator lights. The INSERTION GAIN display shows the gain of the DUT at the displayed frequency. The NOISE FIGURE display shows the noise figure of the DUT at the displayed frequency.

Comments

An external controller can be used in place of the Noise Figure Meter to control the external LO and the Noise Figure Meter in Measurement Mode 1.3. The following general conditions must be observed when using an external controller:

a. Special Function 4.0 (normal talker and listener) must be active. Note that there is no HP-IB code for this special function.

b. Special Function 30.1 (trigger hold) must be active (HP-IB code is T1).

c. The correct measurement parameters (for example, Measurement Mode, frequencies, etc.) must be established. Refer to Table 3-9, Special Function to HP-IB Code Summary, and Table 3-10, Front Panel Keys to HP-IB Code Summary, for applicable HP-IB codes.

d. Perform a triggered calibration with the DUT out of the measurement system (refer to the Calibrate Detailed Operating Instruction).

e. Insert the DUT into the measurement system.

f. Set the Noise Figure Meter's SINGLE sweep on (HP-IB code is W2) or AUTO sweep on (HP-IB code is W1).

g. Set the external LO to the appropriate frequency. Refer to the LO's operating manual for the required HP-IB codes. Allow sufficient time for the output of the external LO to stabilize.

h. Trigger a measurement using the HP-IB code T2. Do not use the alternate HP-IB code 30.2SP for Special Function 30.2 as it will reset the sweep.

i. To determine when to step to a new frequency, read the noise figure results. This read operation cannot be completed until the new data is ready. It is also possible to write an SRQ interrupt routine on the Data Ready SRQ. Refer to Enabling the Service Request Condition, paragraph 3-29.

Measurement Mode 1.3 (cont'd)

(Special Function 1.3)

Comments (cont'd)

j. Continue to loop through steps g, h, and i. A method for determining when the measurements are complete must be programmed into the external controller. One method is to compare the frequency that is sent to the exernal LO with the stop frequency programmed into the Noise Figure Meter and terminate the program after the measurement in which they are equal.

Related Sections

Calibrate
Controller Capability of the Noise Figure Meter
Fixed IF or LO Frequency Selection
HP-IB Addresses
Sideband Selection
Special Functions
Trigger Selection

Measurement Mode 1.4

(Special Function 1.4)

Description

Measurement Mode 1.4 provides a means of using a fixed-frequency external LO and testing over a variable IF range. This mode allows for down conversion in the device under test (DUT). Although the signal measured at the Noise Figure Meter INPUT is always in the range of 10 to 1500 MHz, the Noise Figure Meter uses the Excess Noise Ratio (ENR) of the noise source at the measurement frequency. However, the correct 10 to 1500 MHz ENR is used during calibration. A typical DUT is a mixer or receiver. An external LO is required. All of the Measurement Modes can be set up to use many of the other capabilities of the Noise Figure Meter. For example, each mode can make either UNCORRECTED NOISE FIGURE or CORRECTED NOISE FIGURE AND GAIN measurements. Or, the measurement results for each mode can be displayed on an oscilloscope. For an explanation and comparison of the five Measurement Modes and instructions on how to choose the appropriate Measurement Mode and sideband operation, refer to the Measurement Modes Detailed Operating Instruction.

Procedure

There are many possible measurement procedures. However, the following general procedure applies to all cases:

a. Set frequency parameters (including the fixed frequency for the external LO, Special Function 3.1).

b. Press 1 . 4 SPECIAL FUNCTION to set the Noise Figure Meter to Measurement Mode 1.4.

c. Calibrate in Mode 1.4 (this is only required for a CORRECTED NOISE FIGURE AND GAIN measurement).

d. Insert DUT and measure.

e. The left display shows the swept IF.

Example

To make a swept CORRECTED NOISE FIGURE AND GAIN measurement over an IF of 10 MHz to 1 GHz using 20 MHz steps with a fixed external LO frequency of 10 GHz:

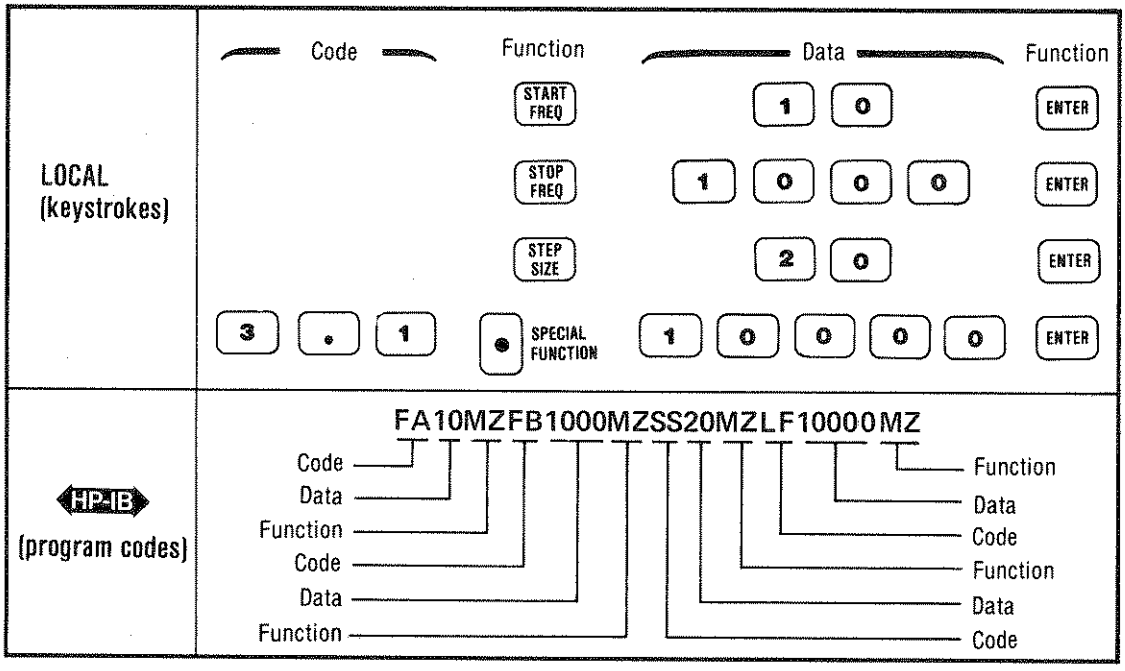
a. Press PRESET (or send HP-IB code PR) to establish initial conditions.

b. Set the frequency parameters for both the calibration and measurement.

Measurement Mode 1.4 (cont'd)

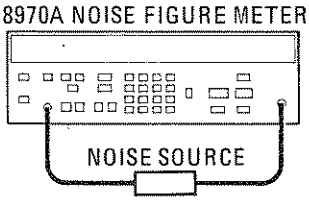
(Special Function 1.4)

Example (cont'd)



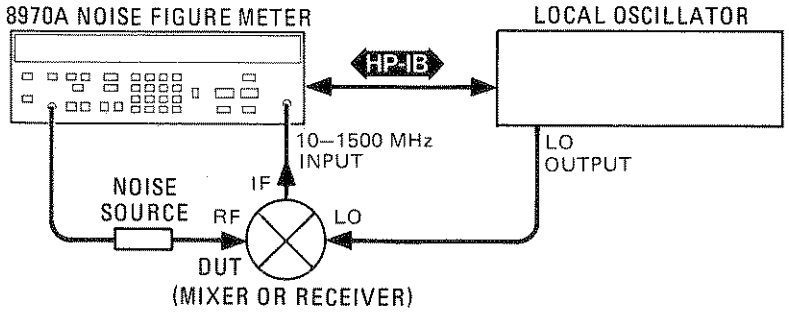
c. Press 1 . 4 SPECIAL FUNCTION (or send HP-IB code E4) to activate Measurement Mode 1.4.

d. To calibrate the Noise Figure Meter, set up the equipment as shown below.



e. Calibrate the equipment in Measurement Mode 1.4 by pressing CALIBRATE (or sending HP-IB code CA).

f. To make the measurement, set up the equipment as shown below.



Measurement Mode 1.4 (cont'd)

(Special Function 1.4)

Example (cont'd)

NOTE

This example assumes that the external LO is tuned to the specified frequency (10 GHz). If the Noise Figure Meter is controlling the LO, the LO tunes to 10 GHz when Special Function 3.1 is entered in step b. If the external LO is not controlled by the Noise Figure Meter, the LO must be separately tuned to 10 GHz. If the Enable External LO Control Special Function (4.1) is active, an external controller cannot be used with the Noise Figure Meter.

g. Press CORRECTED NOISE FIGURE AND GAIN (or send HP-IB code M2).

h. Press SINGLE (or send HP-IB code W2). The Noise Figure Meter will sweep from 10 to 1000 MHz in 20 MHz steps. After the single sweep is completed, the instrument halts.

Program Codes

HP-IB

The HP-IB code for Measurement Mode 1.4 is E4 (or 1.4SP).

Indications

The left display shows each IF frequency at which a measurement is made and the EXT MIX annunciator lights. The INSERTION GAIN display shows the gain of the DUT at the displayed frequency. The NOISE FIGURE display shows the noise figure of the DUT at the displayed frequency.

Related Sections

Calibrate
Controller Capability of the Noise Figure Meter
Fixed IF or LO Frequency Selection
Sideband Selection
Special Functions

Noise Figure (Uncorrected) and Noise Figure and Gain (Corrected)

Description

UNCORRECTED NOISE FIGURE measures the combined noise figure of the device under test and the measurement system (including the effect of the local oscillator, mixer, cables, connectors and adapters).

CORRECTED NOISE FIGURE AND GAIN removes the measurement system noise contribution and allows only the noise figure and gain of the device under test to be displayed. The Noise Figure Meter must be calibrated in the measurement frequency range and measurement mode before a corrected noise figure and gain measurement can be made.

Procedure

To measure uncorrected noise figure, press the NOISE FIGURE key.

To measure corrected noise figure and gain, press the NOISE FIGURE AND GAIN key. If the Noise Figure Meter is not correctly calibrated, error code E20 will be displayed.

Front Panel Key	Program Code (HP-IB)	Stored in Continuous Memory	Can be Stored and Recalled	Preset (and HP-IB Clear) Conditons
NOISE FIGURE (UNCORRECTED)	M1	N	N	Active
NOISE FIGURE AND GAIN (CORRECTED)	M2	N	N	Off

Table categories are explained in the Preset Conditions and Power-Up Sequence Detailed Operating Instruction.

Example

To measure corrected noise figure and gain:

LOCAL (keystrokes)	Measurement ● CORRECTED NOISE FIGURE AND GAIN
(HP-IB) (program codes)	M2

Program Codes (HP-IB)

For HP-IB program codes, refer to Procedure above.

Indications

When the instrument is making uncorrected noise figure measurements, the UNCORRECTED LED above the NOISE FIGURE key is illuminated. The measurement result is displayed in the NOISE FIGURE display. In addition, the INSERTION GAIN display is blank.

Noise Figure (Uncorrected) and Noise Figure and Gain (Corrected) (cont'd)

Indications (cont'd)

When the instrument is making noise figure and gain measurements, the CORRECTED LED above the NOISE FIGURE AND GAIN key is illuminated. The gain of the device under test (DUT) appears in the INSERTION GAIN display and the noise figure of the DUT appears in the NOISE FIGURE display.

Comments

For CORRECTED NOISE FIGURE AND GAIN measurements, it is necessary to calibrate the instrument each time there is a change in measurement modes, equipment (except the DUT), or frequency parameters (if the new frequency parameters are outside of the calibrated range).

UNCORRECTED NOISE FIGURE and CORRECTED NOISE FIGURE AND GAIN measurements are always corrected for T_{cold} and ENR.

Measured noise can be expressed in a variety of units: F, F dB, Y, Y dB, and Te K. Refer to the Display Units Selection Detailed Operating Instruction for additional information.

The noise figure measurement range is 0 to 30 dB. The gain measurement range (for total noise figures less than 30 dB) is −20 to at least +40 dB.

Related Sections

Calibrate
Display Units Selection
Preset Conditions and Power-Up Sequence

Power Measurements
(Special Function 9)

Description

Special Function 9 measures noise power density in dB relative to −174 dBm/Hz with the noise source on or off. Either an approximate or a calibrated measurement can be made. The value −174 dBm/Hz was chosen because this is the thermal noise at 290K in a 1 Hz bandwidth. This special function can be used to make absolute power density measurements or simply to verify that the measurement system setup is operating and the signal path is complete. To exit from Special Function 9, press either UNCORRECTED NOISE FIGURE or CORRECTED NOISE FIGURE AND GAIN.

Procedure

To select a power density measurement, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Functions 9.3 and 9.4 require that a calibration be performed prior to activating the special function. If the calibration has not been performed, error E20 (not calibrated) is displayed and the special function is not activated.

Since the power measurements can be performed from any Measurement Mode, refer to the applicable Detailed Operating Instruction for the correct calibration procedures.

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Preset (and HP-IB Clear) Conditions	Special Function 0.0 Conditions
Description	Code						
SOURCE Off (uncalibrated)	9.1	N5 or 9.1SP	N	Y	Y	Off	Off
SOURCE On (uncalibrated)	9.2	N6 or 9.2SP	N	Y	Y	Off	Off
SOURCE Off (calibrated)	9.3	N7 or 9.3SP	N	Y	Y	Off	Off
SOURCE On (calibrated)	9.4	N8 or 9.4SP	N	Y	Y	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example

To select an uncalibrated power measurement with the noise source on:

LOCAL (keystrokes)	Code: 9 . 2 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	N6

Power Measurements (cont'd)

(Special Function 9)

Program Codes

For HP-IB codes, refer to Procedure above.

HP-IB

Indications

The NOISE FIGURE display shows the selected power measurement result in dB.

Comments

Special Functions 9.3 and 9.4 measure the power density delivered from the DUT. The rest of the measurement system setup is corrected for by the calibration (second stage correction).

The units shown in the NOISE FIGURE display are dB referenced to 290K (−174 dBm/Hz). The equation is:

$$\text{Power displayed} = 10 \log \frac{\text{unknown power density}}{290} \text{ dB}$$

Special Functions 9.1 and 9.2 are similar to 9.3 and 9.4 execpt that they are not calibrated and they use nominal values for noise figure. These Special Functions are primarily used to verify that the measurement system is operating.

Related Sections

Calibrate
Measurement Modes 1.1 through 1.4
Special Functions

Preset Conditions and Power-Up Sequence

(Includes Special Function 0.0)

Description

Power-Up. When first turned on, the Noise Figure Meter performs a sequence of internal checks after which the instrument is ready to make measurements. During the power-up sequence, all front panel indicators light for approximately two seconds to allow the operator to determine if any are defective. Next, four dashes (— — — —) appear in the NOISE FIGURE display for approximately five seconds while the Noise Figure Meter performs a frequency calibration. When the frequency calibration is completed, the Noise Figure Meter restores the same configuration it had before the power was removed. Except that:

a. Sweep is always off.

b. The measurement is always UNCORRECTED NOISE FIGURE.

c. The instrument always turns on in local mode (instead of HP-IB remote).

d. Calibration data is not retained when power is removed.

e. Special Functions 30 through 32, 35.1, 43, 44, and 60 through 72 are not remembered when power is removed.

Preset. The PRESET key sets the Noise Figure Meter to a known state. The front panel is set to the conditions listed in the "Preset and HP-IB Clear Conditions" column in Table 3-12, Front Panel Summary. Table 3-13 lists the default data values that are set for some special functions. Table 3-14, Special Function Summary, in the Special Functions Detailed Operating Instruction provides a complete list of preset conditions for special functions.

In the "Program Code" column in Table 3-12, program codes that are equivalent to front panel keystrokes are listed. HP-IB codes control the Noise Figure Meter's functions over the HP-IB.

The "Stored in Continuous Memory" column in Table 3-12 indicates whether or not the status of a front panel key is retained when the Noise Figure Meter is turned off.

The "Can Be Stored and Recalled" column in Table 3-12 indicates whether or not the status of a front panel key can be stored in an internal storage register for recall at a later time.

Special Functions are off or set to their zero-suffix mode. Exceptions are:

a. Control Function Selection (Special Function 4)

b. HP-IB Addresses (Special Function 40)

c. External LO Programs (Special Function 41)

d. External LO Commands (Special Function 42)

PRESET has no effect on the four special functions listed above.

Preset Conditions and Power-Up Sequence (cont'd)
(Includes Special Function 0.0)

Table 3-12. Front Panel Summary

Front Panel Key	Program Code (HP-IB)	Stored in Continuous Memory	Can be Stored and Recalled	Preset (and HP-IB Clear) Conditions	References and Comments
AUTO Sweep	W1	N	N	Off	Sweep
CALIBRATE	CA	N	N	Off	Calibrate
DECREASE	DE	Y	N	1	Smoothing
ENTER	EN	—	—	—	General Operating Instructions
ENR	NR	Y	N	NC	ENR Table Entry
FREQ INCR	FN	Y	Y	20 MHz	Fixed Frequency Increment
↓	DN	—	—	—	Fixed Frequency Increment
↑	UP	—	—	—	Fixed Frequency Increment
FREQUENCY	FR	Y	Y	30 MHz	Fixed Frequency Tuning
INCREASE	IN	Y	N	1	Smoothing
NOISE FIGURE (UNCORRECTED)	M1	N	N	Active	Noise Figure (Uncorrected) and Noise Figure and Gain (Corrected)
NOISE FIGURE AND GAIN (CORRECTED)	M2	N	N	Off	Noise Figure (Uncorrected) and Noise Figure and Gain (Corrected)
PRESET	PR	—	—	—	Preset Conditions and Power-Up Sequence
RECALL	RC	—	—	—	Store and Recall
SEQ	SQ	—	—	—	Sequence
SINGLE Sweep	W2	N	N	Off	Sweep
SPECIAL FUNCTION	SP	—	—	—	Special Functions
START FREQ	FA	Y	Y	10 MHz	Sweep
STEP SIZE	SS	Y	Y	20 MHz	Sweep
STOP FREQ	FB	Y	Y	1500 MHz	Sweep
STORE	ST	—	—	—	Store and Recall
Sweep and Calibrate Off (must be (must be used to turn these functions off over the HP-IB)	W0	—	—	—	Sweep

Y = Yes, N = No, NC = No Change, — = Not Applicable

Description (cont'd)

Another exception is Service Request, which is set to enable an HP-IB code error to cause an SRQ (Special Function 44.3). In addition, default data values are set for the special functions listed in Table 3-13.

Special Function 0.0. Special Function 0.0 initializes selected special functions. It is similar to PRESET except that default data values are not set. Existing values do not change. Refer to Table 3-14, Special Function Summary, in the Special Functions Detailed Operating Instruction for a complete list of Special Function 0.0 conditions.

Preset Conditions and Power-Up Sequence (cont'd)

(Includes Special Function 0.0)

Table 3-13. Preset Default Values for Special Functions

Special Function		Default Value
Description	Code	
IF	3.0	30 MHz
LO Frequency	3.1	10000 MHz
Loss Compensation		
Before DUT	34.2	0 dB
Temperature of Losses	34.3	0K
After DUT	34.4	0 dB
Measurement Mode 1.1,	1.1	
Measurement Mode 1.2, and	1.2	
Measurement Mode 1.3	1.3	
Start Frequency		8000 MHz
Stop Frequency		12000 MHz
Step Size		200 MHz
Oscilloscope Limits		
Noise Figure Lower Limit	8.1	0
Noise Figure Upper Limit	8.2	8
Gain Lower Limit	8.3	0
Gain Upper Limit	8.4	40
Set Sequence	35.2	1—9
Smoothing Factor	13.2	1
Spot ENR	5.3	15.2 dB
T_{cold}	6.0	296.5K
Spot T_{hot}	5.4	9893K

Procedure

To set the Noise Figure Meter to a known state, press the PRESET key.

To initialize selected special functions, key in 0.0, then press the SPECIAL FUNCTION key.

Example

To initialize selected special functions:

LOCAL (keystrokes)	Code: 0 . 0 — Function: SPECIAL FUNCTION
HP-IB (program codes)	CS

Program Codes HP-IB

Parameter	Program Code HP-IB
PRESET	PR
Special Function 0.0	CS

Preset Conditions and Power-Up Sequence (cont'd)

(Includes Special Function 0.0)

Indications

After pressing PRESET, the NOISE FIGURE display shows four dashes (— — — —) while a frequency calibration is performed. After approximately five seconds, the left display shows 30 MHz, the INSERTION GAIN display is blank, and the NOISE FIGURE display shows noise figure in units of F dB. Also, the UNCORRECTED NOISE FIGURE LED is illuminated.

When Special Function 0.0 is executed, the SPECIAL FUNCTION key LED turns off if it was on.

Comments

Special Function 0.0 does not affect any data entered by special functions or front panel keys.

PRESET is identical to the Device Clear command over the HP-IB.

PRESET does not effect calibration data or information in the ENR table.

PRESET and Special Function 0.0 do not modify any data in the internal storage registers.

Related Sections

Calibration, Frequency
Special Functions

Programming an External LO
(Special Function 42)

Description

Special Function 42 can be used to modify the predefined external LO programs for the HP 8350B Sweep Oscillator (Special Function 41.0) or the HP 8672A Synthesized Signal Generator (Special Function 41.2). It can also be used to define a new program for other external LOs provided the LO is HP-IB compatible. However, a thorough understanding of the HP-IB program requirements and restrictions that apply to the external LO is required.

The two predefined external LO programs are stored in permanent memory (ROM). Activating Special Function 41.0 or 41.2 loads the corresponding predefined program from permanent memory into temporary memory (RAM). The programs stored in the permanent memory are never changed; only the program in temporary memory can be modified. Special Function 42 can change the program data that is stored in the temporary memory. One of the predefined programs or the last modified program is always present in the temporary memory. And, only the program in temporary memory can control an external LO.

Detailed examples will be used to explain the use of Special Function 42. However, a brief definition of the purpose of the individual parts of the program that can be changed using Special Function 42 will make the programs easier to understand:

a. Special Function 42.0 is used to display and change the auxiliary commands. The purpose of the auxiliary commands is to set the external LO to continuous wave (CW) operation and to set the output signal level of the external LO (if it is variable via HP-IB).

b. Special Function 42.1 is used to display and change the CW prefix and suffix. The purpose of the prefix and suffix is to correctly format the frequency commands from the Noise Figure Meter to the external LO. The format is different for different LOs. Frequency data of up to five digits is located between the prefix and suffix. The frequency information is determined by the frequency parameters entered into the Noise Figure Meter during the measurement setup and by the measurement mode in which the instrument is operating.

c. Special Function 42.2 is used to display and change the settling time (in ms). The purpose of the settling time is to ensure that the Noise Figure Meter waits a sufficient amount of time after issuing the frequency command and the auxiliary commands to allow the external LO output to stabilize.

d. Special Functions 42.3 and 42.4 are used to display and change the minimum and maximum frequencies that the program will accept. These entries are in MHz. In most cases, they will represent the frequency capability of the external LO. However, they do not affect the external LO but are only used by the Noise Figure Meter to determine if a requested frequency parameter will be accepted. If an attempt to enter an out-of-range frequency is made, the Noise Figure Meter displays one of the invalid frequency entry error messages.

Predefined Program Listings

The listings for the two predefined programs are shown below. Each listing shows the data that is stored in permanent memory. Also shown are the External LO Commands (Special Functions 42.0 through 42.4) and the data that can be modified by each special function.

Programming an External LO (cont'd)

(Special Function 42)

Predefined Program Listings (cont'd)

External LO Predefined Program Listings

External LO Commands (Special Function 42)	HP 8350A Program (41.0)	HP 8672A Program (41.2)
42.0 Auxiliary Commands	(0) (0)	K(75) 0(48) } 0 dB atten.
	(0) (0)	L(76) 6(54) } –3 dB
	(0) (0)	M(77) 0(48) } AM off
	(0) (0)	N(78) 7(55) } FM off
	(0) (0)	O(79) 3(51) } +10 dBm
42.1 Prefix	C(67)	P(80)
	W(87)	(255)
Suffix	M(77)	Z(90)
	Z(90)	0(48)
42.2 Settling Time	60 ms	20 ms
42.3 Minimum Frequency	2000 MHz	2000 MHz
42.4 Maximum Frequency	18000 MHz	18000 MHz

The following conventions are used in the program listings:

HP-IB a. All HP-IB program codes consist of ASCII characters. The numbers and letters shown before the parentheses (in Special Functions 42.0 and 42.1) are the ASCII characters that make up valid HP-IB program codes.

b. The numbers shown within parentheses are the decimal equivalent of the required ASCII character. (It is this decimal value that is entered into the Noise Figure Meter for Special Functions 42.0 and 42.1.) For example, in the first line of the listing for the HP 8672A program, the entry is K(75). The K is the first ASCII character of a valid HP-IB program code for the HP 8672A. The 75 is the decimal equivalent of the letter K.

The two exceptions to this rule are (0) in the HP 8350B program and (255) in the HP 8672A program. The (0) entry is used as a placeholder. It is ignored by the Noise Figure Meter and is not transmitted on the HP-IB. In the HP 8350B program (Special Function 41.0), there are no preset auxiliary commands. This area contains zeros because no single program can control all possible HP 8350B configurations. This portion of the program must be correctly entered by the user to match the configuration of the HP 8350B used with the Noise Figure Meter. The (255) in the HP 8672A program is used by the Noise Figure Meter to establish that, when controlling the HP 8672A, leading zeros must be sent if they are required to complete five digits of frequency data.

c. The numbers shown without parentheses (in Special Functions 42.2, 42.3, and 42.4) are the actual values used for that function. For example, the "60 ms" shown as the settling time for the HP 8350B program is the actual settling time allowed by that program.

Programming an External LO (cont'd)

(Special Function 42)

Predefined Program Listings (cont'd)

d. The comments following the brackets in the HP 8672A program are the functions performed by each two-character HP-IB code. Note that many two-character HP-IB codes use the first character to establish the instrument function and the second character to establish the setting of that function.

In both programs, a maximum five digits of frequency information are sent between the prefix and the suffix. This information is generated by the front panel settings of frequency parameters on the Noise Figure Meter.

Procedure

To activate a specific programming function, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Auxiliary Commands	42.0	AC or 42.0SP	N	Y	Y	NC	NC
CW Prefix and Suffix	42.1	PS or 42.1SP	N	Y	N	NC	NC
Settling Time in ms	42.2	TM or 42.2SP	N	Y	N	NC	NC
Minimum Frequency in MHz	42.3	MN or 42.3SP	N	Y	N	NC	NC
Maximum Frequency in MHz	42.4	MX or 42.4SP	N	Y	N	NC	NC

Table categories are explained in the Special Functions Detailed Operating Instruction.

Entering Data

Special Function 42.0 allows for modification of the auxiliary commands of the program stored in temporary memory. If one of the two predefined external LO programs is to be modified, Special Function 41.0 or 41.2 should be activated first to ensure that the correct program is in the temporary memory.

HP-IB An auxiliary command is simply an HP-IB program code required to control one function of the external LO. Each program code consists of one or more ASCII character. The decimal equivalent of each ASCII character is stored in one of the ten data locations available for auxiliary commands.

The general procedure for entering data using Special Function 42.0 is as follows:

a. Determine what external LO functions are to be controlled by the Noise Figure Meter.

b. Use the external LO's manual to look up the HP-IB program codes for the above functions.

c. Use Table 3-11, located in Remote Operation near the front of this section, to look up the decimal equivalent for each of the ASCII characters used for the program codes.

d. On the Noise Figure Meter, press 42.0 SPECIAL FUNCTION to display the current number stored in the first of the ten data locations. Enter the decimal equivalent of the

Programming an External LO (cont'd)

(Special Function 42)

Procedure (cont'd)

desired ASCII character from the front panel of the Noise Figure Meter. The allowable range of decimal values is 0 to 255.

e. Press the ENTER key on the Noise Figure Meter's front panel. The next data location available for modification will appear in the Noise Figure Meter's left display. If no change to the existing data is desired, press ENTER to advance to the next data location.

f. Continue stepping through the data locations until all ten have been filled. If all of the auxiliary command data locations are not used in a specific application, always enter zeros in the remaining locations to avoid possible HP-IB command errors.

After all ten locations are displayed, the Noise Figure Meter returns to the previous front panel setup the next time ENTER is pressed. It is also possible to exit Special Function 42.0 at any time by pressing FREQUENCY (and still retain the data).

HP-IB Special Function 42.1 allows for modification of the CW prefix and suffix commands for the external LO program. The prefix is the external LO's HP-IB program code for CW. The suffix is the external LO's program code for MHz. The CW prefix and suffix commands are entered in a manner similar to the auxiliary commands (that is, the decimal equivalent of each ASCII character is entered into the Noise Figure Meter). However, the prefix and suffix HP-IB program codes must each be two ASCII characters or less because only four data locations are available for this Special Function. Enter zeros in any data locations that are not used. The allowable range of decimal values is 0 to 255.

For Special Functions 42.2, 42.3, and 42.4, the decimal value is entered directly into the Noise Figure Meter. The settling time is entered in ms. The allowable range is 0 to 60000 ms. Frequency is entered in MHz. The allowable range is 0 to 60000 MHz.

Modified data can be entered in any order. For example, the settling time can be modified prior to changing the frequency prefix and suffix.

Running the External LO Program

Before the program can be run, several conditions must be met:

a. An HP-IB cable should be connected between the Noise Figure Meter and the external LO.

b. On the Noise Figure Meter, Measurement Mode 1.1 or 1.3 (fixed IF and variable-frequency LO) should be selected. External LO programs can be run in Measurement Modes 1.2 and 1.4 (variable IF and fixed-frequency LO) but the Noise Figure Meter will send out the fixed LO frequency that was selected by Special Function 3.1.

c. The parameters associated with the selected Measurement Mode (such as frequency, fixed IF, and sideband selection) should be set.

d. Special Function 4.1 should be active to enable the Noise Figure Meter to control an external LO.

e. The HP-IB address of the external LO must match the external LO address that is stored in the Noise Figure Meter (use Special Function 40.1).

Programming an External LO (cont'd)

(Special Function 42)

Procedure (cont'd)

f. The internal sweep of the external LO (if one exists) should be off.

Once the above conditions are met, the external LO program stored in the Noise Figure Meter's temporary memory runs whenever a frequency value is entered from the front panel of the Noise Figure Meter. The program is also triggered each time an auxiliary command is changed when an external LO is connected.

When the program is running the following sequence occurs:

a. A frequency command and the auxiliary commands are sent to the external LO.

b. The Noise Figure Meter waits for the programmed settling time and then makes a measurement.

This sequence is repeated until all of the frequencies required by the measurement setup have been sent and the measurement results obtained.

HP-IB Each time the frequency is changed the Noise Figure Meter issues an HP-IB command string. The Noise Figure Meter sends the following HP-IB commands to the external LO in the order indicated:

a. REN and ATN are both set true.
b. the LO's listen address is sent.
c. ATN is released (that is, set false).
d. the frequency command is sent.
e. the auxiliary commands are sent.
f. carriage return (CR) and line feed (LF) are sent.

Because the frequency command preceeds the auxiliary commands, a Preset or Initialize command cannot be used in the auxiliary commands. These type of commands will prevent the external LO from tuning to the required frequencies because after the LO tunes to the requested frequency, it will be reset to its original frequency.

Examples

Example 1 – Modifying and Saving a Predefined Program

In example 1, the HP 8672A program is modified for three different output levels and the modified programs are stored. Modifying the output level will probably be the most frequent change made to this predefined program.

a. On the Noise Figure Meter, press 4 1 . 2 SPECIAL FUNCTION to load the HP 8672A program from permanent memory to temporary memory.

NOTE

A convenient relationship exists that can be used when modifying the output level on the HP 8672A. This relationship only holds true for changing the output level to a value between 0 and 13 dBm. If any other changes are required, the HP 8672A manual must be used to determine the correct HP-IB program codes. To obtain any output level between 0 and 13 dBm, change the fourth auxiliary command entry to 61 minus the desired dBm level. The standard program entry (54) results in a 7 dBm output (61 −7 = 54).

b. Press 4 2 . 0 SPECIAL FUNCTION to allow modification of the auxiliary commands. Verify that the left display shows 75.

Programming an External LO (cont'd)

(Special Function 42)

Examples (cont'd)

c. Press ENTER three times. Verify the left display shows 48, 76, then 54. Pressing ENTER repetitively without entering any data does not change the stored data.

d. Change the output level to 3 dBm by pressing 5 8 ENTER (using the relationship 61−3=58).

e. To store the modified auxiliary commands in storage register 1, press STORE 1. This step stores only the auxiliary commands. The rest of the program information remains in the temporary memory and only needs to be changed when the external LO changes. This information is retained if the instrument is turned off or if PRESET is pressed.

NOTE

It is a good programming practice to step through the remaining auxiliary command data locations to verify that they contain the correct information as shown in the listed program.

f. To modify the output level to 5 dBm and store the modified program in storage register 2, repeat steps b through e. In this sequence, the fourth auxiliary command location is now 58. Change it to 56 and press STORE 2.

NOTE

There are now three HP 8672A programs available to control the external LO. These programs will remain stored in the instrument unless storage registers 1 or 2 are modified using the STORE key. The standard program is always available whenever Special Function 41.2 is activated.

g. To run the program at the 7 dBm level, press 4 1 . 2 SPECIAL FUNCTION and perform the measurement using the appropriate Measurement Mode procedure.

h. To run the program at the 5 dBm level, press RECALL 2 and perform the measurement using the appropriate Measurement Mode procedure.

i. To run the program at the 3 dBm level, press RECALL 1 and perform the measurement using the appropriate Measurement Mode procedure.

NOTE

When modifying and storing a series of different programs, the capability to sequence these programs in a specific order can be useful. For information on sequencing the stored programs, refer to the Sequence Detailed Operating Instruction.

Example 2 — Writing a Program for an External LO Other Than the HP 8350B or HP 8672A.

The second example shows how to write a program for an external LO other than the HP 8350B and HP 8672A. The instrument chosen for this example is the HP 8672A Synthesized Signal Generator. This instrument was chosen because it has a low noise level and could be used to test low frequency mixers. A program listing is provided first and then a brief explanation of the chosen parameters is presented.

Programming an External LO (cont'd)

(Special Function 42)

Examples (cont'd)

HP 8662A Program Listing

External LO Commands (Special Function 42)	HP 8662A Program
42.0 Auxiliary Commands	M(77) } Modulation Off 0(70) } A(65) } amplitude function P(80) } 7(55) 7 +(43) } + dBm units D(68) } (0) (0) (0)
42.1 Prefix	F(70) R(82)
Suffix	M(77) Z(90)
42.2 Settling Time	40 ms
42.3 Minimum Frequency	20 MHz
42.3 Maximum Frequency	1279 MHz

In an external LO program the auxiliary commands are most often used to program the LO to a CW output at a specific level. This is done in the HP 8672A program in the following way:

a. The first two locations are used to send a Modulation Off command. This command sets the HP 8672A to the CW mode.

b. The next five locations set the LO to an output level of +7 dBm.

c. The last three locations are set to decimal zero and used as placeholders to avoid inadvertent HP-IB command outputs.

The prefix and suffix commands are those required by the HP 8672A.

The settling time is chosen to assure that the LO output is stable.

The minimum and maximum frequencies are chosen to be within the range of the LO and to satisfy the requirements of anticipated applications.

Program Codes

HP-IB

For HP-IB codes, refer to Procedure above.

Comments

When the Noise Figure Meter is in AUTO sweep, it waits for twice the entered settling time during the retrace from stop to start frequencies.

Related Sections

HP-IB Addresses
Programs Available to Control an External LO
Sequence
Special Functions

Programs Available to Control an External LO

(Special Function 41)

Description

Special Function 41 selects one of two predefined programs to control an external LO. Special Function 41.0 selects the program for the HP 8350B Sweep Oscillator, Special Function 41.2 selects the program for the HP 8672A Synthesized Signal Generator, and Special Function 41.3 selects the program for the HP 8673B Synthesized Signal Generator. A listing of these programs is contained in the Comments section of this instruction.

The programs are activated when Special Function 4.1 (Enable External LO Control), a Measurement Mode (1.1, 1.2, 1.3, or 1.4), and the correct predefined program have been selected. Either program can be modified using Special Function 42 (External LO Commands). Refer to the Programming an External LO Detailed Operating Instuction for additional information on how to modify these programs.

Procedure

To select one of the predefined programs key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can Be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
HP 8350B Sweep Oscillator Program	41.0	J0 or 41.0SP	N	Y	N	NC	NC
HP 8672A Synthesized Signal Generator Program	41.2	J2 or 41.2SP	N	Y	N	NC	NC
HP 8673B Synthesized Signal Generator Program	41.3	J3 or 41.3SP	N	Y	N	NC	NC

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example

To select the predefined program to control the HP 8672A:

LOCAL (keystrokes)	Code: 4 1 . 2 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	J2

Program Codes HP-IB

For HP-IB codes, refer to Procedure above.

Programs Available to Control an External LO (cont'd)

(Special Function 41)

Comments

A listing of the two predefined programs is provided here for a quick reference. A complete explanation of these programs and instructions on how to modify them are contained in the Programming an External LO Detailed Operating Instruction.

External LO Predefined Programs Listing

External LO Commands (Special Function 42)	HP 8350A Program (41.0)	HP 8672A Program (41.2)
42.0 Auxiliary Commands	(0) (0) (0) (0) (0) (0) (0) (0) (0) (0)	K(75) 0(48) } 0 dB atten. L(76) 6(54) } –3 dB M(77) 0(48) } AM off N(78) 7(55) } FM off O(79) 3(51) } +10 dBm
42.1 Prefix	C(67)	P(80)
	W(87)	(255)
Suffix	M(77)	Z(90)
	Z(90)	0(48)
42.2 Settling Time	60 ms	20 ms
42.3 Minimum Frequency	2000 MHz	2000 MHz
42.4 Maximum Frequency	18000 MHz	18000 MHz

Related Sections

Controller Capability of the Noise Figure Meter
Measurement Modes 1.1 through 1.4
Programming an External LO
Special Functions

RF Attenuation Selection

(Special Functions 60, 61, and 62)

Description RF attenuation selection, display, and hold are available in all measurement modes. It should be noted, however, that only the hold capability (Special Function 62.0) is normally used by most operators. The hold is required during manual measurements (refer to the Manual Measurements Detailed Operating Instruction for additional information). The selection and display of specific RF attenuation settings are more likely to be used during adjustment procedures, performance tests, or troubleshooting procedures. In some specialized applications these capabilities can be helpful, but care must be exercised when using them. It is possible to introduce some very subtle errors in the measurements that the Noise Figure Meter may not be able to guard against. Additional information on how to use and interpret these Special Functions is contained in Section VIII, Service.

Procedure To select a specific RF attenuation setting, display, or hold, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code (HP-IB)	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
RF Attenuation Selection							
Auto	60.0	R0 or 60.0SP	N	N	N	On	On
+20 dB	60.1	R1 or 60.1SP	Y	N	N	Off	Off
+10 dB	60.2	R2 or 60.2SP	Y	N	N	Off	Off
0 dB	60.3	R3 or 60.3SP	Y	N	N	Off	Off
−10 dB	60.4	R4 or 60.4SP	Y	N	N	Off	Off
−20 dB	60.5	R5 or 60.5SP	Y	N	N	Off	Off
−30 dB	60.6	R6 or 60.6SP	Y	N	N	Off	Off
Display RF Attenuator Settings							
Display IF Attenuator	61.0	SR or 61.0SP	N	N	N	Off	Off
RF Attenuator Hold							
RF Attenuator Hold	62.0	RH or 62.0SP	Y	N	N	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

RF Attenuation Selection (cont'd)

(Special Functions 60, 61, and 62)

Example To select the RF attenuator hold function:

LOCAL (keystrokes)	Code: 6 2 . 0 — Function: • SPECIAL FUNCTION
HP-IB (program codes)	RH

Program Codes

HP-IB

For HP-IB codes, refer to Procedure.

Indications When Special Function 61 is implemented, four digits appear in the left display. The digits are either "1" (yes) or "0" (no) to indicate whether or not the corresponding 10 dB pads and 20 dB amplifier are switched into the Input Assembly circuits (see Service Sheet 1 in Section VIII, Service). The first, third, and fourth digits each represent −10 dB (10 dB Pad No. 1, 10 dB Pad No. 2, and 10 dB Pad No. 3, respectively). The second digit represents +20 dB (20 dB Input Gain Amplifier). To obtain the RF attenuator setting, add the attenuation that is represented by each digit in the display. For example, a display of "1 1 1 0" indicates an RF attenuation setting of 0 dB.

Comments If any of the 60 or 70 series of Special Functions (except 60.0 and 70.0) are active, the calibration sequence does not override them. Therefore, to calibrate on one range only, use any of these Special Functions except 60.0 or 70.0. It is also true that if any of these Special Functions are inadvertently active, the calibration sequence will not cover the expected gain range.

Related Sections

Calibrate
IF Attenuation Selection
Manual Measurements
Special Functions

Sequence
(Includes Special Function 35)

Description

The sequence feature allows the user to predetermine the recall order of the storage registers. Manual sequence (recall of registers one at a time) or automatic sequence (continuous recall of registers) can be selected.

Nine digits are used in a sequence. Any combination of registers 1 through 9 is allowed. Zeros used within a sequence are ignored.

Procedure

To set the sequence (that is, the recall order), key in 35.2 SPECIAL FUNCTION. The register to be recalled at each step of the sequence is displayed in turn in the left display. If a change is desired, enter the new register number and press ENTER. If no change is desired, press ENTER to advance to the next step of the sequence. After all nine registers have been displayed, the Noise Figure Meter returns to normal measurement. Pressing the FREQUENCY key at any time terminates setting the sequence.

To select the manual sequence mode, key in 35.0 SPECIAL FUNCTION. The instrument steps through the defined sequence one step at a time each time the SEQ key is pressed. When the end of a sequence is reached, it starts over.

To select the automatic sequence mode, key in 35.1 SPECIAL FUNCTION. Press the SEQ key to start automatic sequencing. The instrument starts a continuous recall of registers in the predetermined sequence. To stop an automatic sequence, press the SEQ key again.

To clear the sequence (that is, set the sequence to 000 000 000), key in 35.3 SPECIAL FUNCTION.

To set the sequence to 1 through 9 in order, press PRESET.

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Manual Sequence	35.0	QM or 35.0SP	N	N	N	On	On
Automatic Sequence	35.1	QA or 35.1 SP	N	N*	N	Off	Off
Set Sequence	35.2	QS or 35.2SP	N	Y	N	NC	1—9
Clear Sequence	35.3	QC or 35.3SP	N	N	N	Off	Off

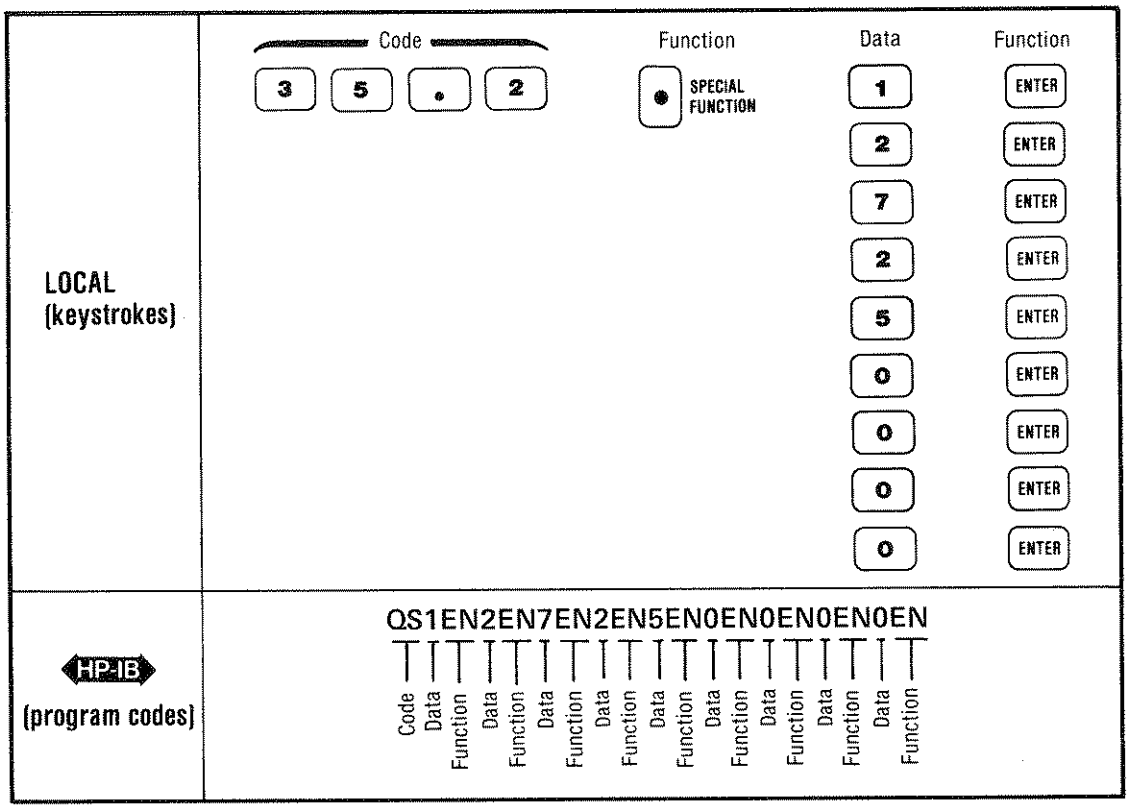
*Enables Special Function key LED to light when SEQ is pressed.

Table categories are explained in the Special Functions Detailed Operating Instruction.

Sequence (cont'd)
(Includes Special Function 35)

Example

To set the register recall sequence to 1, 2, 7, 2 and 5:



Program Codes

HP-IB

The program code for the SEQ key is SQ. The program code for the ENTER key is EN. Refer to Procedure, above, for HP-IB program codes for Special Function 35.

Indications

When the Noise Figure Meter is in the manual sequence mode, pressing the SEQ key causes the storage register being recalled to appear in the left display while the key is depressed.

When the Noise Figure Meter is in the automatic sequence mode, the SPECIAL FUNCTION key LED lights. Register numbers are not displayed during automatic sequencing.

Comments

Register numbers can be repeated in a sequence string.

If fewer than nine register numbers are used for a sequence string, zeros should be entered so that the sequence always has nine digits in it.

For a list of front panel functions that can or cannot be stored and recalled (therefore, can or cannot be used in a sequence), refer to Table 3-12, Front Panel Summary, in the Preset Conditions and Power-Up Sequence Detailed Operating Instruction. For a list of special functions that can and cannot be stored and recalled, refer to Table 3-14, Special Function Summary, in the Special Functions Detailed Operating Instruction.

Related Sections

Preset Conditions and Power-Up Sequence
Special Functions
Store and Recall

Sideband Selection
(Special Function 2)

Description

The measurement system setup dictates the sideband operation to be selected. Special Function 2 tells the Noise Figure Meter which type of sideband operation the measurement system is using. A discussion of measurement modes and sideband selection is contained in the Measurement Modes Detailed Operating Instruction. After the measurement setup is established, use Special Function 2 to convey this information to the Noise Figure Meter. Double sideband, upper single sideband, or lower single sideband can be selected.

In Measurement Mode 1.2, one of the single sideband special functions must be selected or else an error code (E34) is displayed. The reason a double sideband measurement cannot be made in Mode 1.2 is that the frequency at which the measurement is being made is ambiguous. Therefore, one of the two single sideband special functions must be selected and the other sideband must be filtered out after the DUT for a meaningful sweep. This eliminates any noise that is added by the DUT that may fall in the undesired sideband.

It is in Measurement Modes 1.1, 1.3, and 1.4 that the choice between single or double sideband becomes necessary. The following brief description will help clarify the choices available:

a. Special Function 2.0 selects a double sideband measurement. The measured result is an average of the noise figure at two frequencies; the LO frequency plus the IF and the LO frequency minus the IF.

b. Special Function 2.1 offsets the measurement frequency to the LO frequency minus the IF. The Noise Figure Meter uses the ENR value of the offset measurement frequency.

c. Special Function 2.2 offsets the measurement frequency to the LO frequency plus the IF. The Noise Figure Meter uses the ENR value of the offset measurement frequency.

Procedure

To select a specific sideband offset, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Sideband Selection (cont'd)
(Special Function 2)

Procedure (cont'd)

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Double Sideband (no frequency offset)	2.0	B0 or 2.0SP	N	Y	Y	On	On
Lower Single Sideband (measurement frequency less than LO frequency)	2.1	B1 or 2.1 SP	Y	Y	Y	Off	Off
Upper Single Sideband (measurement frequency greater than LO frequency)	2.2	B2 or 2.2SP	Y	Y	Y	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example

To select lower single sideband frequency offset:

LOCAL (keystrokes)	Code: 2 . 1 — Function: SPECIAL FUNCTION
HP-IB (program codes)	B1

Program Codes HP-IB

For HP-IB codes, refer to Procedure above.

Indications

For indications, refer to the "Lights Special Function Key" column in the table in Procedure above.

Related Sections

Measurement Modes
Measurement Modes 1.1 through 1.4
Special Functions

Smoothing (Averaging)

(Includes Special Function 13)

Description

The purpose of smoothing is to reduce jitter in both the NOISE FIGURE and INSERTION GAIN displays. Numbers that are sent to both of these displays are averaged before being displayed.

The Noise Figure Meter has two modes of smoothing: exponential and arithmetic (straight averaging). The equation for exponential smoothing is:

$$\text{new display} = \frac{\text{new measurement}}{n} + \frac{n-1}{n} \text{ (previous display)}$$

where n is the smoothing factor.

The equation for arithmetic smoothing is:

$$\text{new display} = \frac{\text{n measurements}}{n}$$

where n is the smoothing factor.

The smoothing factor can range from 1 to 512 in factors of two. Each time the INCREASE key is pressed, the smoothing factor is doubled (until the smoothing factor is 512). Each time the DECREASE key is pressed, the smoothing factor is halved (until the smoothing factor is 1). A stable display can usually be obtained by increasing the smoothing factor.

When exponential smoothing is used for a fixed frequency measurement, the display is updated approximately five times per second for all smoothing factors. However, when a large smoothing factor is used, the Noise Figure Meter is slow to respond to changes in the noise measurement when tuning from one fixed frequency to another.

Arithmetic smoothing makes the number of measurements indicated by the smoothing factor and averages them before the result is displayed. The display is updated each time n measurements are made, where n is the smoothing factor. With a smoothing factor of 1, three to five measurement updates are made each second. With a smoothing factor of 512, the measurement update interval is typically fifty seconds to one minute.

Calibration and swept measurements always use arithmetic smoothing automatically. Either exponential or arithmetic smoothing can be selected for fixed frequency measurements.

Procedure

To display the smoothing factor, key in 13.2 SPECIAL FUNCTION. If a change is desired, key in the new smoothing factor and then press the ENTER key.

The smoothing factor can also be changed from the front panel. Press INCREASE for more smoothing or press DECREASE for less smoothing. Each time one of these keys is pressed the smoothing factor changes by a factor of two.

To select exponential or arithmetic smoothing for fixed frequency measurements only, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Smoothing (Averaging) (cont'd)

(Includes Special Function 13)

Procedure (cont'd)

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Exponential smoothing mode for fixed frequency measurements	13.0	V0 or 13.0SP	N	Y	N	On	On
Arithmetic smoothing mode for fixed frequency measurements	13.1	V1 or 13.1 SP	N	Y	N	Off	Off
Displays and allows entry of smoothing factor	13.2	AF or 13.2SP	N	Y	N	NC	1

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example To select exponential smoothing and a smoothing factor of 4:

	Code	Function	Data	Function
LOCAL (keystrokes)	1 3 . 0	• SPECIAL FUNCTION		
	1 3 . 2	• SPECIAL FUNCTION	4	ENTER
HP-IB (program codes)	V0F2			

Program Codes HP-IB

Parameter	Program Code HP-IB
INCREASE	IN
DECREASE	DE
Smoothing Factor = 1	F0 or AF1EN
Smoothing Factor = 2	F1 or AF2EN
Smoothing Factor = 4	F2 or AF4EN
Smoothing Factor = 8	F3 or AF8EN
Smoothing Factor = 16	F4 or AF16EN
Smoothing Factor = 32	F5 or AF32EN
Smoothing Factor = 64	F6 or AF64EN
Smoothing Factor = 128	F7 or AF128EN
Smoothing Factor = 256	F8 or AF256EN
Smoothing Factor = 512	F9 or AF512EN

For HP-IB codes for Special Function 13, refer to Procedure above.

Smoothing (Averaging) (cont'd)

(Includes Special Function 13)

Indications

The current smoothing factor is displayed in the left display whenever the INCREASE key or the DECREASE key is depressed.

Comments

The smoothing factor can be changed while swept measurements are in progress. However, the smoothing factor cannot be changed during calibration.

For fixed frequency measurements, arithmetic smoothing is mainly useful in HP-IB systems. Exponential smoothing is best for reading measurement results on the front panel display or on an oscilloscope.

When using exponential smoothing, any time the fixed frequency changes, a number of measurements equal to the smoothing factor is made before any results are displayed. During this time the NOISE FIGURE display shows four dashes (— — — —).

In exponential smoothing, to reduce the settling time after a large measurement change, press the FREQUENCY key to reset the display to the current measurement value.

Related Sections

Calibrate
Fixed Frequency Tuning
Special Functions
Sweep

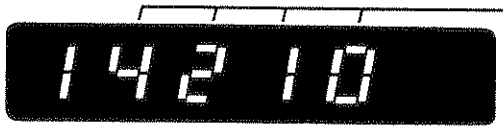
Special Function Catalog
(Special Function 50)

Description Special Function 50 displays the contents of the six-line special function catalog either sequentially or by individual line. The catalog can be used to quickly determine the present status of many of the special functions. For a concise explanation of the special function catalog, refer to the Special Function Catalog Summary shown below. With the exception of the information added for line six, this same information appears on the pullout card in the tray at the bottom of the Noise Figure Meter.

Special Function 50.N displays the Special Function Catalog. 50.0 SP sequences thru all 6 catalog lines. 50.1 thru 50.6 SP display the specified catalog line. For example:

[5] [0] [.] [1] [•] Displays the N = 1 line.

The first displayed digit (N) is the catalog line number. Each of the other digits is the suffix of a specific Special Function as shown in the table below.



This display indicates the following special functions: 1.4, 2.2, 4.1, 5.0

N 1 2 3 4 — Digit positions

LINE NO.	SPECIAL FUNCTION PREFIXES			
1	1	2	4	5
2	10/9*1	11	12*2	13
3	N/A	14	15	*3
4	30	31	32	34
5	35	41*4	43	N/A
6	60*5	70	*6	92

SP code prefixes N = 1

*1 0—4 = 10.0 thru 10.4SP; 5 = 9.1SP; 6 = 9.2SP; 7 = 9.3SP; 8 = 9.4SP.

*2 3 = 12.1SP and 12.2SP selected.

*3 Indicates selected analog output;
0—3 = 7.0 thru 7.3SP; 4 = 22.0SP; 5 = 23.0SP; 6 = 24.0SP; 7 = 82.0SP.

*4 Indicates selected Ext LO program:
0 = 41.0SP (8350B); 2 = 41.2SP (8672A); 3 = 41.3SP (8673B); 0 = Custom Ext LO Program.

*5 0—6 = 60.0 thru 60.6SP; 9 = 63.0 thru 63.5SP.

*6 0 = Normal display; 1 = 80.0SP (Voltmeter Mode, Noise Source Off); 2 = 81.0SP (Voltmeter Mode, Noise Source On).

Special Function Catalog Summary

Special Function Catalog (cont'd)

(Special Function 50)

Procedure

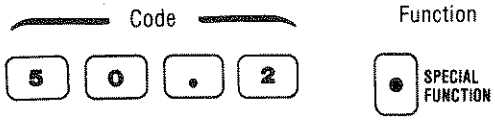
To select a specific special function catalog display, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Sequence through all six lines at once	50.0	G0 or 50.0SP	N	N	N	Off	Off
Display Line 1	50.1	G1 or 50.1SP	N	N	N	Off	Off
Display Line 2	50.2	G2 or 50.2SP	N	N	N	Off	Off
Display Line 3	50.3	G3 or 50.3SP	N	N	N	Off	Off
Display Line 4	50.4	G4 or 50.4SP	N	N	N	Off	Off
Display Line 5	50.5	G5 or 50.5SP	N	N	N	Off	Off
Display Line 6	50.6	G6 or 50.6SP	N	N	N	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example

To display line 2 of the special function catalog:

LOCAL (keystrokes)	
HP-IB (program codes)	G2

Program Codes

HP-IB

For HP-IB codes, refer to Procedure above.

Indications

When Special Function 50.0 is selected, the Noise Figure Meter automatically sequences through all six lines, showing the status of each line for approximately one second in the left display.

When Special Functions 50.1 through 50.6 are selected, the status of the corresponding line is displayed in the left display until another function is selected.

Under the left display are reference characters N, 1, 2, 3, and 4. N refers to the line number and 1, 2, 3, and 4 refer to digit positions in the display.

Comments

To read the special function catalog information via HP-IB, use Special Functions 50.1 through 50.6 and read one line at a time. The HP-IB output format must be set to output all three displays (HP-IB code H1 or 43.1SP).

Related Sections

Special Functions

Special Functions

Description

General Information. Special Functions extend user control of the instrument beyond that normally available from dedicated front panel keys. They are accessed via keyboard entry of the appropriate numeric code terminated by the SPECIAL FUNCTION key. The codes consist of a prefix, decimal, and suffix. Special Functions are grouped by their prefixes into five categories as follows:

Prefix 0

This initializes selected Special Functions. Refer to Table 3-14, Special Function Summary, for a complete listing of initialized Special Function conditions.

Prefixes 1 to 49

These are User Special Functions which are used during normal instrument operation when a special configuration, a special measurement, or special information is required. These Special Functions are described in the Special Function Summary, Table 3-14.

Prefixes 50 to 59

These are Catalog Special Functions and are used to display the status of Special Function settings. Refer to the Special Function Catalog Detailed Operating Instruction for additional information.

Prefixes 60 to 79

These are Auxiliary Special Functions which are normally used for servicing the Noise Figure Meter. However, some of these Special Functions must be used for manual measurements (HOT and COLD). Refer to Section VIII (Service), and the IF Attenuation Selection and RF Attenuation Selection Detailed Operating Instructions for additional information.

Prefixes 80 to 99

These are the Service Special Functions used to assist in troubleshooting an instrument fault. The functions available are quite diverse — special internal measurements, software control, and special service tests and configurations. These Special Functions are discussed in detail in Section VIII, Service.

Special Function Summary Table. A summary of the Special Functions is given in Table 3-14. Most of the Special Functions are explained in more detail in other operating instructions.

The "Lights Special Function Key" column indicates which Special Functions, when active, light the SPECIAL FUNCTION key LED on the front panel.

The "Stored in Continuous Memory" column indicates whether or not the status of a Special Function can be retained when power is removed from the Noise Figure Meter.

The "Can Be Stored and Recalled" column indicates whether or not the status of a Special Function can be stored in an internal storage register for recall at a later time.

The "Special Function 0.0 Conditions" column indicates the status of each Special Function (that is, on, off, or no change) when Special Function 0.0 is selected.

Special Functions (cont'd)

Description (Cont'd)

The "Preset (and HP-IB Clear) Conditions" column indicates the status of each Special Function when the front panel PRESET key is pressed (or HP-IB code PR is sent). In addition, this column indicates default data values that are set for some Special Functions.

Procedure

To use a Special Function, key in the corresponding code, then press the SPECIAL FUNCTION key.

Example

To select Measurement Mode 1.1 (Special Function 1.1):

LOCAL (keystrokes)	Code: 1 . 1 — Function: SPECIAL FUNCTION
HP-IB (program codes)	E1

Indications

The numeric code appears in the left display as it is being entered. Pressing the SPECIAL FUNCTION key activates the selected Special Function. Refer to the "Lights Special Function Key" column in Table 3-14 for a list of Special Functions that light the key LED.

Related Sections

Calibration, Frequency
Calibration, IF Attenuators
Calibration, Input Gain Selection
Controller Capability of the Noise Figure Meter
Data Output to Oscilloscopes and Recorders
Display Resolution
Display Units Selection
Fixed IF or LO Frequency Selection
HP-IB Addresses, Noise Figure Meter and External LO
IF Attenuation Selection
Loss Compensation
Manual Measurement Functions
Measurement Mode 1.0
Measurement Mode 1.1
Measurement Mode 1.2
Measurement Mode 1.3
Measurement Mode 1.4
Power Measurements
Preset Conditions and Power-Up Sequence
Programming an External LO
Programs Available to Control an External LO
RF Attenuation Selection
Sequence
Sideband Selection
Smoothing
Special Function Catalog
Spot ENR, T_{hot}, and T_{cold}
Temperature Units Selection
Trigger Selection

Table 3-14. Special Function Summary (1 of 8)

Special Function		Program Code	Description	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions	References and Comments
Name	Code*								
Initialize Special Functions	0.0	CS	Initializes many Special Functions	N	—	—	—		Preset Conditions and Power Up Sequence
Measurement Mode Selection	1.0	E0	Mode 1.0 (10—1500 MHz measurement)	N	Y	Y	On	On	Measurement Mode 1.0
	1.1	E1	Mode 1.1 (fixed IF; variable freq. ext LO)	N	Y	Y	Off	Off	Measurement Mode 1.1
	1.2	E2	Mode 1.2 (variable IF; fixed freq. ext LO; SSB)	N	Y	Y	Off	Off	Measurement Mode 1.2
	1.3	E3	Mode 1.3 (fixed IF; variable freq. ext LO; mixer is DUT)	N	Y	Y	Off	Off	Measurement Mode 1.3
	1.4	E4	Mode 1.4 (variable IF; fixed freq. ext LO; mixer is DUT)	N	Y	Y	Off	Off	Measurement Mode 1.4
Sideband Frequency Offset	2.0	B0	Double Sideband (no offset)	N	Y	Y	On	On	Sideband Selection
	2.1	B1	Lower Single Sideband ($F_{signal} < F_{LO}$)	Y	Y	Y	Off	Off	
	2.2	B2	Upper Single Sideband ($F_{signal} > F_{LO}$)	Y	Y	Y	Off	Off	
Enter IF and LO Frequencies	3.0	IF	IF (for Modes 1.1 & 1.3)	N	Y	Y	NC	30 MHz	Fixed IF or LO Frequency Selection
	3.1	LF	LO (for Modes 1.2 & 1.4)	N	Y	Y	NC	10 000 MHz	
Control Function Selection	4.0	none	Normal Talker and Listener	N	Y	N	NC	NC	Controller Capability of the Noise Figure Meter
	4.1	none	Enable Ext LO Control	N	Y	N	NC	NC	
	4.2	none	Talk Only	N	Y	N	NC	NC	

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.
N = No; Y = Yes; NC = No Change; — = Not Applicable

Table 3-14. Special Function Summary (2 of 8)

Special Function		Program Code	Description	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions	References and Comments
Name	Code*								
ENR and THOT Settings	5.0	S0	Use ENR Table	N	Y	Y	On	On	ENR Table Entry
	5.1	S1	Use Spot ENR	Y	Y	Y	Off	Off	
	5.2	SE	Display Current ENR in dB	N	N	N	Off	Off	
	5.3	NR	Enter and Use Spot ENR	N	Y	Y	NC	15.2 dB	
	5.4	TH	Enter and Use THOT	N	Y	Y	NC	9893K	
	5.5	SN	Enter Noise Source Identifier	N	Y	N	NC	NC	
TCOLD Setting	6.0	TC	Enter TCOLD	N	Y	Y	NC	296.5K	ENR Table Entry
Output to Oscilloscope	7.0	A0	Noise Figure and Gain	N	Y	N	On	On	Data Output to Oscilloscopes, and Recorders
	7.1	A1	Test Pattern	N	Y	N	Off	Off	
	7.2	A2	Noise Figure Only	N	Y	N	Off	Off	
	7.3	A3	Gain Only	N	Y	N	Off	Off	
Enter Oscilloscope Limits	8.1	NL	Noise Figure Lower Limit	N	Y	Y	NC	0	Data Output to Oscilloscopes and Recorders
	8.2	NU	Noise Figure Upper Limit	N	Y	Y	NC	8	
	8.3	GL	Gain Lower Limit	N	Y	Y	NC	0	
	8.4	GU	Gain Upper Limit	N	Y	Y	NC	40	
Power Measurements	9.1	N5	SOURCE Off (uncal)	N	Y	Y	Off	Off	Power Measurements
	9.2	N6	SOURCE On (uncal)	N	Y	Y	Off	Off	
	9.3	N7	SOURCE Off (cal)	N	Y	Y	Off	Off	
	9.4	N8	SOURCE On (cal)	N	Y	Y	Off	Off	
Noise Figure Display Units	10.0	N0	F dB	N	Y	Y	On	On	Display Units Selection
	10.1	N1	F	N	Y	Y	Off	Off	
	10.2	N2	Y dB	N	Y	Y	Off	Off	
	10.3	N3	Y	N	Y	Y	Off	Off	
	10.4	N4	TeK	N	Y	Y	Off	Off	

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.
N = No; Y = Yes; NC = No Change; — = Not Applicable

Table 3-14. Special Function Summary (3 of 8)

Special Function		Program Code	Description	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions	References and Comments
Name	Code*								
Select Noise Source Temp. Units for Data Input	11.0	D0	K	N	Y	Y	On	On	Temperature Units Selection (Also see Special Functions 5.4, 6.0 and 34.3)
	11.1	D1	°C	N	Y	Y	Off	Off	
	11.2	D2	°F	N	Y	Y	Off	Off	
Display Resolution	12.0	X0	Maximum Resolution	N	Y	N	On	On	Display Resolution
	12.1	X1	Less Res. on Noise Figure	N	Y	N	Off	Off	
	12.2	X2	Less Res. on Gain	N	Y	N	Off	Off	
Smoothing (Averaging)	13.0	V0	Exponential Smoothing	N	Y	N	On	On	Smoothing (Averaging)
	13.1	V1	Arithmetic Averaging	N	Y	N	Off	Off	
	13.2	AF	Smoothing Factor	N	Y	N	NC	1	
Manual Measurement Functions	14.1	MC	Cold Measurement (SOURCE-off)	N	Y	Y	Off	Off	Manual Measurement Functions
	14.2	MH	Hot Measurement (SOURCE-on)	N	Y	Y	Off	Off	
	14.3	CC	Cold Calibration (SOURCE-off)	N	Y	Y	Off	Off	
	14.4	CH	Hot Calibration (SOURCE-on)	N	Y	Y	Off	Off	
	15.0	P0	Display Current Measurement	N	N	Y	On	On	
	15.1	P1	Display Manual Measurement Results	Y	N	Y	Off	Off	
Recorder Functions	20.0	LL	Go to Lower Left	N	N	N	Off	Off	Data Output to Oscilloscopes and Recorders
	21.0	UR	Go to Upper Right	N	N	N	Off	Off	
	22.0	A4	Plot Noise Figure	N	Y	N	Off	Off	
	23.0	A5	Plot Gain	N	Y	N	Off	Off	
	24.0	A6	X-AXIS Output is Noise Figure and Y-AXIS Output is Gain (Strip Chart mode)	N	Y	N	Off	Off	Data Output to Oscilloscopes and Recorders

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.
N = No; Y = Yes; NC = No Change; — = Not Applicable

Table 3-14. Special Function Summary (4 of 8)

Special Function		Program Code	Description	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions	References and Comments
Name	Code*								
Trigger Selection	30.0	T0	Free Run	N	N	N	On	On	Trigger Selection
	30.1	T1	Hold	N	N	N	Off	Off	
	30.2	T2	Execute	N	N	N	Off	Off	
Frequency Calibration	31.0	Y0	Automatic	N	N	N	On	On	Calibration, Frequency
	31.1	Y1	Disable Frequency Cal	N	N	N	Off	Off	
	31.2	Y2	Perform 1 Frequency Cal	N	N	N	Off	Off	
Input Gain Calibration	32.0	C0	20, 10 and 0 dB	N	N	N	On	On	Calibration, Input Gain Selection
	32.1	C1	10, 0 and −10 dB	Y	N	N	Off	Off	
	32.2	C2	0, −10 and −20 dB	Y	N	N	Off	Off	
	32.3	C3	−10, −20 and −30 dB	Y	N	N	Off	Off	
IF Attenuators Calibration	33.0	IC	Calibrate IF Attenuators	N	Y	N	Off	Off	Calibration, IF Attenuators
Loss Compensation	34.0	L0	Off	N	Y	N	On	On	Loss Compensation
	34.1	L1	On	Y	Y	N	Off	Off	
	34.2	LA	Enter Loss before DUT in dB	N	Y	N	NC	0 dB	
	34.3	LT	Enter Temperature of Losses	N	Y	N	NC	0K	
	34.4	LB	Enter Loss after DUT in dB	N	Y	N	NC	0 dB	
Sequence Functions	35.0	QM	Manual	N	N	N	On	On	Sequence
	35.1	QA	Automatic	N[1]	N	N	Off	Off	
	35.2	QS	Set	N	Y	N	NC	1—9	[1]Enables Special Function Key LED to light when SEQ is pressed.
	35.3	QC	Clear	N	N	N	Off	Off	
HP-IB Addresses	40.0	none	Display and Enter 8970A Address	N	Y	N	NC	NC	HP-IB Addresses
	40.1	EA	Display and Enter Ext LO Address	N	Y	N	NC	NC	

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.
N = No; Y = Yes; NC = No Change; — = Not Applicable

Table 3-14. Special Function Summary (5 of 7)

Special Function		Program Code	Description	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions	References and Comments
Name	Code*								
External LO Programs	41.0	J0	HP 8350B Sweep Oscillator	N	Y	N	NC	NC	Programs Available to Control an External LO
	41.2	J2	HP 8672A Syn. Signal Generator	N	Y	N	NC	NC	
	41.3	J3	HP 8673B Syn. Signal Generator	N	Y	N	NC	NC	
External LO Commands	42.0	AC	Auxilliary Commands	N	Y	Y	NC	NC	Programming an External LO
	42.1	PS	CW Prefix and Suffix	N	Y	N	NC	NC	
	42.2	TM	Settling Time in ms	N	Y	N	NC	NC	
	42.3	MN	Min Frequency in MHz	N	Y	N	NC	NC	
	42.4	MX	Max Frequency in MHz	N	Y	N	NC	NC	
HP-IB Data Output Selection	43.0	H0	NOISE FIGURE Only	N	N	N	On	On	Refer to Remote Operation, Hewlett-Packard Interface Bus
	43.1	H1	Frequency (left display), INSERTION GAIN, NOISE FIGURE	N	N	N	Off	Off	
Service Request	44.0	Q0	Disable SRQ Capability (clears all enabled conditions)	N	N	N	Off	Off	Refer to Remote Operations, Hewlett-Packard Interface Bus
	44.1	Q1	Enable Data Ready to cause an SRQ	N	N	N	Off	Off	
	44.2	Q2	Enable Cal Complete to cause an SRQ	N	N	N	Off	Off	
	44.3	Q3	Enable HP-IB Code Error to cause an SRQ	N	N	N	On	On	
	44.6	Q6	Enable Instrument Error to cause an SRQ	N	N	N	Off	Off	

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.
N = No; Y = Yes; NC = No Change; — — Not Applicable

Table 3-14. Special Function Summary (6 of 8)

Special Function		Program Code	Description	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions	References and Comments
Name	Code*								
Special Function Catalog	50.0	G0	Scan Special Function Catalog Lines	N	N	N	Off	Off	Special Function Catalog
	50.1	G1	Line 1 Status	N	N	N	Off	Off	
	50.2	G2	Line 2 Status	N	N	N	Off	Off	
	50.3	G3	Line 3 Status	N	N	N	Off	Off	
	50.4	G4	Line 4 Status	N	N	N	Off	Off	
	50.5	G5	Line 5 Status	N	N	N	Off	Off	
	50.6	G6	Line 6 Status	N	N	N	Off	Off	
RF Attenuation Selection	60.0	R0	Auto	N	N	N	On	On	RF Attenuation Selection
	60.1	R1	+20 dB	Y	N	N	Off	Off	
	60.2	R2	+10 dB	Y	N	N	Off	Off	
	60.3	R3	0 dB	Y	N	N	Off	Off	
	60.4	R4	−10 dB	Y	N	N	Off	Off	
	60.5	R5	−20 dB	Y	N	N	Off	Off	
	60.6	R6	−30 dB	Y	N	N	Off	Off	
Display RF Attenuator Settings	61.0	SR	Display RF Attenuators	N	N	N	Off	Off	RF Attenuation Selection
RF Attenuator Hold	62.0	RH	RF Attenuators are held in the configuration that exists when Special Function 62.0 is activated	Y	N	N	Off	Off	RF AttenuationSelection
Individual RF Attenuator Selection	63.0	Z0	Select RF through Path	Y	N	N	Off	Off	RF Attenuation Selection
	63.1	Z1	Select 10 dB Pad Number 1	Y	N	N	Off	Off	Refer to Section VIII, Service
	63.2	Z2	Select 20 dB Input Amplifier	Y	N	N	Off	Off	
	63.4	Z4	Select 10 dB Pad Number 2	Y	N	N	Off	Off	
	63.5	Z5	Select 10 dB Pad Number 3	Y	N	N	Off	Off	

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.
N = No; Y = Yes; NC = No Change; — = Not Applicable

Table 3-14. Special Function Summary (7 of 8)

Special Function		Program Code	Description	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions	References and Comments
Name	Code*								
IF Attenuation Selection	70.0	I0	Auto	N	N	N	On	On	IF Attenuation Selection
	70.1	I1	0 dB	Y	N	N	Off	Off	
	70.2	I2	5 dB	Y	N	N	Off	Off	
	70.3	I3	10 dB	Y	N	N	Off	Off	
	70.4	I4	15 dB	Y	N	N	Off	Off	
	70.5	I5	20 dB	Y	N	N	Off	Off	
	70.6	I6	25 dB	Y	N	N	Off	Off	
	70.7	I7	30 dB	Y	N	N	Off	Off	
	70.8	I8	35 dB	Y	N	N	Off	Off	
Display IF Attenuator Settings	71.0	SI	Display IF Attenuators	N	N	N	Off	Off	IF Attenuation Selection
IF Attenuator Hold	72.0	IH	IF Attenuators are held in the configuration that exists when Special Function 72.0 is activated	Y	N	N	Off	Off	IF Attenuation Selection
Voltmeter Mode	80.0	VC	Noise Source Off	N	Y	Y	Off	Off	Refer to Section VIII, Service
	81.0	VH	Noise Source On	N	Y	Y	Off	Off	
Recorder Test Functions	82.0	A7	Enable Recorder Test	N	N	N	Off	Off	Refer to Section VIII, Service
	82.1	XV	X-Axis Test	N	N	N	0	NC	
	82.2	YV	Y- Axis Test	N	N	N	0	NC	
Keyboard Test	90.0	KY	Display Key Codes	N	N	N	Off	Off	Refer to Section VIII, Service
	90.1	K1	Key Test—Row 1	N	N	N	Off	Off	
	90.2	K2	Key Test—Row 2	N	N	N	Off	Off	
	90.3	K3	Key Test—Row 3	N	N	N	Off	Off	
	90.4	K4	Key Test—Row 4	N	N	N	Off	Off	
	90.5	K5	Key Test—Row 5	N	N	N	Off	Off	
	90.6	K6	Key Test—Row 6	N	N	N	Off	Off	
	90.7	K7	Key Test—Row 7	N	N	N	Off	Off	
	90.8	K8	Key Test—Row 8	N	N	N	Off	Off	

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.
N = No; Y = Yes; NC = No Change; — = Not Applicable

Table 3-14. Special Function Summary (8 of 8)

Special Function		Program Code	Description	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions	References and Comments
Name	Code*								
Display Test	91.0	DT	Enable Display Test	N	N	N	Off	Off	Refer to Section VIII, Service
0 MHz Hold	92.0	U0	Off	N	N	N	On	On	Refer to Section VIII, Service
	92.1	U1	On	Y	N	N	Off	Off	
Default ENR	95.6	ND	Sets all ENR values to 15.20 dB and Noise Source ID No. to 00000	N	N	N	Off	Off	Refer to Section VIII, Service
Software Date	99.9	SD	Display Software Date	N	N	N	Off	Off	Refer to Section VIII, Service

*Most Special Functions can be programmed using either the code number followed by SP or the HP-IB Code.
N = No; Y = Yes; NC = No Change; — = Not Applicable

Spot ENR, T_{hot}, and T_{cold}

(Special Functions 5 and 6)

Description

Special Functions 5 and 6 perform the following functions:

a. Special Function 5.0 enables use of the ENR (Excess Noise Ratio) table data that was previously entered (refer to the ENR Table Entry Detailed Operating Instruction). This function disables spot ENR. (Spot ENR can be re-enabled using Special Function 5.1).

b. Special Function 5.1 enables use of the previously entered spot ENR value (refer to Special Function 5.3). The ENR table is disabled and the single spot ENR value will be used at all frequencies. (The ENR table can be re-enabled using Special Function 5.0).

c. Special Function 5.2 enables the current value of ENR being used by the instrument to be displayed.

d. Special Function 5.3 enables entry and use of a spot ENR value. The allowable values for spot ENR range from −7 to +17 dB.

e. Special Function 5.4 enables entry and use of T_{hot}. Some noise sources are specified in terms of T_{hot} instead of ENR. The allowable values for T_{hot} (in kelvins) range from 0 to 14824. The equation to convert T_{hot} (in kelvins) to ENR is:

$$ENR = 10 \log (T_{hot}/290 - 1)$$

f. Special Function 5.5 enables display and entry of the noise source identifier. Up to five digits, within the range of 0 to 60000 can be used to identify the noise source. For example, the serial number of the noise source for which the ENR table data was entered can be used.

g. Special Function 6.0 enables entry of a value for T_{cold}. T_{hot} and T_{cold} are used for hot/cold manual measurements. The allowable values for T_{cold} (in kelvins) range from 0 to 9999.

Procedure

To enable use of the ENR table data or spot ENR data, or to display the current ENR, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

To display and enable entry of spot ENR, T_{hot}, T_{cold}, or the noise source identifier, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key. Next, enter the appropriate value using the DATA keys and press ENTER.

Spot ENR, T_{hot}, and T_{cold} (cont'd)

(Special Functions 5 and 6)

Procedure (cont'd)

Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Use ENR Table Data	5.0	S0 or 5.0SP	N	Y	Y	On	On
Use Spot ENR Data	5.1	S1 or 5.1 SP	Y	Y	Y	Off	Off
Display Current ENR in dB	5.2	SE or 5.2SP	N	N	N	Off	Off
Enter and Use Spot ENR	5.3	NE or 5.3SP	N	Y	Y	NC	15.2 dB
Enter and Use T_{hot}	5.4	TH or 5.4SP	N	Y	Y	NC	9893K
Enter Noise Source Identifier	5.5	SN or 5.5SP	N	Y	N	NC	NC
Enter T_{cold}	6.0	TC or 6.0SP	N	Y	Y	NC	296.5K

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example

To enter and use a value of 9800K for T_{hot} (assuming Special Function 11.0 is active).

LOCAL (keystrokes)	Code: 5 . 4 — Function: • SPECIAL FUNCTION — Data: 9 8 0 0 — Function: ENTER
HP-IB (program codes)	TH9800EN (Code: TH; Data: 9800; Function: EN)

Program Codes

HP-IB

For HP-IB codes for Special Functions 5 and 6, refer to Procedure above. The program code for ENTER is EN.

Indications

When Special Function 5.2 or 5.3 is active, the current ENR or spot ENR is shown in the left display in units of dB. If a new spot ENR value is entered, it appears in the left display for as long as the ENTER key is depressed.

When Special Function 5.4 or 6.0 is active, T_{hot} or T_{cold} is shown in the left display in the temperature unit selected by Special Function 11. If a new value is entered for either T_{hot} or T_{cold}, it appears in the left display for as long as the ENTER key is depressed.

When Special Function 5.5 is active, the left display shows five digits. No units are displayed.

Related Sections

ENR Table Entry
Manual Measurement Functions
Special Functions
Temperature Units Selection

Store and Recall

Description Up to ten instrument configurations can be stored in the Noise Figure Meter's storage registers. Front panel settings that are stored and recalled are FREQUENCY, FREQ INCR, START FREQ, STOP FREQ, and STEP SIZE. Table 3-14, Special Function Summary, in the Special Functions Detailed Operating Instruction has a complete listing of special functions that can and cannot be stored and recalled.

Procedure Press STORE and a Data key (a single digit 0-9 to identify the storage register).

Press RECALL and a Data key (a single digit 0-9 to identify the storage register).

Example To recall an instrument configuration that has been stored in register 2:

LOCAL (keystrokes)	Function: RECALL Data: 2
HP-IB (program codes)	RC2 (Code: RC, Data: 2)

Program Codes HP-IB

Key	Program Code HP-IB
STORE	ST
RECALL	RC

Indications When the stored contents of a register are recalled, the instrument configuration changes to the recalled parameter values.

Comments If any key other than a digit is pressed after STORE or RECALL, the store or recall entry will be rejected.

The data in the storage registers is not affected by PRESET or Special Function 0.0.

When the Noise Figure Meter is turned off, data stored in the registers is retained.

Related Sections
Preset Conditions and Power-Up Sequence
Sequence
Special Functions

Sweep

Description

The Noise Figure Meter can sweep the measurement frequency from START FREQ to STOP FREQ. The frequency changes in discrete steps (as set by STEP SIZE) rather than in a continuous analog manner.

The allowable sweep range depends on the measurement mode selected.

Measurement Mode	Range of Sweep	Conditions
1.0	10 to 1500 MHz	
1.1	1 MHz to 60 GHz	Depends on the frequency range of the external LO and the noise source.
1.2	>10 to <1500 MHz	External LO must be set up so that variable IF sweeps 10 to 1500 MHz.
1.3	1 MHz to 60 GHz	Depends on the frequency range of the external LO and the noise source.
1.4	10 to 1500 MHz	IF port response of mixer is being measured. Left display shows IF.

The minimum step size is 1 MHz. The maximum number of frequency points allowable in one sweep is

$$\frac{\text{STOP FREQ - START FREQ}}{\text{STEP SIZE}} + 1$$

However, the maximum number of frequency points that should be used when the sweep is displayed on an oscilloscope is 256. If more points are swept, multiple readings could occur at some points. Other limitations may be caused by the external LO.

Two sweep modes are available: Auto and Single. Each mode uses the sweep parameters that were previously set. Auto mode executes a repetitive sweep, restarting at the end of each sweep. Single mode executes one sweep only. At the end of a single sweep, the instrument remains tuned to the stop frequency.

Procedure

Sweep Range Selection. The START FREQ and STOP FREQ keys set the starting and stopping points of the frequency sweep. STEP SIZE sets the frequency increment. Sweep parameters are selected in a Function - Data - ENTER format. Note that all frequency inputs from the front panel are in MHz.

Sweep Mode Selection. Press the desired mode key (AUTO or SINGLE) to initiate a sweep. To turn a sweep off, press the active sweep mode key a second time.

Sweep (cont'd)

Procedure (cont'd)

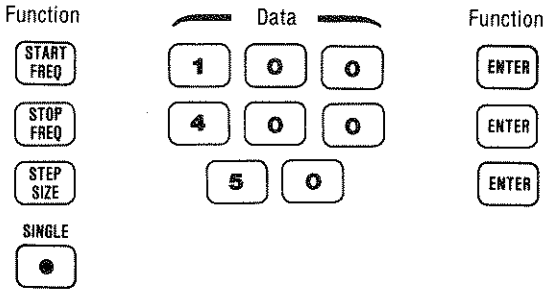
Front Panel Key	Program Code (HP-IB)	Stored in Continuous Memory	Can be Stored and Recalled	Preset (and HP-IB Clear) Conditions
AUTO	W1	N	N	Off
SINGLE	W2	N	N	Off
START FREQ	FA	Y	Y	10 MHz
STEP SIZE	SS	Y	Y	20 MHz
STOP FREQ	FB	Y	Y	1500 MHz

Table categories are explained in the Preset Conditions and Power-Up Sequence Detailed Operating Instruction.

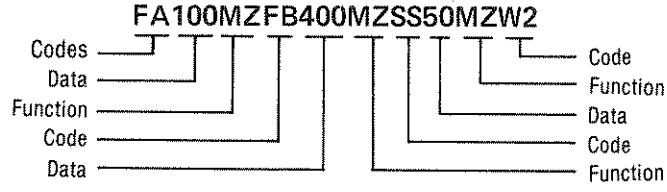
Example

To sweep from 100 MHz to 400 MHz in 50 MHz steps once only:

LOCAL (keystrokes)



(HP-IB) (program codes)



Program Codes (HP-IB)

Parameter	Program Code (HP-IB)
Hz	HZ
MHz	MZ
Sweep Off	W0

For additional HP-IB program codes, refer to Procedure above.

Indications

When the START FREQ or STOP FREQ key is pressed, the left display shows the currently programmed start or stop frequency. The instrument tunes to that frequency and continues measuring there. As a new start or stop frequency is entered, it appears in the left display. When the STEP SIZE key is pressed, the left display shows the step size only for as long as the key is held down. A newly entered value is displayed for as long as the ENTER key is held down.

Sweep (cont'd)

Indications (cont'd)

When the AUTO or SINGLE key is pressed, the LED within the corresponding key lights to indicate that the instrument is in the sweep mode.

Comments

If the stop frequency is less than the start frequency, the instrument sweeps downward. The sweep is slower when it operates in this manner. However, calibration and plotting must be performed in ascending frequency order only.

Pressing the AUTO key starts a sweep at the current frequency if the current frequency is not outside the start-stop range. If the current frequency is outside the start-stop range, the auto sweep starts at the programmed start frequency. To assure that an auto sweep starts at the programmed start frequency, press START FREQ, then AUTO.

AUTO and SINGLE are toggle keys, and they stop the sweep when pressed a second time. However, program codes W1 and W2 do not toggle over the HP-IB. Use program code W0 to stop a sweep over the HP-IB.

Any front panel key except LOCAL, DECREASE, INCREASE, SPECIAL FUNCTION, NOISE FIGURE, and NOISE FIGURE AND GAIN stop the sweep when pressed.

START FREQ, STOP FREQ, and STEP SIZE set the calibration parameters. During calibration, the maximum number of frequency points allowed in a sweep is 81.

If the last step of a sweep causes the frequency to exceed the programmed stop frequency, the Noise Figure Meter tunes a partial step to reach the programmed stop frequency.

Related Sections

Calibrate
Measurement Modes 1.0 through 1.4

Temperature Units Selection
(Special Function 11)

Description Temperature units are used when loss temperature, T_{hot}, or T_{cold} data is entered into the instrument. The instrument can accept temperature data entries in three different measurement units: Kelvins (K), Fahrenheit (°F), or Celsius (°C).

Procedure To select a temperture unit, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code (HP-IB)	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
K	11.0	D0 or 11.0SP	N	Y	Y	On	On
°C	11.1	D1 or 11.1SP	N	Y	Y	Off	Off
°F	11.2	D2 or 11.2SP	N	Y	Y	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

It is not necessary to select temperature units each time temperature data is entered. Once a temperature unit has been selected, all temperature data are entered and displayed in the same unit until that unit is changed (either by PRESET, Special Function 0.0, or by another temperature unit selection).

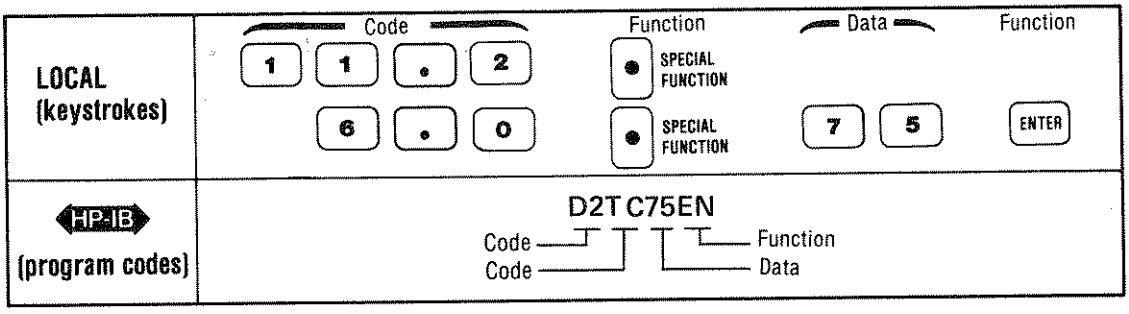
After a temperature unit has been selected, one of the special functions listed below must be active before temperature data can be entered.

Description	Special Function Code	Range of Values		
		K	°C	°F
Enter and Use T_{hot}	5.4	0 to 14824	−273.2 to 14551	−459.7 to 26224
Enter T_{cold}	6.0	0 to 9999	−273.2 to 9725.9	−459.7 to 17539
Enter Temperature of Losses	34.3	0 to 9999	−273.2 to 9725.9	−459.7 to 17539

Next, key in a value for temperature (within the specified range) and press the ENTER key. Up to five digits are allowed for temperature entries. If a minus sign is used, only four digits are allowed. The maximum resolution is to three places to the right of the decimal point.

Temperature Units Selection (cont'd)
(Special Function 11)

Example To enter a value of 75 °F for T_{cold}:



Program Codes HP-IB

For HP-IB codes, refer to Procedure above.

Indications When temperature data has been entered correctly, the selected unit appears in the left display.

Comments The equations used to convert from one temperature unit to another are:

$K = °C + 273.15$

$°F = (9/5)°C + 32$

Related Sections

ENR Table Entry
Loss Compensation
Special Functions
Spot ENR, T_{hot}, and T_{cold}

Trigger Selection
(Special Function 30)

Description

Special Function 30.0 selects free run triggering for continuous measurements.

Special Function 30.1 selects trigger hold to prevent continuous measurements. When trigger hold is active, the frequency and results of the last measurement are held and displayed. No additional measurements are made and the displayed data can be read over the HP-IB as many times as required. Trigger hold is useful when the measurement setup must be reconfigured before making the next measurement.

HP-IB

Special Function 30.2 triggers one measurement and then returns to the previously selected trigger mode. Normally, this trigger execute command is used in conjunction with the trigger hold mode. Once the measurement is complete, the results are displayed and are available via the HP-IB. The measurement results are also output to an oscilloscope or recorder if one is connected to the rear panel. If a smoothing factor other than one has been selected, the Noise Figure Meter makes the number of measurements required by the selected smoothing factor before the smoothed measurement is displayed or available via the HP-IB.

Procedure

To select a specific triggering mode, key in the corresponding Special Function code and then press the SPECIAL FUNCTION key.

Special Function		Program Code (HP-IB)	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Free Run	30.0	T0 or 30.0SP	N	N	N	On	On
Hold	30.1	T1 or 30.1 SP	N	N	N	Off	Off
Execute	30.2	T2 or 30.2SP	N	N	N	Off	Off

Table categories are explained in the Special Functions Detailed Operating Instruction.

Example

To select trigger hold and then execute a single measurement and return to trigger hold:

LOCAL (keystrokes)	Code: 3 0 . 1 — Function: SPECIAL FUNCTION 3 0 . 2 — SPECIAL FUNCTION
HP-IB (program codes)	T1T2

Trigger Selection (cont'd)
(Special Function 30)

Program Codes

HP-IB

For HP-IB codes, refer to Procedure.

Indications

When Special Function 30.0 is active, the front panel displays update continuously. When Special Function 30.1 is active, the front panel displays do not change. When Special Function 30.2 is active, the Noise Figure Meter makes one measurement and then returns to the last selected trigger mode.

Comments

When performing a triggered calibration, only the HP-IB mnemonic code T2 can be used. The Noise Figure Meter does not respond to the alternate 30.2SP code.

Related Sections

Calibrate
Measurement Modes 1.0 through 1.4
Smoothing
Special Functions