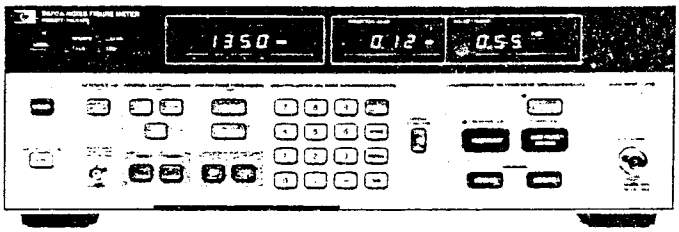
OPERATING AND SERVICE MANUAL

HP 8970A
NOISE FIGURE METER



HEWLETT PACKARD

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SERVICE SHEETS

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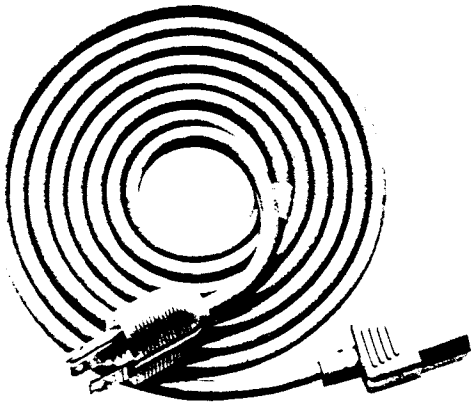
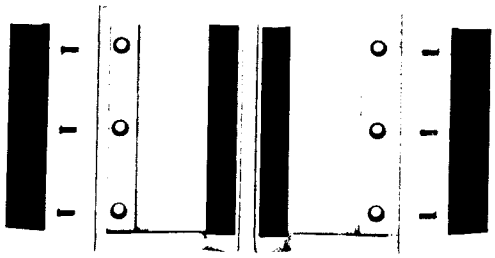
TABLES

TABLES (cont'd)

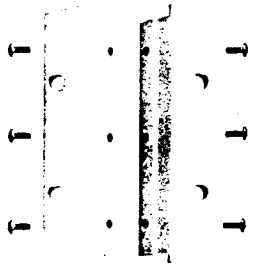
MODEL 8970A



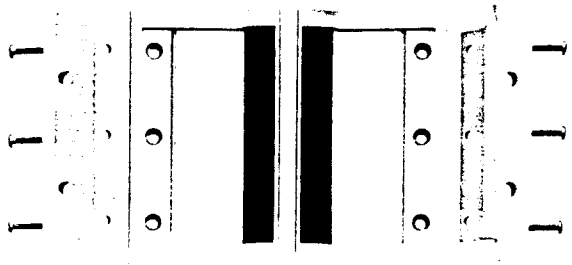
LINE POWER CABLE



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.

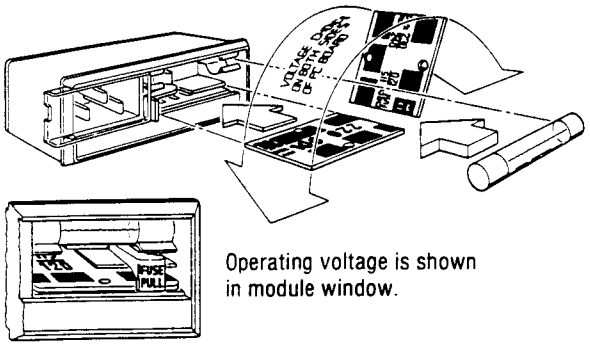
Verify that the line voltage selection card and the fuse are matched to the power source. Refer to Figure 2-1, Line Voltage and Fuse Selection.

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.

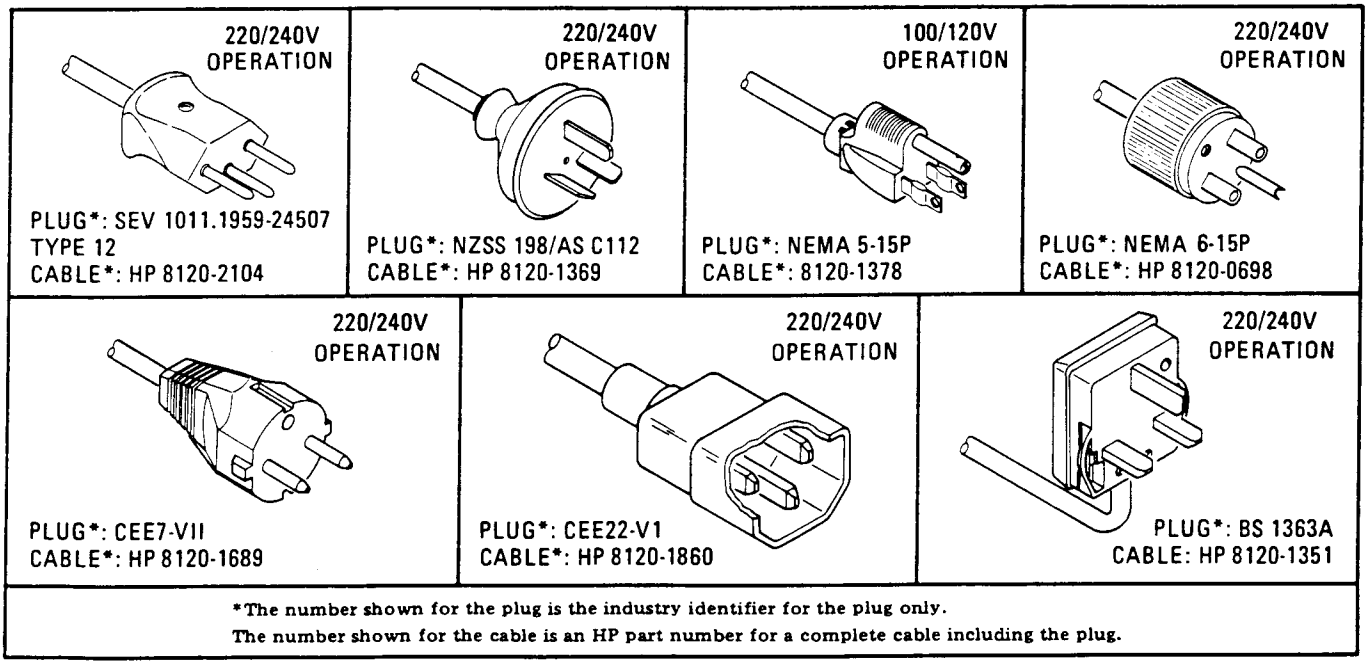
2-7. HP-IB Address Selection HP-IB

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.

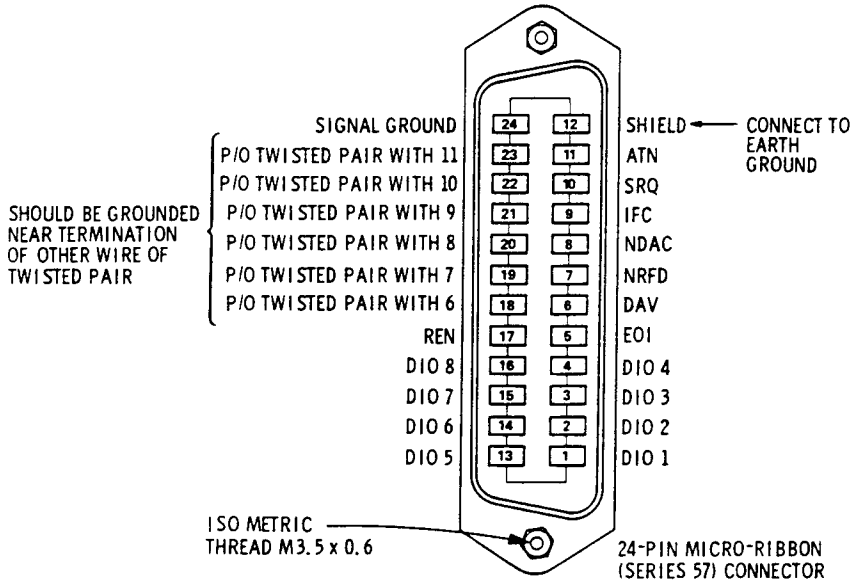
2-13. STORAGE AND SHIPMENT

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.)

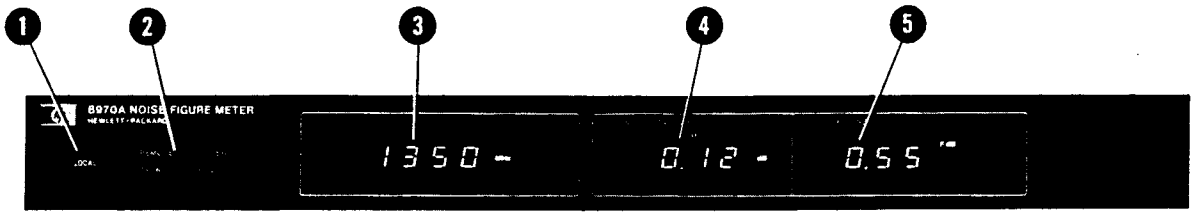
b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

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.

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.

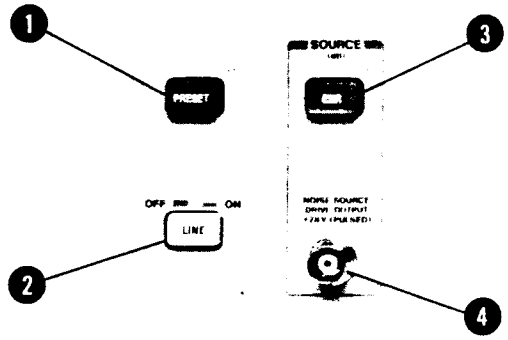
All data as it is being entered (except ENR in the "ENR versus Frequency" table).

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



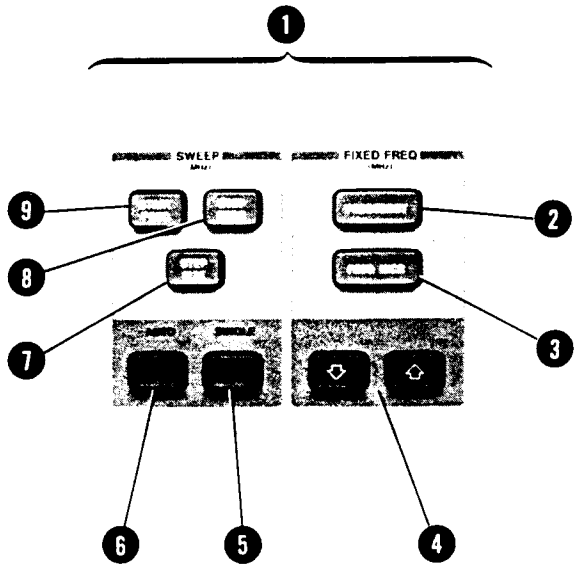
1 PRESET Key. Returns the instrument to a known state. Refer to the Preset Conditions and Power-Up Sequence Detailed Operating Instruction for a list of preset conditions and default values.

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.

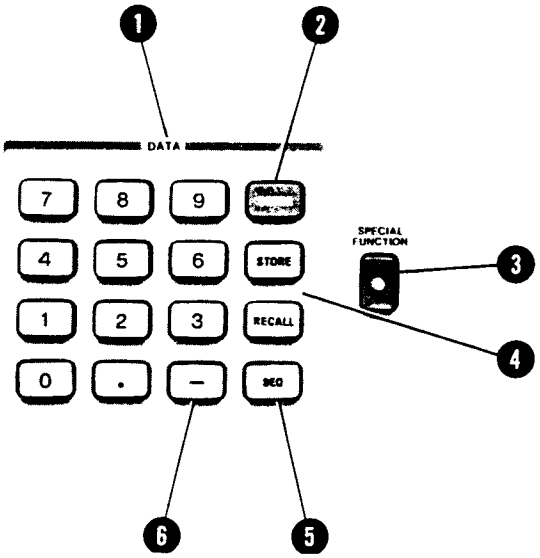
6 AUTO Key. Starts a sweep from the current frequency. The sweep repeats from START FREQ to STOP FREQ in increments determined by STEP SIZE until terminated. Auto sweep is terminated by pressing the AUTO key a second time.

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.

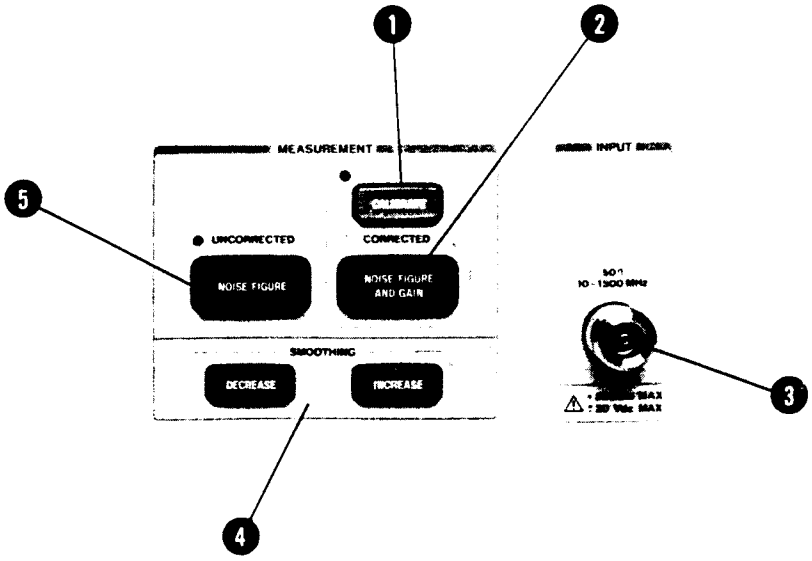
When the STORE key is used as a prefix for a numeric key (a single digit 0 — 9 to identify the register), the current instrument configuration is stored in that internal storage register.

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.

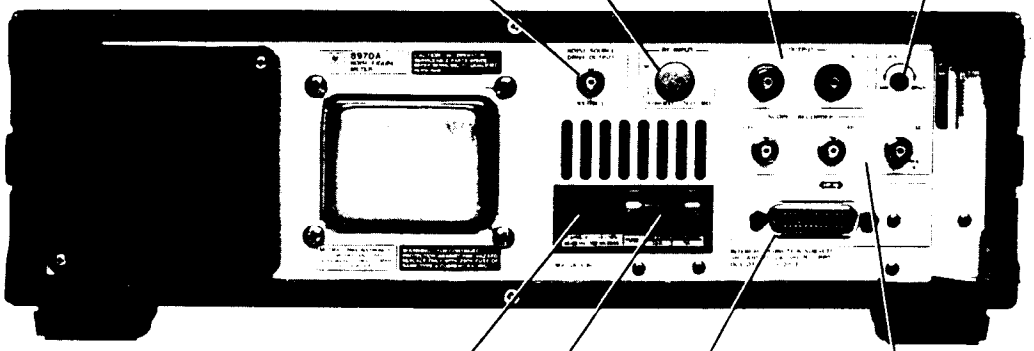
CAUTION

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.

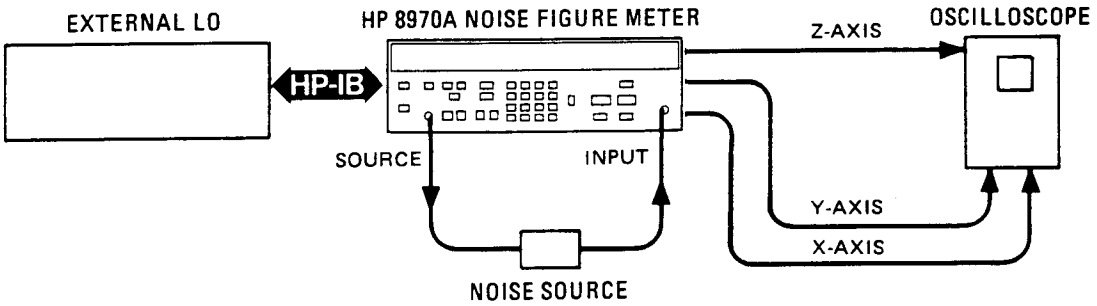


Figure 3-8. Basic Functional Checks Setup

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)

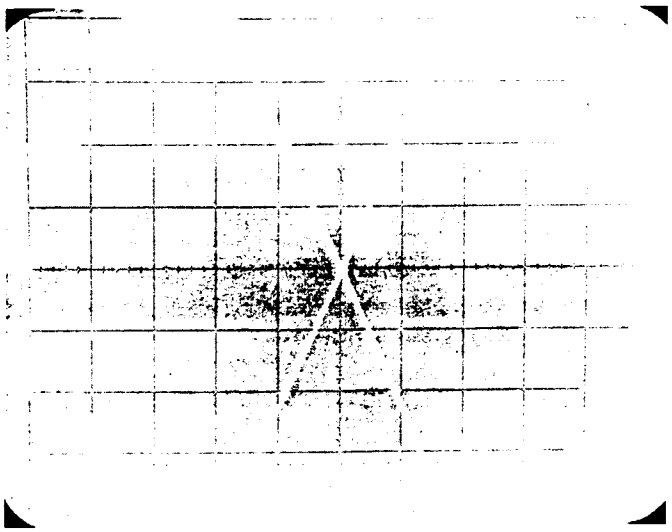


Figure 3-9. Test Pattern on Oscilloscope

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)

OPERATOR'S CHECKS

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.

OPERATOR'S CHECKS

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

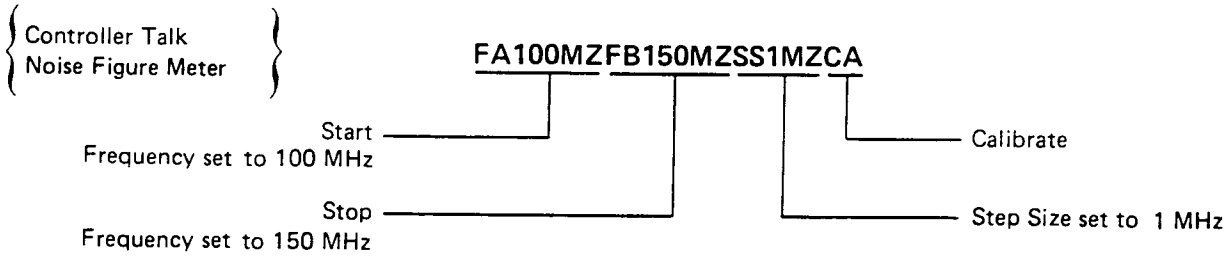


Table 3-3. Message Reference Table (1 of 2)

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

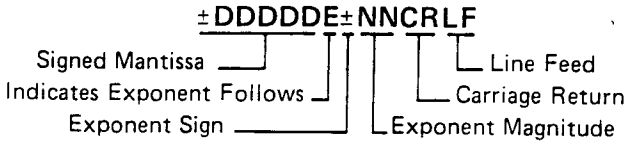
Depending on how the control functions are set, the Noise Figure Meter can either talk only, control an external LO, or talk and listen both (normal operation). If set to both talk and listen, the instrument sends Data messages when addressed to talk. The instrument then remains configured to talk until 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

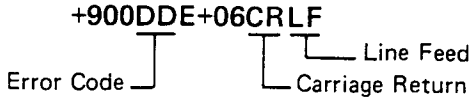
Front Panel Display[1]	HP-IB Output Format	Conditions
Left Display	+DDDDDE+06	Frequency
	±DDDDDE±NN	Data other than frequency
	+90000E+06	Display is blank
INSERTION GAIN[2]	±DDDDDE±NN	Gain is displayed
	+90000E+06	Display is blank
NOISE FIGURE[2]	±DDDDDE±NN	Normal display
	+DDDDDDE-05	Voltmeter mode
	+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

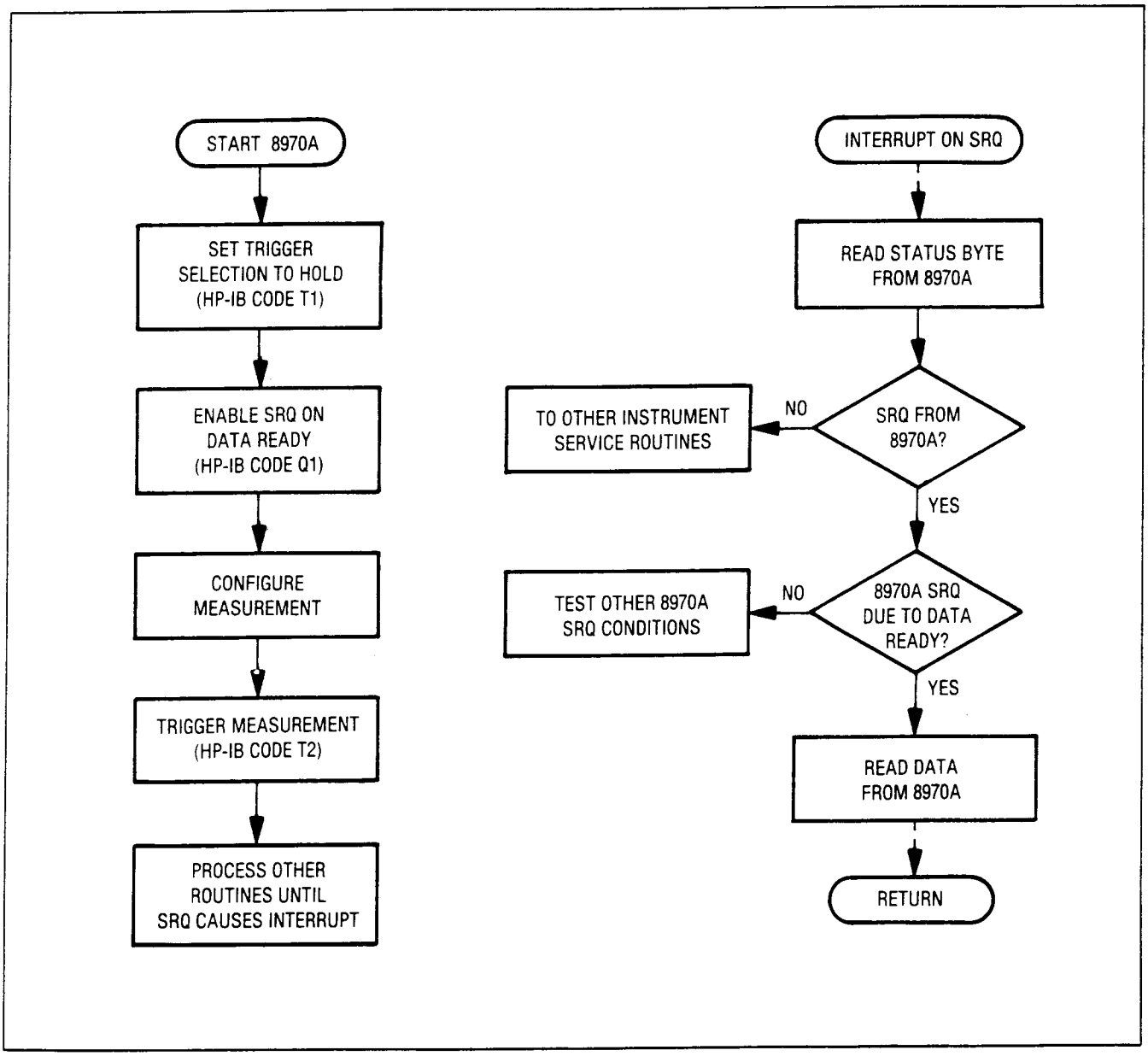


Figure 3.10 Example Flow Chart for Driving the Noise Figure Meter Using the Require Service Message (SRQ)

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

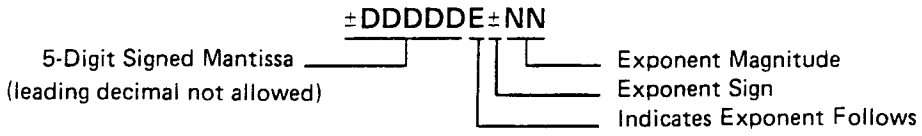
The Abort message is the means by which the controller sets the Interface Clear (IFC) bus control line true. When the Abort message is received, the Noise Figure Meter becomes unaddressed and stops talking or listening.

HP-IB

HP-IB SYNTAX AND CHARACTERISTICS SUMMARY

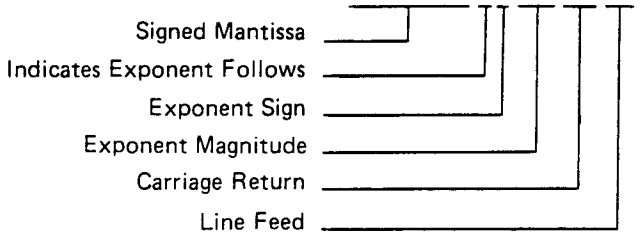
Address:
Selected and displayed on front panel using Special Function 44.0, Noise Figure Meter HP-IB Address. Factory set to 8 decimal.

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

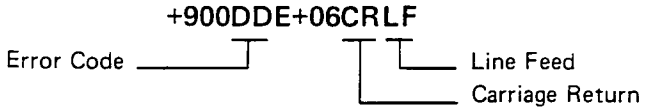


Output Formats: (Except in Voltmeter mode).*

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 turn these functions off over the HP-IB)	W0
NOISE FIGURE (UNCORRECTED)	M1		
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

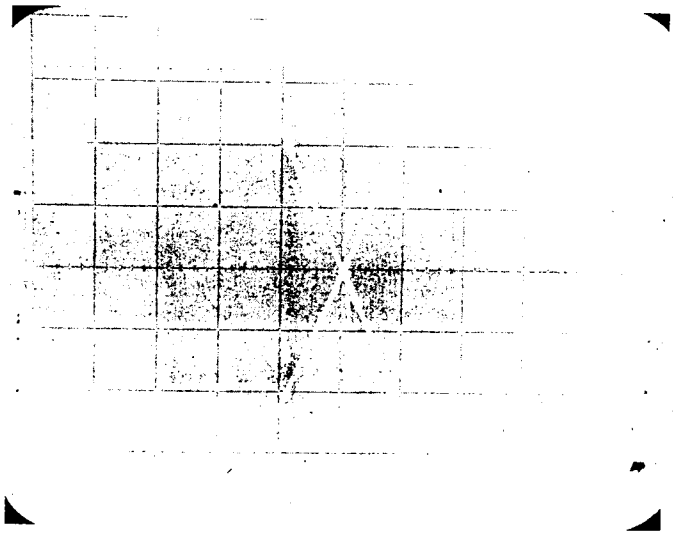
a. Connect the X-AXIS, Y-AXIS, and Z-AXIS outputs on the rear panel of the Noise Figure Meter to the A, B, and Z (or horizontal, vertical, and Z) inputs of the oscilloscope as appropriate. Select the DC mode for all oscilloscope inputs.

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)

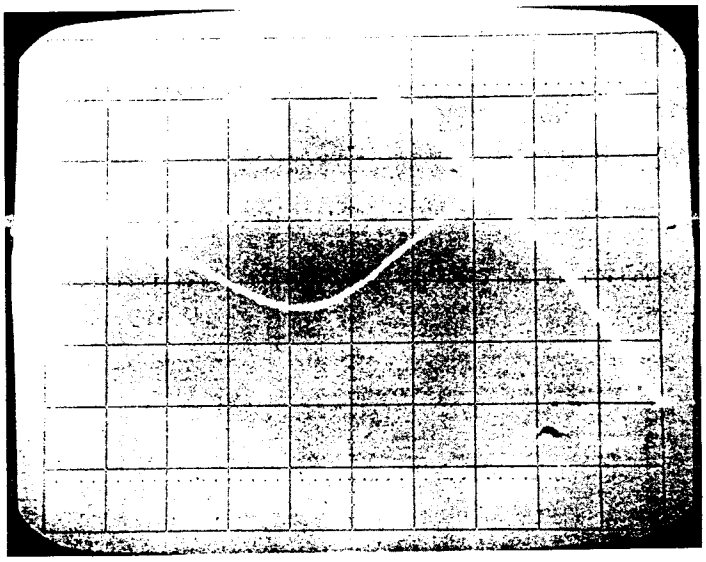
(Special Functions 7, 8, and 20 through 24)

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.

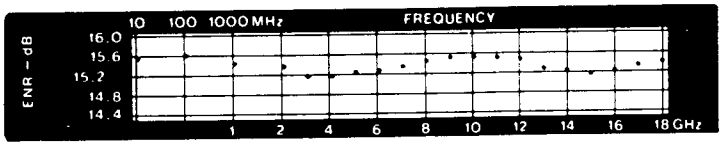
Related Sections

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.

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.

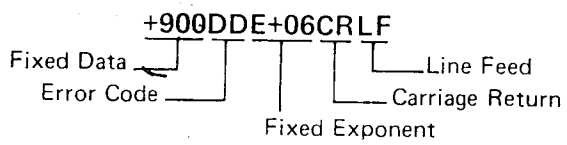
Nonvolatile errors typically occur when the instrument has received conflicting commands from the operator. The instrument stops making measurements and waits for the conflict to be resolved by the operator. An example of this type of conflict is selecting a corrected measurement when a calibration has 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

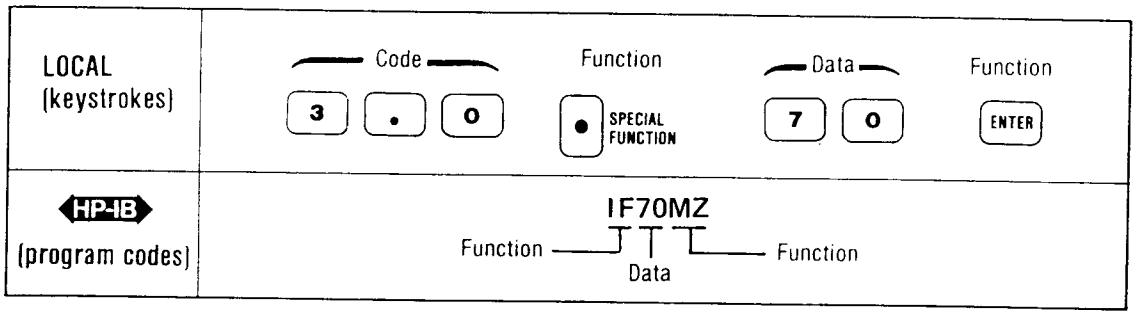
Table categories are explained in the Special Functions Detailed Operating Instruction.

Fixed IF or LO Frequency Selection (cont'd)

(Special Function 3)

Example

To select a fixed IF of 70 MHz:



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

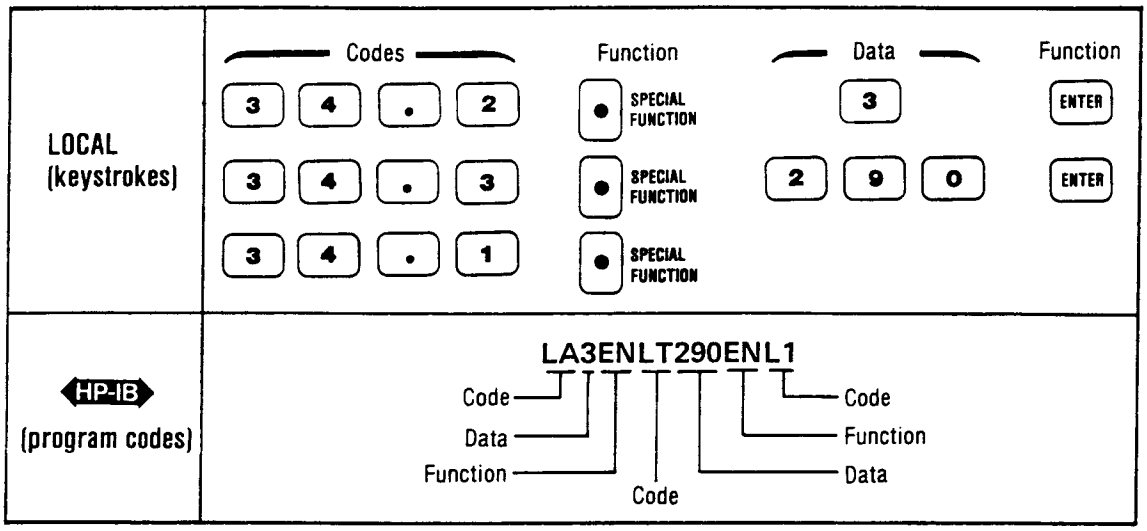
Table categories are explained in the Special Functions Detailed Operating Instruction.

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 Continuous 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.

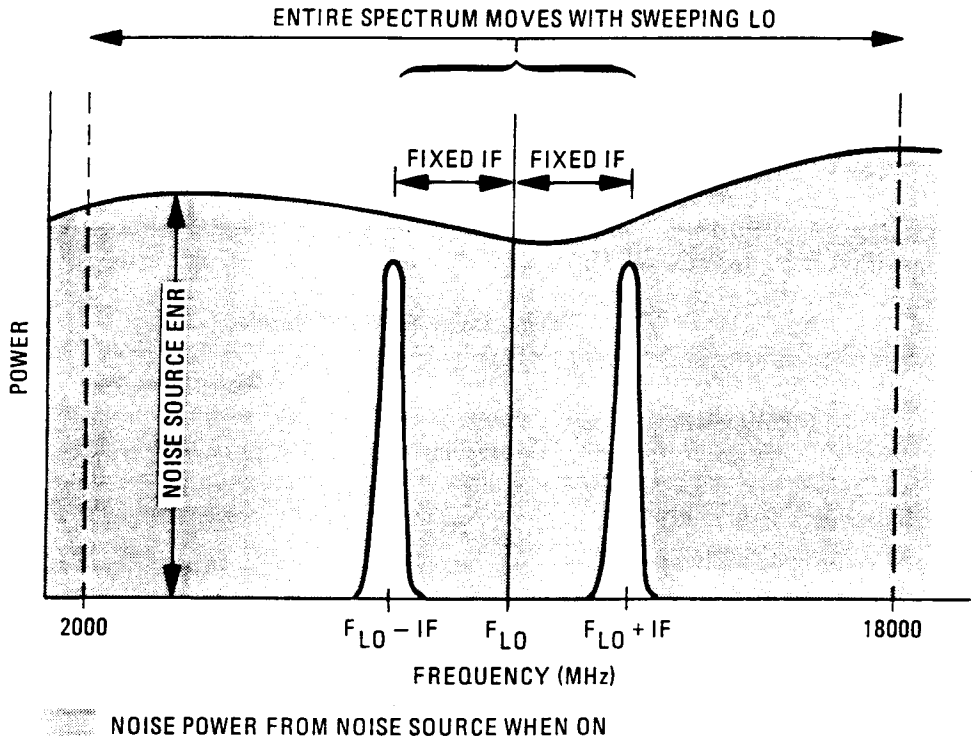
The noise source output is the same for all modes. For a noise source with a nominal Excess Noise Ratio (ENR) of 15.2 dB, the output is broadband random noise varying between approximately −158.8 dBm/Hz when on (hot) and −174 dBm/Hz when off (cold). The ENR of the noise source varies slightly over the 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.

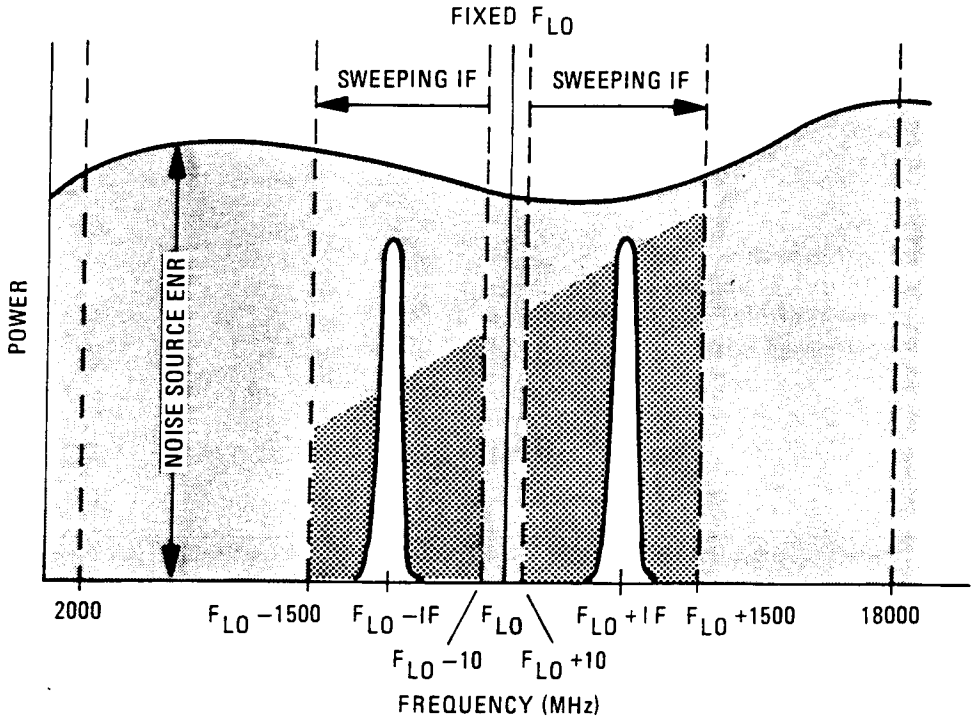
There is no mixer used in Measurement Mode 1.0. Looking back into the mixer in Measurement Modes 1.1 and 1.3, the Noise Figure Meter passband translates into two sidebands. Each sideband is separated from the LO frequency by a fixed IF (the receiving frequency of the Noise Figure Meter). As the LO frequency 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

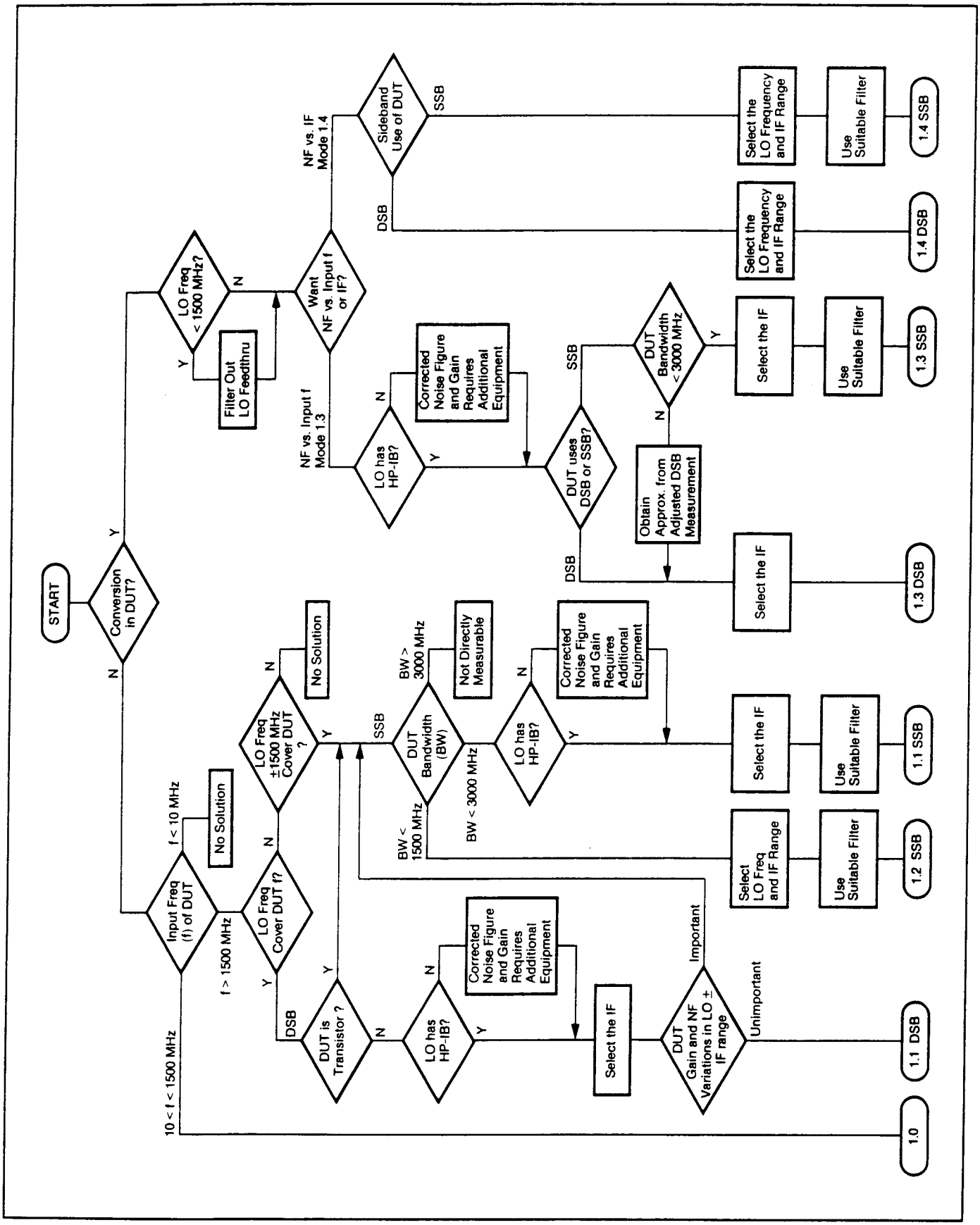
Prior to making any measurement, the Measurement Mode and sideband operation that are best suited to that specific measurement must be chosen.

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).

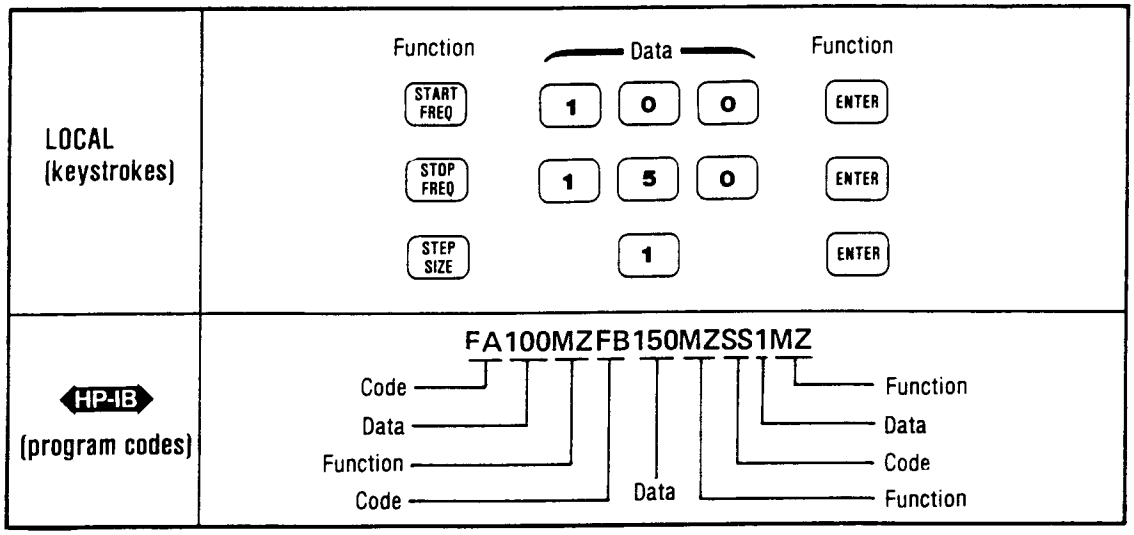
c. Insert DUT and measure.

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.

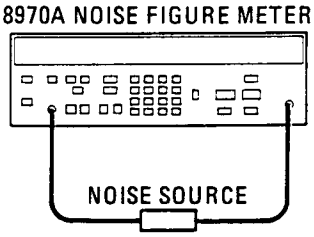


Measurement Mode 1.0 (cont'd)

(Special Function 1.0)

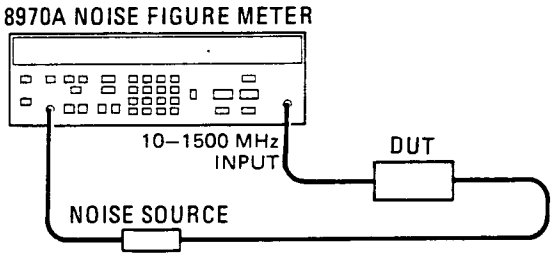
Example (cont'd)

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 instruetion.

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.

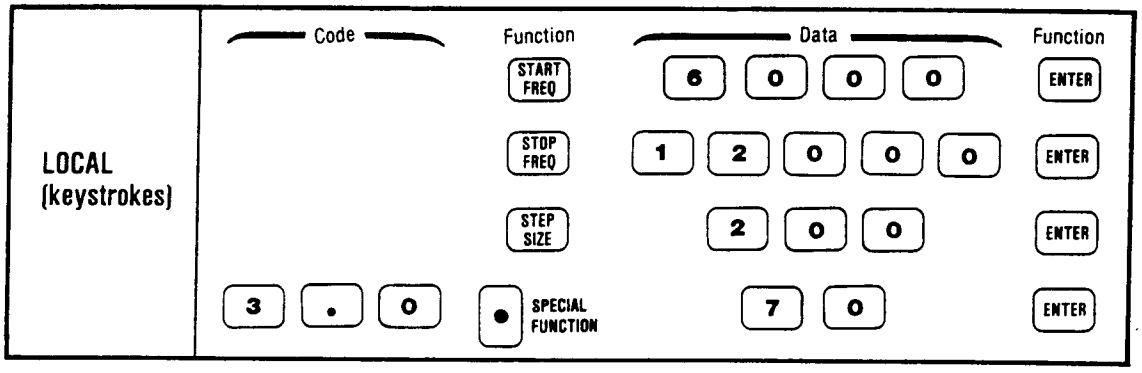
NOTE

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

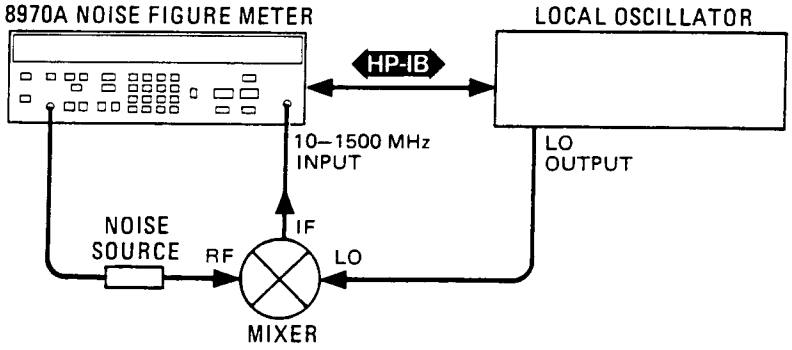
b. Press 1 . 1 SPECIAL FUNCTION to activate Measurement Mode 1.1.

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.



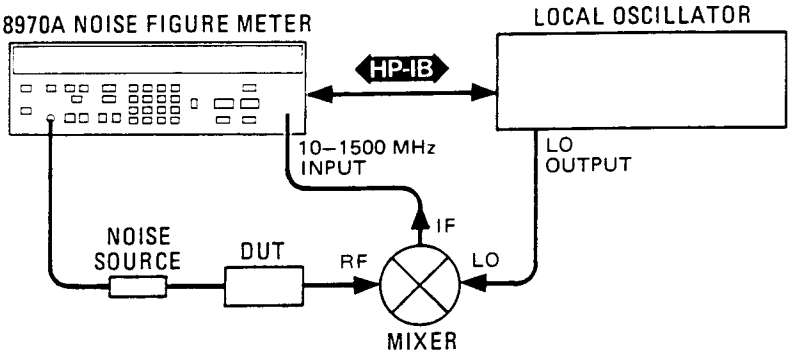
f. Calibrate the equipment in Measurement Mode 1.1 by pressing CALIBRATE.

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).

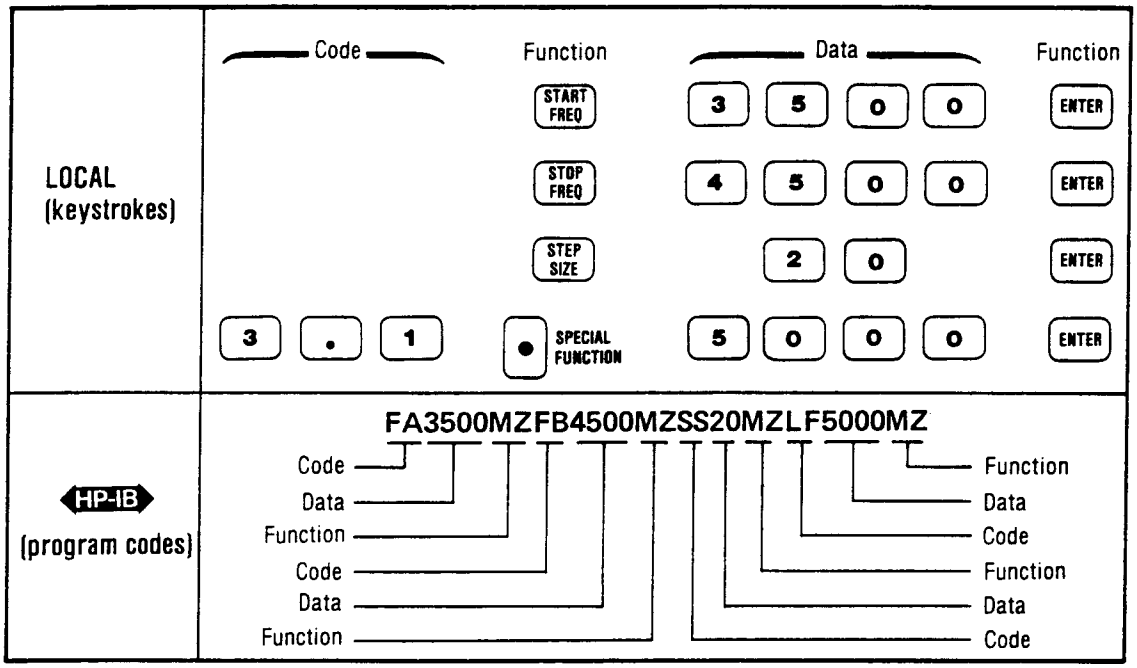
c. Press 1 . 2 SPECIAL FUNCTION (or send HP-IB code E2) to activate Mode 1.2. Note that error E33 (IF will be out of range) is displayed. This error is cleared when the correct frequency parameters are entered in step d.

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

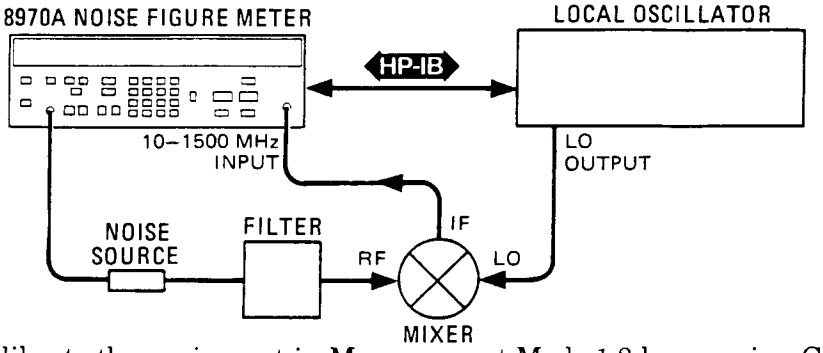
Measurement Mode 1.2 (cont'd)

(Special Function 1.2)

Example (cont'd)

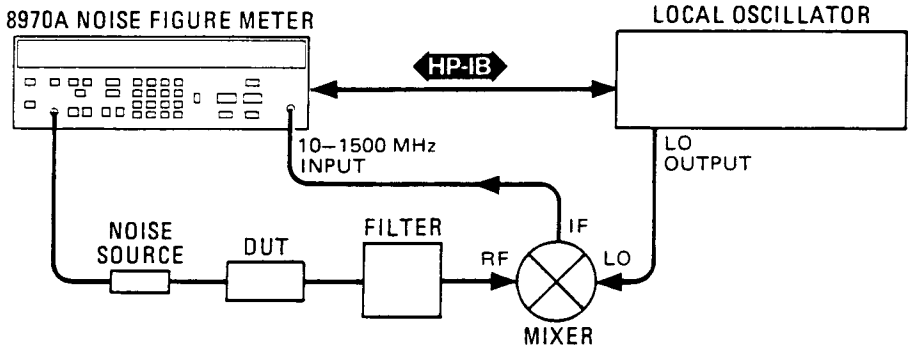


e. To calibrate the Noise Figure Meter, set up the equipment as shown below.



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

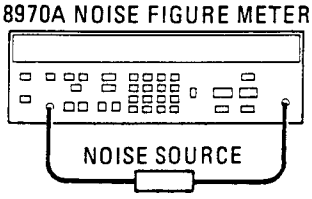
Measurement Mode 1.3 must be activated prior to entering the frequency parameters to avoid error E35 (entered value is out of range).

b. Press 1 . 3 SPECIAL FUNCTION to activate Measurement Mode 1.3.

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

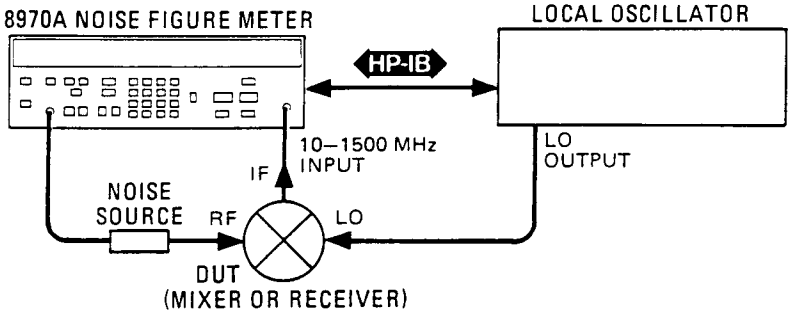
LOCAL (keystrokes)	Code	Function	Data	Function
		START FREQ	3 0 0 0	ENTER
		STOP FREQ	4 5 0 0	ENTER
		STEP SIZE	2 0	ENTER
	3 . 0	• SPECIAL FUNCTION	7 0	ENTER

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:

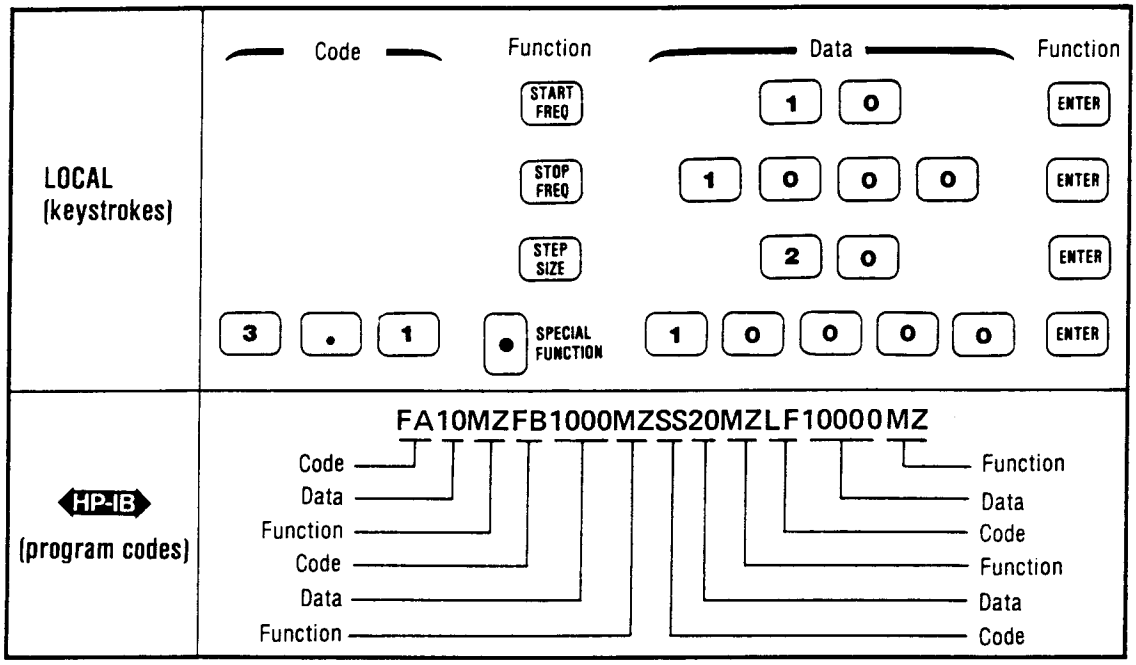
a. Press PRESET (or send HP-IB code PR) to establish initial conditions.

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

Measurement Mode 1.4 (cont'd)

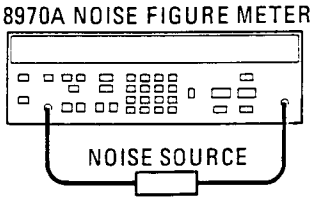
(Special Function 1.4)

Example (cont'd)



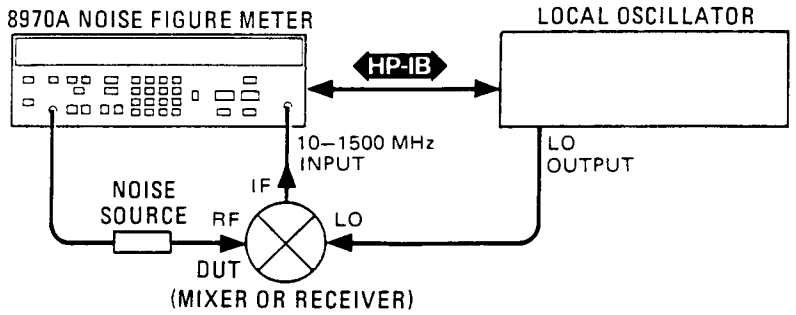
c. Press 1 . 4 SPECIAL FUNCTION (or send HP-IB code E4) to activate Measurement Mode 1.4.

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

HP-IB

For HP-IB codes, refer to Procedure above.

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)	K(75)
	(0)	0(48) } 0 dB atten.
	(0)	L(76)
	(0)	6(54) } -3 dB
	(0)	M(77)
	(0)	0(48) } AM off
	(0)	N(78)
	(0)	7(55) } FM off
	(0)	O(79)
	(0)	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 4 2 . 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)	K(75) } 0 dB atten.
	(0)	0(48) }
	(0)	L(76) } -3 dB
	(0)	6(54) }
	(0)	M(77) } AM off
	(0)	0(48) }
	(0)	N(78) } FM off
	(0)	7(55) }
	(0)	O(79) } +10 dBm
	(0)	3(51) }
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.

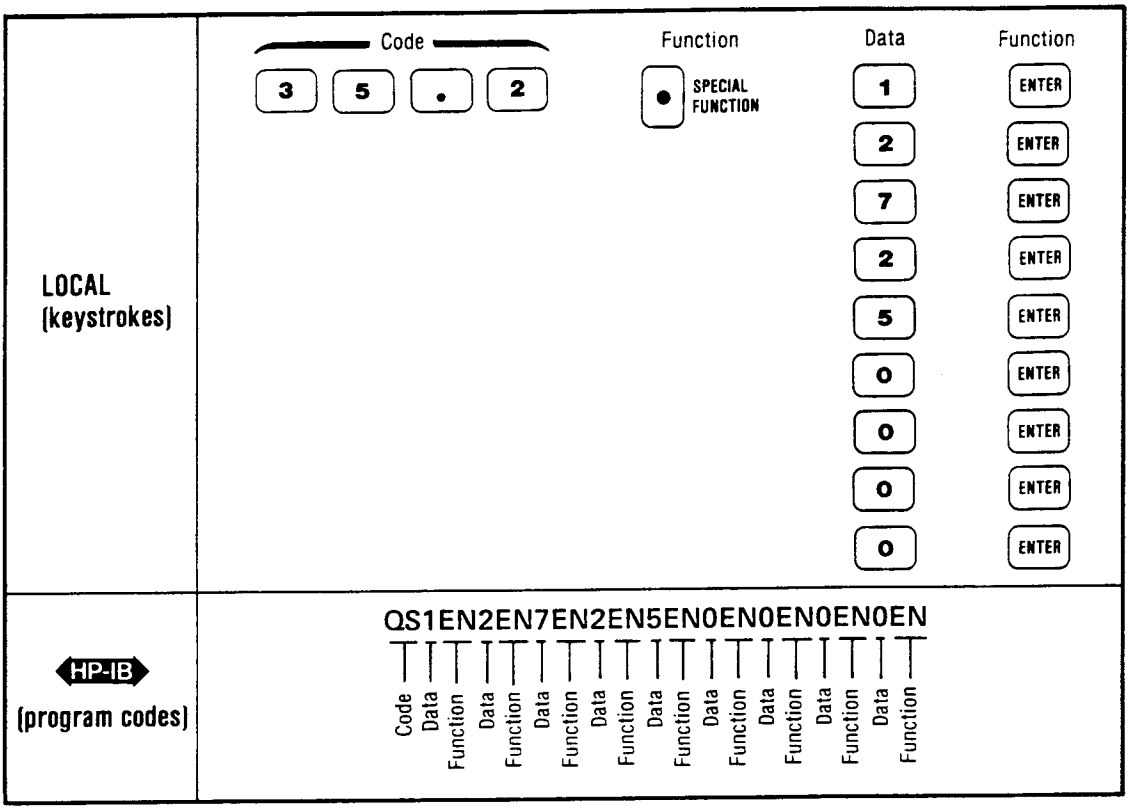
Special Function		Program Code HP-IB	Lights Special Function Key	Stored in Continuous Memory	Can be Stored and Recalled	Special Function 0.0 Conditions	Preset (and HP-IB Clear) Conditions
Description	Code						
Manual Sequence	35.0	QM or 35.0SP	N	N	N	On	On
Automatic Sequence	35.1	QA or 35.1 SP	N	N*	N	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.

SP Code suffixes

This display indicates the following special functions: 1.4, 2.2, 4.1, 5.0

N	1	2	3	4
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

Digit positions

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)	Code: 5 0 . 2 — Function: • SPECIAL FUNCTION
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	[1]Enables Special Function Key LED to light when SEQ is pressed.
	35.2	QS	Set	N	Y	N	NC	1—9	
	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 Refer to Section VIII, Service
	63.1	Z1	Select 10 dB Pad Number 1	Y	N	N	Off	Off	
	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)

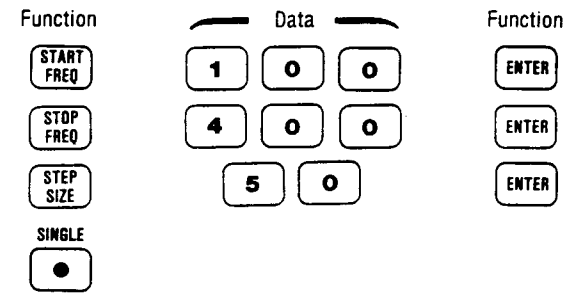
Front Panel Key	Program Code HP-IB	Stored in Continuous Memory	Can be Stored and Recalled	Preset (and HP-IB Clear) Conditions
AUTO	W1	N	N	Off
SINGLE	W2	N	N	Off
START FREQ	FA	Y	Y	10 MHz
STEP SIZE	SS	Y	Y	20 MHz
STOP FREQ	FB	Y	Y	1500 MHz

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

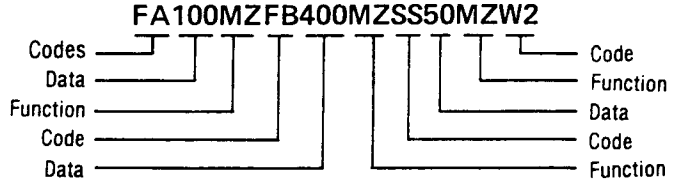
Example

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).

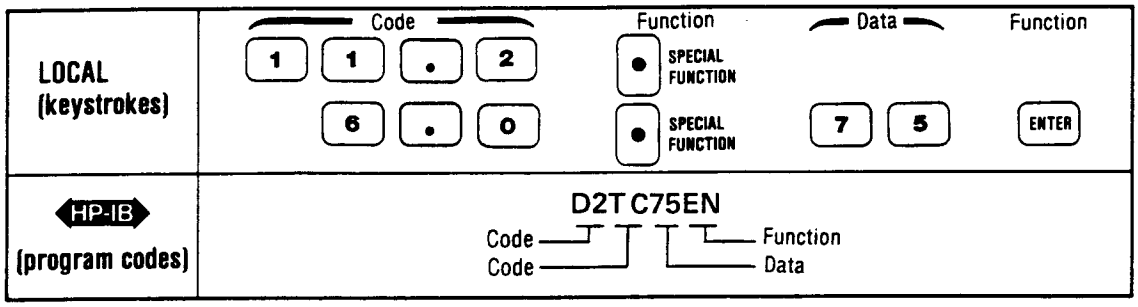
After a temperature unit has been selected, one of the special functions listed below must be active before temperature data can be entered.

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 For HP-IB codes, refer to Procedure above.

HP-IB

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

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. An automated test tape is available from Hewlett-Packard which will run the performance tests. This tape is available by ordering, 8970A Performance Test Tape, Part Number 08970-10001.

NOTES

Unless otherwise noted, no warm-up period is required for the tests.

Line voltage must be within +5% and − 10% of nominal, if the performance tests are to be considered valid.

4-2. EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in Table 1-3, Recommended Test Equipment in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-3. TEST RECORD

Results of the performance tests may be tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. The results, recorded at incoming inspection, can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

4-4. CALIBRATION CYCLE

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

PERFORMANCE TESTS

4-5. TUNING ACCURACY PERFORMANCE TEST

Specification TUNING ACCURACY: (from 10 to 40 C) ±(1 MHz + 1% of frequency), ±6 MHz maximum.

Description The Noise Figure Meter is tuned to the frequency where accuracy is to be tested. The point of maximum IF signal level is found by stepping the signal source through the passband while monitoring the level at the internal noise power detector. A power reference is set, and the 3-dB passband frequencies are determined. The tuned center frequency of the Noise Figure Meter is then found as the average of the 3-dB frequencies. This tuned frequency is compared to limits derived from the specifications above.

Equipment:

Frequency Doubler	HP 11721A
Signal Generator	HP 8656A

Procedure

1. Connect the signal generator RF output to the Noise Figure Meter INPUT.
2. Turn on the equipment, and and allow it to warm up for one half hour. Set the signal generator output level to −30 dBm.
3. On the Noise Figure Meter, key in 31.2 SPECIAL FUNCTION to execute a frequency calibration, then key in 31.1 SPECIAL FUNCTION to inhibit any further frequency calibrations. Key in 10.2 SPECIAL FUNCTION to set the display units to read Y-Factor in dB.
4. Tune both the Noise Figure Meter and the signal generator to 10 MHz.
5. On the Noise Figure Meter, key in 80.0 SPECIAL FUNCTION to display the noise power detector output in volts. Key in 62.0 SPECIAL FUNCTION to hold the RF attenuators. Key in 72.0 SPECIAL FUNCTION to hold the IF attenuators.
6. Tune the signal generator up and down in 100 kHz steps until the maximum voltage display on the Noise Figure Meter is located. The 3-dB point should be within approximately 4 MHz of center frequency.
7. On the Noise Figure Meter, key in 14.1 SPECIAL FUNCTION to activate the manual measurement mode and make a cold measurement. Key in 14.2 SPECIAL FUNCTION to exit the cold measurement mode (and store that value) and to make hot measurements. Finally, key in 15.1 SPECIAL FUNCTION to set the Noise Figure Meter to actively display the ratio of hot to cold values. The NOISE FIGURE display should now indicate 0.00 dB.
8. Tune the signal generator up and down to find the 3-dB frequencies to within 100 kHz. Find the center frequency by summing the 3-dB frequencies and dividing by two. The center frequency should be within the limits in the table below.

PERFORMANCE TESTS

Procedure (cont'd)

9. Repeat steps 5 through 8 for each of the frequencies in the table below.

Nominal Tuned Frequency (MHz)	Lower 3-dB Frequency (MHz)	Upper 3-dB Frequency (MHz)	Center Frequency (MHz)		
			Min.	Actual	Max.
10	_____	_____	8.9	_____	11.1
100	_____	_____	98	_____	102
300	_____	_____	296	_____	304
500	_____	_____	494	_____	506

10. Insert the frequency doubler at the signal generator output.
11. Tune the Noise Figure Meter to 1000 MHz. Tune the signal generator to 500 MHz.
12. On the Noise Figure Meter, key in 80.0 SPECIAL FUNCTION to display the noise power detector output in volts.
13. Tune the signal generator up and down until the maximum voltage display is located.
14. On the Noise Figure Meter, key in 14.1 SPECIAL FUNCTION to activate the manual measurement mode and make a cold measurement. Key in 14.2 SPECIAL FUNCTION to exit the cold measurement mode (and store that value) and to make hot measurements. Finally, key in 15.1 SPECIAL FUNCTION to set the Noise Figure Meter to actively display the ratio of hot to cold values. The Noise Figure display should now indicate 0.00 dB.
15. Tune the signal generator up and down to find the 3-dB frequencies to within 10 kHz. Compute the center frequency by summing the 3-dB frequencies and dividing by two. The center frequency should be within the limits in the table below.
16. Repeat steps 12 through 15 for each of the fundamental frequencies in the table below. For each frequency in the table, tune the Noise Figure Meter to twice that frequency.

Signal Generator Frequency (MHz)	Lower 3-dB Frequency (MHz)	Upper 3-dB Frequency (MHz)	Center Frequency (MHz)		
			Min.	Actual	Max.
500	_____	_____	497	_____	503
650	_____	_____	647	_____	653
750	_____	_____	747	_____	753

Note: Frequencies shown are as indicated on the signal generator display. The Noise Figure Meter is tuned to twice these frequencies.

PERFORMANCE TESTS

4-6. INPUT SWR PERFORMANCE TEST

Specification INPUT SWR (reflection coefficient): <1.7 (0.26); 10 to 1500 MHz (50 ohms reference impedance).

Description The frequency range of the Noise Figure Meter is scanned for frequencies where the return loss is near specification limits. Then, each high point is checked individually against the specification. This is done for several input gain settings.

Equipment

Attenuator, 10 dB	HP 8491A Option 010
Frequency Counter	HP 5340A
Power Meter	HP 436A
Power Sensor	HP 8484A
Power Splitter	HP 11667A
Sweep Oscillator	HP 8620C/86222B Option 002
SWR Bridge	Wiltron 60N50

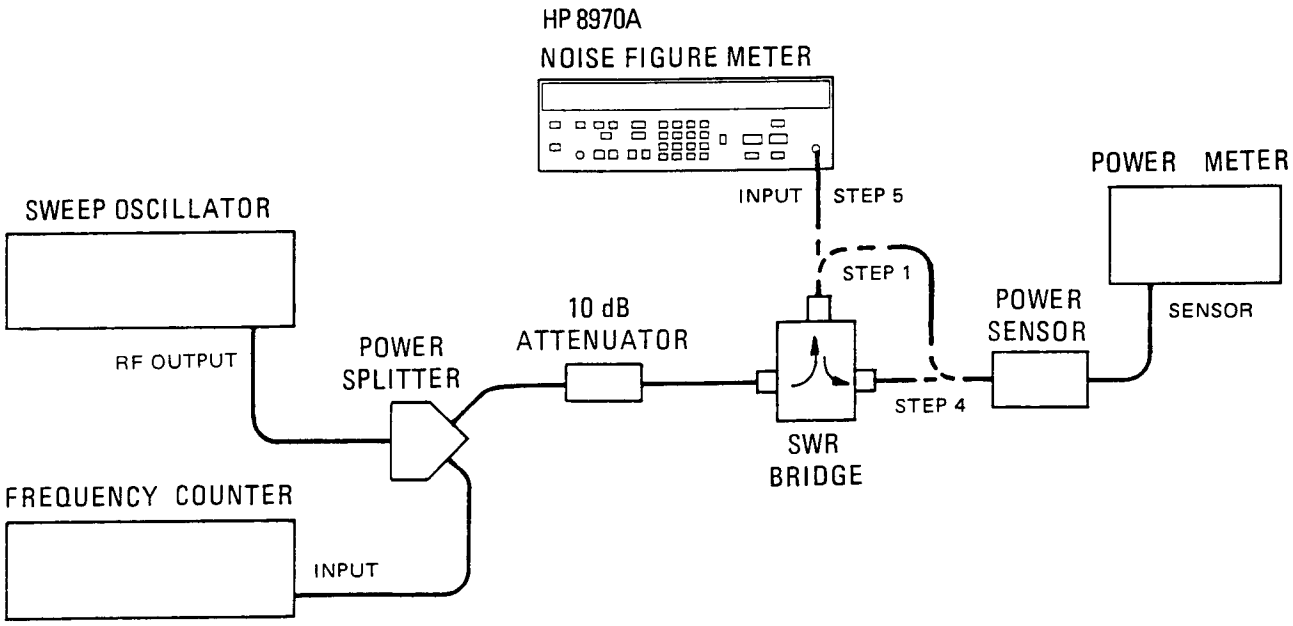


Figure 4-1. Input SWR Test Setup

Procedure

1. Connect equipment as shown in Figure 4-1. Note that the power sensor is connected to the test port of the SWR bridge.

2. Set the sweep oscillator for a 10 MHz continuous wave output as read on the frequency counter. Set the sweep oscillator power level to −23 dBm at the test port of the SWR bridge, as read on the power meter. Sweep oscillator power should be approximately +3 dBm.

PERFORMANCE TESTS

Procedure (cont'd)

3. On the Noise Figure Meter, key in 0.0 SPECIAL FUNCTION to initialize most Special Functions and 60.1 SPECIAL FUNCTION to set the input gain to +20 dB.

4. Tune the sweep oscillator to 1500 MHz. Connect the power sensor to the reflected output port of the SWR bridge. Set a relative reference on the power meter.

5. Connect the test port of the SWR bridge to the Noise Figure Meter INPUT. Slowly tune the sweep oscillator down in frequency to 10 MHz. While tuning, note each frequency at which the power meter reading peaks at less than 12.5 dB below the 0 dB reference set in step 4. For example, if the power meter display showed −11.0 dB, then the frequency should be noted. However, a reading of −13.0 dB indicates a return loss well within specifications.

6. For each frequency noted in step 5, tune the sweep oscillator and the Noise Figure Meter to that frequency. Disconnect the SWR bridge from the Noise Figure Meter INPUT, and set a power meter reference. Reconnect the SWR bridge to the Noise Figure Meter INPUT. The power meter should read greater than 11.73 dB below the reference.

INPUT SWR PERFORMANCE TEST	Min.	Actual	Max.
+20 dB Input Gain Setting Frequency			
_____ MHz		_____	−11.73 dB
_____ MHz		_____	−11.73 dB
_____ MHz		_____	−11.73 dB
+10 dB Input Gain Setting Frequency			
_____ MHz		_____	−11.73 dB
_____ MHz		_____	−11.73 dB
_____ MHz		_____	−11.73 dB
0 dB Input Gain Setting Frequency			
_____ MHz		_____	−11.73 dB
_____ MHz		_____	−11.73 dB
_____ MHz		_____	−11.73 dB

7. On the Noise Figure Meter, key in 60.2 SPECIAL FUNCTION to set the input gain to +10 dB. Repeat steps 4 through 6.

8. On the Noise Figure Meter, key in 60.3 SPECIAL FUNCTION to set the input gain to 0 dB. Repeat steps 4 through 6.

PERFORMANCE TESTS

4-7. NOISE FIGURE RANGE AND ACCURACY PERFORMANCE TEST

Specification NOISE FIGURE MEASUREMENT CHARACTERISTICS Range: 0.1 to 30 dB. Instrumentation Uncertainty: ±0.1 dB for a noise source in a 0 to 55°C in a 300K environment with a noise source ENR of 14 to 16 dB.

Description Level ratios of −0.1 dB, −1 dB, −5 dB, −10 dB, −15 dB, and −20 dB are generated. The levels are measured on the power meter, and linear power ratios are computed. The levels are simultaneously measured on the Noise Figure Meter, and linear voltage ratios are computed. The voltage ratios are squared and then subtracted from the linear power ratios to compute the Y-Factor error. This error is compared to accuracy limits derived from the 0.1 dB noise figure accuracy specification. (A 15 dB ENR value is assumed.) The reading at −20 dB and the reading at −5 dB are used to compute a second 15 dB ratio. This ratio is also checked for accuracy.

NOTES

This test is difficult to perform. Passing the test requires minimum drift in both the measurement equipment and the Noise Figure Meter. The more rapidly the test is performed, the more closely the test results will indicate the actual performance of the instrument. If the instrument fails by a narrow margin, performing the test more quickly will probably allow the instrument to pass.

Since the Noise Figure Meter is highly sensitive to RF signals at its input, spurious transmissions or noise can adversely affect performance test results. Use short well shielded cables and a minimum of adapters when performing this test.

Equipment

Attenuator, 6 dB	HP 8491A Opt. 006
Attenuator, 1 dB Step.	HP 8494A Opt. 001
Calculator	HP 41C
Digital Voltmeter	HP 3455A
Filter, Low-Pass	HP 360B
Power Sensor	HP 8484A
Power Splitter	HP 11667A
Signal Generator	HP 8656A

Procedure

1. Connect equipment as shown in Figure 4-2, except do not connect the power sensor to the step attenuator.
2. Turn on all equipment and allow it to warm up for one hour.
3. Set the signal generator for a 50 MHz continuous wave output at −17 dBm.
4. On the Noise Figure Meter, set FREQUENCY to 50 MHz. Key in 80.0 SPECIAL FUNCTION to display the noise power detector output in volts (voltmeter mode). Key in 31.1 SPECIAL FUNCTION to inhibit frequency calibrations. Key in 60.5 SPECIAL FUNCTION to set the input gain to −20 dB. Key in 70.6 SPECIAL FUNCTION to set the IF attenuation to −25 dB. Set the smoothing factor to 4 using the INCREASE and DECREASE keys.
5. Zero the power meter and set the 1 dB step attenuator to 10 dB. Connect the power sensor to the 1 dB step attenuator as shown in Figure 4-2.

PERFORMANCE TESTS

NOISE FIGURE RANGE AND ACCURACY PERFORMANCE TEST (cont'd)

Procedure (cont'd)

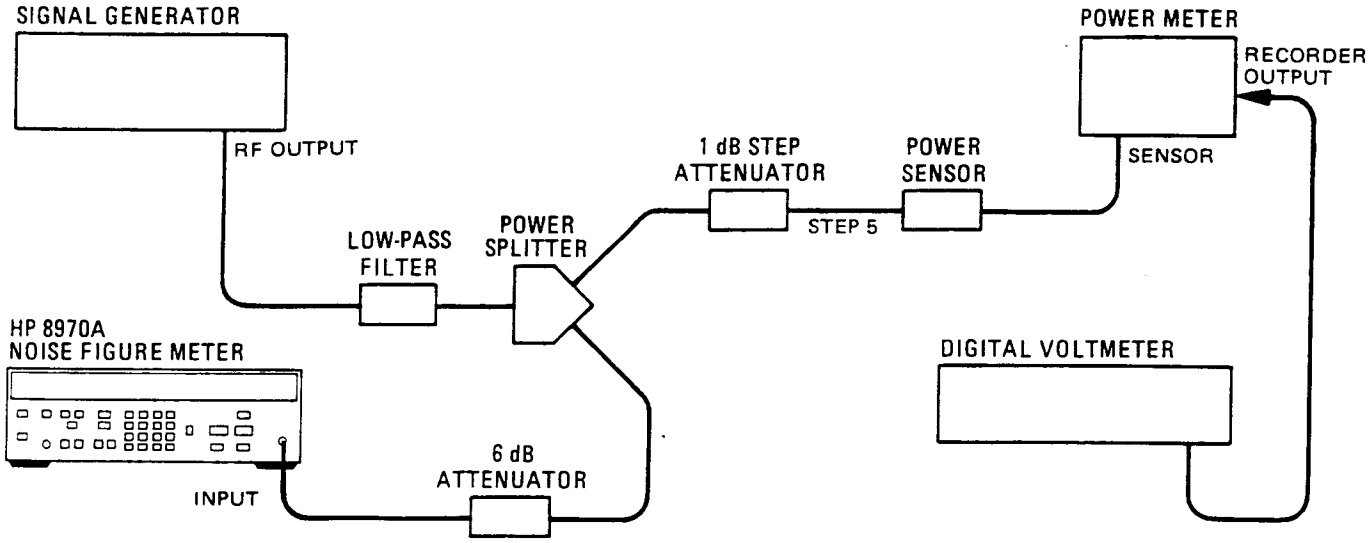


Figure 4-2. Noise Figure Instrumentation Accuracy Test Setup

6. Peak the Noise Figure Meter display reading by tuning the signal generator up and down in frequency in 10 kHz increments.

7. Increase the signal generator power in 0.1 dB steps until the combined INSERTION GAIN and NOISE FIGURE displays on the Noise Figure Meter indicate as close as possible to 1.00000 volts. The signal generator power should be near −14.7 dBm. Note this power level as indicated on the signal generator.

_____ dBm

8. Set the step attenuator for a power meter reading as close as possible to 1.000 uW.

9. Set the digital voltmeter to read dc volts on the high resolution setting. Using the manual trigger control, trigger several readings then stop on a typical reading. Note this reading using full resolution.

_____ Vdc

10. Note the voltmeter mode reading on the Noise Figure Meter also using full resolution.

_____ Vdc

11. Decrease the signal generator power by 0.1 dB.

12. Using the same technique as in step 9, take a voltmeter reading.

_____ Vdc

PERFORMANCE TESTS

NOISE FIGURE RANGE AND ACCURACY PERFORMANCE TEST (cont'd)

Procedure (cont'd)

13. Note the new voltmeter mode reading on the Noise Figure Meter.
_____ Vdc

14. Decrease the signal generator output power to 1 dB below that set in step 7.

15. Using the same technique as in step 9, take a voltmeter reading.
_____ Vdc

16. Note the new voltmeter mode reading on the Noise Figure Meter.
_____ Vdc

17. Decrease the signal generator output power to 5 dB below that set in step 7.

18. Using the same technique as in step 9, take a voltmeter reading.
_____ Vdc

19. Note the new voltmeter mode reading on the Noise Figure Meter.
_____ Vdc

20. Decrease the signal generator output power to 10 dB below that set in step 7.

21. Using the same technique as in step 9, take a voltmeter reading. (Note that the power meter may change ranges for this reading. If it does, the voltmeter reading taken must be decreased by a factor of 10.)
_____ Vdc

22. Note the new voltmeter mode reading on the Noise Figure Meter.
_____ Vdc

23. Decrease the signal generator output power to 15 dB below that set in step 7.

24. Using the same technique as in step 9, take a voltmeter reading. (Remember to decrease this reading by a factor of 10.)
_____ Vdc

25. Note the new voltmeter mode reading on the Noise Figure Meter.
_____ Vdc

26. Decrease the signal generator output power to 20 dB below that set in step 7.

27. Using the same technique as in step 9, take a voltmeter reading. (Note that the power meter may change ranges again. If so this voltmeter reading must be decreased by a factor of 100.)
_____ Vdc

28. Note the new voltmeter mode reading on the Noise Figure Meter.
_____ Vdc

PERFORMANCE TESTS

NOISE FIGURE RANGE AND ACCURACY PERFORMANCE TEST (cont'd)

Procedure (cont'd)

29. Fill in the table below using the readings from the appropriate steps above. For the column on the far right, square the readings in the previous column.

Voltmeter Readings (Vdc)		Noise Figure Meter Readings		
			(Vdc)	$(Vdc)^2$
Step 9	_____	Step 10	_____	_____
Step 12	_____	Step 13	_____	_____
Step 15	_____	Step 16	_____	_____
Step 18	_____	Step 19	_____	_____
Step 21	_____	Step 22	_____	_____
Step 24	_____	Step 25	_____	_____
Step 27	_____	Step 28	_____	_____

30. Fill in the table below by computing the indicated ratios (Y-Factors). The ratios of the second set of columns should be computed from the squared voltages from the previous table. Subtract the ratios of the second set of columns from those of the first set to yield the net error (difference). The result should be within the indicated limits.

Ratios (Y-Factors)				Difference		
				Min.	Actual	Max.
(Step 9) / (Step 12)	_____	(Step 10) / (Step 13)	_____	−0.00053	_____	+0.00054
(Step 9) / (Step 15)	_____	(Step 10) / (Step 16)	_____	−0.00589	_____	+0.00603
(Step 9) / (Step 18)	_____	(Step 10) / (Step 19)	_____	−0.04922	_____	+0.05037
(Step 9) / (Step 21)	_____	(Step 10) / (Step 22)	_____	−0.20487	_____	+0.20964
(Step 9) / (Step 24)	_____	(Step 10) / (Step 25)	_____	−0.69706	_____	+0.71330
(Step 18) / (Step 27)	_____	(Step 19) / (Step 28)	_____	−0.69706	_____	+0.71330

PERFORMANCE TESTS

4-8. GAIN MEASUREMENT UNCERTAINTY PERFORMANCE TEST

Specification GAIN MEASUREMENT CHARACTERISTICS Range: −20 to +40 dB. Instrumentation Uncertainty: ±0.2 dB.

Description Net gain is generated by removing attenuation from a high gain setup. The net gain is alternately measured first by a power meter and then by the Noise Figure Meter. The two measurements should compare within 0.2 dB.

NOTES

This test is difficult to perform. Passing the test requires minimum drift in both the measurement equipment and the Noise Figure Meter. The more rapidly the test is performed, the more closely the test results will indicate the actual performance of the instrument. If the instrument fails by a narrow margin, performing the test more quickly will probably allow the instrument to pass.

Since the Noise Figure Meter is highly sensitive to RF signals at its input, spurious transmissions or noise can adversly affect performance test results. Use short well shielded cables and a minimum of adapters when performing this test.

Equipment

Attenuator, 10 dB (2 required)	HP 8491A Opt. 010
Attenuator, 20 dB	HP 8491A Opt. 020
Attenuator, 1 dB Step	HP 8494A Opt. 001
Attenuator, 10 dB Step	HP 8495A Opt. 001
Filter, Low-Pass	HP 360B
Noise Source	HP 346B Opt. 001
Power Meter	HP 436A
Power Sensor	HP 8484A
Power Splitter	HP 11667A
Wideband Amplifier I	HP 8447D Opt. 010
Wideband Amplifier II	HP 8447F Opt. 010

Procedure

1. Connect the noise source directly to the Noise Figure Meter INPUT. Turn on all equipment, and allow it to warm up for a half hour.

2. On the Noise Figure Meter, press PRESET, then key in 33.0 SPECIAL FUNCTION to perform an IF calibration.

NOTE

This procedure relies critically upon the proper setup of the power meter. If readings yield results that are out of specification, check that the calibration adjustment and zero setting of the power meter are valid. Always disconnect the power sensor from the test setup when zeroing.

3. Connect the equipment as shown in Figure 4-3.

4. On the Noise Figure Meter, press the ENR key to access the ENR table with in the Noise Figure Meter. Using the DATA keys and the ENTER key, modify the 10, 101, 1000 and 2000 MHz ENR entries to correspond to the noise source ENR chart. Exit the ENR table entry mode by pressing the FREQUENCY key.

PERFORMANCE TESTS

GAIN MEASUREMENT UNCERTAINTY PERFORMANCE TEST (cont'd)

Procedure

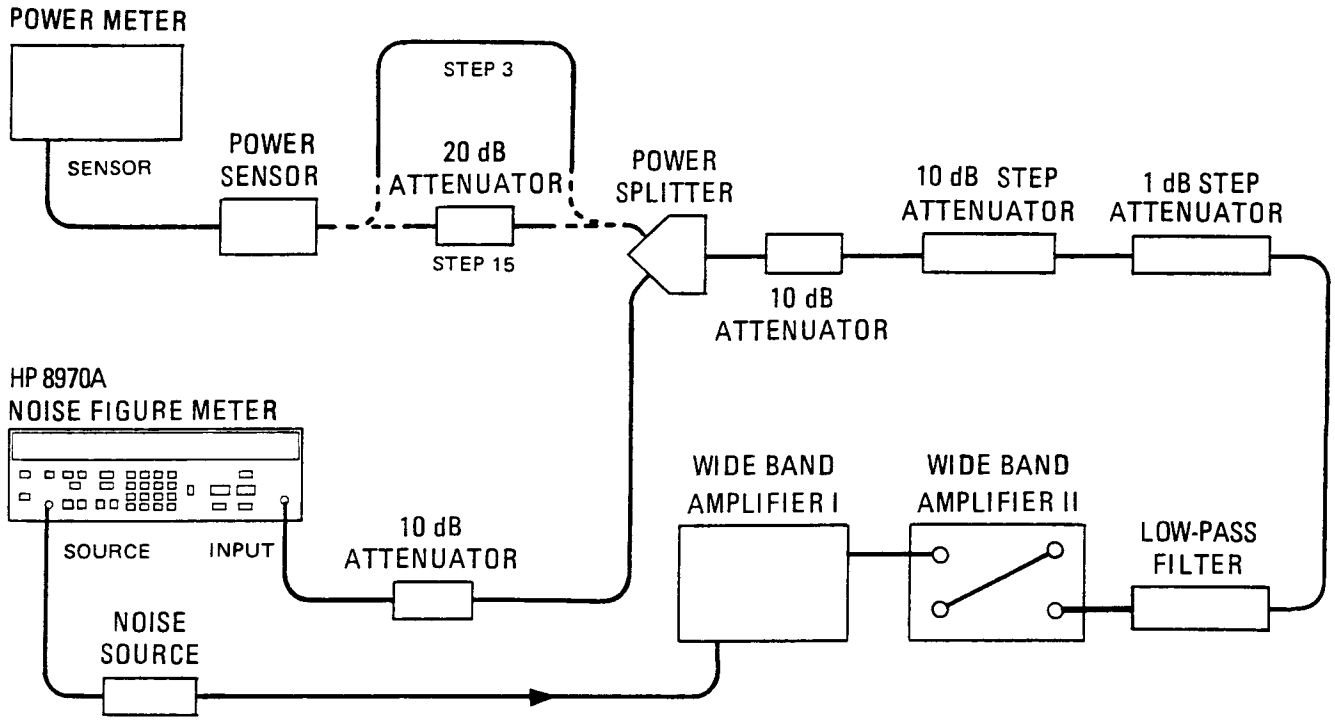


Figure 4-3. Gain Measurement Uncertainty Test Setup

5. On the Noise Figure Meter, set START FREQ, STOP FREQ, and FREQUENCY all to 1000 MHz.
6. Set the 10 dB step attenuator for 40 dB of attenuation. Set the 1 dB step attenuator for a power level no greater than −48 dBm as read on the power meter.
7. On the Noise Figure Meter, press INCREASE to set the smoothing factor to 8. Press CALIBRATE.
8. When calibration is complete, key in 81.0 SPECIAL FUNCTION to turn on the noise source and display the noise power detector output in volts (voltmeter mode). Press STORE 1 to store this setting in the instrument memory.
9. Set a relative reference on the power meter. (Press dBREL key on 436A. Press NF and GAIN keys.)
10. Set the step attenuator for 30 dB of attenuation. Note the power meter reading.

    (Power Meter ≈10 dB Gain) _____ dB

11. On the Noise Figure Meter, press NOISE FIGURE AND GAIN. Note the Insertion Gain reading.

    (Noise Figure Meter ≈10 dB Gain) _____ dB

12. On the Noise Figure Meter, press RECALL 1.

PERFORMANCE TESTS

GAIN MEASUREMENT UNCERTAINTY PERFORMANCE TEST (cont'd)

Procedure (cont'd)

13. Set the step attenuator for 20 dB of attenuation. Note the power meter reading.

    (Power Meter ≈20 dB Gain) _____ dB

14. On the Noise Figure Meter, press NOISE FIGURE AND GAIN. Note the Insertion Gain reading.

    (Noise Figure Meter ≈20 dB Gain) _____ dB

15. Insert a 20 dB attenuator into the setup at the input to the power sensor.

16. On the Noise Figure Meter, press RECALL 1.

17. Note the power meter reading.

    (Power Meter Reference) _____ dB

18. On the Noise Figure Meter, press NOISE FIGURE AND GAIN. Note the Insertion Gain Reading.

    (Noise Figure Meter Reference) _____ dB

19. On the Noise Figure Meter, press RECALL 1.

20. Set the step attenuator for 10 dB of attenuation. Note the power meter reading.

    (Power Meter ≈30 dB Gain) _____ dB

21. On the Noise Figure Meter, press NOISE FIGURE AND GAIN. Note the Insertion Gain reading.

    (Noise Figure Meter ≈30 dB Gain) _____ dB

22. On the Noise Figure Meter, press RECALL 1.

23. Set the step attenuator for 0 dB of attenuation. Note the power meter reading.

    (Power Meter ≈40 dB Gain) _____ dB

24. On the Noise Figure Meter, press NOISE FIGURE AND GAIN. Note the Insertion Gain reading.

    (Noise Figure Meter ≈40 dB Gain) _____ dB

25. Subtract the reading of step 17 from that of step 13. This is the value of the 20 dB attenuator as seen by the power meter.

    (20 dB Attenuator) _____ dB

26. Subtract the reading of step 18 from that of step 14. This is the Noise Figure Meter reference correction factor.

    (Noise Figure Meter Correction Factor) _____ dB

PERFORMANCE TESTS

GAIN MEASUREMENT UNCERTAINTY PERFORMANCE TEST (cont'd)

Procedure (cont'd)

27. Fill appropriate values into the following table, then subtract the values for the Noise Figure Meter from the power meter readings above them to yield the net error. The error should be within ±0.2 dB.

Power Meter	Step 10	Step 13	Step 20 + Step 25	Step 23 + Step 25
	_____ dB	_____ dB	_____ dB	_____ dB
Noise Figure Meter	Step 11	Step 14	Step 21 + Step 26	Step 24 + Step 26
	_____ dB	_____ dB	_____ dB	_____ dB
Error	_____ dB	_____ dB	_____ dB	_____ dB

PERFORMANCE TESTS

4-9. INSTRUMENT NOISE FIGURE PERFORMANCE TEST

Specification INSTRUMENT NOISE FIGURE: <7 dB + 0.003 dB per MHz on the most sensitive input range.

Description A noise source is connected to the Noise Figure Meter INPUT, and the instrument measures its own noise figure in the UNCORRECTED mode.

Equipment Noise Source ..... HP 346B Opt. 001

Procedure

1. Connect the noise source between the SOURCE output and the INPUT of the Noise Figure Meter. Turn on the Noise Figure Meter, then press PRESET. Set FREQ INCR to 100 MHz.

2. Press the ENR key to access the ENR table within the Noise Figure Meter. Using the DATA keys and the ENTER key, modify the 10, 101, 1000, and 2000 MHz ENR entries to correspond to the noise source ENR chart. Exit the ENR table entry mode by pressing the FREQUENCY key.

3. Key in 33.0 SPECIAL FUNCTION to perform an IF calibration. Use the INCREASE key to set the smoothing factor to 4. Select UNCORRECTED NOISE FIGURE.

4. Note the NOISE FIGURE display reading at each frequency, while using the step up key (up arrow) to tune the Noise Figure Meter through its tuning range. The Noise Figure measurement results should be less than those shown in the table below.

Frequency (MHz)	Noise Figure (dB)	
	Actual	Maximum
10	_____	7.03
110	_____	7.33
210	_____	7.63
310	_____	7.93
410	_____	8.23

PERFORMANCE TESTS

INSTRUMENT NOISE FIGURE PERFORMANCE TEST (cont'd)

Procedure (cont'd)

Frequency (MHz)	Noise Figure (dB)	
	Actual	Maximum
510	_____	8.53
610	_____	8.83
710	_____	9.13
810	_____	9.43
910	_____	9.73
1010	_____	10.03
1110	_____	10.33
1210	_____	10.63
1310	_____	10.93
1410	_____	11.23
1510	_____	11.53

Table 4-1. Performance Test Record (1 of 2)

Hewlett-Packard Company
Model 8970A
Noise Figure Meter

Tested by _____

Serial Number _____ Date _____

Para. No.	Test	Results		
		Min.	Actual	Max.
4-5	**TUNING ACCURACY PERFORMANCE TEST**			
	Tuned Frequency			
	10 MHz	8.9 MHz	_____	11.1 MHz
	100 MHz	98 MHz	_____	102 MHz
	300 MHz	296 MHz	_____	304 MHz
	500 MHz	494 MHz	_____	506 MHz
	1000 MHz	994 MHz	_____	1006 MHz
	1300 MHz	1294 MHz	_____	1306 MHz
	1500 MHz	1494 MHz	_____	1506 MHz
4-6	**INPUT SWR PERFORMANCE TEST**			
	+20 dB Input Gain Setting Frequency			
	_____ MHz		_____	−11.73 dB
	_____ MHz		_____	−11.73 dB
	_____ MHz		_____	−11.73 dB
	+10 dB Input Gain Setting Frequency			
	_____ MHz		_____	−11.73 dB
	_____ MHz		_____	−11.73 dB
	_____ MHz		_____	−11.73 dB
	0 dB Input Gain Setting Frequency			
	_____ MHz		_____	−11.73 dB
	_____ MHz		_____	−11.73 dB
	_____ MHz		_____	−11.73 dB
4-7	**NOISE FIGURE RANGE AND ACCURACY PERFORMANCE TEST**		**Difference**	
	$\frac{\text{Step 9}}{\text{Step 12}} - \frac{\text{Step 10}^2}{\text{Step 13}^2}$	−0.00053	_____	+0.00054
	$\frac{\text{Step 9}}{\text{Step 15}} - \frac{\text{Step 10}^2}{\text{Step 16}^2}$	−0.00589	_____	+0.00603
	$\frac{\text{Step 9}}{\text{Step 18}} - \frac{\text{Step 10}^2}{\text{Step 19}^2}$	−0.04922	_____	+0.05037
	$\frac{\text{Step 9}}{\text{Step 21}} - \frac{\text{Step 10}^2}{\text{Step 22}^2}$	−0.20487	_____	+0.20964
	$\frac{\text{Step 9}}{\text{Step 24}} - \frac{\text{Step 10}^2}{\text{Step 25}^2}$	−0.69706	_____	+0.71330
	$\frac{\text{Step 18}}{\text{Step 27}} - \frac{\text{Step 19}^2}{\text{Step 28}^2}$	−0.69706	_____	+0.71330

Table 4-1. Performance Test Record (2 of 2)

Hewlett-Packard Company
Model 8970A
Noise Figure Meter
Serial Number _____

Tested by _____

Date _____

Para. No.	Test	Results Min.	Actual	Max.
4-8	**GAIN MEASUREMENT UNCERTAINTY PERFORMANCE TEST**			
	Power Meter Reading — **Noise Figure Meter Reading**			
	Step 10 — Step 11			
	_____ dB − _____ dB	−0.2 dB	_____	+0.2 dB
	Step 13 — Step 14			
	_____ dB − _____ dB	−0.2 dB	_____	+0.2 dB
	Step 20 + Step 25 — Step 21 + Step 26			
	_____ dB − _____ dB	−0.2 dB	_____	+0.2 dB
	Step 23 + Step 25 — Step 24 + Step 26			
	_____ dB − _____ dB	−0.2 dB	_____	+0.2 dB
4-9	**INSTRUMENT NOISE FIGURE PERFORMANCE TEST**			
	Frequency			
	10 MHz		_____	7.03 FdB
	110 MHz		_____	7.33 FdB
	210 MHz		_____	7.63 FdB
	310 MHz		_____	7.93 FdB
	410 MHz		_____	8.23 FdB
	510 MHz		_____	8.53 FdB
	610 MHz		_____	8.83 FdB
	710 MHz		_____	9.13 FdB
	810 MHz		_____	9.43 FdB
	910 MHz		_____	9.73 FdB
	1010 MHz		_____	10.03 FdB
	1110 MHz		_____	10.33 FdB
	1210 MHz		_____	10.63 FdB
	1310 MHz		_____	10.93 FdB
	1410 MHz		_____	11.23 FdB
	1510 MHz		_____	11.53 FdB

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

This section contains adjustments and checks that assure peak performance of the Noise Figure Meter. The instrument should be readjusted after repair or after failure to pass a performance test. Allow a 30 minute warm-up period prior to performing the adjustments unless noted otherwise.

To determine which performance tests and adjustments to perform after a repair, refer to the paragraph entitled Related Adjustments. After the repair and/or adjustment, performance tests are usually required to verify performance.

5-2. SAFETY CONSIDERATIONS

This section contains information, cautions, and warnings which must be followed for your protection and to avoid damage to the equipment.

WARNINGS

Adjustments described in this section are performed with power supplied to the instrument and with protective covers removed. Maintenance should be performed only by service trained personnel who are aware of the hazard involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.

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

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

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

5-3. EQUIPMENT REQUIRED

Each adjustment procedure contains a list of required test equipment. The test equipment is identified by callouts in the test setup diagrams where included.

If substitutions must be made for the specified test equipment, refer to Table 1-3 in Section I for the minimum specifications. It is important that the test equipment meet the critical specifications listed in the table, if the Noise Figure Meter is to meet its performance requirements.

5-4. FACTORY-SELECTED COMPONENTS

Factory selected components are identified on the schematics and parts list by an asterisk (*) which follows the reference designator. The normal value or range of the components is shown. The manual change sheets may provide updated information pertaining to the selected components. Table 5-1 lists the reference designator, the criterion used for selecting a particular value, the normal range and the service sheet where the component part is shown.

5-5. RELATED ADJUSTMENTS

With one exception, the procedures in this section can be performed in any order. However, it is advisable to check the power supply voltages first. The 280 MHz Oscillator, the 300 MHz IF Bandpass Filter, the Second Converter LO Frequency, and the 2050 MHz Bandpass Filter adjustments should all be done prior to the 20 MHz IF Gain adjustment.

Table 5-1. Factory Selected Components

Reference Designator	Service Sheet	Range of Values	Process of Selection
A6L6	1		Refer to 20 dB Input Amplifier Gain Adjustment.
A8C5	4	20—39 pF	Perform the 20 MHz IF gain adjustment. On a spectrum analyzer, set the center frequency to 19.5 MHz, frequency span to 10 MHz, reference level to −43 dBm, resolution bandwidth to 100 kHz, and scale to 1 dB/division. Connect the spectrum analyzer to the IF OUTPUT on the rear panel of the Noise Figure Meter. Center the 20 MHz IF passband on the spectrum analyzer and measure its flatness between the center frequency −1 MHz and the center frequency +1 MHz. If the flatness of the passband varies more than 1 dB over this 2 MHz frequency range, change A8C5. Increase the capacitance if the passband tilts to the right. Decrease the capacitance if the passband tilts to the left.
A13R19	7	1.0—1.33 kΩ	Refer to Frequency Cal RF Detector and First LO Offset Adjustments.
A6R39	1	133—196 kΩ	Refer to Input Power Detector Offset and Gain Adjustment.
A13R66	7	5.11—9.09 kΩ	Refer to Frequency Cal RF Detector and First LO Offset Adjustments.

ADJUSTMENTS

5-6. POWER SUPPLY ADJUSTMENTS

Reference Service Sheets 11 and 19.

Description A digital voltmeter monitors the +5V supply while it is adjusted. Then, the normally pulsing +28V noise source drive supply is inhibited from pulsing off, and is set to +28V. The other supply voltages are checked.

Equipment Digital Voltmeter.....HP 3455A

Procedure

1. Set voltmeter to measure +5 Vdc. Connect the input high lead to A14TP1 (+5V) and the low lead to A14TP2 (GND).
2. Adjust +5V ADJUST, A9R9, for +5.00 ±0.05 Vdc at A14TP1.
3. On the Noise Figure Meter, key in 81.0 SPECIAL FUNCTION to turn the +28V supply on continuously.
4. Set voltmeter to measure +28 Vdc. Connect the voltmeter input to the front panel NOISE SOURCE DRIVE OUTPUT jack, J1. (The voltmeter high input should be connected to the jack center conductor.)
5. Adjust +28V OUT, A12R7, for a voltmeter reading of +28.00 ±0.1 Vdc.
6. Connect the voltmeter input to the rear panel NOISE SOURCE DRIVE OUTPUT jack, J3. The voltmeter reading should be +28 ±0.1 Vdc.
7. On the Noise Figure Meter, key in 80.0 SPECIAL FUNCTION to turn off the +28V supply. The voltmeter reading should be <1 Vdc.
8. On the Noise Figure Meter, press PRESET to reinitiate pulsing fo the +28V power supply.
9. Check the other supplies with the voltmeter as shown below. Connect the voltmeter low input to A9TP4 (GND).

Supply	Test Point	Voltage Limits (Vdc)
+15V	A9TP2	±1.0
−15V	A9TP1	±1.0

ADJUSTMENTS

5-7. VOLTMETER OFFSET ADJUSTMENT

Reference Service Sheet 5.

Description The input to the A7 Voltmeter Assembly is disconnected and the Noise Figure Meter is set to read volts. The voltmeter offset is then adjusted for a front panel reading of zero.

Procedure

1. With the Noise Figure Meter power off, remove the cover over the A7 Voltmeter Assembly. (The assembly is accessed from the top of the instrument.) Disconnect the white-orange-yellow wire at the point marked (VIN). Replace the cover and fasten with one screw. Turn on the Noise Figure Meter, and let it warm up one half hour.

2. On the Noise Figure Meter, key in 80.0 SPECIAL FUNCTION to put the instrument into voltmeter mode. Use the INCREASE and DECREASE keys to set the smoothing factor to 8. Adjust VOLTMETER OFFSET, A7R34, for a front panel display of 0V ±0.00003 Vdc.

3. Remove power, remove the cover, replace the white-orange-yellow wire to the point marked (VIN), and reinstall the cover over the Voltmeter Assembly.

ADJUSTMENTS

5-8. NOISE POWER DETECTOR ADJUSTMENT

Reference Service Sheet 5.

Description Two RF levels that differ by 5 dB are generated. The levels are measured on a power meter, and a linear power ratio is computed. The levels are simultaneously measured using the detector in the Noise Figure Meter. The detector bias adjustment is set so that the Noise Figure Meter reading of the lower of the two levels best fits the optimum detector accuracy setting.

NOTES

This adjustment is difficult to perform. Proper adjustment requires minimum drift in both the measurement equipment and the Noise Figure Meter. For best results, perform the adjustment quickly.

Since the Noise Figure Meter is highly sensitive to RF signals at its input, spurious transmissions or noise can adversely affect performance test results. Use short well-shielded cables and a minimum of adapters when performing this adjustment.

Equipment

Attenuator, 6 dB	HP 8491A Opt. 006
Attenuator, 1dB Step	HP 8494A Opt. 001
Calculator	HP 41C
Digital Voltmeter	HP 3455A
Filter, Low-Pass	HP 360B
Power Meter	HP 436A
Power Sensor	HP 8484A
Power Splitter	HP 11667A
Signal Generator	HP 8656A

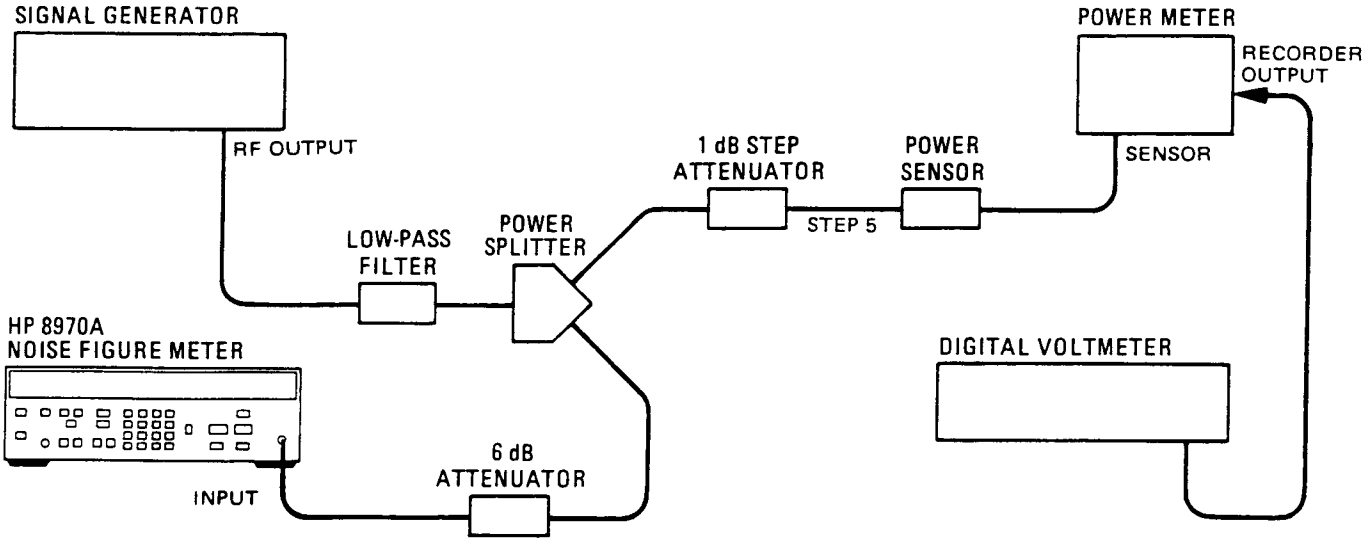


Figure 5-1. Noise Power Detector Adjustment Setup

ADJUSTMENTS

NOISE POWER DETECTOR ADJUSTMENT (cont'd)

Procedure (cont'd)

1. Connect equipment as shown in Figure 5-1, except do not connect the power sensor to the step attenuator.

2. Turn on all equipment and allow it to warm up for one hour.

3. Set the signal generator for a 700 MHz continuous wave output at −17 dBm.

4. On the Noise Figure Meter, set FREQUENCY to 700 MHz. Key in 80.0 SPECIAL FUNCTION to display the noise power detector output in volts (voltmeter mode). Key in 31.1 SPECIAL FUNCTION to inhibit frequency calibrations. Key in 60.5 SPECIAL FUNCTION to set the input gain to −20 dB. Key in 70.6 SPECIAL FUNCTION to set the IF attenuation to −25 dB. Set the smoothing factor to 4 using the INCREASE and DECREASE keys.

5. Zero the power meter, and set the 1 dB step attenuator to 10 dB. Connect the power sensor to the 1 dB step attenuator as shown in Figure 5-1.

6. Peak the Noise Figure Meter display reading by tuning the signal generator up and down in frequency in 10 kHz increments.

7. Increase the signal generator power in 0.1 dB steps until the combined INSERTION GAIN and NOISE FIGURE displays on the Noise Figure Meter indicate as close as possible to 1.00000 volts. The signal generator power should be near −14.7 dBm. Note this power level as read on the signal generator.

   _____ dBm

8. Set the step attenuator for a power meter reading as close as possible to but not more than 1.000 μW.

   NOTE

   The intent is to set the level into the power meter near the top of a power meter range. Test setup sensitivity may vary so that it may be necessary to add attenuation greater than is permitted by the 1 dB step attenuator. If more attenuation is needed, an 8491B fixed attenuator of appropriate value will do.

9. Set the digital voltmeter to read dc volts on the high resolution setting. Using the manual trigger control, trigger several readings then stop on a typical reading. Note this reading using full resolution.

   (Vp1) _____ Vdc

10. Note the voltmeter mode reading on the Noise Figure Meter also using full resolution.

    (Vn1) _____ Vdc

11. Decrease the signal generator power by 5.0 dB.

ADJUSTMENTS

NOISE POWER DETECTOR ADJUSTMENT (cont'd)

Procedure (cont'd)

12. Using the same technique as in step 9 take a voltmeter reading.

(Vp2) _____ Vdc

13. Compute the voltmeter mode reading, Vn2, for which the Noise Power Detector bias is to be adjusted.

$$Vn2 = (0.99885)\,(Vn1)\,\sqrt{\frac{(Vp2)}{(Vp1)}}$$

(Vn2) _____ Vdc

14. Adjust BIAS, A8R4, for a Noise Figure Meter voltmeter mode reading of the voltage computed in step 13.

15. Disconnect the signal generator output temporarily. On the Noise Figure Meter, key in 60.6 Special Function to set the RF gain to −30 dB. Key in 70.8 Special Function to set the IF attenuation to 35 dB. The Noise Figure Meter display should read 0.016 ±0.005 Vdc.

16. Reconnect the signal generator output, and perform the procedure a second time to check that the detector has been adjusted properly.

ADJUSTMENTS

5-9. 280 MHz OSCILLATOR ADJUSTMENT

Reference Service Sheets 2 and 3.

Description The tank capacitor of the third local oscillator is adjusted for a 280 MHz LO signal.

Equipment Spectrum Analyzer ..... HP 8565A

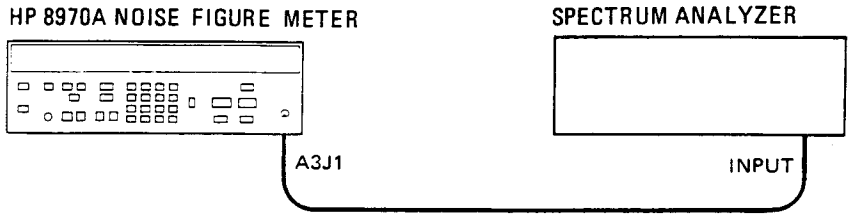


Figure 5-2. 280 MHz Oscillator Adjustment Setup

Procedure

1. Set the spectrum analyzer input attenuation to 20 dB, reference level to −30 dBm, frequency span to 500 kHz per division, and 30 kHz resolution bandwidth. Set the center frequency to 280 MHz, trigger to free run, and video filtering off.

2. With the Noise Figure Meter power off, remove the small 20 MHz IF cover (front left). Move A3C82 (in sockets) to connect the input from the 300 MHz IF to A3J1.

3. With all equipment power off, connect the equipment as shown in Figure 5-2.

4. Turn on the equipment power. Note that an error display on the Noise Figure is normal when the signal path is broken. Adjust 280 MHz OSC, A4C11, until a 280 MHz signal appears on the spectrum analyzer display. Adjust A4C11 to peak the signal level on the display (>−40 dBm is typical).

5. If you are not proceeding to the next adjustment, turn off the Noise Figure Meter, place A3C82 back into its original position, and replace the 20 MHz IF cover.

ADJUSTMENTS

5-10. 300 MHz IF BANDPASS FILTER ADJUSTMENT

Reference Service Sheets 2 and 3.

Description The 300 MHz IF passband is checked. If adjustment is necessary, a swept signal is injected into the 300 MHz IF while the output is monitored with a spectrum analyzer. The 300 MHz bandpass filter is aligned for proper bandpass characteristics.

Equipment

Signal Generator	HP 8656A
Spectrum Analyzer	HP 8565A
Sweep Oscillator	HP 8620C/86222B Opt. 002

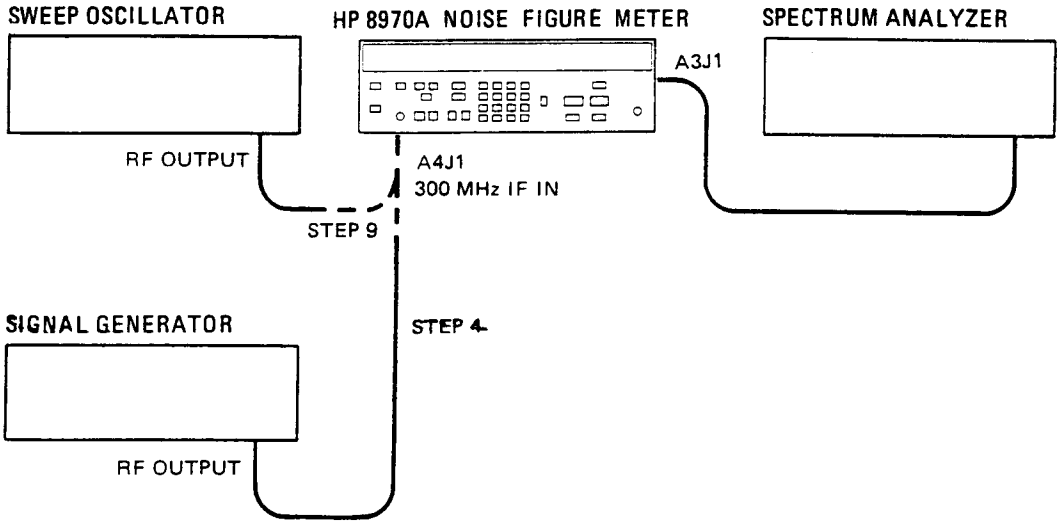


Figure 5-3. 300 MHz IF Bandpass Filter Adjustment Setup

Procedure

1. Set the signal generator for a 300.00 MHz CW signal at −30 dBm.
2. Set spectrum analyzer reference level to −18 dBm, input attenuation to 20 dB, frequency span to 5 MHz per division, and resolution bandwidth to between 100 and 300 kHz. Set center frequency to 25 MHz, trigger to free run, and video filter off. Set sweep time to 0.1 seconds and vertical resolution to 2 dB per division.
3. With the Noise Figure Meter power off, remove the small 20 MHz IF cover (front left). Move A3C82 (in sockets) to connect the input from the 300 MHz IF to A3J1.
4. Connect the equipment as shown in Figure 5-3. Turn on the equipment. Note that an error display on the Noise Figure Meter is normal when the signal path is broken.
5. A −20 dBm signal ±1 dB should be visible at the fourth vertical graticule line from the left (at 20 MHz) on the spectrum analyzer display. If the signal meets the above limits, set the signal exactly on the fourth vertical graticule line from the left and continue with step 7.

ADJUSTMENTS

300 MHz IF BANDPASS FILTER ADJUSTMENT (cont'd)

Procedure (cont'd)

6. If no signal is visible, start by setting FLTR 1, A4C9, FLTR 2, A4C12, FLTR 3, A4C17, and FLTR 4, A4C19, to midrange, then continue with the next step. If a signal is visible, but is not at −20 dBm ±1 dB, then continue with the next step.

7. Find, then peak the signal at 20 MHz by adjusting FLTR 2, A4C12, and FLTR 3, A4C17. Continue to adjust for maximum signal strength with adjustments FLTR 1, A4C9, and FLTR 4, A4C19. When the signal strength is maximized, set the signal exactly on the fourth vertical graticule line from the left and continue with the next step.

8. Set the sweep oscillator for a −30 dBm, 80 MHz wide swept signal centered at 300 MHz. Set the sweep time to 0.01 seconds and the vernier to maximum.

9. Disconnect the signal generator, and connect the sweeper to A4J1 (300 MHz IF IN). (See Figure 5-3.)

10. Check that the passband displayed on the spectrum analyzer is centered on the fourth vertical graticule line from the left. The passband should be greater than 10 MHz wide at the 3−dB points and flat to within one half dB within 2 MHz of the center frequency. If so, no further adjustment is necessary.

11. Starting with FLTR 2, A4C12, and FLTR 3, A4C17, adjust FLTR 1-4 (A4C9, C12, C17, and C19 respectively) for a passband display as described in the previous step. The gain, from the sweeper input to the IF output, on the spectrum analyzer display should be 10 dB.

12. Remove the power from the Noise Figure Meter, place A3C82 back into its original position, and replace the 20 MHz IF cover.

ADJUSTMENTS

5-11. SECOND CONVERTER LO FREQUENCY ADJUSTMENT

Reference Service Sheet 2.

Description The second converter LO is adjusted to 1750 MHz.

Equipment

Frequency Counter	HP 5340A
Adapter	HP 1250-1113

NOTE

The special adapter in Figure 5-4 is made from a standard subminiature RF male to male adapter, HP 1250-1113. The adapter's nuts must be soldered to the body of the adapter so they will both turn with the body. Be sure to space the nuts properly before soldering. (See Figure 5-4.)

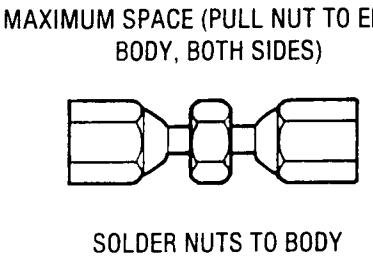


Figure 5-4. Special Adapter used in Second Converter LO and Passband Adjustments

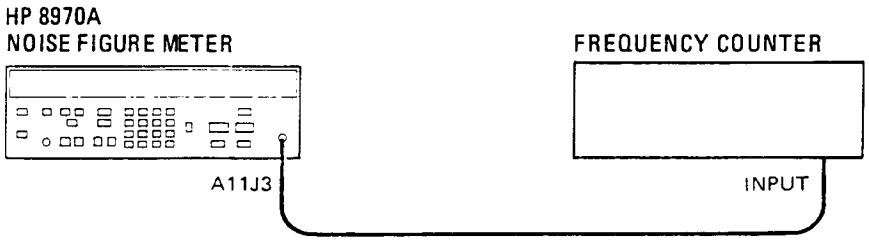


Figure 5-5. Second Converter LO Frequency Adjustment Setup

Procedure

1. Connect equipment as shown in Figure 5-5.
2. Adjust SECOND LO FREQUENCY, A11Z4, for a frequency counter display of 1749.8 to 1750.2 MHz. Use an allen wrench, through the center of a drilled out 5/16 inch nut driver, to enable nut to be tightened without shifting frequency.

ADJUSTMENTS

5-12. 2050 MHz BANDPASS FILTER ADJUSTMENT

Reference Service Sheet 2.

Description A swept 2050 MHz signal is injected into the second converter assembly, and the bandpass resonators are adjusted for best amplitude and flatness.

Equipment

Sweep Oscillator	HP 8620C/86222B Opt. 002
Spectrum Analyzer	HP 8565A
Adapter	HP 1250-1113

NOTE

For special modification to adapter 1250-1113, see Figure 5-4.

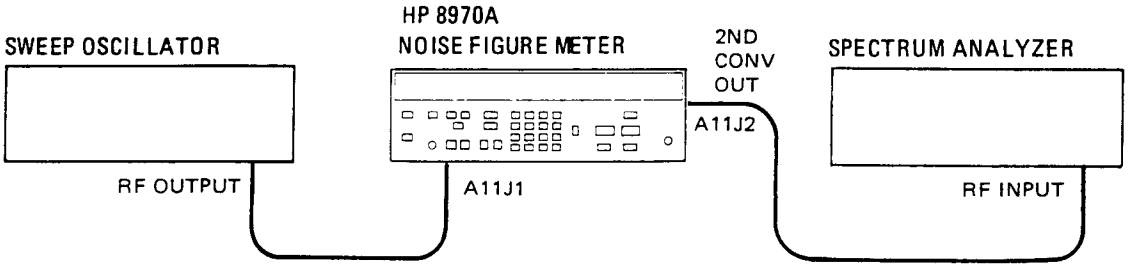


Figure 5-6. 2050 MHz Bandpass Filter Adjustment Setup

Procedure

1. Set the sweep oscillator for a −10 dBm 100 MHz wide swept signal centered at 2050 MHz. Set the sweep time to 0.01 seconds with the vernier at maximum.

2. Set the spectrum analyzer reference level to −10 dBm, input attenuation to 20 dB, frequency span to 5 MHz per division, and resolution bandwidth to 100 kHz. Set the center frequency to 300 MHz, trigger to free run, and video filter off.

3. Connect the equipment as shown in Figure 5-6. Note that an error display on the Noise Figure Meter is normal when the signal path is broken.

4. Check that the 3 dB passband displayed on the spectrum analyzer is 18 to 20 MHz wide. The passband should be flat within 0.4 dB for 2 MHz on either side of the 300 MHz center frequency. Passband points at 8 MHz on either side of the center frequency should be within 1 dB of each other. If these conditions are met, no adjustment is necessary.

5. If the passband requires adjustment, start by loosening the locknuts on A11Z1, A11Z2, and A11Z3. If only minor adjustment is needed, continue with step 6. If extensive adjustment is needed, carefully turn the tuning screws clockwise until each touches on the bottom of the cavity. Then, unscrew each of the tuning screws four full turns from bottom.

6. Adjust A11Z1 and A11Z3 for maximum passband amplitude while preserving overall flatness.

ADJUSTMENTS

2050 MHz BANDPASS FILTER ADJUSTMENT (cont'd)

Procedure (cont'd)

7. Adjust A11Z2 for maximum passband amplitude. If necessary, readjust A11Z1 and A11Z3 to achieve the best compromise between passband flatness and amplitude. When adjustment is complete, the passband should be as described in step 4.
8. Adjust 2nd MIXER MATCH, A11L2, for best passband amplitude and shape.
9. Reconnect W5 and W6.

ADJUSTMENTS

5-13. FREQUENCY CAL RF DETECTOR AND FIRST LO OFFSET ADJUSTMENTS

Reference Service Sheets 3 and 7.

Description The Frequency Cal RF Detector frequency and gain adjustments are set.

Equipment

Digital Voltmeter	HP 3455A
Frequency Counter	HP 5340A
Spectrum Analyzer	HP 8565A

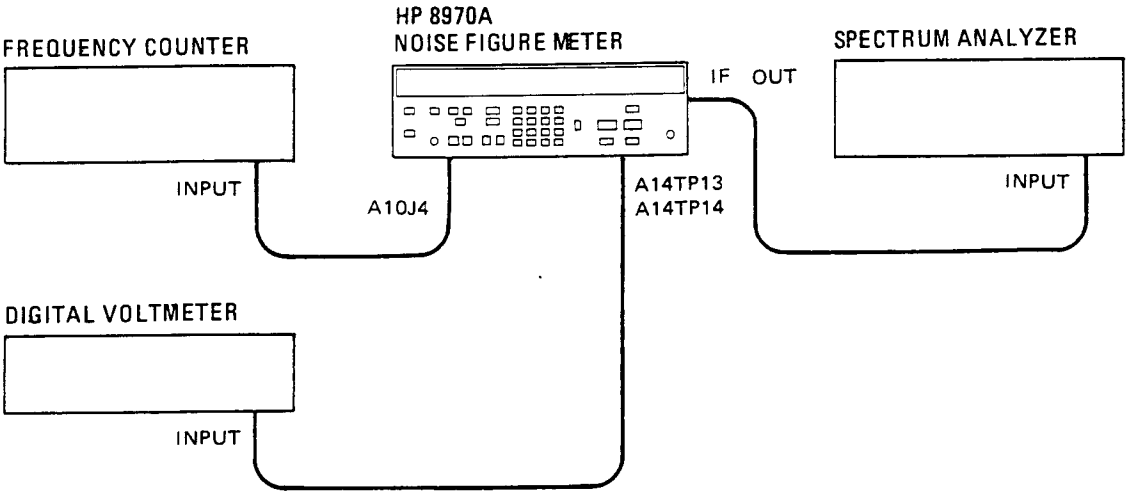


Figure 5-7. Frequency Cal RF Detector and First LO Offset Adjustment Setup

Procedure

1. Set the spectrum analyzer reference level to −10 dBm, input attenuation to 20 dB, frequency span to 1 MHz per division, and resolution bandwidth to 30 kHz. Set the center frequency to 20 MHz, trigger to free run, with video filtering set to 0.01 (or approximately 300 Hz).

2. On the Noise Figure Meter, key in 70.1 SPECIAL FUNCTION to set the IF attenuation to 0 dB.

3. Connect the equipment as shown in Figure 5-7. Connect the voltmeter high input to FREQ CAL DET IN, A14TP13, and the low input to GND, A14TP14.

4. Set the center of the 20 MHz IF passband exactly on the center vertical graticule of the spectrum analyzer display.

5. On the Noise Figure Meter key, in 70.5 SPECIAL FUNCTION to reduce the IF gain by 20 dB and 92.1 SPECIAL FUNCTION to tune the instrument to a 0 MHz input. Adjust 1st LO OFFSET, A13R17, until the signal is exactly centered on the center vertical graticule of the spectrum analyzer display. If the signal cannot be properly adjusted, perform step 6, otherwise continue with step 7.

ADJUSTMENTS

FREQUENCY CAL RF DETECTOR AND FIRST LO OFFSET ADJUSTMENTS (cont'd)

Procedure (cont'd)

6. If the adjustment in step 5 cannot be made, A13R19 must be selected as follows.
   a. Set 1st LO OFFSET, A13R17 to midrange.
   b. Note the frequency counter display.
   c. If the frequency is greater than 2050 MHz, increase A13R19 one standard value. If the frequency is less than 2050 MHz, decrease A13R19 one standard value.
   d. Readjust LO OFFSET, A13R17, until the signal is exactly centered on the center vertical graticule of the spectrum analyzer display. If this still cannot be done, repeat a through c. Note the value of A13R19 should be no less than 1000 ohms, or greater than 1470 ohms.
   e. Continue with step 7.

7. Adjust DET FREQ, A3C43, to peak the dc voltage reading on the digital voltmeter. If no peak is apparent, set DET GAIN, A3R19, to mid-range before peaking the DET FREQ adjustment.

8. Adjust DET GAIN, A3R19, for a voltmeter reading of 2.40 to 2.60 Vdc.

9. Tune the Noise Figure Meter to 1500 MHz. Adjust 1st LO GAIN, A13R11, for a counter reading of 3549.5 to 3551.5 MHz. If the frequency cannot be adjusted to within this range, perform step 10; otherwise this adjustment is complete.

10. If the adjustment in step 9 cannot be made, A13R66 must be selected as follows.
    a. Note the frequency counter display as 1st LO GAIN, A3R11 is adjusted. If the frequency adjustment range is on the high side of 3551.5 MHz, increase A13R66 one standard value. If the frequency adjustment range is on the low side of 3549.5 MHz, decrease A13R66 one standard value.
    b. Readjust 1st LO GAIN, A13R11, for a frequency counter reading of 3549.5 to 3551.5 MHz. If this still cannot be done, repeat a. Note the value of A13R66 should be no less than 5110 ohms, or no greater than 9090 ohms.

ADJUSTMENTS

5-14. INPUT POWER DETECTOR OFFSET AND GAIN ADJUSTMENT

Reference Service Sheet 1.

Description The offset and gain of the Input Power Detector dc amplifier are set.

Equipment

Digital Voltmeter	HP 3455A
Signal Generator	HP 8656A

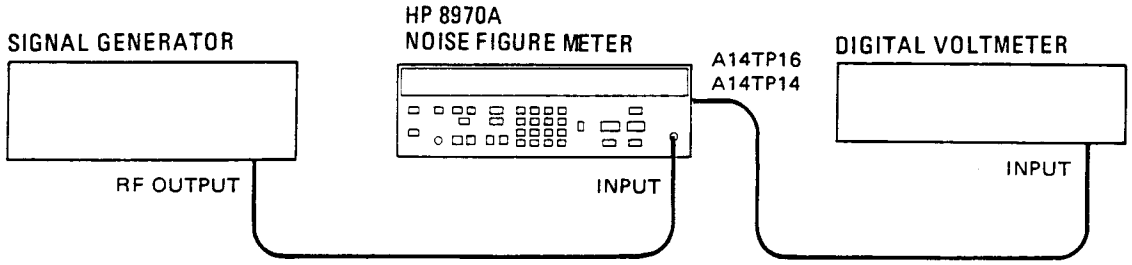


Figure 5-8. Input Power Detector Offset and Gain Adjustment Setup

Procedure

1. Connect equipment as shown in Figure 5-8. Connect the voltmeter low lead to GND, A14TP14, for a ground reference. Turn on the equipment, and allow the Noise Figure Meter to warm up for one hour.
2. Set the signal generator output to −127 dBm.
3. On the Noise Figure Meter, key in 60.3 SPECIAL FUNCTION to set the RF gain to 0 dB.
4. Adjust OFFSET, A6R41, for a digital voltmeter reading of 0 ±0.01 Vdc.
5. Set the signal generator for an output of −18 dBm at 30 MHz.
6. Adjust GAIN, A6R42, for a digital voltmeter reading of 6 ±0.05 Vdc. If the voltage cannot be adjusted within this range, perform step 7; otherwise, this adjustment is completed.
7. If the adjustment in step 6 cannot be made, A6R39 must be selected as follows:
   a. Set A6R39 fully clockwise or counterclockwise, whichever gives the closest reading to 6.9 Vdc.
   b. Not the digital voltmeter display.
   c. If the displayed voltage is greater than 6.9 Vdc, decrease A6R39 one standard value. If the displayed voltage is less than 6.9 Vdc, increase A6R39 one standard value.
   d. Repeat steps 4 through 6. If the adjustment in step 6 still cannot be done, repeat step 7. The value of A6R39 must be ≥133 KΩ and ≤196 KΩ.

ADJUSTMENTS

5-15. 20 MHz IF GAIN ADJUSTMENT

Reference Service Sheet 3.

Description The Noise Figure Meter is set for maximum gain.The 20 MHz IF gain is set so that the Noise Figure Meter internal voltmeter reads 1 volt with an active noise source at the instrument input.

Equipment Noise Source ..... HP 346b Opt. 001

Procedure

1. Connect the noise source to the Noise Figure Meter INPUT. Turn on the Noise Figure Meter.

2. On the Noise Figure Meter, press PRESET. Key in 81.0 SPECIAL FUNCTION to turn the noise source on and put the Noise Figure Meter into the voltmeter mode. Key in 60.1 SPECIAL FUNCTION to set the RF gain to +20 dB. Key in 70.1 SPECIAL FUNCTION to set the IF attenuation to 0 dB.

3. Adjust IF GAIN, A3R36, for a front panel display of 1 ±0.05 Vdc. This display is composed of the combination of the INSERTION GAIN and NOISE FIGURE displays. Display SMOOTHING can be used to stabilize the front panel reading.

ADJUSTMENTS

5-16. DISPLAY LINEARITY AND X- AND Y-AXIS GAIN ADJUSTMENTS

Reference Service Sheets 16 and 17.

Description The x-axis and y-axis gain adjustments are set for an output voltage range of 10 Vdc. The display linearity is set for constant horizontal spacings between display points.

Equipment

Oscilloscope	HP 1740A
Digital Voltmeter	HP 3455A

Procedure

1. Set the digital voltmeter to read dc volts and connect it to the Noise Figure Meter rear panel X-AXIS output.

2. Turn on the Noise Figure Meter, and key in 21.0 SPECIAL FUNCTION to set the X-AXIS and Y-AXIS outputs to their maximum levels. Adjust X GAIN, A13R47, for a digital voltmeter reading of 6 ±0.05 Vdc.

3. Connect the digital voltmeter to the Noise Figure Meter rear panel Y-AXIS output. Adjust Y GAIN, A13R34, for a digital voltmeter reading of 6 ±0.05 Vdc.

4. Connect the Noise Figure Meter rear panel X-AXIS output to the oscilloscope channel B input. Connect the Y-AXIS output to the oscilloscope channel A input. Connect the Noise Figure Meter Z-AXIS output to the oscilloscope z-axis input. Set the B channel gain to 0.5 volts per division dc coupled. Select the A versus B display mode on the oscilloscope.

5. On the Noise Figure Meter, key in 7.1 SPECIAL FUNCTION to access the oscilloscope test pattern. Adjust the oscilloscope gain and position controls until the test pattern exactly fits on the oscilloscope graticule.

6. On the Noise Figure Meter, press PRESET. Set the SWEEP STEP SIZE to 100 MHz. Key in 7.2 SPECIAL FUNCTION to select the noise figure oscilloscope display. Press the SINGLE SWEEP key. A line will be traced along the top of the oscilloscope display. When the line is 1/2 way across the screen, press SINGLE SWEEP again, to stop the sweep. The trace should extend 1/2 way across the top of the screen, and then continue the rest of the way at the bottom of the screen. If not, repeat this step.

7. Adjust DISPLAY LINEARITY, A13R29, so the last line segment at the top of the oscilloscope display is best aligned with the segments before it.

ADJUSTMENTS

5-17. 20 dB INPUT AMPLIFIER GAIN ADJUSTMENT

Reference Service Sheet 1.

Description The 20 dB Input Amplifier is adjusted by selecting the value of L6 on the A6 Input Assembly. This adjustment should only be performed if the Input Amplifier has been repaired or if relay chatter on the Input Assembly is noticed. If relay chatter is noticed, perform the Input Power Detector Offset and Gain Adjustment, paragraph 5-15, before this procedure.

Equipment

Frequency Counter	HP 5340A
Power Meter	HP 436A
Power Sensor	HP 8484A
Sweep Oscillator	HP 8620C/86222B Opt. 002

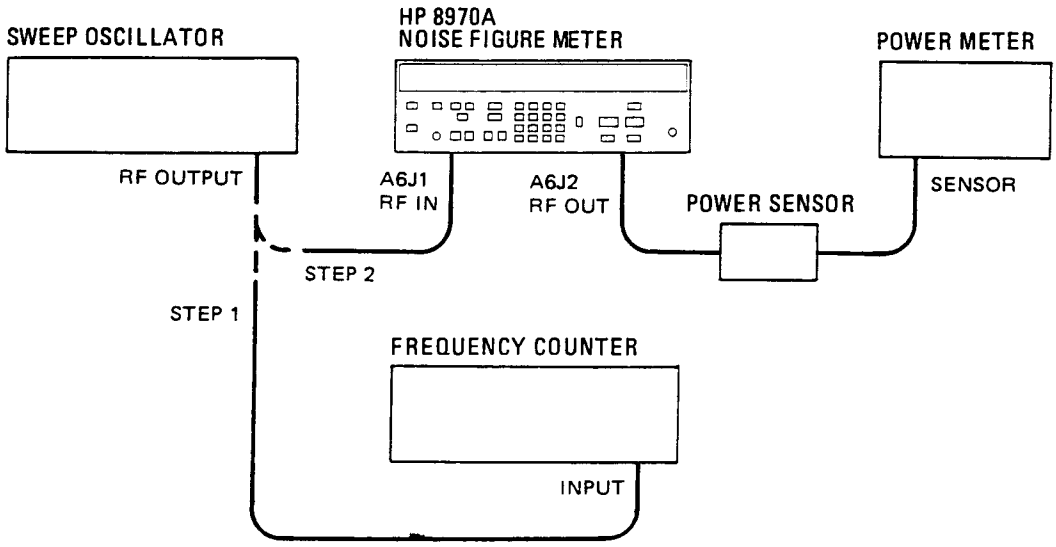


Figure 5-9. 20 dB Input Amplifier Gain Adjustment Setup

Procedure

1. Connect the sweep oscillator output to the frequency counter input. Set the sweep oscillator for a 1500 MHz CW signal at approximately −50 dBm.
2. Connect the sweep oscillator to the Noise Figure Meter A6J1, RF IN. Connect the power sensor to A6J2, RF OUT. (See Figure 5-9.)
3. On the Noise Figure Meter, key in 63.0 SPECIAL FUNCTION to set the Input Assembly for a thru line connection.
4. Adjust the sweep oscillator for an output level of −50 dBm as read on the power meter. Set a relative reference on the power meter.
5. On the Noise Figure Meter, key in 60.1 SPECIAL FUNCTION to insert the 20 dB Input Amplifier.

ADJUSTMENTS

20 dB INPUT AMPLIFIER GAIN ADJUSTMENT (cont'd)

Procedure (cont'd)

6. The power meter should indicate between 19.5 and 20.5 dB. If so, no adjustment is necessary.

7. If adjustment is needed, turn off the equipment, and remove the cover over the A6 Input Assembly. Unsolder the shorting wire laying across A6L6. The wire lays across one of several near shorts that span the printed circuit loop that forms L6.

8. Turn on the equipment, and reestablish the gain reading by repeating steps 3 through 5.

9. Move a shorting wire back and forth along the loop of L6 until a gain of 19.5 to 20.5 dB, as read on the power meter, is obtained. Solder the wire to the board in that position.

NOTE

Moving the shorting wire toward A6Q1 reduces the amplifier gain.

10. Replace the connections to the A6 Input Assembly, and replace the covers.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

This section contains information for ordering parts. Table 6-2 lists abbreviations used in the parts list and throughout the manual. Table 6-3 lists all replaceable parts in reference designator order. Table 6-4 contains the names and addresses that correspond to the manufacturer's code numbers.

6-2. RESTORED YIG OSCILLATORS

The YIG Oscillator (G1) may be replaced on an exchange basis, thus affording a considerable cost saving. Exchange, factory-repaired, and tested oscillators are available only on a trade-in basis; therefore, the defective oscillators must be returned for credit. For this reason, oscillators required for spare parts stock must be ordered by the new part number. The new YIG Oscillator part number is 5086-7080. The restored YIG Oscillator part number is 5086-6080.

6-3. ABBREVIATIONS

Table 6-2 lists abbreviations used in the parts list, schematics, and throughout the manual. In some cases, two forms of the abbreviation are used; one all in capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-4. REPLACEABLE PARTS LIST

Table 6-3 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numerical order by reference designation.

c. Miscellaneous parts.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. Part number check digit (CD).

c. The total quantity (Qty) in the instrument, which appears only at the first listing of a particular part number.

d. The description of the part.

e. A typical manufacturer of the part in a five-digit code.

f. The manufacturer's number for the part.

6-5. FACTORY SELECTED PARTS (*)

Parts marked with an asterisk (*) are factory selected parts. The value listed in the parts list is the nominal value. Refer to Sections V for information on determining what value to use for replacement.

6-6. PARTS LIST BACKDATING (†)

Parts marked with a dagger (†) are different in instruments with serial number prefixes lower than the one that this manual applies to directly. Table 7-1 lists the backdating changes by serial number prefix. The backdating changes are contained in Section VII.

6-7. PARTS LIST UPDATING (Change Sheet)

Production changes to instruments made after the publication of this manual are accompanied by a change in the serial number prefix. Changes to the parts list are recorded by serial number prefix on a MANUAL CHANGES supplement. Also, parts list errors are noted in the ERRATA portion of the MANUAL CHANGES supplement.

6-8. ILLUSTRATED PARTS BREAKDOWNS

Most mechanical parts are identified in Figures 6-1 through 6-5. These figures are located near the end of the Replaceable Parts table.

6-9. HARDWARE

Both metric and nonmetric screws are used in the Noise Figure Meter. The nonmetric screws have a dull steel gray appearance. Metric screws have a shiny silver appearance.

6-10. ORDERING INFORMATION

To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number (with the check digit), indicate the quantity required and address the order to the nearest Hewlett-Packard office (see note). The check digit will ensure accurate and timely processing of your order.

To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

NOTE

Within the USA, it is better to order directly from the HP Parts Center in Mountain View, California. Ask your nearest HP office for information and forms for the "Direct Mail Order System."

6-11. RECOMMENDED SPARES LIST

Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard prepares a "Recommended Spares" list for this instrument. The contents of the list are based on failure reports and repair data. Quantities given are for one year of parts support. A complimentary copy of the "Recommended Spares" list may be requested from your nearest Hewlett-Packard office.

When stocking parts to support more than one instrument or to support a variety of Hewlett-Packard instruments, it may be more economical to work from one consolidated list rather than simply adding together stocking quantities from the individual instrument lists. Hewlett-Packard will prepare consolidated "Recommended Spares" lists for any number or combination of instruments. Contact your nearest Hewlett-Packard office for details.

Table 6-2. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A . . . . . assembly
AT . . attenuator; isolator; termination
B . . . . . fan; motor
BT . . . . . battery
C . . . . . capacitor
CP . . . . . coupler
CR . . . . . diode; diode thyristor; varactor
DC . . . directional coupler
DL . . . . . delay line
DS . . . . . annunciator; signaling device (audible or visual); lamp; LED
E . . . . . miscellaneous electrical part
F . . . . . fuse
FL . . . . . filter
H . . . . . hardware
HY . . . . . circulator
J . . . electrical connector (stationary portion); jack
K . . . . . relay
L . . . . . coil; inductor
M . . . . . meter
MP . . . . . miscellaneous mechanical part
P . . . electrical connector (movable portion); plug
Q . . . . . transistor: SCR; triode thyristor
R . . . . . resistor
RT . . . . . thermistor
S . . . . . switch
T . . . . . transformer
TB . . . . . terminal board
TC . . . . . thermocouple
TP . . . . . test point
U . . . . . integrated circuit; microcircuit
V . . . . . electron tube
VR . . . . voltage regulator; breakdown diode
W . . . . cable; transmission path; wire
X . . . . . socket
Y . . . . crystal unit (piezoelectric or quartz)
Z . . . . tuned cavity; tuned circuit

ABBREVIATIONS

A . . . . . ampere
ac . . . . alternating current
ACCESS . . . . . accessory
ADJ . . . . . adjustment
A/D . . . . analog-to-digital
AF . . . . . audio frequency
AFC . . . . . automatic frequency control
AGC . . . . . automatic gain control
AL . . . . . aluminum
ALC . . . . . automatic level control
AM . . . amplitude modulation
AMPL . . . . . amplifier
APC . . . . automatic phase control
ASSY . . . . . assembly
AUX . . . . . auxiliary
avg . . . . . average
AWG . . . . American wire gauge
BAL . . . . . balance
BCD . . . . . binary coded decimal
BD . . . . . board
BE CU . . . . . beryllium copper
BFO . . . . . beat frequency oscillator
BH . . . . . binder head
BKDN . . . . . breakdown
BP . . . . . bandpass
BPF . . . . . bandpass filter
BRS . . . . . brass
BWO . . . . . backward-wave oscillator
CAL . . . . . calibrate
ccw . . counter-clockwise
CER . . . . . ceramic
CHAN . . . . . channel
cm . . . . . centimeter
CMO . . cabinet mount only
COAX . . . . . coaxial
COEF . . . . . coefficient
COM . . . . . common
COMP . . . . . composition
COMPL . . . . . complete
CONN . . . . . connector
CP . . . . . cadmium plate
CRT . . . cathode-ray tube
CTL . . . . complementary transistor logic
CW . . . . . continuous wave
cw . . . . . clockwise
cm . . . . . centimeter
D/A . . . . digital-to-analog
dB . . . . . decibel
dBm . . . . decibel referred to 1 mW
dc . . . . . direct current
deg . . degree (temperature interval or difference)
^{o} . . . . . degree (plane angle)
^{o}C . . . . . degree Celsius (centigrade)
^{o}F . . . . degree Fahrenheit
^{o}K . . . . . degree Kelvin
DEPC . . deposited carbon
DET . . . . . detector
diam . . . . . diameter
DIA . . . diameter (used in parts list)
DIFF AMPL . . differential amplifier
div . . . . . division
DPDT . . . . . double-pole, double-throw
DR . . . . . drive
DSB . . . . double sideband
DTL . . . . diode transistor logic
DVM . . . digital voltmeter
ECL . . . . emitter coupled logic
EMF . . electromotive force
EDP . . . . . electronic data processing
ELECT . . . . . electrolytic
ENCAP . . . . encapsulated
EXT . . . . . external
F . . . . . farad
FET . . . . . field-effect transistor
F/F . . . . . flip-flop
FH . . . . . flat head
FIL H . . . . . fillister head
FM . . frequency modulation
FP . . . . . front panel
FREQ . . . . . frequency
FXD . . . . . fixed
g . . . . . gram
GE . . . . . germanium
GHz . . . . . gigahertz
GL . . . . . glass
GRD . . . . . ground(ed)
H . . . . . henry
h . . . . . hour
HET . . . . . heterodyne
HEX . . . . . hexagonal
HD . . . . . head
HDW . . . . . hardware
HF . . . . . high frequency
HG . . . . . mercury
HI . . . . . high
HP . . . . . Hewlett-Packard
HPF . . . . . high pass filter
HR . . . . . hour (used in parts list)
HV . . . . . high voltage
Hz . . . . . Hertz
IC . . . . integrated circuit
ID . . . . . inside diameter
IF . . . . . intermediate frequency
IMPG . . . . . impregnated
in . . . . . inch
INCD . . . . . incandescent
INCL . . . . . include(s)
INP . . . . . input
INS . . . . . insulation
INT . . . . . internal
kg . . . . . kilogram
kHz . . . . . kilohertz
kΩ . . . . . kilohm
kV . . . . . kilovolt
lb . . . . . pound
LC . . . . . inductance-capacitance
LED . . light-emitting diode
LF . . . . . low frequency
LG . . . . . long
LH . . . . . left hand
LIM . . . . . limit
LIN . . . linear taper (used in parts list)
lin . . . . . linear
LK WASH . . . lock washer
LO . . . low; local oscillator
LOG . . . . logarithmic taper (used in parts list)
log . . . . . logrithm(ic)
LPF . . . . . low pass filter
LV . . . . . low voltage
m . . . . . meter (distance)
mA . . . . . milliampere
MAX . . . . . maximum
MΩ . . . . . megohm
MEG . . . . meg (10^6) (used in parts list)
MET FLM . . . . metal film
MET OX . . metallic oxide
MF . . . medium frequency; microfarad (used in parts list)
MFR . . . . . manufacturer
mg . . . . . milligram
MHz . . . . . megahertz
mH . . . . . millihenry
mho . . . . . mho
MIN . . . . . minimum
min . . . . . minute (time)
. . .' . . . . . minute (plane angle)
MINAT . . . . . miniature
mm . . . . . millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-2. Reference Designations and Abbreviations (2 of 2)

MOD ..... modulator
MOM ..... momentary
MOS ..... metal-oxide semiconductor
ms ..... millisecond
MTG ..... mounting
MTR ... meter (indicating device)
mV ..... millivolt
mVac ..... millivolt, ac
mVdc ..... millivolt, dc
mVpk .... millivolt, peak
mVp-p ... millivolt, peak-to-peak
mVrms .... millivolt, rms
mW ..... milliwatt
MUX ..... multiplex
MY ..... mylar
μA ..... microampere
μF ..... microfarad
μH ..... microhenry
μmho ..... micromho
μs ..... microsecond
μV ..... microvolt
μVac ..... microvolt, ac
μVdc ..... microvolt, dc
μVpk ... microvolt, peak
μVp-p ... microvolt, peak-to-peak
μVrms .... microvolt, rms
μW ..... microwatt
nA ..... nanoampere
NC ..... no connection
N/C .... normally closed
NE ..... neon
NEG ..... negative
nF ..... nanofarad
NI PL ..... nickel plate
N/O ..... normally open
NOM ..... nominal
NORM ..... normal
NPN ... negative-positive-negative
NPO .... negative-positive zero (zero temperature coefficient)
NRFR .. not recommended for field replacement
NSR ..... not separately replaceable
ns ..... nanosecond
nW ..... nanowatt
OBD ... order by description
OD ..... outside diameter
OH ..... oval head
OP AMPL ... operational amplifier
OPT ..... option
OSC ..... oscillator
OX ..... oxide
oz ..... ounce
Ω ..... ohm
P .... peak (used in parts list)
PAM .... pulse-amplitude modulation
PC ..... printed circuit
PCM .. pulse-code modulation; pulse-count modulation
PDM ..... pulse-duration modulation
pF ..... picofarad
PH BRZ phosphor bronze
PHL ..... Phillips
PIN ... positive-intrinsic-negative
PIV ..... peak inverse voltage
pk ..... peak
PL ..... phase lock
PLO ..... phase lock oscillator
PM .... phase modulation
PNP ... positive-negative-positive
P/O ..... part of
POLY ..... polystyrene
PORC ..... porcelain
POS .. positive; position(s) (used in parts list)
POSN ..... position
POT ..... potentiometer
p-p ..... peak-to-peak
PP ... peak-to-peak (used in parts list)
PPM ..... pulse-position modulation
PREAMPL ... preamplifier
PRF .... pulse-repetition frequency
PRR .... pulse repetition rate
ps ..... picosecond
PT ..... point
PTM ..... pulse-time modulation
PWM ..... pulse-width modulation
PWV ..... peak working voltage
RC ..... resistance-capacitance
RECT ..... rectifier
REF ..... reference
REG ..... regulated
REPL ..... replaceable
RF ..... radio frequency
RFI .... radio frequency interference
RH .... round head; right hand
RLC ..... resistance-inductance-capacitance
RMO ... rack mount only
rms .... root-mean-square
RND ..... round
ROM .. read-only memory
R&P ..... rack and panel
RWV ... reverse working voltage
S ... scattering parameter
s ..... second (time)
..." . second (plane angle)
S-B ..... slow-blow (fuse) (used in parts list)
SCR ... silicon controlled rectifier; screw
SE ..... selenium
SECT ..... sections
SEMICON ..... semiconductor
SHF ..... superhigh frequency
SI ..... silicon
SIL ..... silver
SL ..... slide
SNR .. signal-to-noise ratio
SPDT ..... single-pole, double-throw
SPG ..... spring
SR ..... split ring
SPST ..... single-pole, single-throw
SSB ..... single sideband
SST ..... stainless steel
STL ..... steel
SQ ..... square
SWR .. standing-wave ratio
SYNC ..... synchronize
T .. timed (slow-blow fuse)
TA ..... tantalum
TC ..... temperature compensating
TD ..... time delay
TERM ..... terminal
TFT .. thin-film transistor
TGL ..... toggle
THD ..... thread
THRU ..... through
TI ..... titanium
TOL ..... tolerance
TRIM ..... trimmer
TSTR ..... transistor
TTL .. transistor-transistor logic
TV ..... television
TVI television interference
TWT .. traveling wave tube
U ..... micro (10^{-6}) (used in parts list)
UF ... microfarad (used in parts list)
UHF .. ultrahigh frequency
UNREG .... unregulated
V ..... volt
VA ..... voltampere
Vac ..... volts, ac
VAR ..... variable
VCO ... voltage-controlled oscillator
Vdc ..... volts, dc
VDCW. . volts, dc, working (used in parts list)
V(F) ..... volts, filtered
VFO .. variable-frequency oscillator
VHF ..... very-high frequency
Vpk ..... volts, peak
Vp-p .. volts, peak-to-peak
Vrms ..... volts, rms
VSWR ... voltage standing wave ratio
VTO ..... voltage-tuned oscillator
VTVM .... vacuum-tube voltmeter
V(X) ..... volts, switched
W ..... watt
W/ ..... with
WIV .... working inverse voltage
WW ..... wirewound
W/O ..... without
YIG .. yttrium-iron-garnet
Z_o ..... characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08970-60007	8	1	KEYBOARD ASSEMBLY	28480	08970-60007
A1DS1	1990-0665	3	10	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS2	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS3	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS4	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS5	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS6	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1J1	1251-5649	7	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-5649
A1J2†	1251-8391	2	4	CONN-POST TYPE .100-PIN-SPCG 4-CONT	28480	1251-8391
A1MP1	5041-0943	3	1	KEY CAP-HALF (LOCAL)	28480	5041-0943
A1MP2	5041-2092	7	1	KEY CAP-HALF (ENR)	28480	5041-2092
A1MP3	5041-2709	3	1	KEY CAP-HALF (ENTER)	28480	5041-2709
A1MP4	5041-0818	1	1	KEY CAP-HALF SM/GRAY (8)	28480	5041-0818
A1MP5	5041-0817	0	1	KEY CAP-HALF SM/GRAY (7)	28480	5041-0817
A1MP6	5041-2099	4	1	KEY CAP-HALF (PRESET)	28480	5041-2099
A1MP7	5041-2706	0	1	KEY CAP-SDF (NOISE FIGURE)	28480	5041-2706
A1MP8	5041-0816	9	2	KEY CAP-HALF SM/GRAY (9)	28480	5041-0816
A1MP9	5041-0352	8	2	KEY CAP-HALF SURFACE LIGHT (SINGLE)	28480	5041-0352
A1MP10	5041-2100	8	2	KEY CAP-HALF (ARROW)	28480	5041-2100
A1MP11	5041-2708	2	1	KEY CAP- (SEQ)	28480	5041-2708
A1MP12	5041-0808	9	1	KEY CAP-HALF (.)	28480	5041-0808
A1MP13	5041-0819	2	1	KEY CAP-HALF SM/GRAY (0)	28480	5041-0819
A1MP14	5041-2100	8		KEY CAP-HALF (ARROW)	28480	5041-2100
A1MP15	5041-2704	8	1	KEY CAP-SDQ (DECREASE)	28480	5041-2704
A1MP16	5041-1835	4	1	KEY CAP-HALF (-)	28480	5041-1835
A1MP17	5041-2093	8	1	KEY CAP-HALF (START FREQ)	28480	5041-2093
A1MP18	5041-2096	1	1	KEY CAP-HALF SDQ (FREQUENCY)	28480	5041-2096
A1MP19	5041-0987	5	1	KEY CAP-HALF (STORE)	28480	5041-0987
A1MP20	5041-0815	8	1	KEY CAP-HALF SM/GRAY (5)	28480	5041-0815
A1MP21	5041-0814	7	1	KEY CAP-HALF SM/GRAY (4)	28480	5041-0814
A1MP22	5041-2094	9	1	KEY CAP-HALF (STOP/FREQ)	28480	5041-2094
A1MP23	5041-2707	1	1	KEY CAP-SDF (NOISE FIGURE & GAIN)	28480	5041-2707
A1MP24	5041-0816	9		KEY CAP-HALF SM/GRAY (6)	28480	5041-0816
A1MP25	5041-0352	8		KEY CAP-HALF SURFACE LIGHT (AUTO)	28480	5041-0352
A1MP26	5041-2097	2	1	KEY CAP-SDQ (FRED INCR)	28480	5041-2097
A1MP27	5041-0810	3	1	KEY CAP-HALF (RECALL)	28480	5041-0810
A1MP28	5041-0812	5	1	KEY CAP-HALF SM/GRAY (2)	28480	5041-0812
A1MP29	5041-0811	4	1	KEY CAP-HALF SM/GRAY (1)	28480	5041-0811
A1MP30	5041-2095	0	1	KEY CAP-HALF (STEP SIZE)	28480	5041-2095
A1MP31	5041-0484	7	1	KEY CAP-HALF BUTTER-SCOTCH YELLOW (SPECIAL FUNCTION)	28480	5041-0484
A1MP32	5041-0813	6	1	KEY CAP-HALF SM/GRAY (3)	28480	5041-0813
A1MP33	5041-2098	3	1	KEY CAP-SDQ (CALIBRATE)	28480	5041-2098
A1MP34	5041-2705	9	1	KEY CAP-SDQ (INCREASE)	28480	5041-2705
A1MP35	0380-1344	3	11	SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP36	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP37	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP38	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP39	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP40	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP41	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP42	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP43	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP44	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1MP45	0380-1344	3		SPACER-RVT-ON 9-MM-LG 4.8-MM-ID	28480	0380-1344
A1R1	0698-0082	7	7	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R2	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R3	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R4	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R5	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R6	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1S1	5060-9436	7	34	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S9	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S10	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S11	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S12	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S13	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S14	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S15	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S16	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S17	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S18	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S19	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S20	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S21	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S22	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S23	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S24	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S25	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S26	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S27	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S28	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S29	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S30	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S31	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S32	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S33	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S34	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1TP1†				NOT ASSIGNED		
A1TP2†				NOT ASSIGNED		
A1TP3	1251-0600	0	12	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2†	08970-60018	1	1	DISPLAY ASSEMBLY	28480	08970-60018
A2C1	0180-0229	7	5	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2C2	0160-3879	7	99	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C4	0180-1735	2	1	CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
A2C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C10	0160-3878	6	8	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C15	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C21	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C22	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C23	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C24	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2DS1†	1990-0730	3	13	DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7	13	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS2†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS3†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS4†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS5†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS6†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS7†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS8†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS9†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS10†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS11†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS12†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS13†	1990-0730	3		DISPLAY-NUM-SEG 1-CHAR .3-H RED	28480	5082-7611
	1200-1123	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-1123
A2DS14	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A2DS15	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A2DS16	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A2DS17†				NOT ASSIGNED		
A2DS18	1990-0696	0	1	LED-LIGHT BAR MODULE LUM-INT=3MCD	28480	1LM1-2300
	1200-0904	0	1	SOCKET-DSPL 4-CONT SIP W-WRAP	28480	1200-0904
A2DS19-A2DS22†				NOT ASSIGNED		
A2DS23	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A2DS24-A2DS30†				NOT ASSIGNED		
A2DS31-A2DS34†	1990-0759	6	4	LED-LIGHT BAR MODULE LUM-INT=3MCD	28480	HLMP-2620
	1200-1124	8	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-1124
A2J1†	1251-7727	6	1	CONNECTOR- 7 PIN NSR; P/O A2W1	28480	1251-7727
A2L1	9100-1611	4	2	INDUCTOR RF-CH-MLD 220NH 20%	28480	9100-1611
A2MP1†	7121-2961	1	1	LABEL-INFORMATION MYLAR	28480	7121-2961
A2MP2†				NOT ASSIGNED		
A2MP3†				NOT ASSIGNED		
A2R1	0757-0279	0	8	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2R2	1810-0207	9	1	NETWORK-RES 8-SIP22.0K OHM X 7	01121	208A223
A2R3	0757-0199	3	5	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2R4	0757-0123	3	2	RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A2R5	0757-0123	3		RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A2R6	0757-0442	9	25	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R7	0757-0470	3	1	RESISTOR 162K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1623-F
A2R8	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A2R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R12	1810-0205	7	5	NETWORK-RES 8-SIP4.7K OHM X 7	01121	208A472
A2R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R14	1810-0205	7		NETWORK-RES 8-SIP4.7K OHM X 7	01121	208A472
A2R15	0698-3155	1	4	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A2R16	1810-0330	9	13	NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R17	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R18	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R19	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R20	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R21	1810-0203	5	1	NETWORK-RES 8-SIP470.0 OHM X 7	01121	208A471
A2R22	1810-0381	0	4	NETWORK-RES 8-SIP150.0 OHM X 7	11236	750-81-R150
A2R23	1810-0381	0		NETWORK-RES 8-SIP150.0 OHM X 7	11236	750-81-R150
A2R24	1810-0381	0		NETWORK-RES 8-SIP150.0 OHM X 7	11236	750-81-R150
A2R25	1810-0381	0		NETWORK-RES 8-SIP150.0 OHM X 7	11236	750-81-R150
A2R26	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R27	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R28	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R29	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R30	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R31	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R32	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2R33	1810-0330	9		NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471
A2U1	1820-1568	8	3	IC BFR TTL LS BUS QUAD	01295	SN74LS125AN
A2U2	1820-1201	6	3	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2U3	1820-1199	1	5	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2U4†	1858-0047	5	3	TRANSISTOR ARRAY 16-PIN PLSTC DIP	13606	ULN-2003A
A2U5†	1858-0047	5		TRANSISTOR ARRAY 16-PIN PLSTC DIP	13606	ULN-2003A
A2U6†	1826-0759	9	2	IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A2U7	1820-1216	3	3	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2U8	1820-1794	2	8	IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A2U9	1820-1987	5	3	IC SHF-RGTR TTL LS COM CLEAR STOR 8-BIT	01295	SN74LS299N
A2U10	1820-1858	9	24	IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U11	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U12	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U13	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U14	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U15	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U16	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U17	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U18	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U19	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U20	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U21	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U22	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U23	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U24	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U25	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U26	1820-1987	5		IC SHF-RGTR TTL LS COM CLEAR STOR 8-BIT	01295	SN74LS299N
A2U27	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2U28	1820-1427	8	1	IC DCDR TTL LS 2-TO-4-LINE DUAL 2-INP	01295	SN74LS156N
A2U29	1820-1416	5	3	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A2W1	8120-3299	9	1	FLAT RIBBON ASSY 28-AWG 20-COND	28480	8120-3299
A2W2	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A3	08970-60003	4	1	20 MHZ IF ASSEMBLY	28480	08970-60003
A3C1	0160-4698	0	6	CAPACITOR-FXD 56PF +-1% 200VDC CER	28480	0160-4698
A3C2				NOT ASSIGNED		
A3C3	0160-0576	5	25	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C4	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C5	0160-5376	3	4	CAPACITOR-FXD 200PF +-1% 200VDC CER	28480	0160-5376
A3C6	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C8	0160-4698	0		CAPACITOR-FXD 56PF +-1% 200VDC CER	28480	0160-4698
A3C9				NOT ASSIGNED		
A3C10	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C11	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C12	0160-5376	3		CAPACITOR-FXD 200PF +-1% 200VDC CER	28480	0160-5376
A3C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C15	0160-4698	0		CAPACITOR-FXD 56PF +-1% 200VDC CER	28480	0160-4698
A3C16	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A3C21	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C22	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C23	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C24	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C25	0160-4698	0		CAPACITOR-FXD 56PF +-1% 200VDC CER	28480	0160-4698
A3C26				NOT ASSIGNED		
A3C27	0160-5376	3		CAPACITOR-FXD 200PF +-1% 200VDC CER	28480	0160-5376
A3C28	0160-4698	0		CAPACITOR-FXD 56PF +-1% 200VDC CER	28480	0160-4698
A3C29				NOT ASSIGNED		
A3C30	0160-5376	3		CAPACITOR-FXD 200PF +-1% 200VDC CER	28480	0160-5376
A3C31	0160-4698	0		CAPACITOR-FXD 56PF +-1% 200VDC CER	28480	0160-4698
A3C32	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C33	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C34	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C35	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C36	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C37	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C38	0160-3874	2	3	CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3C39	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C40	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C41	0160-3874	2		CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3C42	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C43	0121-0451	3	2	CAPACITOR-V TRMR-AIR 1.7-11PF 175V	74970	187-0106-028
A3C44	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C45	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C46	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C47	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C48	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C49	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C50	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C51	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C52	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C53	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C54	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C55	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C56	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C57	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C58	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C59	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C60	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C61	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C62	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C63	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C64	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C65	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C66	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C67	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C68	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C69	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C70	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C71	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C72	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C73	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C74	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C75	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C76				NOT ASSIGNED		
A3C77				NOT ASSIGNED		
A3C78	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C79	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C80	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C81	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C82	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
	1251-1556	7	1	CONNECTOR-SGL CONT SKT .018-IN BSC-SZ	28480	1251-1556
A3C83	0160-3029	9	1	CAPACITOR-FXD 7.5PF +-.5PF 100VDC CER	28480	0160-3029

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3CR1	1901-0050	3	16	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR3	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3E1	9170-0847	3	5	CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A3E2	9170-0847	3		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A3J1	1250-0835	1	1	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
	3050-0079	3	1	WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
A3L1	9140-0179	1	10	INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3L2	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3L3	9140-0611	6	5	INDUCTOR RF-CH-MLD 1.5UH 1% .105DX.26LG	28480	9140-0611
A3L4	9140-0612	7	2	INDUCTOR RF-CH-MLD 1.8UH 1% .105DX.26LG	28480	9140-0612
A3L5	9100-1617	0	8	INDUCTOR RF-CH-MLD 3.9UH 10%	28480	9100-1617
A3L6	9100-1617	0		INDUCTOR RF-CH-MLD 3.9UH 10%	28480	9100-1617
A3L7	9140-0611	6		INDUCTOR RF-CH-MLD 1.5UH 1% .105DX.26LG	28480	9140-0611
A3L8	9100-1617	0		INDUCTOR RF-CH-MLD 3.9UH 10%	28480	9100-1617
A3L9	9100-1617	0		INDUCTOR RF-CH-MLD 3.9UH 10%	28480	9100-1617
A3L10	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3L11	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3L12	9140-0611	6		INDUCTOR RF-CH-MLD 1.5UH 1% .105DX.26LG	28480	9140-0611
A3L13	9140-0612	7		INDUCTOR RF-CH-MLD 1.8UH 1% .105DX.26LG	28480	9140-0612
A3L14	9140-0611	6		INDUCTOR RF-CH-MLD 1.5UH 1% .105DX.26LG	28480	9140-0611
A3L15	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3L16	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3L17	9140-0111	1	4	INDUCTOR RF-CH-MLD 3.3UH 10%	28480	9140-0111
A3L18	9140-0111	1		INDUCTOR RF-CH-MLD 3.3UH 10%	28480	9140-0111
A3L19	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3L20	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3L21	9100-1617	0		INDUCTOR RF-CH-MLD 3.9UH 10%	28480	9100-1617
A3L22	9100-1617	0		INDUCTOR RF-CH-MLD 3.9UH 10%	28480	9100-1617
A3L23	9100-1617	0		INDUCTOR RF-CH-MLD 3.9UH 10%	28480	9100-1617
A3L24	9100-1617	0		INDUCTOR RF-CH-MLD 3.9UH 10%	28480	9100-1617
A3L25	9140-0111	1		INDUCTOR RF-CH-MLD 3.3UH 10%	28480	9140-0111
A3L26	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3L27	9140-0111	1		INDUCTOR RF-CH-MLD 3.3UH 10%	28480	9140-0111
A3Q1	1854-0345	8	3	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3Q2	1855-0235	7	5	TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	28480	1855-0235
A3Q3	1853-0405	9	4	TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A3Q4	1855-0235	7		TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	28480	1855-0235
A3Q5	1854-0597	2	5	TRANSISTOR NPN 2N5943 SI TO-39 PD=1W	04713	2N5943
	1205-0011	0	6	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A3Q6	1855-0420	2	9	TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A3Q7	1855-0235	7		TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	28480	1855-0235
A3Q8	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A3Q9	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A3Q10	1854-0597	2		TRANSISTOR NPN 2N5943 SI TO-39 PD=1W	04713	2N5943
	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A3Q11	1854-0597	2		TRANSISTOR NPN 2N5943 SI TO-39 PD=1W	04713	2N5943
	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A3Q12	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A3Q13	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A3Q14	1855-0235	7		TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	28480	1855-0235
A3Q15	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A3Q16	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A3Q17	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A3Q18	1855-0235	7		TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	28480	1855-0235
A3Q19	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A3Q20	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
	1205-0037	0	2	HEAT SINK TO-18-CS	28480	1205-0037
A3Q21	1854-0686	0	1	TRANSISTOR NPN SI TO-72 PD=200MW FT=4GHZ	28480	1854-0686

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R1	0698-3153	9	8	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R3	0757-0424	7	2	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3R4	0757-0873	0	2	RESISTOR 1.62K 1% .5W F TC=0+-100	28480	0757-0873
A3R5	0757-0394	0	5	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R6†	0757-0280	3	17	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R7†	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R8	0757-0402	1	2	RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3R9†	0698-0089	4	1	RESISTOR 1.78K 1% .5W F TC=0+-100	28480	0698-0089
A3R10	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R11	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R12	0757-0463	4	2	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A3R13	0698-3162	0	8	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A3R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R15	0757-0465	6	12	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R16	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3R17	0757-0397	3	2	RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A3R18	0757-0817	2	2	RESISTOR 750 1% .5W F TC=0+-100	28480	0757-0817
A3R19	2100-3296	8	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 17-TRN	28480	2100-3296
A3R20	0757-0288	1	3	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A3R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R22	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3R23	0757-0401	0	12	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R24	0757-0416	7	7	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R25	0698-8606	7	1	RESISTOR 450 .1% .125W F TC=0+-25	28480	0698-8606
A3R26	0698-6364	0	1	RESISTOR 50 .1% .125W F TC=0+-25	28480	0698-6364
A3R27	0698-3434	9	1	RESISTOR 34.8 1% .125W F TC=0+-100	24546	C4-1/8-T0-34R8-F
A3R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R29	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R30	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R31	0698-8827	4	2	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A3R32	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A3R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R34	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3R35†	0698-3430	5	1	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A3R36	2100-2060	2	1	RESISTOR-TRMR 50 20% C TOP-ADJ 1-TRN	73138	82PR50
A3R37	0757-0817	2		RESISTOR 750 1% .5W F TC=0+-100	28480	0757-0817
A3R38	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3R39	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R40	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A3R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R42	0698-6448	1	1	RESISTOR 216.2 .1% .125W F TC=0+-25	28480	0698-6448
A3R43	0698-6323	1	1	RESISTOR 100 .1% .125W F TC=0+-25	28480	0698-6323
A3R44	0757-0395	1	1	RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-56R2-F
A3R45	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R46	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R47	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A3R48	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R49	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3R50	0698-3442	9	2	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A3R51	0757-0815	0	1	RESISTOR 562 1% .5W F TC=0+-100	28480	0757-0815
A3R52	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3R53	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R54	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A3R55	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R56	0699-0824	7	1	RESISTOR 218.8 .1% .125W F TC=0+-25	28480	0699-0824
A3R57	0699-0825	8	1	RESISTOR 281.2 .1% .125W F TC=0+-25	28480	0699-0825
A3R58	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3R59	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R60	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R61	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R62	0757-0463	4		RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A3R63	0757-0873	0		RESISTOR 1.62K 1% .5W F TC=0+-100	28480	0757-0873
A3R64	0698-3437	2	1	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A3R65	0698-3439	4	2	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3RT1	0837-0015	2	1	THERMISTOR DISC 500-OHM TC=-4.4%/C-DEG	28480	0837-0015
A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3U1	1826-0217	4	3	IC OP AMP GP DUAL TO-99 PKG	07933	RC4558T
A3U2	1826-0217	4		IC OP AMP GP DUAL TO-99 PKG	07933	RC4558T
A3U3	1826-0217	4		IC OP AMP GP DUAL TO-99 PKG	07933	RC4558T
A3VR1	1902-0955	9	1	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.062%	28480	1902-0955
A3W1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A3W2	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A3W3	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A3W4	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A3W5	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A4	08970-60002	3	1	300 MHZ IF ASSEMBLY	28480	08970-60002
A4C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C3	0160-4389	6	3	CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A4C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C6†	0160-4517	2	1	CAPACITOR-FXD 1.2PF +-.25PF 200VDC CER	28480	0160-4517
A4C7	0160-3874	2		CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A4C8	0160-4494	4	1	CAPACITOR-FXD 39PF +-5% 200VDC CER 0+-30	28480	0160-4494
A4C9	0121-0452	4	4	CAPACITOR-V TRMR-AIR 1.3-5.4PF 175V	74970	187-0103-028
A4C10				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4C11	0121-0452	4		CAPACITOR-V TRMR-AIR 1.3-5.4PF 175V	74970	187-0103-028
A4C12	0121-0452	4		CAPACITOR-V TRMR-AIR 1.3-5.4PF 175V	74970	187-0103-028
A4C13	0160-4103	2	1	CAPACITOR-FXD 220PF +-5% 100VDC CER	72982	8121-M100-COG-221J
A4C14				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4C15	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C17	0121-0451	3		CAPACITOR-V TRMR-AIR 1.7-11PF 175V	74970	187-0106-028
A4C18				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4C19	0121-0452	4		CAPACITOR-V TRMR-AIR 1.3-5.4PF 175V	74970	187-0103-028
A4C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C21	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C22	0160-4381	8	1	CAPACITOR-FXD 1.5PF +-.25PF 200VDC CER	28480	0160-4381
A4C23	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4E1	9170-0847	3		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A4J1	1250-1781	8	4	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1781
A4L1	9140-0144	0	7	INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A4L2†				NOT ASSIGNED		
A4L3	9100-2247	4	1	INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A4L4	08970-80003	6	4	INDUCTOR-IF 300 MHZ	28480	08970-80003
A4L5	08970-80003	6		INDUCTOR-IF 300 MHZ	28480	08970-80003
A4L6				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L7				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L8	08970-80003	6		INDUCTOR-IF 300 MHZ	28480	08970-80003
A4L9	08970-80003	6		INDUCTOR-IF 300 MHZ	28480	08970-80003
A4L10	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A4MP1	08970-00015	2	1	SHIELD-300 MHZ	28480	08970-00015
A4Q1	1854-0597	2		TRANSISTOR NPN 2N5943 SI TO-39 PD=1W	04713	2N5943
	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A4Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A4Q3	1853-0459	3	7	TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A4Q4	1854-0591	6	1	TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR-90
A4R1†	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A4R2†	0757-0042	5	1	RESISTOR 12.3K 1% .5W F TC=0+-100	28480	0757-0042
A4R3	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4R4	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A4R5	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R6	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A4R7†	0698-3446	3	2	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A4R8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R9	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4R10	0698-0083	8	1	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A4R11	0698-3438	3	2	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4R12†	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A4TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4U1	0955-0095	8	1	MIXER FREQ: 1 TO 500MHZ; CONVERSION LOSS	28480	0955-0095
	1251-3172	7	1	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A4W1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A4Y1	1GA1-8000	2	1	THIN FILM CIRCUIT	28480	1GA1-8000
	3050-0786	9	1	WASHER-FL NM NO. 0 .063-IN-ID .187-IN-OD	28480	3050-0786
A5				NOT ASSIGNED		
A6	08970-60001	2	1	INPUT ASSEMBLY	28480	08970-60001
A6C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C2				NOT ASSIGNED		
A6C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C15	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C17	0160-4031	5	1	CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4031
A6C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C19				NOT ASSIGNED		
A6C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR6	1901-0941	1	1	DIODE-SM SIG SCHOTTKY	28480	1901-0941
A6J1	1250-1781	8		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1781
A6J2	1250-1781	8		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1781
A6K1†	0490-0565	1	5	RELAY 2C 12VDC-COIL	28480	0490-0565
	3050-0737	0	5	WASHER-FL NM 1/4 IN .254-IN-ID .4-IN-OD	28480	3050-0737
A6K2†	0490-0565	1		RELAY 2C 12VDC-COIL	28480	0490-0565
	3050-0737	0		WASHER-FL NM 1/4 IN .254-IN-ID .4-IN-OD	28480	3050-0737
A6K3†	0490-0565	1		RELAY 2C 12VDC-COIL	28480	0490-0565
	3050-0737	0		WASHER-FL NM 1/4 IN .254-IN-ID .4-IN-OD	28480	3050-0737
A6K4†	0490-0565	1		RELAY 2C 12VDC-COIL	28480	0490-0565
	3050-0737	0		WASHER-FL NM 1/4 IN .254-IN-ID .4-IN-OD	28480	3050-0737
A6K5†	0490-0565	1		RELAY 2C 12VDC-COIL	28480	0490-0565
	3050-0737	0		WASHER-FL NM 1/4 IN .254-IN-ID .4-IN-OD	28480	3050-0737
A6L1	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A6L2	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A6L3	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A6L4	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A6L5	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6L6*				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6Q1	1854-0864	6	1	TRANSISTOR NPN PD=400MW	28480	HXTR-6105
A6Q2	1854-0863	5	1	TRANSISTOR NPN PD=450MW	28480	HXTR-2101
A6Q3	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A6Q4	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A6R1	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R2	0699-0092	1	6	RESISTOR 96.25 .1% .25W F TC=0+-50	28480	0699-0092
A6R3	0699-0091	0	3	RESISTOR 71.15 .1% .25W F TC=0+-50	28480	0699-0091
A6R4	0699-0092	1		RESISTOR 96.25 .1% .25W F TC=0+-50	28480	0699-0092
A6R5	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R6†	0699-1308	4	6	RESISTOR 51.1 1% .05W F TC=0+-100	08484	0699-1308
A6R7	0698-7253	8	2	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A6R8†	0699-1308	4		RESISTOR 51.1 1% .05W F TC=0+-100	08484	0699-1308
A6R9†	0699-1308	4		RESISTOR 51.1 1% .05W F TC=0+-100	08484	0699-1308
A6R10†	0698-1124	0	1	RESISTOR-FXD 261 OHM 1% .25W	28480	0698-1124
A6R11	0698-3447	4	2	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A6R12†	0699-1308	4		RESISTOR 51.1 1% .05W F TC=0+-100	08484	0699-1308
A6R13†	0699-1308	4		RESISTOR 51.1 1% .05W F TC=0+-100	08484	0699-1308
A6R14	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R15	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R16†	0699-1308	4		RESISTOR 51.1 1% .05W F TC=0+-100	08484	0699-1308
A6R17	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A6R18†	0699-1309	5	6	RESISTOR 61.9 1% .05W F TC=0+-100	28480	0699-1309
A6R19†	0698-1123	9	1	RESISTOR-FXD 196OHM 1% .25W	28480	0698-1123
A6R20†	0699-1309	5		RESISTOR 61.9 1% .05W F TC=0+-100	28480	0699-1309
A6R21	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A6R22†	0699-1309	5		RESISTOR 61.9 1% .05W F TC=0+-100	28480	0699-1309
A6R23	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R24†	0699-1309	5		RESISTOR 61.9 1% .05W F TC=0+-100	28480	0699-1309
A6R25†	0699-1309	5		RESISTOR 61.9 1% .05W F TC=0+-100	28480	0699-1309
A6R26†	0699-1309	5		RESISTOR 61.9 1% .05W F TC=0+-100	28480	0699-1309
A6R27	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R28	0699-0092	1		RESISTOR 96.25 .1% .25W F TC=0+-50	28480	0699-0092
A6R29	0699-0091	0		RESISTOR 71.15 .1% .25W F TC=0+-50	28480	0699-0091
A6R30	0699-0092	1		RESISTOR 96.25 .1% .25W F TC=0+-50	28480	0699-0092
A6R31	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R32	0699-0092	1		RESISTOR 96.25 .1% .25W F TC=0+-50	28480	0699-0092
A6R33	0699-0091	0		RESISTOR 71.15 .1% .25W F TC=0+-50	28480	0699-0091
A6R34	0699-0092	1		RESISTOR 96.25 .1% .25W F TC=0+-50	28480	0699-0092
A6R35	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A6R36†	0727-0074	0	2	RESISTOR 436.2 .5% .25W CF TC=0-500	28480	0727-0074
A6R37	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A6R38†	0727-0008	0	1	RESISTOR 11.61 .5% .25W CF TC=0-500	28480	0727-0008
A6R39*	0698-3452	1	1	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A6R40†	0727-0074	0		RESISTOR 436.2 .5% .25W CF TC=0-500	28480	0727-0074
A6R41	2100-3089	7	1	RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	32997	3292W-1-502
A6R42	2100-2655	1	1	RESISTOR-TRMR 100K 10% C TOP-ADJ 1-TRN	73138	82PR100K
A6RT1	0837-0008	3	1	THERMISTOR DISC 1K-OHM TC=-3.8%/C-DEG	28480	0837-0008
A6U1	1826-0266	3	1	IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-05EJ
A6W1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6W2	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6W3	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6W4	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6W5	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6W6	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6W7	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6W8				WIRE-22AWG		
A6W9				WIRE-22AWG		
A6W10				WIRE-22AWG		
A6W11				WIRE-22AWG		

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A7	08970-60005	6	1	VOLTMETER ASSEMBLY	28480	08970-60005
A7C1	0180-0197	8	2	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A7C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A7C3	0160-4404	6	2	CAPACITOR-FXD .15UF +-10% 100VDC POLYP	28480	0160-4404
A7C4	0160-4404	6		CAPACITOR-FXD .15UF +-10% 100VDC POLYP	28480	0160-4404
A7C5	0160-2055	9	30	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C8	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A7C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A7CR1	1901-0376	6	6	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A7CR2	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A7CR3	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A7CR4	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A7L1	9140-0114	4	7	INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A7L2	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A7MP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7MP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7MP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7MP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7MP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7MP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7MP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7Q1	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A7Q2	1855-0305	2	1	TRANSISTOR J-FET 2N4117A N-CHAN D-MODE	17856	2N4117A
A7Q3	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A7Q4	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A7Q5	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A7Q6	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A7Q7	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A7Q8	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A7R1	0757-0420	3	1	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A7R2	0757-0428	1	4	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A7R3	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R4	0698-8319	9	2	RESISTOR 10K 1% .1W F TC=0+-10	19701	5033Z1/8-T13-1002-F
A7R5	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R7	0699-0096	5	1	RESISTOR 12K .1% .1W F TC=0+-10	28480	0699-0096
A7R8	0699-0748	4	1	RESISTOR 57.4K .1% .1W F TC=0+-15	28480	0699-0748
A7R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R10	0698-3150	6	4	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A7R11	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A7R12	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A7R13	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A7R14	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A7R15	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A7R16	0757-0419	0	5	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A7R17	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A7R18	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A7R19	0757-0444	1	2	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A7R20	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A7R21	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A7R22	0683-2265	1	4	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A7R23	0683-2265	1		RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A7R24	0683-2265	1		RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A7R25	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R26	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A7R27	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A7R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R29	0683-2265	1		RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A7R30	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7R31	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A7R32	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A7R33	0757-0338	2	1	RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1001-F
A7R34	2100-3288	8	1	RESISTOR-TRMR 50 20% C TOP-ADJ 17-TRN	28480	2100-3288
A7R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R36	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A7R37	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A7TP1	0360-0535	0	53	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A7U1	1826-0026	3	2	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A7U2	1826-0547	3	1	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	01295	TL072ACP
A7VR1	1902-0786	4	1	DIODE-ZNR 1N937 9V 5% DO-7 PD=.5W	24046	1N937
A7VR2	1902-0928	6	5	DIODE-ZNR 6.9V 4% TO-92 TC=+.002%	27014	LM329
A8	08970-60004	5	1	NOISE POWER DETECTOR ASSEMBLY	28480	08970-60004
A8C1	0160-4385	2	1	CAPACITOR-FXD 15PF +-5% 200VDC CER 0+-30	28480	0160-4385
A8C2				NOT ASSIGNED		
A8C3	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A8C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C5*	0160-4766	3	1	CAPACITOR-FXD 30PF +-5% 200VDC CER 0+-30	28480	0160-4766
A8C6	0160-4350	1		CAPACITOR-FXD 68PF +-5% 200VDC CER 0+-30	28480	0160-4350
A8C7	0160-4387	4	2	CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A8C8	0160-4764	1	2	CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4764
A8C9	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A8C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C15	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8CR1	1901-1085	6	4	DIODE-SM SIG SCHOTTKY	28480	1901-1085
A8CR2	1901-1085	6		DIODE-SM SIG SCHOTTKY	28480	1901-1085
A8CR3	1901-1085	6		DIODE-SM SIG SCHOTTKY	28480	1901-1085
A8CR4	1901-1085	6		DIODE-SM SIG SCHOTTKY	28480	1901-1085
A8E1	9170-0847	3		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A8E2	9170-0847	3		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A8J1	1250-1781	8		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1781
A8L1	9140-0503	5	1	INDUCTOR 3.6UH 1% .166DX.385LG Q=33	28480	9140-0503
A8L2	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A8L3	9140-0611	6		INDUCTOR RF-CH-MLD 1.5UH 1% .105DX.26LG	28480	9140-0611
A8L4	9100-1612	5	2	INDUCTOR RF-CH-MLD 330NH 20%	28480	9100-1612
A8L5	9100-1612	5		INDUCTOR RF-CH-MLD 330NH 20%	28480	9100-1612
A8L6	9140-0105	3	2	INDUCTOR RF-CH-MLD 8.2UH 10%	28480	9140-0105
A8L7	9140-0105	3		INDUCTOR RF-CH-MLD 8.2UH 10%	28480	9140-0105
A8Q1	1854-0597	2		TRANSISTOR NPN 2N5943 SI TO-39 PD=1W	04713	2N5943
	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
	3050-0405	9	1	WASHER-FL NM NO. 0 .064-IN-ID .133-IN-OD	28480	3050-0405
A8Q2	1854-0719	0	1	TRANSISTOR NPN SI TO-72 PD=500MW FT=4GHZ	28480	1854-0719
	1205-0037	0		HEAT SINK TO-18-CS	28480	1205-0037
A8R1	0757-0316	6	1	RESISTOR 42.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A8R2	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R3	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A8R4	2100-0569	2	1	RESISTOR-TRMR 1M 20% C TOP-ADJ 1-TRN	28480	2100-0569
A8R5	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A8R6	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A8R7	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A8R8	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A8R9	0757-0816	1	1	RESISTOR 681 1% .5W F TC=0+-100	28480	0757-0816
A8R10	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A8R11	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A8R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A8U1	1826-0471	2	1	IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
A8VR1	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
				MISCELLANEOUS PARTS		
	0362-0265	7	3	CONNECTOR-SGL CONT SKT 1.14-MM-BSC-SZ	28480	0362-0265
A9	08970-60010	3	1	POWER SUPPLY ASSEMBLY	28480	08970-60010
A9C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C7	0180-2926	5	1	CAPACITOR-FXD 850UF+75-10% 100VDC AL	28480	0180-2926
	2190-0011	8	3	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
	2680-0128	7	3	SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A9C8	0180-3072	4	2	CAPACITOR-FXD 2900UF+75-10% 40VDC AL	28480	0180-3072
	2190-0011	8		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
	2680-0128	7		SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A9C9	0180-3117	8	2	CAPACITOR-FXD 9000UF+80-20% 20VDC AL	28480	0180-3117
A9C10	0180-3117	8		CAPACITOR-FXD 9000UF+80-20% 20VDC AL	28480	0180-3117
A9C11	0180-0291	3	3	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A9C12	0180-0116	1	2	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A9C13	0180-3072	4		CAPACITOR-FXD 2900UF+75-10% 40VDC AL	28480	0180-3072
	2190-0011	8		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
	2680-0128	7		SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A9C14	0160-4084	8	1	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C15	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A9C16	0180-0058	0	2	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A9C17	0180-2208	6	1	CAPACITOR-FXD 220UF+-10% 10VDC TA	56289	150D227X9010S2
A9C18	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A9C19	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A9C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9CR1	1901-0028	5	14	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR2	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR3	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR4	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR5	1906-0231	2	1	DIODE-CT-RECT 200V 15A	28480	1906-0231
	0515-0410	9	2	SCREW-MACH M3 X 0.5 20MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	0590-1076	3	6	THREADED INSERT-NUT M3 X 0.5 1.5-MM-LG	28480	0590-1076
	1200-0043	8	4	INSULATOR-XSTR ALUMINUM	28480	1200-0043
	1200-1031	6	2	CONNECTOR-SGL CONT SKT .125-IN-BSC-SZ	28480	1200-1031
	08660-40002	6	4	INSULATOR-TO-3	28480	08660-40002
A9CR6	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR7	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR8	1901-0418	7	1	DIODE-PWR RECT 400V 1.5A	28480	1901-0418
A9CR9	1901-0470	1	2	DIODE-HV RECT 1KV 600MA DO-41	28480	1901-0470
A9CR10	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR11	1901-0470	1		DIODE-HV RECT 1KV 600MA DO-41	28480	1901-0470
A9CR12	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR13	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9CR14	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A9DS1	1990-0523	2	3	LED-LAMP LUM-INT=1MCD IF=50MA-MAX BVR=5V	28480	5082-4950
A9DS2	1990-0523	2		LED-LAMP LUM-INT=1MCD IF=50MA-MAX BVR=5V	28480	5082-4950
A9DS3	1990-0523	2		LED-LAMP LUM-INT=1MCD IF=50MA-MAX BVR=5V	28480	5082-4950
A9F1	2110-0518	2	1	FUSE 3A 125V NTD .348X.25	75915	273003
	1251-2194	1	1	CONNECTOR-SGL CONT SKT .021-IN-BSC-SZ	28480	1251-2194

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9J1	1251-3751	8	1	CONNECTOR 8-PIN M POST TYPE	28480	1251-3751
A9J2†	1251-7728	7	1	CONNECTOR- 12 PIN	28480	1251-7728
A9J3†	1251-8394	5	1	CONN-POST TYPE .100-PIN-SPCG 15-CONT	28480	1251-8394
A9MP1	08970-20060	9	1	HEAT SINK	28480	08970-20060
A9MP2	1400-0440	3	1	CABLE TIE .062-1.75-DIA .184-WD NYL	28480	1400-0440
A9MP3	08970-00009	4	1	BRACKET-POWER SUPPLY	28480	08970-00009
	0515-0212	9	1	SCREW-MACH M3.5 X 0.6 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
A9Q1	1854-0814	6	2	TRANSISTOR NPN SI TO-66 PD=75W FT=3MHZ	28480	1854-0814
	0515-0211	8	2	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	0590-1076	3		THREADED INSERT-NUT M3 X 0.5 1.5-MM-LG	28480	0590-1076
	1205-0085	8	2	HEAT SINK TO-66-CS	28480	1205-0085
A9Q2	1854-0814	6		TRANSISTOR NPN SI TO-66 PD=75W FT=3MHZ	28480	1854-0814
	0515-0211	8		SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	0590-1076	3		THREADED INSERT-NUT M3 X 0.5 1.5-MM-LG	28480	0590-1076
	1205-0085	8		HEAT SINK TO-66-CS	28480	1205-0085
A9Q3†	1884-0244	9	1	THYRISTOR-SCR VRRM=400	3L585	S2600D
A9Q4†	1205-0073	4	1	HEAT SINK TO-5/TO-39-CS	28480	1205-0073
A9R1	2100-1757	2	1	RESISTOR-TRMR 500 5% WW SIDE-ADJ 1-TRN	28480	2100-1757
A9R2	0757-0835	4	1	RESISTOR 6.81K 1% .5W F TC=0+-100	28480	0757-0835
A9R3	0757-1078	9	2	RESISTOR 1.47K 1% .5W F TC=0+-100	28480	0757-1078
A9R4	0698-3441	8	2	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A9R5	0698-0090	7	1	RESISTOR 464 1% .5W F TC=0+-100	28480	0698-0090
A9R6	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A9R7	0757-1078	9		RESISTOR 1.47K 1% .5W F TC=0+-100	28480	0757-1078
A9R8	0757-1000	7	2	RESISTOR 51.1 1% .5W F TC=0+-100	28480	0757-1000
A9R9	2100-1768	5	1	RESISTOR-TRMR 20 5% WW TOP-ADJ 1-TRN	28480	2100-1768
A9R10	0757-0403	2	2	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A9R11	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R12	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A9R13	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A9R14	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A9R15	0757-0417	8	1	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A9TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A9TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A9TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A9TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A9TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A9TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A9TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A9U1	1826-0402	9	1	IC V RGLTR TO-3	80103	LAS-1515
	0515-0410	9		SCREW-MACH M3 X 0.5 20MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	0590-1076	3		THREADED INSERT-NUT M3 X 0.5 1.5-MM-LG	28480	0590-1076
	1200-0043	8		INSULATOR-XSTR ALUMINUM	28480	1200-0043
	1200-1301	3	2	CONN-SGL CONT SKT .125-IN-BSC-SZ	28480	1200-1301
	08660-40002	6		INSULATOR, TO-3	28480	08660-40002
A9U2	1826-0513	3	1	IC V RGLTR TO-3	80103	LAS-1905
	0590-1076	3		THREADED INSERT-NUT M3 X 0.5 1.5-MM-LG	28480	0590-1076
	1200-0043	8		INSULATOR-XSTR ALUMINUM	28480	1200-0043
	1200-1301	3		CONN-SGL CONT SKT .125-IN-BSC-SZ	28480	1200-1301
	08660-40002	6		INSULATOR, TO-3	28480	08660-40002
	0515-0057	0	2	SCREW-MACH M3 X 0.5 20MM-LG PAN-HD	28480	0515-0057
A9U3	1826-0169	5	1	IC V RGLTR TO-3	27014	LM320K-15
	0515-0057	0		SCREW-MACH M3 X 0.5 20MM-LG PAN-HD	28480	0515-0057
	0590-1076	3		THREADED INSERT-NUT M3 X 0.5 1.5-MM-LG	28480	0590-1076
	1200-0043	8		INSULATOR-XSTR ALUMINUM	28480	1200-0043
	1251-3402	6	1	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-3402
	1200-1031	6		CONNECTOR-SGL CONT SKT .125-IN-BSC-SZ	28480	1200-1031
	08660-40002	6		INSULATOR, TO-3	28480	08660-40002
A9VR1	1902-3301	5	1	DIODE-ZNR 34.8V 5% DO-35 PD=.4W	28480	1902-3301
A9VR2	1902-1342	0	2	DIODE-ZNR 1N4742A 12V 5% PD=1W IR=5UA	04713	1N4742A
A9VR3	1902-0943	5	1	DIODE-ZNR 2.4V 5% DO-35 PD=.4W TC=-.037%	28480	1902-0943
A9VR4	1902-0952	6	1	DIODE-ZNR 5.6V 5% DO-35 PD=.4W TC=+.046%	28480	1902-0952
A9VR5	1902-1342	0		DIODE-ZNR 1N4742A 12V 5% PD=1W IR=5UA	04713	1N4742A

See introduction to this section for ordering information
*Indicates factory selected value
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9XA12	1251-0472	4	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A10	08970-60151	3	1	FIRST CONVERTER ASSEMBLY	28480	08970-60151
A10CR1	08558-20095	0	1	DIODE ASSEMBLY	28480	08558-20095
A10J1	1250-1020	8	4	CONNECTOR-RF SMA FEM SGL-HOLE-RR 50-OHM	28480	1250-1020
A10J2	1250-1020	8		CONNECTOR-RF SMA FEM SGL-HOLE-RR 50-OHM	28480	1250-1020
A10J3	1250-1020	8		CONNECTOR-RF SMA FEM SGL-HOLE-RR 50-OHM	28480	1250-1020
A10J4	1250-1020	8		CONNECTOR-RF SMA FEM SGL-HOLE-RR 50-OHM	28480	1250-1020
A10MP1	08558-00052	7	1	GASKET-1ST CONVERTER	28480	08558-00052
A10MP2	08558-20042	7	1	COVER-1ST CONVERTER	28480	08558-20042
	2200-0606	0	15	SCREW-MACH 4-40 .438-IN-LG 82 DEG	28480	2200-0606
	2200-0171	4	4	SCREW-MACH 4-40 .75-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
	2260-0009	3	2	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A10MP3	08558-20043	8	1	MOUNT-1ST CONVERTER	28480	08558-20043
A10R1	0698-7212	9	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-TO-100R-F
A10R2	0698-7221	0	1	RESISTOR 237 1% .05W F TC=0+-100	24546	C3-1/8-TO-237R-F
A11	08970-60152	4	1	SECOND CONVERTER ASSEMBLY	28480	08970-60152
A11C1	0160-3036	8	2	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A11C2	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A11C3	0160-2436	0	1	CAPACITOR-FDTHRU 10PF 20% 200V CER	28480	0160-2436
A11C4	0140-0075	7	1	CAPACITOR-FDTHRU 22PF 10% 500V MICA	72982	666-053-01A0-220K
A11CP1	08970-00025	4	1	COUPLING-LOOP INPUT	28480	08970-00025
	2190-0572	6	4	WASHER-LK HLCL NO. 0 .062-IN-ID .1-IN-OD	28480	2190-0572
	3030-0422	8	4	SCREW-SKT HD CAP 0-80 .188-IN-LG SST-302	00000	ORDER BY DESCRIPTION
A11CP2	08970-00027	6	2	COUPLING-LOOP FILTER	28480	08970-00027
	2190-0572	6		WASHER-LK HLCL NO. 0 .062-IN-ID .1-IN-OD	28480	2190-0572
	3030-0422	8		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-302	00000	ORDER BY DESCRIPTION
A11CP3	08970-00027	6		COUPLING-LOOP FILTER	28480	08970-00027
	2190-0572	6		WASHER-LK HLCL NO. 0 .062-IN-ID .1-IN-OD	28480	2190-0572
	3030-0422	8		SCREW-SKT HD CAP 0-80 .188-IN-LG SST-302	00000	ORDER BY DESCRIPTION
A11CR1†	1901-1107	3	1	DIODE-SCHOTTKY SM SIG	28480	1901-1107
	2190-0572	6		WASHER-LK HLCL NO. 0 062-IN-ID .1-IN-OD	28480	2190-0572
	3030-0422	8		SCREW-SKT HD CAP 0-80 188-IN-LG SST-302	00000	ORDER BY DESCRIPTION
A11J1	1250-1157	2	1	CONNECTOR-RF SMA FEM THD-HOLE 50-OHM	28480	1250-1157
A11J2	1250-1435	9	1	CONN:RF: 500 OHM: SMC	28480	1250-1435
	2190-0124	4	2	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9	1	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A11J3†	1250-1194	7	1	CONNECTOR-RF SM-SLD M SGL-HOLE-FR 50-OHM	28480	1250-1194
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A11L1	9100-2255	4	1	INDUCTOR RF-CH-MLD 470NH 10% .105DX.26LG	28480	9100-2255
A11L2†	08558-80001	4	1	COIL-2ND CONVERTER	28480	08558-80001
A11MP1	08970-20052	9	1	COVER-2ND CONVERTER	28480	08970-20052
	2200-0107	6	26	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A11MP2	08558-20121	3	1	BLOCK-CAVITY 2ND CONVERTER	28480	08558-20121
A11MP3	08558-20058	5	1	LID-2ND CONVERTER OSCILLATOR	28480	08558-20058
	2200-0107	6		SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0119	0	7	SCREW-MACH 4-40 1-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A11MP4	08970-00039	0	1	GASKET-OSCILLATOR	28480	08970-00039
A11MP5	08970-00026	5	1	MOUNTING TAB-MIXER DIODE	28480	08970-00026
A11MP6	0360-0002	6	1	TERMINAL-SLDR LUG PL-MTG FOR-#2-SCR	28480	0360-0002
	0520-0173	2	2	SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A11MP7	2200-0171	4		SCREW-MACH 4-40 .75-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A11MP8	08565-20068	6	1	CAP-INNER ELEMENT	28480	08565-20068
A11MP9	08565-20069	7	1	CAP-OUTER ELEMENT	28480	08565-20069
A11MP10	08565-20092	6	1	CAP-DIELECTRIC	28480	08565-20092
A11R1	0757-0346	2	1	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A11Z1	3030-0397	6	4	SCREW-SET 10-32 1-IN-LG FLAT-PT BRS	00000	ORDER BY DESCRIPTION
	2740-0001	3	3	NUT-HEX-DBL-CHAM 10-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
	3050-0226	2	4	WASHER-FL MTLC NO. 10 .203-IN-ID	28480	3050-0226
A11Z2	3030-0397	6		SCREW-SET 10-32 1-IN-LG FLAT-PT BRS	00000	ORDER BY DESCRIPTION
	2740-0001	3		NUT-HEX-DBL-CHAM 10-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
	3050-0226	2		WASHER-FL MTLC NO. 10 .203-IN-ID	28480	3050-0226

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11Z3	3030-0397	6		SCREW-SET 10-32 1-IN-LG FLAT-PT BRS	00000	ORDER BY DESCRIPTION
	2740-0001	3		NUT-HEX-DBL-CHAM 10-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
	3050-0226	2		WASHER-FL MTLC NO. 10 .203-IN-ID	28480	3050-0226
A11Z4	3030-0397	6		SCREW-SET 10-32 1-IN-LG FLAT-PT BRS	00000	ORDER BY DESCRIPTION
	0380-0573	8	1	STANDOFF-HEX .625-IN-LG 10-32THD	00000	ORDER BY DESCRIPTION
	3050-0226	2		WASHER-FL MTLC NO. 10 .203-IN-ID	28480	3050-0226
	08558-20074	5	1	INSULATOR-COUPLING POST	28480	08558-20074
A11A1	08970-60014	7	1	2ND CONVERTER OSCILLATOR ASSEMBLY	28480	08970-60014
	0520-0173	2		SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0115	6	1	SCREW-MACH 4-40 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A11A1Q1	5086-4218	7	1	HP-IB TO-72 PKG	28480	5086-4218
	08970-20073	4	1	INSULATOR-XSTR DAP-GL	28480	08970-20073
A11A1R1	0683-4705	8	1	RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A11A1R2	0683-2715	6	1	RESISTOR 270 5% .25W FC TC=-400/+600	01121	CB2715
A12	08970-60015	8	1	NOISE SOURCE DRIVE ASSEMBLY	28480	08970-60015
A12C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C2	0180-2206	4	1	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A12C3	0160-4764	1		CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4764
A12C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A12C5	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A12CR1	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A12CR2	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A12CR3	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A12CR4	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A12DS1	1990-0485	5	1	LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A12MP1	1530-1098	4	2	CLEVIS 0.070-IN W SLT: 0.454-IN PIN CTR	00000	ORDER BY DESCRIPTION
	0515-0165	1	2	SCREW-MACH M3.5 X 0.6 12MM-LG PAN-HD	28480	0515-0165
	0535-0007	2	2	NUT-HEX DBL-CHAM M3.5 X 0.6 2.8MM-THK	00000	ORDER BY DESCRIPTION
	2190-0585	1	2	WASHER-LK HLCL 3.5 MM 3.6-MM-ID	28480	2190-0585
A12MP2				SAME AS A12MP1		
A12Q1	1854-0810	2	5	TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A12Q2	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A12R1	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A12R2	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A12R3	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A12R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R5†	0811-2820	7	1	RESISTOR 4.7 5% .75W PW TC=0+-50	91637	RS1/2-T2-4R7-J
A12R6	0699-0148	8	1	RESISTOR 31.6K .1% .1W F TC=0+-15	28480	0699-0148
A12R7	2100-3109	2	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
A12R8	0698-8319	9		RESISTOR 10K 1% .1W F TC=0+-10	19701	5023Z1/8-T13-1002-F
A12R9	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A12R10	0698-3444	1	1	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A12TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A12TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A12TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A12TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A12U1	1826-0177	5	1	IC 723 V RGLTR TO-100	15818	723BE
A12VR1	1902-0564	6	1	DIODE-ZNR 34.8V 5% DO-15 PD=1W TC=+.078%	28480	1902-0564
A12VR2	1902-0928	6		DIODE-ZNR 6.9V 4% TO-92 TC=+.002%	27014	LM329
A12VR3	1902-0562	4	1	DIODE-ZNR 22V 5% PD=1W IR=5UA	28480	1902-0562
A13†	08970-60020	5	1	DRIVER ASSEMBLY (INCLUDES CHASSIS PART W9)	28480	08970-60020
A13BT1†	1420-0314	2	1	BATTERY 3V 0.14A-HR LITHIUM POLYCARBON	28480	1420-0314
	1400-1210	7	1	HOLDER-BAT 1-WD	28480	1400-1210
A13C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A13C2	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-345
A13C3-A13C5†				NOT ASSIGNED		
A13C6	0160-3877	5	2	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13C7	0180-1746	5	4	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A13C8	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A13C9	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A13C10	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C11	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C12	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C13	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C14	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C15	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C16	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C17	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C18	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C19	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C20	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C21	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C22-A13C25				NOT ASSIGNED		
A13C26	0180-1719	2	1	CAPACITOR-FXD 22UF+-10% 25VDC TA	06001	69F146G8
A13C27	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C28	0160-0127	2	1	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A13C29	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A13C30	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C31	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C32	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C33	0160-4401	3	1	CAPACITOR-FXD .01UF +-10% 100VDC POLYP	28480	0160-4401
A13C34†	0160-4350	1	3	CAPACITOR-FXD 68PF +-5% 200VDC CER 0+-30	28480	0160-4350
A13C35	0160-4526	3	2	CAPACITOR-FXD 42PF +-5% 200VDC CER 0+-30	28480	0160-4526
A13C36	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C37†	0160-5624	4	3	CAPACITOR-FXD 5600PF +-5% 100VDC	28480	0160-5624
A13C38	0160-4682	2	2	CAPACITOR-FXD 1000PF +-2.5% 160VDC POLYP	28480	0160-4682
A13C39	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C40	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C41	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C42	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C43	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C44	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C45	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C46	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C47†	0160-4350	1		CAPACITOR-FXD 68PF +-5% 200VDC CER 0+-30	28480	0160-4350
A13C48	0160-4526	3		CAPACITOR-FXD 42PF +-5% 200VDC CER 0+-30	28480	0160-4526
A13C49	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C50	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C51†	0160-5624	4		CAPACITOR-FXD 5600PF +-5% 100VDC	28480	0160-5624
A13C52	0160-4682	2		CAPACITOR-FXD 1000PF +-2.5% 160VDC POLYP	28480	0160-4682
A13C53	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13C54	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A13C55†				NOT ASSIGNED		
A13C56	0160-0301	4	1	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A13C57†	0160-3451	1	28	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A13CR1†				NOT ASSIGNED		
A13CR2†				NOT ASSIGNED		
A13CR3	1901-0033	2	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A13CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A13CR5	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A13CR6	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A13CR7†	1901-0841	0	1	DIODE-SM SIG SCHOTTKY	28480	HSCH-1001
A13G1†	1813-0174	5	1	XTAL-CLOCK-OSCILLATOR 4-MHZ 0.01% TTL	28480	1813-0174
A13J1†	1251-8392	3	4	CONN-POST TYPE .100-PIN-SPCG 6-CONT	28480	1251-8392
A13J2	1251-5720	5	2	CONNECTOR 34-PIN M POST TYPE	28480	1251-5720
A13J3†	1251-8391	2		CONN-POST TYPE .100-PIN-SPCG 4-CONT	28480	1251-8391
A13J4†	1251-8392	3		CONN-POST TYPE .100-PIN-SPCG 6-CONT	28480	1251-8392
A13J5†	1251-8391	2		CONN-POST TYPE .100-PIN-SPCG 4-CONT	28480	1251-8391

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13L1	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A13L2	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A13L3	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A13MP1†	08970-20022	3	2	SCREW-MODIFIED	28480	08970-20022
A13MP2	3050-0139	6	2	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0139
A13MP3†	0510-0124	2	1	THREADED INSERT-NUT 6-32 .18-IN-LG STL	28480	0510-0124
A13MP4	1400-0966	8	2	CLIP-CMPNT .17-.185-DIA .195-WD STL	91506	6015-13AT
A13MP5	0403-0115	4	2	BUMPER FOOT-ADH MTG .5-IN-WD .25-IN-THK	28480	0403-0115
A13Q1	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A13Q2	1854-0477	7	2	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A13Q3	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A13Q4	1854-0637	1	1	TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A13Q5	1854-0811	3	3	TRANSISTOR NPN SI PD=625MW FT=100MHZ	28480	1854-0811
A13R1	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A13R2-A13R7†				NOT ASSIGNED		
A13R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A13R9	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A13R10	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A13R11	2100-3659	7	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 17-TRN	32997	3292W-1-203
A13R12	0811-3368	0	2	RESISTOR 100K 1% .05W PWW TC=0+-10	28480	0811-3368
A13R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R14	0811-3368	0		RESISTOR 100K 1% .05W PWW TC=0+-10	28480	0811-3368
A13R15	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A13R16	0699-0234	3	1	RESISTOR 6.915K .1% .1W F TC=0+-5	28480	0699-0234
A13R17	2100-1738	9	1	RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	73138	82PR10K
A13R18	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A13R19*	0757-0274	5	2	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A13R20	0698-8549	7	1	RESISTOR 2.1K .5% .1W F TC=0+-5	28480	0698-8549
A13R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R23	0757-0276	7	1	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A13R24	0698-3458	7	1	RESISTOR 348K 1% .125W F TC=0+-100	28480	0698-3458
A13R25	0811-2939	9	2	RESISTOR 120 .05% .5W PWW TC=0+-5	14140	1251-1/8-C-121-A
A13R26	0757-1000	7		RESISTOR 51.1 1% .5W F TC=0+-100	28480	0757-1000
A13R27	0811-2939	9		RESISTOR 120 .05% .5W PWW TC=0+-5	14140	1251-1/8-C-121-A
A13R28	0698-0084	9	1	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A13R29	2100-1986	9	3	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A13R30	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A13R31	0698-3152	8	5	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A13R32	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A13R33	0698-0085	0	2	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A13R34	2100-1986	9		RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A13R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R36	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R37	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R38	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R39-A13R42				NOT ASSIGNED		
A13R43	0698-3620	5	3	RESISTOR 100 5% 2W MO TC=0+-200	28480	0698-3620
A13R44	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A13R45	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A13R46	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A13R47	2100-1986	9		RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A13R48	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A13R49	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R50	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R51	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R52	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R53	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A13R54	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A13R55	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A13R56-A13R58				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13R59	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R60				NOT ASSIGNED		
A13R61	0698-3620	5		RESISTOR 100 5% 2W MO TC=0+-200	28480	0698-3620
A13R62	0698-3620	5		RESISTOR 100 5% 2W MO TC=0+-200	28480	0698-3620
A13R63	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R64	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R65	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R66†	0757-0439	4	1	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A13R67†				NOT ASSIGNED		
A13R68†	0757-0438	3	5	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A13R69†	0757-0398	4	4	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A13RT1†	0837-0291	6	1	THERMISTOR DISC 10-OHM TC=-3.8%/C-DEG	28480	0837-0291
A13TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP8	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP9	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP11	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP12	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP13	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP14	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP15	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP16	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP17	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP18	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP19	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP20	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP21	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13TP22	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A13U1	1820-1416	5		IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A13U2	1820-1197	9	4	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A13U3	1820-1423	4	4	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A13U4				NOT ASSIGNED		
A13U5	1826-0488	1	6	IC OP AMP WB TO-99 PKG	27014	LM218H
A13U6	1826-0727	1	3	IC SMPL/HOLD 14-DIP-C PKG	06665	SMP-81FY
A13U7	1826-0488	1		IC OP AMP WB TO-99 PKG	27014	LM218H
A13U8	1826-0488	1		IC OP AMP WB TO-99 PKG	27014	LM218H
A13U9	1826-0188	8	2	IC CONV 8-B-D/A 16-DIP-C PKG	04713	MC1408L-8
A13U10	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A13U11	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A13U12	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A13U13	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A13U14	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A13U15	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A13U16	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A13U17†				NOT ASSIGNED		
A13U18†				NOT ASSIGNED		
A13U19	1820-1416	5		IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A13U20	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A13U21	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A13U22				NOT ASSIGNED		
A13U23	1826 0488	1		IC OP AMP WB TO-99 PKG	27014	LM218H
A13U24	1826-0727	1		IC SMPL/HOLD 14-DIP-C PKG	06665	SMP-81FY
A13U25	1826-0488	1		IC OP AMP WB TO-99 PKG	27014	LM218H
A13U26	1826-0488	1		IC OP AMP WB TO-99 PKG	27014	LM218H
A13U27	1826-0188	8		IC CONV 8-B-D/A 16-DIP-C PKG	04713	MC1408L-8
A13U28	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A13U29	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A13U30	1820-2096	9	2	IC CNTR TTL LS BIN DUAL 4-BIT	01295	SN74LS393N

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13U31	1820-2096	9		IC CNTR TTL LS BIN DUAL 4-BIT	01295	SN74LS393N
A13U32	1826-0726	0	1	IC CONV 12-B-D/A 24-DIP-P PKG	24355	AD565JN/BIN
A13U33	1826-0508	6	1	IC CONV 10-B-D/A 16-DIP-C PKG	24355	AD561JD
A13U34	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A13U35	1820-1212	9	2	IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112AN
A13U36	1826-0026	3		IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A13U37	1820-1204	9	1	IC GATE TTL LS NAND DUAL 4-INP	01295	SN74LS20N
A13U38	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A13U39	1820-1212	9		IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112AN
A13U40	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A13U41	1820-1207	2	2	IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
A13U42	1826-0600	9	1	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074ACN
A13VR1	1902-0579	3	1	DIODE-ZNR 5.1V 5% PD=1W IR=10UA	28480	1902-0579
A13VR2	1902-0962	8	1	DIODE-ZNR 15V 5% DO-35 PD=.4W TC=+.087%	28480	1902-0962
A13VR3	1902-0928	6		DIODE-ZNR 6.9V 4% TO-92 TC=+.002%	27014	LM329
A13VR4				NOT ASSIGNED		
A13VR5	1902-0554	4	2	DIODE-ZNR 10V 5% PD=1W IR=10UA	28480	1902-0554
A13VR6	1902-0551	1	1	DIODE-ZNR 6.2V 5% PD=1W IR=10UA	28480	1902-0551
A13VR7				NOT ASSIGNED		
A13VR8	1902-0554	4		DIODE-ZNR 10V 5% PD=1W IR=10UA	28480	1902-0554
A13W1				NOT ASSIGNED		
A13W2-A13W5†	8159-0005	0	19	RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A13Y1†				NOT ASSIGNED		
A14	08970-60009	0	1	CONTROLLER ASSEMBLY	28480	08970-60009
A14C1	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A14C2	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A14C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C5	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A14C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C9†	0160-5624	4		CAPACITOR-FXD 5600PF +-5% 100VDC	28480	0160-5624
A14C10	0180-0374	3	1	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A14C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C13	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A14C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C23	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C24	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A14C25				NOT ASSIGNED		
A14C26	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A14CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A14CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A14J1†	1251-8392	3		CONN-POST TYPE .100-PIN-SPCG 6-CONT	28480	1251-8392
A14J2†	1251-8281	9	1	CONN-POST TYPE .100-PIN-SPCG 5-CONT	28480	1251-8281
A14J3	1251-5671	5	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-5671
A14J4†	1251-8392	3		CONN-POST TYPE .100-PIN-SPCG 6-CONT	28480	1251-8392
A14J5†	1251-8393	4	1	CONN-POST TYPE .100-PIN-SPCG 7-CONT	28480	1251-8393

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14J6	1251-5720	5		CONNECTOR 34-PIN M POST TYPE	28480	1251-5720
A14L1	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A14L2	9100-1611	4		INDUCTOR RF-CH-MLD 220NH 20%	28480	9100-1611
A14L3	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A14MP1†	08970-20022	3		SCREW-MODIFIED	28480	08970-20022
A14MP2	3050-0139	6		WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0139
A14MP3†	0510-1024	3	1	RETAINER-RING E-R EXT .188-IN-DIA STL	28480	0510-1024
A14MP4	1400-0966	8		CLIP-CMPNT .17-.185-DIA .195-WD STL	91506	6015-13AT
A14MP5	0403-0115	4		BUMPER FOOT-ADH MTG .5-IN-WD .25-IN-THK	28480	0403-0115
A14MP6†	3050-0172	7	1	WASHER-FL NM NO. 10 .203-IN-ID	28480	3050-0172
A14Q1	1853-0393	4	1	TRANSISTOR PNP SI TO-18 PD=500MW	28480	1853-0393
A14Q2	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A14Q3	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A14Q4	1854-0811	3		TRANSISTOR NPN SI PD=625MW FT=100MHZ	28480	1854-0811
A14Q5	1854-0811	3		TRANSISTOR NPN SI PD=625MW FT=100MHZ	28480	1854-0811
A14R1	0757-0422	5	1	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A14R2	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A14R3	0698-7089	8	1	RESISTOR 450 1% .125W F TC=0+-100	28480	0698-7089
A14R4	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R5	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R6	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R7	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A14R8	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A14R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R10	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R11	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A14R12	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R13	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R14	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R15	1810-0205	7		NETWORK-RES 8-SIP4.7K OHM X 7	01121	208A472
A14R16	1810-0205	7		NETWORK-RES 8-SIP4.7K OHM X 7	01121	208A472
A14R17	1810-0206	8	1	NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103
A14R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R19	1810-0205	7		NETWORK-RES 8-SIP4.7K OHM X 7	01121	208A472
A14R20	0698-3435	0	1	RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A14R21	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A14R22	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A14R23	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A14R24	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R25	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A14R26	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A14R27	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A14R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R29	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A14R30	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A14R31				NOT ASSIGNED		
A14R32	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A14S1	3101-2170	8	1	SWITCH-PB SPDT MOM	28480	3101-2170
A14S2	3101-2135	5	1	SWITCH-RKR DIP-RKR-ASSY DPDT .05A 30VDC	28480	3101-2135
A14TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP8	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP9	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP11	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP12	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP13	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP14	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP15	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14TP16	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP17	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP18	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14TP19	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A14U1	08970-80101	5	1	ROM-#1	28480	08970-80101
	1200-0541	1	13	SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U2	08970-80102	6	1	ROM-#2	28480	08970-80102
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U3	08970-80103	7	1	ROM-#3	28480	08970-80103
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U4	08970-80104	8	1	ROM-#4	28480	08970-80104
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U5	08970-80105	9	1	ROM-#5	28480	08970-80105
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U6	08970-80106	0	1	ROM-#6	28480	08970-80106
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U7	08970-80107	1	1	ROM-#7	28480	08970-80107
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U8	08970-80108	2	1	ROM-#8	28480	08970-80108
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U9	08970-80109	3	1	ROM-#9	28480	08970-80109
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U10	08970-80110	6	1	ROM-#10	28480	08970-80110
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U11	08970-80111	7	1	ROM-#11	28480	08970-80111
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U12	08970-80112	8	1	ROM-#12	28480	08970-80112
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U13	08970-80113	9	1	ROM-#13	28480	08970-80113
	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A14U14				NOT ASSIGNED		
A14U15	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A14U16	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A14U17	1820-1207	2		IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
A14U18	1820-1208	3	2	IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A14U19	1818-0438	4	8	IC NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A14U20	1818-1330	7	2	IC CMOS 4096 (4K) STAT RAM 300-NS 3-S	S0545	UPD444C-1
A14U21	1818-0438	4		IC NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A14U22	1818-0438	4		IC NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A14U23	1818-0438	4		IC NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A14U24	1818-0438	4		IC NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A14U25	1818-1330	7		IC CMOS 4096 (4K) STAT RAM 300-NS 3-S	S0545	UPD444C-1
A14U26	1818-0438	4		IC NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A14U27	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A14U28	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A14U29	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A14U30	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A14U31	1818-0438	4		IC NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A14U32	1818-0438	4		IC NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A14U33	1820-2075	4	5	IC TRANSCEIVER TTL LS BUS OCTL	28480	1820-2075
A14U34	1820-2075	4		IC TRANSCEIVER TTL LS BUS OCTL	28480	1820-2075
A14U35	1820-2075	4		IC TRANSCEIVER TTL LS BUS OCTL	28480	1820-2075
A14U36	1820-2075	4		IC TRANSCEIVER TTL LS BUS OCTL	28480	1820-2075
A14U37	1820-1208	3		IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A14U38	1820-0495	8	1	IC DCDR TTL 4-TO-16-LINE 4-INP	01295	SN74154N
A14U39	1820-2485	0	1	IC RCVR TTL LS BUS OCTL	01295	SN75160N
A14U40	1820-1568	8		IC BFR TTL LS BUS QUAD	01295	SN74LS125AN
A14U41	1820-2549	7	1	IC-8291A P HPIB	28480	1820-2549
	1200-0654	7	5	SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A14U42†	1858-0047	5		TRANSISTOR ARRAY 16-PIN PLSTC DIP	13606	ULN-2003A
A14U43	1820-1730	6	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A14U44	1820-1987	5		IC SHF-RGTR TTL LS COM CLEAR STOR 8-BIT	01295	SN74LS299N
A14U45	1820-2075	4		IC TRANSCEIVER TTL LS BUS OCTL	28480	1820-2075
A14U46	1820-1481	4	2	IC NMOS	04713	MC6821L
	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14U47	1820-2099	2	1	IC MICPROC NMOS 8-BIT	04713	MC6802P
	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A14U48	1820-1481	4		IC NMOS	04713	MC6821L
	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A14U49	1820-2463	4	1	IC-DIRECT MEMORY ACCESS CONTROLLER, 16	28480	1820-2463
	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A14U50	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A14U51	1820-0661	0	3	IC GATE TTL OR QUAD 2-INP	01295	SN7432N
A14U52	1820-1568	8		IC BFR TTL LS BUS QUAD	01295	SN74LS125AN
A14U53	1820-1443	8	1	IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A14U54	1820-0661	0		IC GATE TTL OR QUAD 2-INP	01295	SN7432N
A14U55	1820-2058	3	2	IC MISC TTL S QUAD	07263	MC3448AL
A14U56	1820-2058	3		IC MISC TTL S QUAD	07263	MC3448AL
A14U57	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A14U58	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A14U59	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A14U60	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A14U61	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A14U62	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A14U63	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A14U64	1820-0661	0		IC GATE TTL OR QUAD 2-INP	01295	SN7432N
A14U65	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A14U66	1826-0727	1		IC SMPL/HOLD 14-DIP-C PKG	06665	SMP-81FY
A14U67†	1826-0759	9		IC COMPARATOR GP QUAD 14-DIP-C PKG	04713	LM339J
A14VR1	1902-0928	6		DIODE-ZNR 6.9V 4% TO-92 TC=+.002%	27014	LM329
A14VR2	1902-0928	6		DIODE-ZNR 6.9V 4% TO-92 TC=+.002%	27014	LM329
A14VR3	1902-0947	9	1	DIODE-ZNR 3.6V 5% DO-35 PD=.4W TC=-.036%	28480	1902-0947
A14W1	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A15	0960-0443	1	1	MODULE-FILTER LINE	28480	0960-0443
A16	08970-60011	4	1	HP-IB CONNECTOR ASSEMBLY	28480	08970-60011
A16J1	1251-3283	1	1	CONNECTOR 24-PIN F MICRORIBBON	28480	1251-3283
A16J2	8120-3298	8	1	FLAT RIBBON ASSY 28-AWG 20-COND	28480	8120-3298
A16MP1	0380-0643	3	2	STANDOFF-HEX .255-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
A16MP2	0380-0643	3		STANDOFF-HEX .255-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
A16MP3	1530-1098	4		CLEVIS 0.070-IN W SLT: 0.454-IN PIN CTR	00000	ORDER BY DESCRIPTION
	0515-0165	1		SCREW-MACH M3.5 X 0.6 12MM-LG PAN-HD	28480	0515-0165
	0535-0007	2		NUT-HEX DBL-CHAM M3.5 X 0.6 2.8MM-THK	00000	ORDER BY DESCRIPTION
	2190-0585	1		WASHER-LK HLCL 3.5 MM 3.6-MM-ID	28480	2190-0585
A17	08970-60016	9	1	FIRST LO FILTER ASSEMBLY	28480	08970-60016
A17C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17J1†	1251-8391	2		CONN-POST TYPE .100-PIN-SPCG 4-CONT	28480	1251-8391
A17MP1	0380-0321	4	1	SPACER-RVT-ON .125-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
AT1	0960-0472	6	1	ISOLATOR-2 PORT	28480	0960-0472
B1†	3160-0381	3	1	FAN-TBAX 30-CFM 115V 50/60-HZ 1.5KV-DIEL	28480	3160-0381
	0515-0252	7	1	SCREW-MACH M3 X 0.5 40MM-LG PAN-HD	28480	0515-0252
	0590-1362	0	1	THREADED INSERT-PULL-IN M3 X 0.5	28480	0590-1362
	2190-0584	0	2	WASHER-LK HLCL 3.0 MM 3.1-MM-ID	28480	2190-0584
	0360-0269	7	1	TERMINAL-SLDR LUG LK-MTG FOR-#8-SCR	28480	0360-0269
	0624-0215	3	1	SCREW-TPG 8-32 .25-IN-LG PAN-HD-POZI STL	28480	0624-0215
BT1†			2	NOT ASSIGNED		
C1	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
C2	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
C3	0160-4065	5	2	CAPACITOR-FXD .1UF +-20% 250VAC(RMS)	28480	0160-4065
C4	0160-4065	5		CAPACITOR-FXD .1UF +-20% 250VAC(RMS)	28480	0160-4065
C5†	0160-3451	1	3	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
F1	2110-0043	8	1	FUSE 1.5A 250V NTD 1.25X.25 UL	28480	2110-0043
F1	2110-0001	8	1	FUSE 1A 250V NTD 1.25X.25 UL	75915	312001
FL1	9135-0148	3	1	FILTER-LOW PASS	28480	9135-0148
FL2†	9135-0174	5	17	FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL3†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL4†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL5†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL6†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL7†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL8†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL9†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL10†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL11†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL12†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL13†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL14†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL15†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL16†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL17†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
FL18†	9135-0174	5		FILTER-LOW PASS LEADS-TERMS	28480	9135-0174
G1	5086-7080	7	1	YIG OSCILLATOR (NEW)	28480	5086-7080
G1	5086-6080	5	1	YIG OSCILLATOR (RESTORED)	28480	5086-6080
	08558-00076	5	1	STRAP	28480	08558-00076
	0520-0136	7	1	SCREW-MACH 2-56 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0014	1	1	WASHER-LK INTL T NO. 2 .089-IN-ID	28480	2190-0014
	0610-0001	6	1	NUT-HEX-DBL-CHAM 2-56-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
J1	1250-0083	1	5	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (NOISE SOURCE DRIVE)	28480	1250-0083
	2190-0016	3	5	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8	5	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	8150-0477	2	1	WIRE 24AWG W/BR/G 300V PVC 7X32 80C	28480	8150-0477
	8150-0701	5	1	WIRE 24AWG W/V/GY 300V PVC 7X32 80C	28480	8150-0701
	0360-1190	5	2	TERMINAL-SLDR LUG PL-MTG FOR-#3/8-SCR	28480	0360-1190
J2	08970-60057	8	2	CONNECTOR ASSY-INPUT (EXCEPT OPT. 001) (NOISE SOURCE DRIVE)	28480	08970-60057
J3	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	0360-1190	5		TERMINAL-SLDR LUG PL-MTG FOR-#3/8-SCR	28480	0360-1190
J4				NOT ASSIGNED		
J5	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (X-AXIS)	28480	1250-0083
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J6	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (Y-AXIS)	28480	1250-0083
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J7	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (Z-AXIS)	28480	1250-0083
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
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†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
J8				NSR; P/O W7 (IF)		
J9†	1250-1032	2	1	CONN RF BNC-BHD MTG (DET)	28480	1250-1032
	2190-0068	5	1	WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
	2950-0005	2	1	NUT-HEX-DBL-CHAM 5/16-24-THD .219-IN-THK	00000	ORDER BY DESCRIPTION
J10				NOT ASSIGNED		
J11	08970-60057	8		CONNECTOR ASSY-INPUT (OPT. 001 ONLY)	28480	08970-60057
M1†				NOT ASSIGNED		
MP1†	08970-20025	6	1	FRAME-FRONT MOD.	28480	08970-20025
MP2	08970-00024	3	1	REAR PANEL	28480	08970-00024
MP3	5020-8836	5	1	CORNER STRUTS (15°)	28480	5020-8836
	2510-0192	6	2	SCREW-MACH 8-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP4	08970-00010	7	1	BRACKET-RF SECTION (RIGHT)	28480	08970-00010
MP5	08970-00011	8	1	BRACKET-RF SECTION (LEFT)	28480	08970-00011
	2510-0192	6		SCREW-MACH 8-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP6	08970-00041	4	1	STRUT-HINGE BRACKET	28480	08970-00041
	0515-0210	7	4	SCREW-MACH M4 X 0.7 8MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
MP7	5060-9834	9	1	COVER (TOP)	28480	5060-9834
	0510-0043	4	2	RETAINER-RING E-R EXT .141-IN-DIA STL	28480	0510-0043
	0570-1171	7	2	SCREW-SPCL 6-32 .468-IN-LG UNCT 100	00000	ORDER BY DESCRIPTION
MP8	08970-00038	9	1	COVER (BOTTOM)	28480	08970-00038
	0510-0043	4		RETAINER-RING E-R EXT .141-IN-DIA STL	28480	0510-0043
	0570-1171	7		SCREW-SPCL 6-32 .468-IN-LG UNCT 100	00000	ORDER BY DESCRIPTION
	7120-8138	4	1	LABEL-WARNING 6-MM-WD 51-MM-LG VINYL	28480	7120-8138
MP9	5060-9879	2	1	COVER (SIDE) W/RECESS	28480	5060-9879
MP10	5060-9936	2	1	COVER (SIDE) PERFORATED	28480	5060-9936
MP11	5060-9803	2	1	STRAP-HANDLE ASSEMBLY (15°)	28480	5060-9803
MP12	5040-7219	8	1	HANDLE-CAP (FRONT)	28480	5040-7219
MP13	5040-7220	1	1	HANDLE-CAP (REAR)	28480	5040-7220
MP14	5001-0439	8	1	TRIM-SIDE (FRONT FRAME)	28480	5001-0439
MP15	5040-7202	9	1	TRIM-SIDE (TOP)	28480	5040-7202
MP16	1460-1345	5	1	TILT STAND SST	28480	1460-1345
MP17	5040-7201	8	1	FOOT-FULL 1/2 MOD.	28480	5040-7201
MP18	08970-00006	1	1	COVER-RF SECTION (TOP)	28480	08970-00006
	0515-0225	4	1	SCREW-MACH M3.5 X 0.6 10MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	0403-0115	4	3	BUMPER FOOT-ADH MTG .5-IN-WD .25-IN-THK	28480	0403-0115
MP19	1460-1901	9	1	WIREFORM 388-MM-W STL ZN	28480	1460-1901
MP20	1460-0107	5	1	SPRING-CPRSN .335-IN-OD 1-IN-OA-LG MUW	28480	1460-0107
MP21	08970-20053	0	1	CASTING-MACH	28480	08970-20053
	2190-0091	4	1	WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0091
	3050-0176	1	1	WASHER-FL MTLC NO. 8 .188-IN-ID	28480	3050-0176
	0515-0210	7		SCREW-MACH M4 X 0.7 8MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	2740-0001	3	1	NUT-HEX-DBL-CHAM 10-32-THD .109-IN-THK (ATTACH BD. ASSY TO CASTING)	00000	ORDER BY DESCRIPTION
MP22	08903-00022	0	1	TRAY-INFO SHEET	28480	08903-00022
MP23	9320-4801	6	1	CARD-INFORMATION INFO CARD	28480	9320-4801
MP24	9320-4802	7	1	CARD-INFORMATION INFO CARD	28480	9320-4802
MP25	9320-4803	8	1	CARD-INFORMATION INFO CARD	28480	9320-4803
MP26-MP29				NOT ASSIGNED		
MP30†	08970-00046	9	1	PANEL (FRONT)	28480	08970-00046
	2360-0116	5	2	SCREW-MACH 6-32 .312-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP31†	08970-00045	8	1	PANEL-WINDOW	28480	08970-00045
	0510-1149	3	1	RETAINER-PUSH ON KB-TO-SHFT EXT	28480	0510-1149
MP32†				NOT ASSIGNED		
MP33†				NOT ASSIGNED		
MP34	08970-00018	5	1	SPACER-PANEL (SMALL)	28480	08970-00018
MP35	08970-00017	4	1	SPACER-PANEL (LARGE)	28480	08970-00017
MP36	5040-6889	6	1	LIGHT PIPES (19MM)	28480	5040-6889
MP37	5040-6888	5	1	LIGHT PIPES (12MM)	28480	5040-6888
MP38	08970-00016	3	1	PANEL-LIGHT PIPE	28480	08970-00016
MP39	08970-00003	8	1	BRACKET-FRONT PANEL	28480	08970-00003
	2190-0586	2	1	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
	0535-0006	1	1	NUT-HEX DBL-CHAM M4 X 0.7 3.2MM-THK	00000	ORDER BY DESCRIPTION
MP40	7120-1254	1	1	NAMEPLATE .312-IN-WD .54-IN-LG AL	28480	7120-1254

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP41	5041-1682	9	1	KEY CAP-LINE SWITCH	28480	5041-1682
MP42	08970-80002	5	1	PLUG-HOLE (OPTION 001 ONLY)	28480	08970-80002
MP43				NOT ASSIGNED		
MP44				NOT ASSIGNED		
MP45†	08970-20070	1	1	WINDOW-FRONT	28480	08970-20070
MP46-MP49				NOT ASSIGNED		
MP50	4040-1890	8	1	RETAINER, FILTER 3.803-IN-WD	28480	4040-1890
	3050-0891	7	1	WASHER-FL MTLC 3.0 MM 3.3-MM-ID	28480	3050-0891
	2190-0584	0		WASHER-LK HLCL 3.0 MM 3.1-MM-ID	28480	2190-0584
	0515-0211	8	6	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
MP51	0380-1361	4	1	STANDOFF-HEX 10-MM-LG M3.0 X 0.5-THD	28480	0380-1361
MP52	3160-0300	6	1	FINGER GUARD	28480	3160-0300
MP53	4208-0220	2	1	FOAM-POLYU 6.3-MM-THK 31.8-MM-WD	28480	4208-0220
MP54	3150-0405	1	1	FILTER-AIR POLYU	28480	3150-0405
MP55	7100-0114	8	1	TRANSFORMER COVER .88-DP	28480	7100-0114
MP56	08970-00040	3	1	SHIELD-POWER LINE	28480	08970-00040
	0515-0211	8		SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	7120-3738	0	1	LABEL-WARNING .62-IN-WD 1-IN-LG AL	28480	7120-3738
MP57	6960-0009	1	1	PLUG-HOLE FL-HD FOR .438-D-HOLE BRS (EXCEPT OPT. 001)	28480	6960-0009
MP58	0515-0224	3		SCREW-MACH M3.5 X 0.6 12MM-LG PAN-HD (FOR A9MP3)	00000	ORDER BY DESCRIPTION
MP59†	0360-1158	5	1	TERMINAL-SLDR LUG PL-MTG FOR-#1/2-SCR	86928	5413-21
	2360-0195	0	1	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	28480	2360-0195
MP60	5040-7221	2	1	STANDOFF-REAR PANEL	28480	5040-7221
MP61	08558-00008	3	1	BRACKET-YIG OSCILLATOR	28480	08558-00008
	0515-0211	8		SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
MP62	08558-20119	9	1	STANDOFF-TAPERED	28480	08558-20119
MP63	2200-0109	8	1	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP64	2200-0113	4	1	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP65	0515-0210	7		SCREW-MACH M4 X 0.7 8MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
MP66†	1400-0510	8	1	CLAMP-CABLE .15-DIA .62-WD NYL	28480	1400-0510
MP67-MP69				NOT ASSIGNED		
MP70	0403-0115	4		BUMPER FOOT-ADH MTG .5-IN-WD .25-IN-THK	28480	0403-0115
MP71†	08970-00007	2	1	RF SECTION COVER (BOTTOM)	28480	08970-00007
	0515-0212	9	2	SCREW-MACH M3.5 X 0.6 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	0520-0165	2	1	SCREW-MACH 2-56 .312-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP72	1600-1107	5	1	STAMPING-AL RF COVER-INTERNAL	28480	1600-1107
MP73	1600-1111	1	1	STAMPING-AL RF COVER-INTERNAL	28480	1600-1111
MP74	1600-1106	4	1	STAMPING-AL RF COVER-INTERNAL	28480	1600-1106
MP75	1600-1105	3	1	STAMPING-AL RF COVER-INTERNAL	28480	1600-1105
MP76	1600-1113	3	1	STAMPING-AL RF COVER-INTERNAL	28480	1600-1113
MP77	1600-1108	6	2	STAMPING-AL RF COVER-INTERNAL	28480	1600-1108
MP78	1600-1109	7	1	STAMPING-AL RF COVER-INTERNAL	28480	1600-1109
MP79	1600-1110	0	1	STAMPING-AL RF COVER-INTERNAL	28480	1600-1110
MP80	1600-1114	4	1	STAMPING-AL RF COVER-INTERNAL	28480	1600-1114
MP81	08970-00008	3	1	COVER-A6	28480	08970-00008
	0515-0212	9		SCREW-MACH M3.5 X 0.6 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	3050-0003	3	1	WASHER-FL NM NO. 6 .141-IN-ID .375-IN-OD	28480	3050-0003
	0403-0115	4		BUMPER FOOT-ADH MTG .5-IN-WD .25-IN-THK	28480	0403-0115
MP82	1600-1112	2	1	STAMPING-AL RF COVER-INTERNAL	28480	1600-1112
MP83	1600-1108	6		STAMPING-AL RF COVER-INTERNAL	28480	1600-1108
MP84				NOT ASSIGNED		
MP85	08970-00012	9	1	BRACKET-HINGE (FRONT)	28480	08970-00012
	2360-0116	5		SCREW-MACH 6-32 .312-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP86	08970-00013	0	1	BRACKET-HINGE (REAR)	28480	08970-00013
	0515-0211	8		SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
MP87	08970-20055	2	1	BRACKET-POWER SWITCH	28480	08970-20055
	0515-0211	8		SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	2360-0459	9	1	SCREW-MACH 6-32 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP88	08970-00021	0	1	BRACKET-2ND CONVERTER	28480	08970-00021
	2200-0107	6	1	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0515-0210	7		SCREW-MACH M4 X 0.7 8MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
MP89	08970-00022	1	1	BRACKET-ISOLATOR, 2ND CONVERTER	28480	08970-00022
	2200-0111	2	1	SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP90	0400-0201	3	1	GROMMET-RND .25-IN-ID .438-IN-GRV-OD	28480	0400-0201
MP91	1400-0017	0	1	CLAMP-CABLE .312-DIA .375-WD NYL (FOR S1)	28480	1400-0017
	2190-0018	5	2	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
	0515-0224	3	3	SCREW-MACH M3.5 X 0.6 12MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	3050-0892	8	2	WASHER-FL MTLC 3.5 MM 3.8-MM-ID	28480	3050-0892
	0535-0007	2	2	NUT-HEX DBL-CHAM M3.5 X 0.6 2.8MM-THK	00000	ORDER BY DESCRIPTION
MP92	1400-0025	0	1	CLAMP-CABLE .5-DIA .5-WD NYL (FOR FL1)	28480	1400-0025
	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
	0515-0224	3		SCREW-MACH M3.5 X 0.6 12MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	3050-0892	8		WASHER-FL MTLC 3.5 MM 3.8-MM-ID	28480	3050-0892
	0535-0007	2		NUT-HEX DBL-CHAM M3.5 X 0.6 2.8MM-THK	00000	ORDER BY DESCRIPTION
MP93	2360-0115	4	1	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI (A12 ASSY TO A9 ASSY)	00000	ORDER BY DESCRIPTION
MP94	1251-3720	1	1	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND (WIRING HARNESS TO FL2-18)	28480	1251-3720
MP95	0360-0042	4	1	TERMINAL-SLDR LUG PL-MTG FOR-#6-SCR (FOR FL12 AND FL18)	28480	0360-0042
P1	1251-5043	5	4	CONNECTOR 5-PIN F POST TYPE (TO A13J5)	22526	65039-032
	1251-4182	1	12	CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1	13	CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
P2	1251-5043	5		CONNECTOR 5-PIN F POST TYPE (TO A17J1)	22526	65039-032
P3	1251-5043	5		CONNECTOR 5-PIN F POST TYPE (TO A13J3)	22526	65039-032
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
P4†	1251-4492	6	2	CONNECTOR 6-PIN F POST TYPE (TO A13J4)	28480	1251-4492
	1251-4169	4	4	CONNECTOR 7-PIN F POST TYPE	28480	1251-4169
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
P5	1251-5043	5		CONNECTOR 5-PIN F POST TYPE (TO A1J2)	22526	65039-032
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
P6	1251-4741	8	1	CONNECTOR 9-PIN F POST TYPE (TO A2J1)	28480	1251-4741
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
P7	1251-4169	4		CONNECTOR 7-PIN F POST TYPE (TO A14J1)	28480	1251-4169
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
P8	1251-5060	6	1	CONNECTOR 8-PIN F POST TYPE (TO A14J5)	28480	1251-5060
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
P9	1251-4492	6		CONNECTOR 6-PIN F POST TYPE (TO A14J2)	28480	1251-4492
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
P10	1251-4169	4		CONNECTOR 7-PIN F POST TYPE (TO A14J4)	28480	1251-4169
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
P11	1251-4169	4		CONNECTOR 7-PIN F POST TYPE (TO A13J1)	28480	1251-4169
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
P12	1251-4491	5	1	CONNECTOR 13-PIN F POST TYPE (TO A9J2)	28480	1251-4491
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803

See introduction to this section for ordering information
† Indicates factory selected value
* Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
P13	1251-5207	3	1	CONNECTOR 16-PIN F POST TYPE (TO A9J3)	28480	1251-5207
	1251-4182	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ SQ	28480	1251-4182
	1251-3803	1		CONNECTOR 12-PIN M RECT-MINTR	28480	1251-3803
S1	08970-60155	7	1	LINE SWITCH ASSEMBLY (INCLUDES W11)	28480	08970-60155
S2	3103-0094	5	1	SWITCH-THRM FXD +193F 15A OPN-ON-RISE	28480	3103-0094
	0515-0211	8		SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	1251-2410	4	1	CONTACT-CONN U/W-UTIL MALE CRP	28480	1251-2410
	1251-2411	5	1	CONTACT-CONN U/W-UTIL FEM CRP	28480	1251-2411
	1251-7015	5	1	CONNECTOR-SGL CONT FEM-SNAP RND	28480	1251-7015
	1251-7016	6	1	CONNECTOR-SGL CONT M-SNAP RND	28480	1251-7016
T1	9100-2640	1	1	TRANSFORMER-POWER 100/120/220/240V	28480	9100-2640
	0515-0125	3	1	SCREW-MACH M5 X 0.8 45MM-LG PAN-HD (EXCEPT OPT. 001)	28480	0515-0125
	3050-0139	6	1	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0139
	0515-0295	8	1	SCREW-MACH M5 X 0.8 50MM-LG PAN-HD (OPTION 001 ONLY)	28480	0515-0295
	0535-0005	0	1	NUT-HEX DBL-CHAM M5 X 0.8 5.3MM-THK	00000	ORDER BY DESCRIPTION
	2190-0587	3	1	WASHER-LK HLCL 5.0 MM 5.1-MM-ID	28480	2190-0587
VR1†	1902-0943	5	1	DIODE-ZNR 2.4V 5% DO-35 PD=.4W TC=-.037%	28480	1902-0943
W1	08970-20064	3	1	CABLE ASSY-SEMIRIGID (J2 TO FL1) (EXCEPT OPT. 001)	28480	08970-20064
W2	08970-20066	5	1	CABLE ASSY-SEMIRIGID (FL1 TO A6) (EXCEPT OPT. 001)	28480	08970-20066
W3	08970-20062	1	1	CABLE ASSY-SEMIRIGID (A6 TO A10)	28480	08970-20062
W4	08970-20061	0	1	CABLE ASSY-SEMIRIGID (A10 TO AT1)	28480	08970-20061
W5	08970-20063	2	1	CABLE ASSY-SEMIRIGID (AT1 TO A11)	28480	08970-20063
W6	08970-20069	8	1	CABLE ASSY-SEMIRIGID (A11 TO A4)	28480	08970-20069
W7	08970-60058	9	1	CABLE ASSY-(A8 TO J8); INCL J8	28480	08970-60058
	0590-1011	6	1	NUT-KNRLD-R 15/32-32-THD .12-IN-THK	28480	0590-1011
W8†	08970-20023	4	1	CABLE ASSY-SEMIRIGID (G1 TO A10)	28480	08970-20023
W9	8120-3300	3	1	CABLE ASSY-RIBBON (A13 TO A14)	28480	8120-3300
W10				NSR; PART OF A16J2		
W11				NSR; PART OF S1		
W12	08970-20067	6	1	CABLE ASSY-SEMIRIGID (J11 TO FL1; OPT. 001 ONLY)	28480	08970-20067
W13	08970-20068	7	1	CABLE ASSY-SEMIRIGID (FL1 TO A6; OPT. 001 ONLY)	28480	08970-20068
W14	8120-1378	1	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT	28480	8120-1378
W15				WIRE-22AWG (A4 TO A3)		
W16				WIRE-22AWG (A3 TO A8)		
W17†				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-4. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address		Zip Code
S0545	NIPPON ELECTRIC CO	TOKYO	JP	
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
02111	SPECTROL ELECTRONICS CORP	CITY OF IND	CA	91745
02114	FERROXCUBE CORP	SAUGERTIES	NY	12477
03888	K D I PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
06001	MEPCO ELECTRA CORP	COLUMBIA	SC	29063
06665	PRECISION MONOLITHICS INC	SANTA CLARA	CA	95050
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW	CA	94042
07933	RAYTHEON CO SEMICONDUCTOR DIV HQ	MOUNTAIN VIEW	CA	94040
08484	BREEZE CORPORATIONS INC	UNION	NJ	07083
11236	CTS OF BERNE INC	BERNE	IN	46711
13606	SPRAGUE ELECT CO SEMICONDUCTOR DIV	CONCORD	NH	03301
14140	EDISON ELEK DIV MCGRAW-EDISON	MANCHESTER	NH	03130
15818	TELEDYNE SEMICONDUCTOR	MOUNTAIN VIEW	CA	94043
17856	SILICONIX INC	SANTA CLARA	CA	95054
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
22526	BERG ELEK DIV DUPONT	NEW CUMBERLAND	PA	17070
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD	MA	01880
24355	ANALOG DEVICES INC	NORWOOD	MA	02062
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
25403	N.V. PHILIPS-ELCOMA DEPARTMENT	EINDHOVEN	HL	02876
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
3L585	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE	CA	92507
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE	PA	16512
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON	CA	92634
74970	JOHNSON E F CO	WASECA	MN	56093
75915	LITTELFUSE INC	DES PLAINES	IL	60016
80103	LAMBDA ELECTRONICS CORP	MELVILLE	NY	11746
86928	SEASTROM MFG CO	GLENDALE	CA	91201
91506	AUGAT INC	ATTLEBORO	MA	02703
91637	DALE ELECTRONICS INC	COLUMBUS	NE	68601

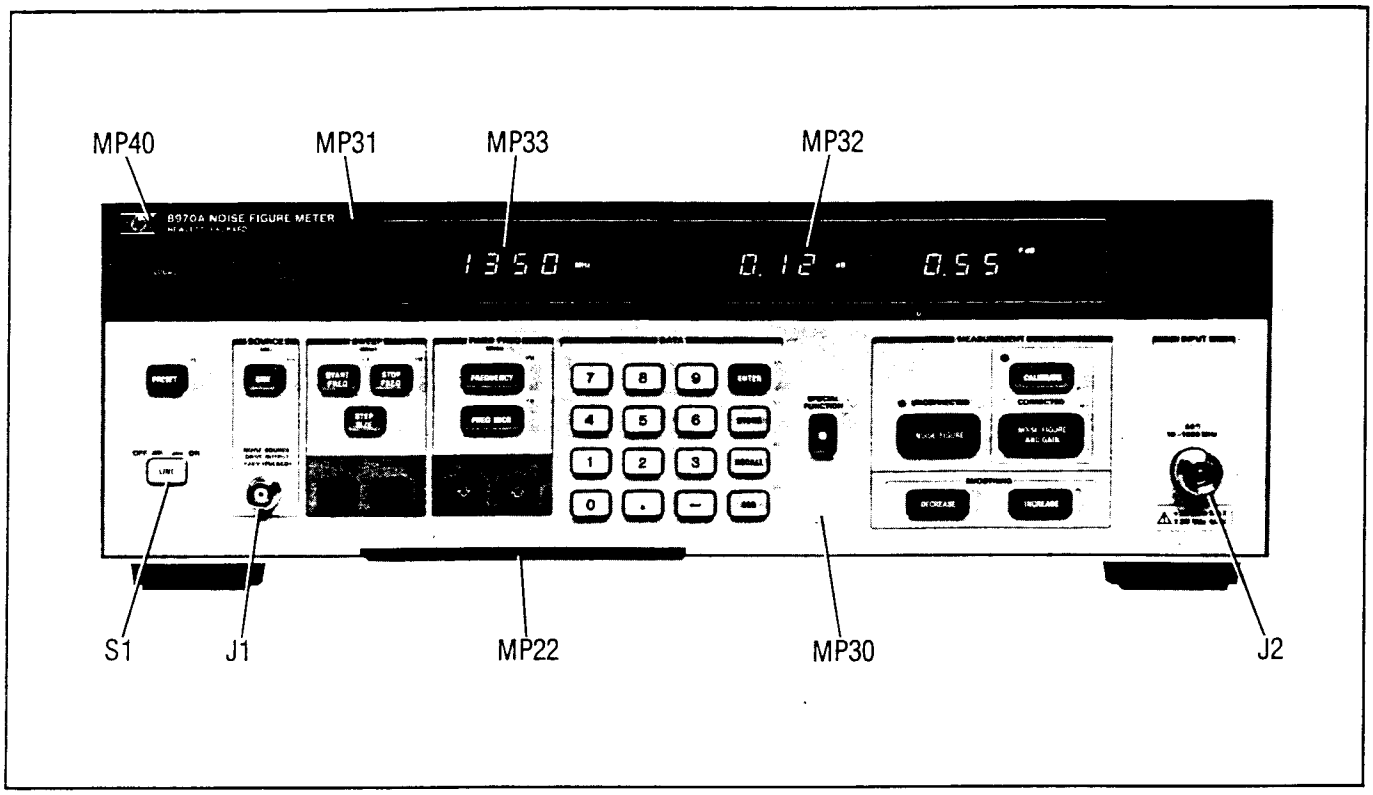

Figure 6-1. Chassis and Mechanical Parts Identification – Front Panel

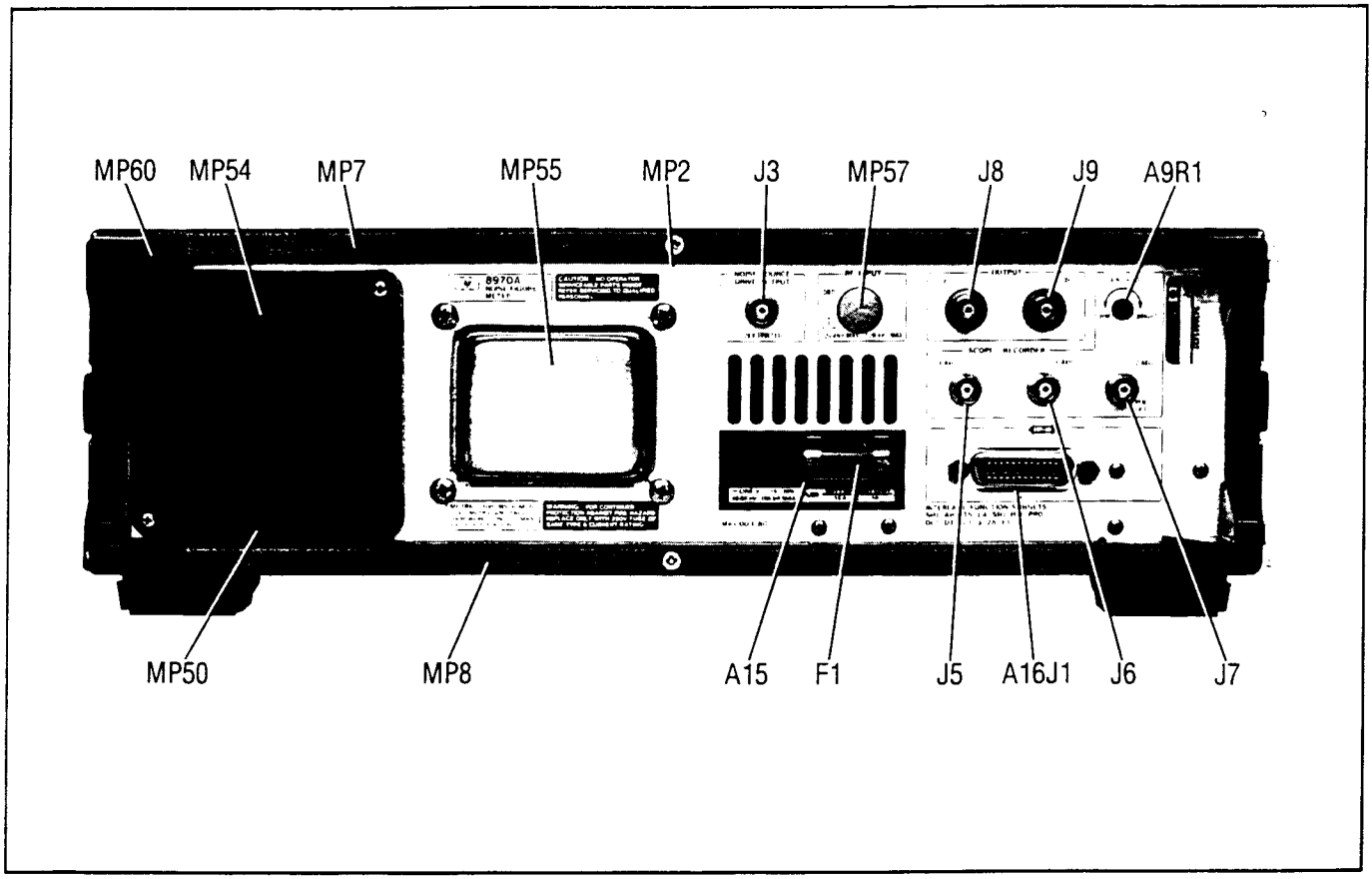

Figure 6-2. Chassis and Mechanical Parts Identification – Rear Panel

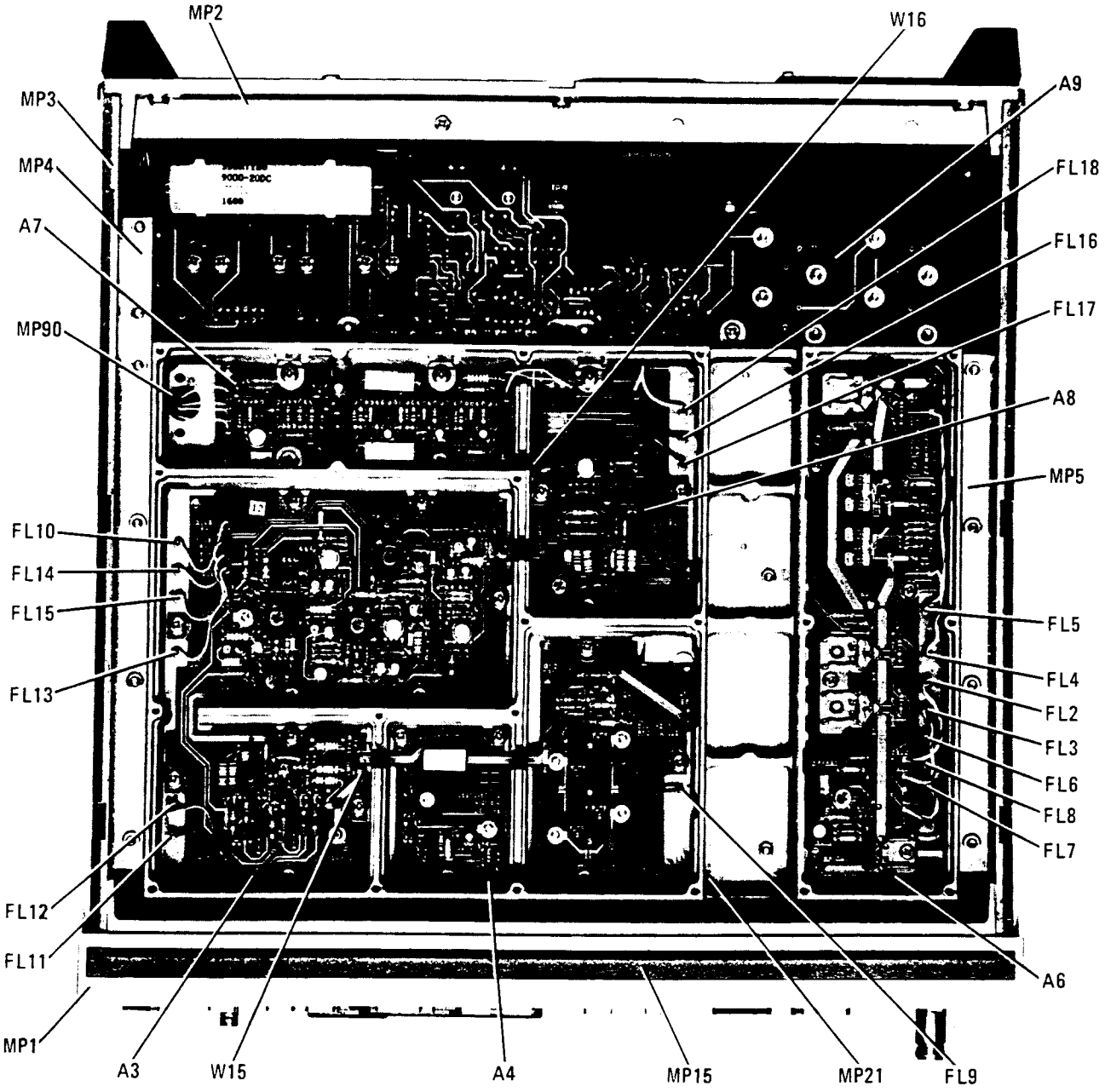

Figure 6-3. Top Chassis Parts, Mechanical Parts, and Cable Identification (with RF covers removed)

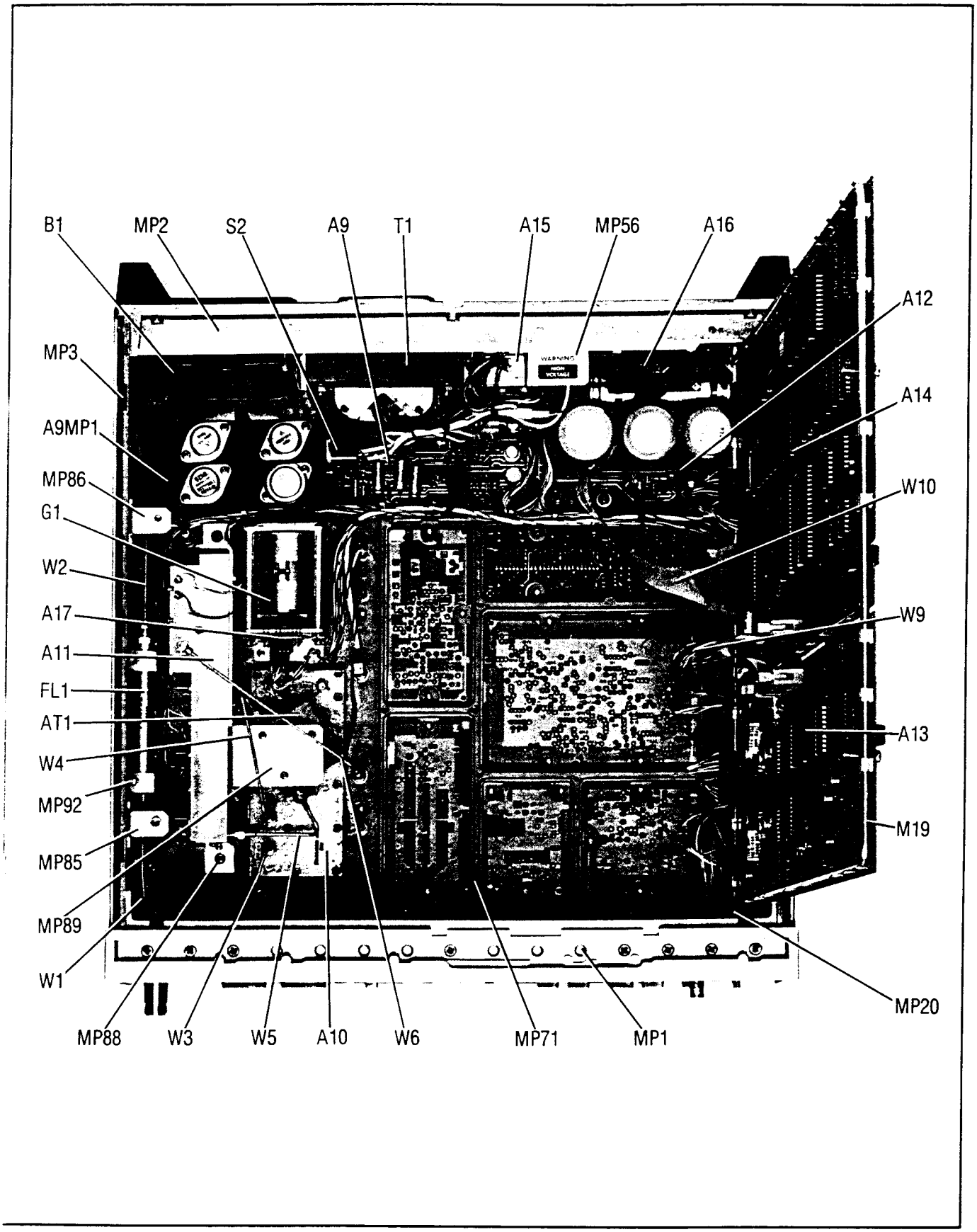

Figure 6-4. Bottom Chassis Parts, Mechanical Parts, and Cable Identification

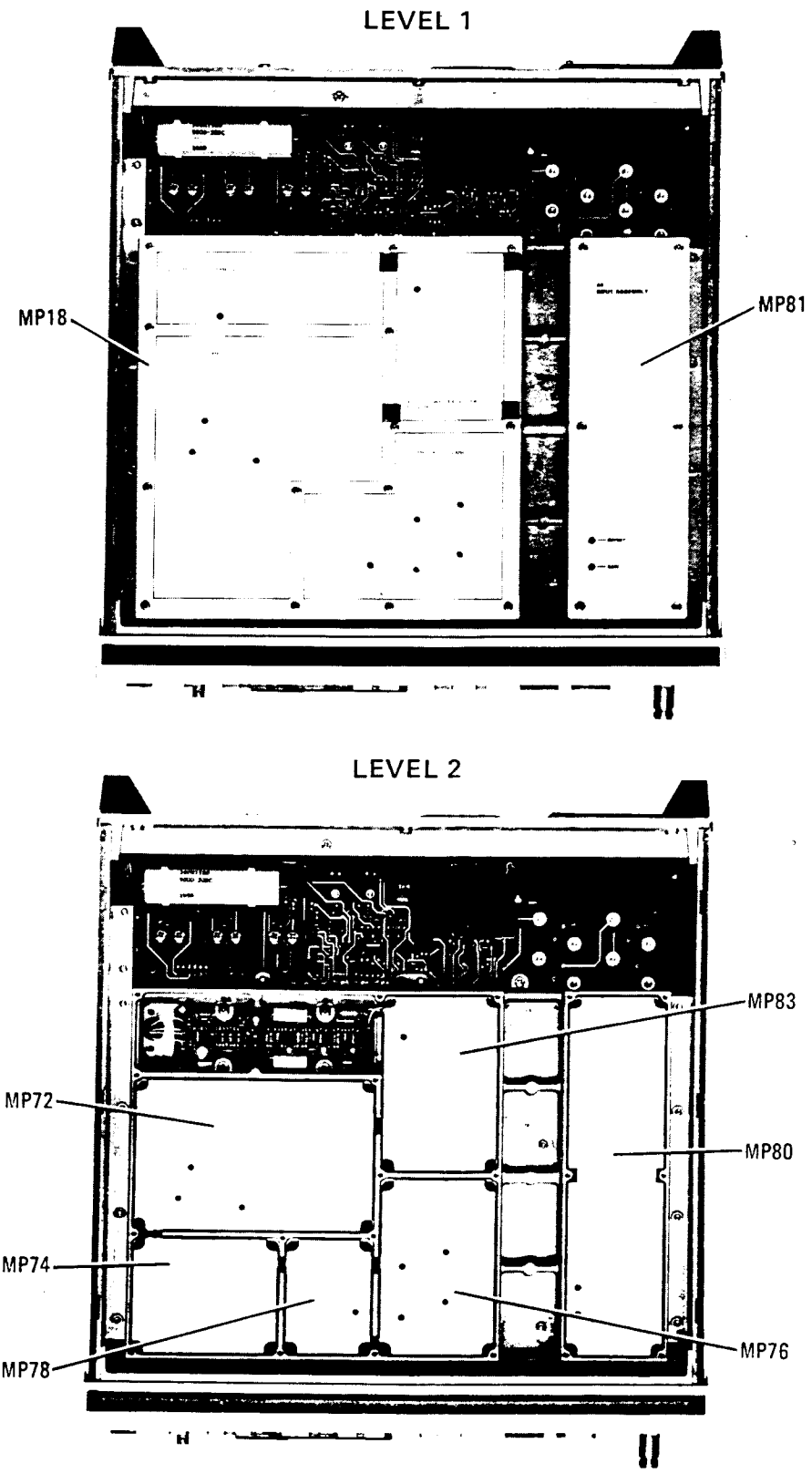

Figure 6-5. Top Internal RF Covers Identification

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

This section contains manual change instructions for backdating this manual for HP Model 8970A Noise Figure Meters that have serial number prefixes lower than 2438A.

7-2. MANUAL CHANGES

To adapt this manual to your instrument, refer to Table 7-1 and make all of the manual changes listed opposite your instrument's serial number or prefix. The manual changes are listed in serial number sequence and should be made in the sequence listed. For example, Change A should be made after Change B, Change B should be made after Change C, etc. Table 7-2 is a summary of changes by page number.

If your instrument's serial number or prefix is not listed on the title page of this manual or in Table 7-1, it may be documented on a MANUAL CHANGES supplement. For additional important information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL and MANUAL CHANGES SUPPLEMENT in Section I of this manual.

Table 7-1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes
2116A	E, D, C, B, A
2210A	E, D, C, B
2222A	E, D, C
2303A	E, D
2414A	E

Table 7-2. Summary of Manual Changes by Page Number (1 of 2)

Page	Description	Changes
6-5	A1J2	D
6-6	A1TP1, A1TP2	D
6-6	A2	A
6-7	A2DS1—A2DS13	E
6-7	A2DS17	A
6-7	A2DS19—A2DS22	A
6-7	A2DS24—A2DS30	A
6-7	A2DS31—A2DS34	A,E
6-7	A2J1	D
6-7	A2MP1—A2MP3	A
6-8	A2U4, A2U5	D
6-8	A2U6	C
6-11	A3R6, A3R7,	
6-11	A3R9	A
6-11	A3R35	B
6-12	A4C6	C
6-12	A4L2	A
6-12	A4R1, A4R2,	
6-13	A4R7, A4R12	A
6-13	A6K1—A6K5	C
6-14	A6R6, A6R8, A6R9	D
6-14	A6R10	C
6-14	A6R12, A6R13,	
6-14	A6R16, A6R18	D
6-14	A6R19	C
6-14	A6R20, A6R22,	
6-14	A6R24, A6R25,	
6-14	A6R26	D
6-14	A6R36, A6R38	B,C
6-14	A6R39	C,D
6-14	A6R40	B,C
6-18	A9J2, A9J3	D
6-18	A9Q3, A9Q4	D
6-19	A11CR1	C
6-19	A11J3	C
6-19	A11L2	C
6-20	A12R5	C
6-20	A13	C
6-20	A13BT1	
6-20	A13C3—A13C5,	
6-21	A13C34,	
6-21	A13C37, A13C47,	
6-21	A13C51, A13C55,	
6-21	A13C57	C
6-21	A13CR1, A13CR2,	
6-21	A13CR7	C
6-21	A13G1	C
6-21	A13J1, A13J3	D
6-21	A13J4	C,D
6-21	A13J5	D
6-22	A13MP1, A13MP3	B
6-22	A13R2—A13R7,	
6-23	A13R66—A13R69	C
6-23	A13RT1	D
6-23	A13U17, A13U18	C
6-24	A13W2—A13W5	C
6-24	A13Y1	C
6-24	A14C9	C
6-24	A14J1, A14J2,	
6-24	A14J4, A14J5	D
6-25	A14MP1, A14MP3	B
6-25	A14MP6	C
6-26	A14U42	D
6-27	A14U67	C
6-27	A17J1	D
6-28	B1	C
6-28	BT1	C
6-28	C5	E
6-28	FL2—FL18	C
6-29	J9	C
6-29	M1	B
6-29	MP1	C
6-29	MP30, MP31	B
6-29	MP32, MP33	A
6-30	MP59	E
6-30	MP45, MP66	A
6-30	MP71	C
6-31	P4	C

Table 7-2. Summary of Manual Changes by Page Number (2 of 2)

Page	Description	Changes
6-32	VR1	E
6-32	W8, W17	B
(BD1)	Meter	B
(BD4)	Meter	B
SS1	R36, R38	B,C
	R39	C,D
	R40	B,C
SS2	300MHz IF Amp	A
	C6	C
SS3	Q20	A
	R6, R7, R9	A
	R35	B
SS5	C5	E
	VR1	E
SS6	Meter	B,C
	TP1, TP2	D
SS7	A13	C
	R11, R66	C
	W17	B
SS10	A2	A
SS13	BT1	C
SS16	BT1	C
SS17	A13	C
	C47	C
	R67, R68	C
	W5	C
SS19	A12R5	C
	B1	C

MANUAL CHANGES

7-3. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Table 6-3:

Change A2 to 08970-60008 (CD9) DISPLAY ASSEMBLY.
Add A2DS17 as follows: 1990-0696 (CD0) LED-LIGHT BAR MODULE LUM-INT=3MCD. 1200-0904 (CD0) SOCKET-DISPL 4-CONT SIP W-WRAP.
Add A2DS19 - 22 as follows: 1990-0696 (CD0) LED-LIGHT BAR MODULE LUM-INT=3MCD. 1200-0904 (CD0) SOCKET-DISPL 4-CONT SIP W-WRAP.
Add A2DS24 - 30 as follows: 1990-0696 (CD0) LED-LIGHT BAR MODULE LUM-INT=3MCD. 1200-0904 (CD0) SOCKET-DISPL 4-CONT SIP W-WRAP.
Delete A2DS31 - 34.
Change A2MP1 to 08970-00042 (CD5) LABEL - LEFT DISPLAY.
Add A2MP2 08970-00043 (CD6) LABEL - MIDDLE DISPLAY.
Add A2MP3 08970-00044 (CD7) LABEL - RIGHT DISPLAY.
Change A3R6 to 0698-3153 (CD9) RESISTOR 3.83K 1% .125W F TC=0 ±100, 24546 C4-1/8-T0-3831F.
Change A3R7 to 0757-0442 (CD9) RESISTOR 10K 1% .125W F TC=0 ±100, 24546 C4-1/8-T0-1002F
Change A3R9 to 0757-0873 (CD0) RESISTOR 1.62K 1% .5W F TC=0 ±100, 24546 C4-1/8-T0-51R1-F.
Add A4L2 9100-0346 (CD0) INDUCTOR RF-CH-MLD 50NH 20% .105DX.26LG.
Change A4R1 to 0757-0442 (CD9) RESISTOR 10K 1% .125W F TC=0 ±100 24546 C4-1/8-T0-1002-F.
Change A4R2 to 0757-0288 (CD1) RESISTOR 9.09K 1% .125W F TC=0 ±100 19701 MF4C1/8-T0-9091-F.
Change A4R7 to 0757-0420 (CD3) RESISTOR 750 1% .125W F TC=0 ±100 24546 C4-1/8-TO-751-F.
Change A4R12 to 0698-7236 (CD7) RESISTOR 1K 1% .05W F TC=0 ±100 24546 C3-1/8-T0-1001-F.
Add MP32 08970-20057 (CD4) WINDOW (RIGHT).
Add MP33 08970-20056 (CD3) WINDOW (LEFT).
Delete MP45.
Delete MP66.

MANUAL CHANGES

CHANGE A (cont'd)

Service Sheet 2 (schematic):

On the A4 Assembly, replace the 300 MHz IF Amplifier circuit with the following partial schematic.

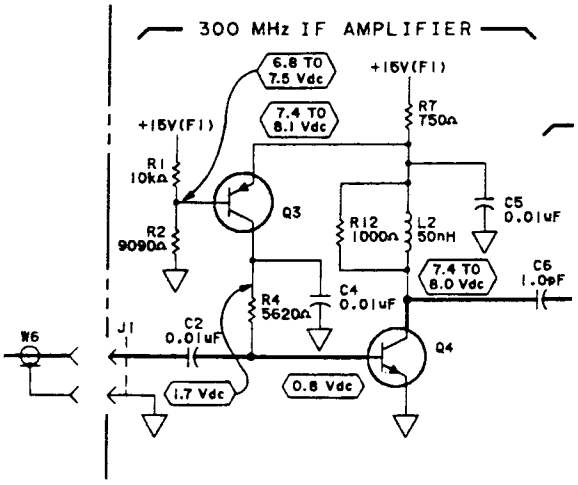

Figure 7-1. P/O Schematic 2 (P/O Change A)

Service Sheet 3 (schematic):

Change the value of R6 to 3830Ω.
Change the value of R7 to 10 kOhms.
Change the value of R9 to 1620Ω.
Change the voltage at the base of Q20 to "10.1 to 10.6 Vdc."
Change the voltage at the emitter of Q20 to "9.3 to 9.8 Vdc."

Service Sheet 10 (schematic):

Replace the appropriate portion of the schematic with the attached partial schematic.

MANUAL CHANGES

CHANGE A (cont'd)

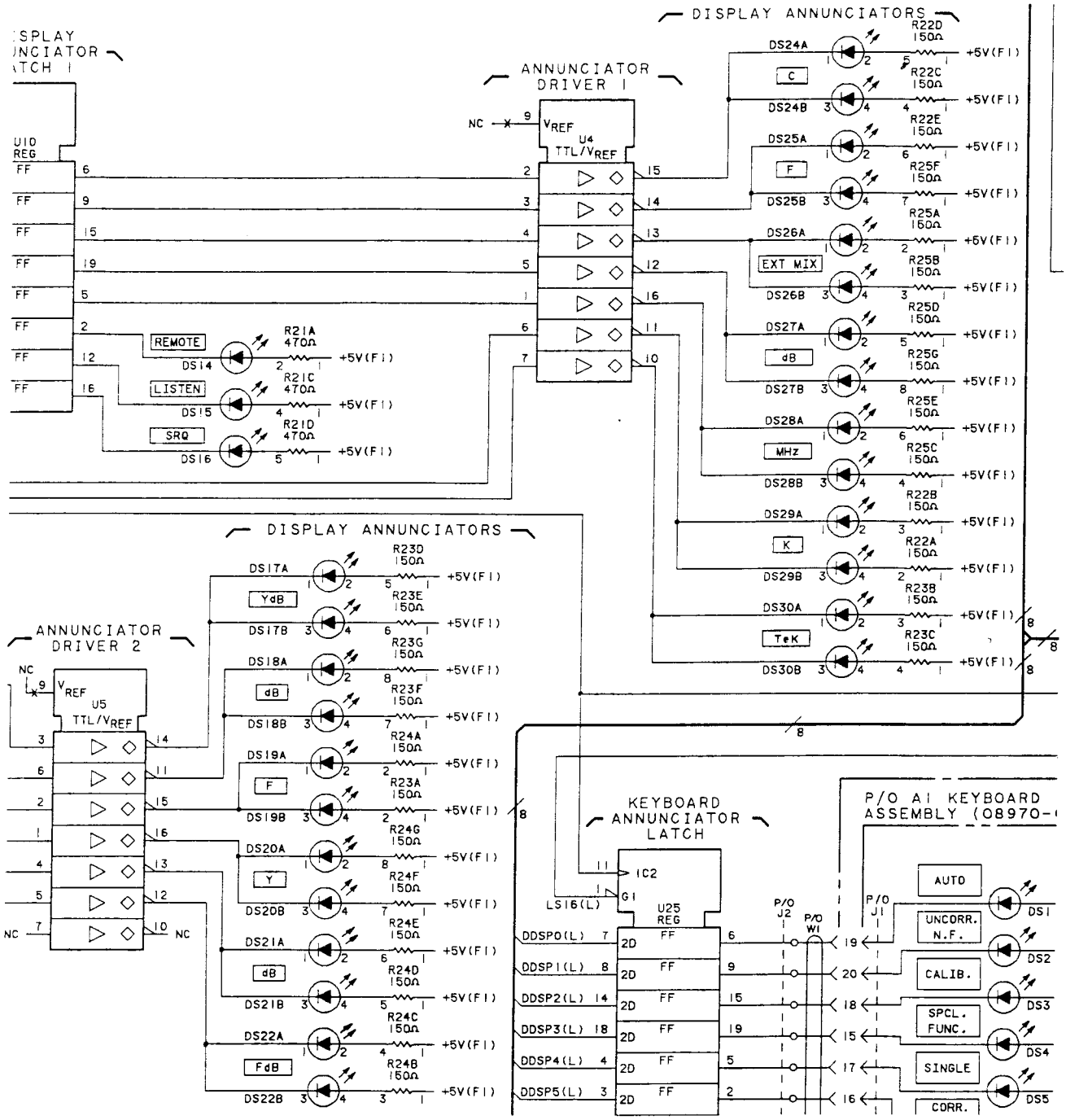

Figure 7-2. P/O Schematic 10 (P/O Change A)

MANUAL CHANGES

CHANGE B

NOTE

One of the components affected by this change is front panel meter M1. The meter was originally located on the far right of the front panel, next to the NOISE FIGURE display. It should be indicated in the front panel photos in Sections I and III. The meter provides an analog indication of data shown in the NOISE FIGURE display.

Table 6-3:

Change A3R35 to 0698-3435 (CD0) RESISTOR 38.3 1% .125W F TC=0 ±100 24546 C4-1/8-T0-38R3-F.
Change A6R36 to 0727-0074 (CD0) RESISTOR 436.2 .5% .25W CF TC=0-500.
Change A6R38 to 0727-0008 (CD0) RESISTOR 11.61 .5% .25W CF TC=0-500.
Change A6R40 to 0727-0074 (CD0) RESISTOR 436.2 .5% .25W CF TC=0-500.
Change A13MP1 to 0515-0053 (CD6) SCREW-MACH M4X0.7 10MM-LG PAN HD.
Change A13MP3 to 0510-0045 (CD6) RETAINER-RING E-R EXT .188-IN-DIA STL.
Change A14MP1 to 0515-0053 (CD6) SCREW-MACH M4X0.7 10MM-LG PAN HD.
Change A14MP3 to 0510-0045 (CD6) RETAINER-RING E-R EXT .188-IN-DIA STL.
Add M1 as follows: 1120-1591 (CD3) METER 0362-0227 (CD1) CONNECTOR-SGL CONT SKT 1.14-MM-BSC-SZ 2200-0105 (CD4) SCREW MACH 4-40 .312-IN-LG PAN-HD POZI 0460-1776 (CD5) PAD-FOAM
Change the first entry in MP30 to 08970-00001 (CD6) PANEL (FRONT).
Change the first entry in MP31 to 08970-00002 (CD7) PANEL-WINDOW.
W8 was originally 08970-20065 (CD4) CABLE ASSY SEMI-RIGID (W17 TO A10). W17 was originally 1250-1249 (CD3) ADAPTER-COAX RTANG F-SMA M-SMA (G1 TO W8). The recommended replacement for W8 is listed in Table 6-3. It connects G1 to A10; W17 is deleted. No manual change is recommended.

Service Sheet BD1 (block diagram):

Replace the appropriate portion of BD1 with the following partial block diagram.

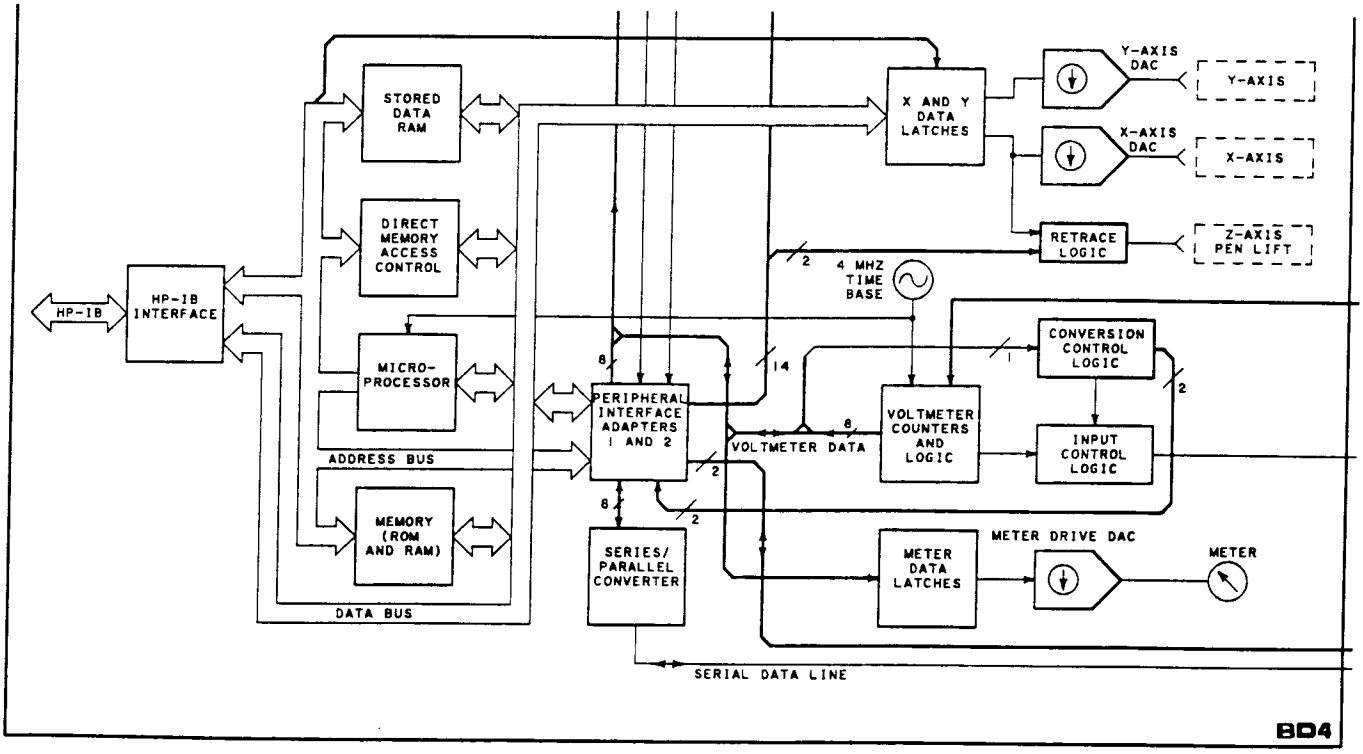

Figure 7-3. P/O Block Diagram 1 (P/O Change B)

MANUAL CHANGES

CHANGE B (cont'd)

Service Sheet BD4 (block diagram):
Replace the appropriate portion of BD4 with the following partial block diagram.

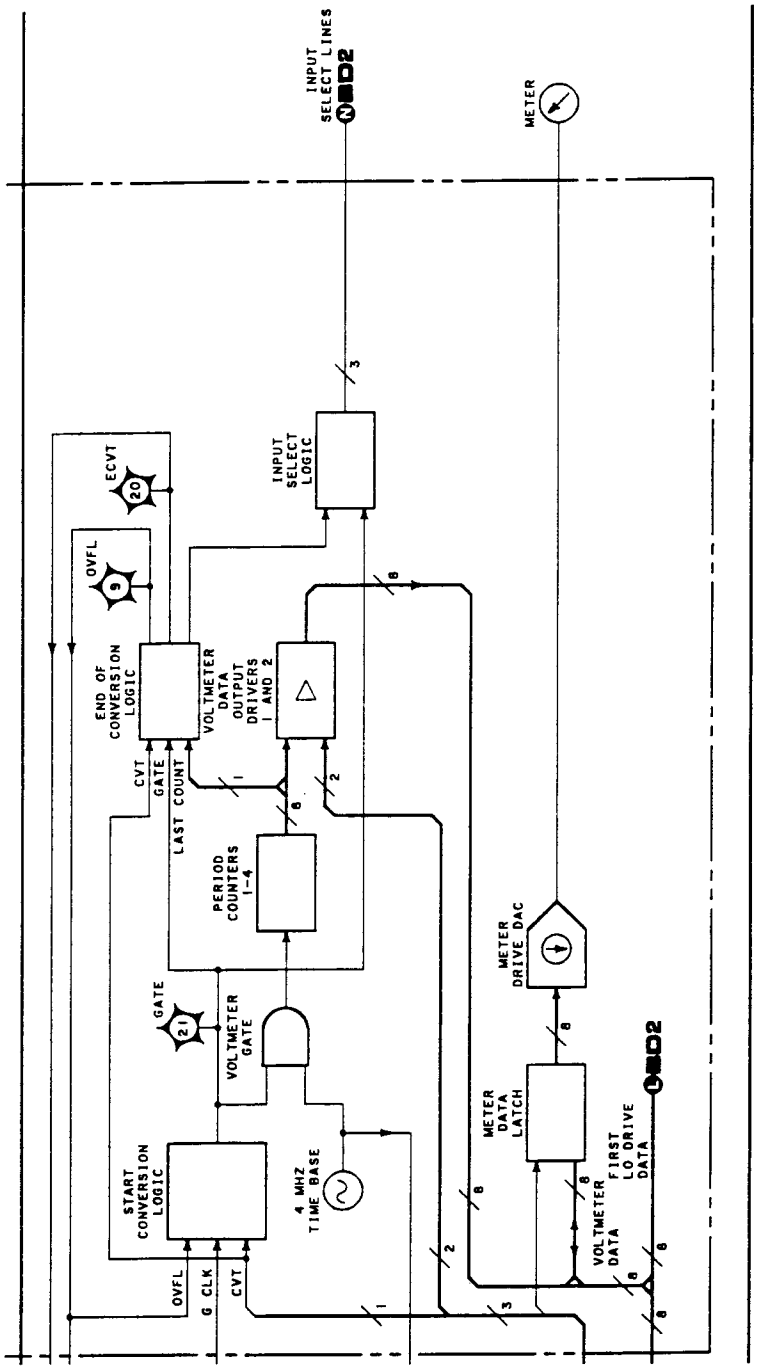

Figure 7-4. P/O Block Diagram 4 (P/O Change B)

MANUAL CHANGES

CHANGE B (cont'd)

Service Sheet BD4 (Troubleshooting):
Add the following signature analysis routine:

Meter Circuits: Start: A14TP8, (D1), /
Stop: A14TP9, (D2), /
Clock: A14TP11, (ϕ2), \
(Service Sheets 6, 11, and 14)

Node (Ref. Desig.)-pin	Signal Name	Signature
A13U17-3	R/$\overline{W}$	66C1
-18	DA0	098H
-4	DA1	CA74
-17	DA2	73C0
-7	DA3	F298
-14	DA4	757H
-8	DA5	AF3F
-13	DA6	P37P
-11	DA7	13A4
U18-5	E3	H60P
-6	—	F5C6
-7	—	198A
-8	—	502F
-9	—	691H
-10	—	879C
-11	—	AHHC
-12	—	2FP7

Service Sheet 1 (schematic):
Change the value of R36 to 436.2Ω.
Change the value of R38 to 11.61Ω.
Change the value of R40 to 436.2Ω.
Change the name of the circuit circuit comprising R36, R38, and R40 to "2 dB Pad."
Service Sheet 3 (schematic):
Change the value of R35 to 38.3Ω.

MANUAL CHANGES

CHANGE B (cont'd)

Service Sheet 6 (schematic):

Add M1 and the wires that connect it to the A1 Keyboard Assembly as shown in the following partial schematic.

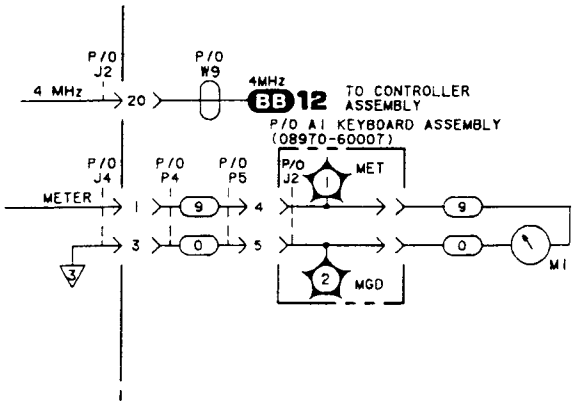

Figure 7-5. P/O Schematic 6 (P/O Change B)

Service Sheet 7 (schematic):

W17 (coax adapter) was originally inserted between W8 and G1J2. The recommended replacement deletes W17 and has W8 connected directly to G1J2, as shown in the schematic. Therefore, no manual change is recommended.

CHANGE C

Table 5-1:

Delete A6R39 from the table.

Delete A13R66 from the table.

Table 6-3:

A2U6 was originally 1826-0138 (CD8) IC COMPARATOR GP QUAD 14-DIP P PKG. The part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended.

A4C6 was originally 0160-0690 (CD4) CAPACITOR-FXD 1 PF ±.5 PF 100VDC CER. The part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended.

Change the first entry under A6K1 - K5 to 0490-0565 (CD1) RELAY 2C 12VDC-COIL.

A6R10 was originally 0698-7222 (CD1) RESISTOR 261 1% .05W F TC=0±100. The part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended.

A6R19 was originally 0698-7219 (CD1) RESISTOR 196 1% .05W F TC=0±100. The part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended.

Change A6R36 to 0727-0064 (CD8) RESISTOR 292.4 .5% .25W CF TC=0-500.

Change A6R38 to 0727-0010 (CD4) RESISTOR 17.61 .5% .25W CF TC=0-500.

Remove the asterisk (*) from A6R39.

Change A6R40 to 0727-0064 (CD8) RESISTOR 292.4 .5% .25W CF TC=0-500.

A11CR1 was originally 1901-0633 (CD1) DIODE-SM SIG SCHOTTKY. The part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended.

The first entry under A11J3 was originally 1250-0829 (CD3) CONNECTOR-RF SMC M SGL-HOLE-FR 50-OHM. The part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended.

A11L2 was originally 08558-80009 COIL-SECOND CONVERTER. The recommended replacement is listed in Table 6-3. Therefore, no manual change is recommended.

MANUAL CHANGES

CHANGE C (cont'd)

Table 6-3 (cont'd):

Change A12R5 to 0811-2822 (CD9) RESISTOR 6.8 5% .75W PW TC=0 ±50.

A13 was originally 08970-60006 (CD7) DRIVER ASSEMBLY. If this assembly is being replaced, order part number 08970-60020 (CD5).

NOTE

One of the components affected by this change is battery BT1. The battery was originally rechargable and located in the chassis. It was moved to Assembly A13 and made replacable. The battery provides the power to the nonvolatile CMOS RAM while the instrument is turned off.

Delete A13BT1.

Add A13C3 0160-3451 (CD1) CAPACITOR-FXD .01UF +80-20% 100VDC CER.

Add A13C4 0160-4494 (CD4) CAPACITOR-FXD 39PF ±5% 200VDC CER 0 ±30.

Add A13C5 0160-4764 (CD1) CAPACITOR-FXD 150PF ±5% 100VDC CER.

Change A13C34 and A13C47 to 0160-4385 (CD2) CAPACITOR-FXD 15 PF ±5% 200 VDC CER 0 ±30.

A13C37 and A13C51 were originally 0160-3855 (CD4) CAPACITOR-FXD 5600 PF ±5%. The part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended.

Add A13C55 0160-3456 (CD6) CAPACITOR-FXD 1000PF ±10% 1KVDC CER.

Delete A13C57.

Add A13CR1 and A13CR2 1901-0376 (CD6) DIODE-GEN PRP 35V 50MA DO-35.

Delete A13CR7.

Delete A13G1.

A13J4 was originally 1251-4989 (CD6) CONNECTOR 5-PIN M POST TYPE. The part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended

Add A13R2 0698-0084 (CD9) RESISTOR 2.15K 1% .125W F TC=0±100.

Add A13R3 0757-0280 (CD3) RESISTOR 1K 1% .125W F TC=0±100.

Add A13R4 0757-0439 (CD4) RESISTOR 6.81K 1% .125W F TC=0±100.

Add A13R5 0757-0439 (CD4) RESISTOR 6.81K 1% .125W F TC=0±100.

Add A13R6 0698-0084 (CD9) RESISTOR 2.15K 1% .125W F TC=0±100.

Add A13R7 0757-0280 (CD3) RESISTOR 1K 1% .125W F TC=0±100.

Delete A13R66*, A13R67, and A13R68.

Delete A13R69.

Add A13U17 1820-1858 (CD9) IC FF TTL LS D-TYPE OCTL 01295 SN74LS377N.

Add A13U18 1826-0188 (CD8) IC CONV 8-B-D/A 16-DIP-C-PKG 04713 MC1408L-8.

Delete A13W2—5.

Add A13Y1 0410-0465 (CD2) CRYSTAL-QUARTZ 4.00000 MHZ HC-6/U-HLDR.

A14C9 was originally 0160-3855 (CD9) CAPACITOR-FXD 5600PF ±5%. The recommended replacement is listed in Table 6-3. Therefore, no manual change is recommended.

Delete A14MP6.

A14U67 was originally 1826-0138 (CD8) IC COMPARATOR GP QUAD 14-DIP-P-PKG. The recommended replacement is listed in Table 6-3. Therefore, no manual change is recommended.

Under B1, delete TERMINAL-SLDR LUG 0360-0269 and SCREW 0624-0215.

Add BT1 as follows:

08672-60092 (CD0) BATTERY PACK.

0520-0165 (CD2) SCREW-MACH 2-56 .312-IN-LG 82 DEG.

08672-00011 (CD7) CLAMP-BATTERY.

MANUAL CHANGES

CHANGE D (cont'd)

Service Sheet 1 (schematic):
Change the value of R39 to 162 kOhms.

Service Sheet 6 (schematic):
Add TP1 (MET) and TP2 (MGD) to the A1 Keyboard Assembly (TP1 is on wire 9 and TP2 is on wire 0).

CHANGE E

Table 6-3:
Change the second entry under A2DS1 through A2DS13 to 1200-0859 (CD4) SOCKET-IC 14-CONT DIP DIP-SLDR.
Change the second entry under A2DS31 through A2DS34 to 1200-1124 (CD8) SOCKET-IC 16-PIN DIP.
Delete C5, MP59, and VR1.

Service Sheet 5 (schematic):
Delete C5 and VR1.