HP 3589A Performance Test Guide

(Includes HP 35689A/B)

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8600 Soper Hill Road Everett, Washington 98205-1298 U.S.A.

HEWLETT PACKARD

Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.

Ground The Instrument

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

Do Not Operate In An Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Keep Away From Live Circuits

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

Do Not Service or Adjust Alone

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

Do Not Substitute Parts or Modify Instrument

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

Dangerous Procedure Warnings

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

Warning 

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

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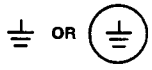
Safety Symbols

The following safety symbols are used throughout this manual and in the instrument. Familiarize yourself with each symbol and its meaning before operating this instrument.

General Definitions of Safety Symbols Used On Equipment or In Manuals.

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

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked.)



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.

Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

Warning

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which if not correctly performed or adhered to, could result in injury or death to personnel.

Caution

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

Note

The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

Registration Card

Make sure you send in the product registration card located in the red brochure included in your HP 3589A and HP 35689A/B shipping carton. This assures that you will hear about future HP 3589A and HP 35689A/B product and service updates. If the brochure has been misplaced, simply mail or fax the following information to the indicated address/fax number.

- Model Numbers:
- Serial Numbers:
- Your Name:
- Position:
- Company Name:
- Division:
- Mail Stop:
- Street:
- City:
- State or Province:
- Postal Code:
- Country:
- Telephone: ( )-

Mail to:

ATTN: Quality and Productivity MS230
Hewlett-Packard Company
Lake Stevens Instrument Division
8600 Soper Hill Rd.
Everett, WA 98205-1298

Or FAX:

(206)335-2828
No cover sheet is required.
Quality and Productivity Department MS230

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Chapter 3: Verifying Specifications

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Introducing the HP 3589A and HP 35689A/B

Instrument Description

The HP 3589A Spectrum/Network Analyzer is a high performance, 10 Hz to 150 MHz, synthesized network/spectrum analyzer offering swept spectrum, narrow band zoom, and vector network measurements. Swept spectrum mode uses digital IF filters that allow increased measurement speed (up to four times faster than conventional swept-tuned analyzers for comparable measurements) with no additional amplitude error or resolution loss. Narrow band zoom mode uses an implementation of the Fast Fourier Transform to provide even faster measurements (up to 350 times faster than conventional swept-tuned analyzers for comparable measurements) with even greater resolving power. Narrow band zoom mode can be used for spans of 40 kHz and less. Vector network mode provides complete frequency-domain characterization. With the addition of the HP 35689A/B S-Parameter Test Set, the HP 3589A can do complete one-port or two-port vector network analysis. The HP 35689A is a 50Ω S-Parameter test set and the HP 35689B is a 75Ω S-Parameter test set.

The HP 3589A Spectrum/Network Analyzer has a built-in source with programmable amplitude. Measurements can be saved using the internal non-volatile memory or the internal 3.5-inch flexible disk drive. Plots and prints of the measurements can be made directly to HP-IB printers and plotters. Options include time-gated spectrum analysis, HP Instrument BASIC programming language (IBASIC), and PC-compatible keyboards.

Safety Considerations

The HP 3589A Spectrum/Network Analyzer and the HP 35689A/B S-Parameter Test Set are Safety Class 1 instruments (provided with a protective earth terminal). Although these instruments have been designed in accordance with international safety standards, this manual contains information, cautions and warnings that must be followed to ensure safe operation and retain the instruments in safe operating condition. Service must be performed by trained service personnel who are aware of the hazards involved (such as fire and electrical shock).

Options

The following options are available to upgrade your HP 3589A Spectrum/Network Analyzer. Order HP 3589U followed by the option number below:

- 1D5 High Stability Frequency Reference
- 1D6 Time-Gated Spectrum Analysis
- 1C1 Additional 2 Mbyte RAM
- 1C2 HP Instrument BASIC

Accessories

The accessories are listed in four tables — table 1-1 lists accessories supplied with the HP 3589A Spectrum/Network Analyzer, table 1-2 lists accessories supplied with the HP 35689A/B S-Parameter Test Set, table 1-3 lists accessories available for the HP 3589A Spectrum/Network Analyzer, and table 1-4 lists accessories available for the HP 35689A/B S-Parameter Test Set.

Table 1-1. Accessories Supplied with the HP 3589A

Accessory	Part Number
Line Power Cable	See figure 2-3
Plastic Transportation Disk	HP 5061-2819
25Ω BNC feedthrough series resistors (2)	HP 1250-2275
Nylon mounting clips for BNC feedthrough series resistor (2)	HP 1400-1356
N-to-BNC adapters (2)	HP 1250-0780
Standard Data Format Utilities Includes: *Standard Data Format Utilities Disk, 3 1/2 inch, 1 Of 2* *Standard Data Format Utilities Disk, 3 1/2 inch, 2 Of 2* *Standard Data Format Utilities Disk, 5 1/4 inch, 1 Of 2* *Standard Data Format Utilities Disk, 5 1/4 inch, 2 Of 2* *Standard Data Format Utilities User's Guide* *Standard Data Format Utilities Quick Reference*	HP 5061-8037 HP 5010-3316 HP 5010-3317 HP 5010-3318 HP 5010-3319 HP 5959-5791 HP 5959-5790
HP 3589A Performance Test Guide Includes: *HP 3589A Semiautomated Performance Test Disk* *HP 35689A/B Semiautomated Performance Test Disk*	HP 03589-90001 HP 03589-19407 HP 35689-19402
HP 3589A Quick Start Guide	HP 03589-90002 in English or HP 03589-90005 in Japanese
HP 3589A Operator's Guide	HP 03589-90021
HP 3589A Programmer's Reference	HP 03589-90020
With option 1D5 Coax BNC (m)-to-coax BNC(m) connector	 HP 1250-1499

Table 1-2. Accessories Supplied with the HP 35689A/B

Accessory	Part Number
Line Power Cable	See figure 2-3
RF Connecting Cables (2)	HP 8120-4387
Interconnect Cable	HP 35689-61612

Table 1-3. Available Accessories for the HP 3589A

Accessory	Part Number
Active probe	HP 41800A
50 to 75 ohm minimum loss pad	HP 11852B #C04
Rack mount kit	HP 35660-86010
Box of ten 3.5-inch double-sided, double-density disks	HP 92192A
HP 3589A Operator's Reference	HP 03589-90000
HP Instrument BASIC User's Handbook	HP E2083-90000
Using HP Instrument BASIC with the HP 3589A	HP 03589-90009
Sample IBASIC Programs Disk	HP 5959-5710
Service kit	HP 03588-84401
HP 3589A Service Guide Includes: *HP 3589A Semiautomated Performance Test Disk* *HP 35689A Semiautomated Performance Test Disk*	HP 03589-90010 HP 03589-19407 HP 35689-19402
PC Style 101-key keyboard U.S. ASCII U.K. English German French Italian Spanish Swedish Keyboard cable	 HP C1405A #ABA HP C1405A #ABU HP C1405A #ABD HP C1405A #ABF HP C1405A #ABZ HP C1405A #ABE HP C1405A #ABS HP 5081-2249
Transit case	HP 9211-2663

Table 1-4. Available Accessories for the HP 35689A/B

Accessory	Part Number
Handle kit	HP 5062-3988
Rack mount kit	HP 5062-3974
Rack mount and handle kit	HP 5062-3975

Firmware Version Code

As with changes to the instrument hardware, Hewlett-Packard also makes changes to its firmware. To determine which version of firmware is in your analyzer, press the following keys:

[Special Fctn]
[NON-VOL SETUP]
[VERSION]

An information block appears on the screen for about five seconds (pressing [VERSION] repeats the information).

Serial Numbers

Hewlett-Packard makes frequent improvements to its products to enhance their performance, usability, or reliability, and to control costs. HP service personnel have access to complete records for each instrument model, based on the equipment's serial number. Whenever you contact HP about your analyzer, have the complete serial number available to ensure obtaining the most complete and accurate information possible.

A serial number label is attached to the rear of the analyzer. The serial number has two parts — the prefix (the first four numbers and a letter) and the suffix (the last five numbers).

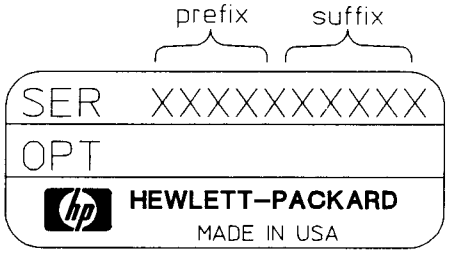


Figure 1-1. Serial Number Label

You can also access the serial number from the front panel by pressing the following keys:

[Special Fctn]
[NON-VOL SETUP]
[SERIAL NUMBER]

An information block appears on the screen for about five seconds (pressing [SERIAL NUMBER] repeats the information).

Recommended Test Equipment

The recommended test equipment is listed in six tables. Tables 1-5, 1-6 , and 1-7 list the equipment needed to verify specifications for the HP 3589A, HP 35689A, and HP 35689B. Tables 1-8, 1-9, and 1-10 list the additional equipment needed to adjust or troubleshoot the HP 3589A, HP 35689A, and HP 35689B. Other equipment may be substituted for the recommended model if it meets or exceeds the listed critical specifications. When substitutions are made, you may have to modify the procedures to accommodate the different operating characteristics.

Table 1-5. Recommended Test Equipment for the HP 3589A

Instrument	Critical Specifications	Recommended Model
Attenuator	(2) 10 dB 20 to 30 MHz	HP 8491A Opt 010
Digital Multimeter	Frequency Range: 10 Hz to 300 kHz AC Range: 2 mV to 20V Amplitude Accuracy: ± 0.1% dBm Math Mode	HP 3458A
Frequency Standard	Frequency Accuracy: ±0.0025 ppm	HP 5061B
Milliwatt Power Meter	Power Range: ± 0.2 dBm 10 Hz to 100 Hz: ± 0.4 dB 100 Hz to 30 kHz: ± 0.27 dB 300 kHz: ± 0.035 dB 30 kHz to 150 MHz: ± 0.13 dB Input Impedance: 50Ω 0 dBm Control Voltage Output	W & G EPM-1†
Power Meter	Frequency Range: 100 kHz to 150 MHz Input Range: 100 kHz to 150 MHz Amplitude Accuracy (with power sensor): ± 0.27 dB	HP 438A Alternate HP 436A
Power Sensor	SWR: ≤ 1.20 Impedance: 50Ω	HP 8482A
Power Splitter	SWR: ≤ 1.10 Input Impedance: 50Ω Two Outputs	HP 11667A
Power Supply	Volts: +20 Vdc Amps: 0.5	HP 6236B
Spectrum Analyzer	Frequency Range: 100 Hz to 150 MHz Amplitude Range: –100 to 20 dBm Dynamic Range: ≤ –52 dBc Phase Noise: <–86 dBm/Hz at 500 Hz offset Marker Noise Function	HP 8568B

† This equipment is only used in the "Input Amplitude Accuracy and Flatness" test. The "Alternate Input Amplitude Accuracy and Flatness" test does not require this equipment. To order this equipment contact Wandel & Goltermann, Inc., 1800 Wyatt Drive Suite 2, Santa Clara, CA 95054 (408) 988-7622.

Table 1-5. Recommended Test Equipment for the HP 3589A (continued)

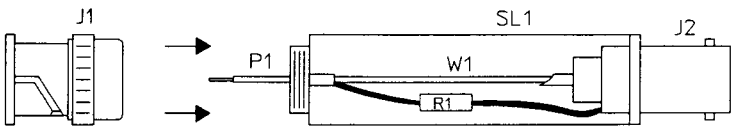
Instrument	Critical Specifications	Recommended Model
Synthesized Signal Generator	Dynamic Range: <–92 dBc Frequency Range: 1 MHz to 150 MHz Impedance: 50Ω Resolution: 0.1 Hz External Reference Input	HP 8663A Alternate HP 8662A
Step Attenuator (with calibration data at 100 kHz and 300 kHz)	0 to 70 dB: ± 0.02 dB	HP 355D Alternate HP 8495A HP 8495B
Synthesizer	Frequency Range: 10 Hz to 10 MHz Impedance: 50Ω	HP 3326A Alternate HP 3325A HP 3325B
Synthesizer/Level Generator	Frequency Range: 10 MHz to 25 MHz Harmonic Distortion: ≤ –32 dBc	HP 3335A
21 MHz Low Pass Filter	Filter Rejection: ≤ –60 dB Impedance: 50Ω	TTE # J87-21M-50-613B †
50 MHz Low Pass Filter	Filter Rejection: ≤ –60 dB Impedance: 50Ω	TTE # J87-50M-50-613B †
10 dB Amplifier	(2) Frequency Range: 10 kHz to 150 MHz	QB-210 ‡
50Ω Directional Bridge	Directivity: >40 dB Impedance: 50Ω Frequency Range: 50 to 150 MHz	HP 35677-63502
50Ω Feedthrough Termination	± 0.2% at dc	HP 11048C
100 kΩ Feedthrough Termination	± 0.2% at dc	see figure 1-2
Adapters	(5) N(m)-to-BNC(f) (4) SMA(m)-to-BNC(f) BNC(f)-to-Dual Banana Plug (2) N(f)-to-BNC(m) N(f)-to-BNC(f) N(m)-to-N(m) (2) SMA(m)-to-BNC(m) BNC Tee (2) BNC(f)-to-Alligator Clip	HP 1250-0780 HP 1250-1200 HP 1251-2277 HP 1250-0077 HP 1250-1536 †† HP 1250-1475 HP 1250-1787 HP 1250-0781 Pomona model 2630 ‡‡
Cables	(7) BNC-to-BNC 122 cm Error Correction Cable	HP 8120-1840 HP 03588-61630 ††

† To order this equipment contact TTE, Inc. 2214 S. Benny Avenue, Los Angeles, CA 90064.

‡ To order this equipment contact Q-Bit Corp. PO Box 2208, Melbourne, FL 32901 (407) 727-1838.

†† This equipment is only used in the "Input Amplitude Accuracy and Flatness" test. The "Alternate Input Amplitude Accuracy and Flatness" test does not require this equipment.

‡‡ To order this equipment contact ITT Pomona Electronics, 1500 East Ninth Street, Pomona, CA 91769 (714) 623-3463.



MATERIALS:

Item	Qty	Description	HP Part Number
J1	1	Connector BNC male	1250-0052
J2	1	Connector BNC female	1250-0083
P1	1	Pin	1250-0089
SL1	1	Sleeve	1531-0246
R1	1	Resistor 100 kΩ	0757-0465
W1	2cm	Wire 24 AWG	8150-0295

Figure 1-2. 100 kΩ Feedthrough Termination

Table 1-6. Recommended Test Equipment for the HP 35689A

Instrument	Critical Specifications	Recommended Model
Spectrum/Network Analyzer	HP 35689A/B interface	HP 3589A
Short	50Ω, N(m)	HP 11512A
Z0 Terminations	(2) Precision 50Ω, N(m), ≥ 52 dB return loss 50Ω, N(m), ≥ 26 dB return loss	HP 909C HP 909A
Cables	(2) 50Ω, N(m)-to-N(m) (2) BNC-to-BNC 122 cm	HP 8120-4666 HP 8120-1840
Adapters	50Ω, N(f)-to-N(f) (5) 50Ω, N(m)-to-BNC(f) (2) SMA(m)-to-BNC(f) 50Ω, N(m)-to-N(m)	HP 1250-1472 HP 1250-0780 HP 1250-1200 HP 1250-1475
50Ω Directional Bridge	Directivity: >40 dB, Impedance: 50Ω Frequency Range: 50 to 150 MHz	HP 35677-63502

Table 1-7. Recommended Test Equipment for the HP 35689B

Instrument	Critical Specifications	Recommended Model
Spectrum/Network Analyzer	HP 35689A/B interface	HP 3589A
Shorts	75Ω, N(m) 50Ω, N(m)	HP1250-1530 HP 11512A
Z0 Terminations	(2) Precision 75Ω, N(m), ≥ 52 dB return loss 50Ω, N(m), ≥ 26 dB return loss	HP 909E HP 909A
Cables	(2) 75Ω, N(m)-to-N(m) (2) BNC-to-BNC 122 cm	HP 8120-4667 HP 8120-1840
Adapters	75Ω, N(f)-to-N(f) (5) 50Ω, N(m)-to-BNC(f) (2) SMA(m)-to-BNC(f) 50Ω, N(m)-to-N(m)	HP 1250-1529 HP 1250-0780 HP 1250-1200 HP 1250-1475
50Ω Directional Bridge	Directivity: >40 dB, Impedance: 50Ω Frequency Range: 50 to 150 MHz	HP 35677-63502

Table 1-8. Additional Recommended Test Equipment for the HP 3589A †

Instrument	Critical Specifications	Recommended Model
Frequency Counter	Frequency Range: 10 to 500 MHz Resolution: <1 Hz at 10 MHz Frequency Accuracy: $\pm 25 \times 10^{-3}$ Hz Sensitivity: –28 dBm Impedance: 1 MΩ	HP 5334B Opt 030 Alternate HP 5343A
Logic Probe	TTL/CMOS Maximum Clock: >25 MHz	HP 545A Alternative HP 5006A HP 5005A/B
Oscilloscope	Bandwidth: ≥ 150 MHz Vertical Sensitivity: 10 mV/div Input Coupling: AC, DC, 50Ω Waveform Math: A-B Trigger: Ext, Int, Chop	HP 54111D
Oscilloscope Probe	Input R: ≥ 1 MΩ Division Ratio: 10:1	HP 10431A
Oscilloscope Probe	Input R: ≥ 1 MΩ Division Ratio: 1:1	HP 10438A
Resistive Divider Probe Kit	Impedance: 50Ω Division Accuracy: ± 3% Input Capacitance: <0.7 pF Division Ratio: 1:1, 5:1, 10:1, 20:1, 50:1, 100:1	HP 10020A
Ball Driver Hex Tool	Size 3/32	Bondhus ‡
Spectrum Analyzer	Impedance: 1 MΩ Frequency Range: 20 Hz to 200 kHz Amplitude Accuracy: ± 1dB	HP 3585B
Adapter	SMB(f)-to-Coax BNC(f)	HP 1250-1236
HP 3589A Service Kit	 Includes: Power Supply Test Board SMB Extender Cables (7) Extender Board, 12 pin Extender Board, 48 pin Fast Bus Extender Cable BNC-to-SMB Cable (2) Capacitive Load SMB-to-SMB Adapter (2) Flat -Edge Adjustment Tool Small Adjustment Tool Service Disks	HP 03589-84401 Includes: HP 35672-66590 HP 03585-61610 HP 03588-66595 HP 03588-66596 HP 35660-61621 HP 03585-61616 HP 35660-64401 HP 1250-0669 HP 8710-1928 HP 8710-1514 HP 03589-69401

† Not required for performance tests—only required for adjustment and troubleshooting procedures.

‡ To order this equipment contact Tool Kit Specialist Inc. Sunnyvale, CA (408) 745-6020.

Table 1-9. Additional Recommended Test Equipment for the HP 35689A †

Instrument	Critical Specifications	Recommended Model
Cables	(3) 50 Ω, N(m)-to-N(m), 183 cm 50 Ω, SMA(m)-to-Right Angle SMA(m)	HP 11500A Pomona 4814-BB-48
Adapter	N(m)-to-SMA(f)	HP 1250-1250

† Not required for performance tests—only required for troubleshooting procedures.

Table 1-10. Additional Recommended Test Equipment for the HP 35689B †

Instrument	Critical Specifications	Recommended Model
Cables	(2) 50 Ω, N(m)-to-N(m), 183 cm 50 Ω, SMA(m)-to-Right Angle SMA(m) 75 Ω, BNC(m)-to-BNC(m)	HP 11500A Pomona 4814-BB-48 HP 11652-60013
Cable Kit	Cables (2) 75 Ω, N(m)-to-N(m), 610 mm Adapter 75 Ω, N(f)-to-N(f)	HP 35679B
Adapters	N(m)-to-SMA(f) 75 Ω, N(m)-to-BNC(f) 75 Ω, N(f)-to-BNC(m)	HP 1250-1250 HP 1250-1535 HP 1250-1534
Feedthrough Series Resistor	25Ω BNC	HP 1250-2275

† Not required for performance tests—only required for troubleshooting procedures.

HP 3589A Specifications

General Specifications

Note: All specifications apply from 10 Hz to 150 MHz and include 30 minute warm-up from ambient conditions unless otherwise noted. Supplemental characteristics (identified as characteristic only) are non-warranted functional and feature information.

The general specifications apply independent of the measurement type selected. Refer to the spectrum measurements and network measurements for specifications that are measurement type dependent.

Frequency Specifications

Frequency range
Tuning range: 0 Hz to 150 MHz
Specifications for 50 and 75Ω apply over the frequency range 10 Hz to 150 MHz. The 1 MΩ input operates over the full span and is specified from 10 Hz to 40 MHz.

Frequency accuracy
Frequency accuracy is specified using the frequency counter marker function and is the sum of initial accuracy, aging, and frequency counter resolution.

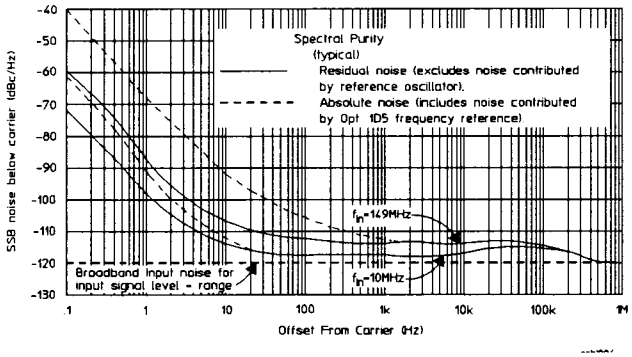
Initial accuracy:

	Without opt 1D5	With opt 1D5‡
20 ° to 30 °C	± 0.5 ppm	± 0.01 ppm
0 ° to 55 °C	± 3.0 ppm	± 0.07 ppm
Aging†	± 0.25 ppm/mo	± 0.125 ppm/mo

† Referenced to the most recent reference calibration at 23 °C.
‡ Add ± 0.1 ppm if the instrument has been continually powered < 48 hours.

Frequency counter resolution: 0.1 Hz

Stability
Spectral Purity: See chart below.
Noise sidebands: less than -105 dBc when measured at a 1 kHz offset from CW signal and normalized to a 1 Hz noise-power bandwidth.



Note: Equivalent noise bandwidth is narrower than 1 Hz for spans below 150 Hz with the narrowband zoom measurement type, providing additional reduction in phase noise from that shown. This maintains good dynamic range, even for extremely small offset frequencies in narrow spans. Noise is reduced by 10*Log[1/noise bandwidth] dBc relative to the previous graph.

Drift/residual FM
The HP 3589A uses a fully synthesized local oscillator and is phase-locked to the frequency reference throughout the sweep. Refer to the frequency accuracy specifications stated earlier for the resulting accuracy.

Amplitude Specifications

Amplitude measurement range:

Maximum Safe Input Level

	50Ω	75Ω	1 MΩ
Avg Continuous Power: (10 Hz to 150 MHz)	26 dBm	28 dBm	13 dBV
dc Voltage:	± 4V	± 4V	± 25V
Combined ac/dc:	± 4 Vpk	± 4 Vpk	± 25 Vpk

Maximum Without Degrading Performance

	50Ω	75Ω	1 MΩ
Input dc:	± 3 Vdc	± 3 Vdc	± 25 Vdc
Measured input:	20 dBm	22 dBm† 26 dBm‡	± 7 dBV

† With included BNC adapter
‡ With minimum loss pad (optional)

Input range settings
(characteristic only)
50Ω input (in 10 dB steps): +20 dBm to -20 dBm
75Ω input (in 10 dB steps): +21.76 dBm to -18.24 dBm, with included BNC adapter and automatic corrections.
+25.72 dBm to -14.28 dBm, with minimum loss pad (option) and automatic corrections
1 MΩ input (in 10 dB steps): +7 dBV to -33 dBV

Amplitude display range
Reference level: -1000 to +1000 dBm, dB
Display resolution: 0.001 to 100 dB/div
Marker resolution: 0.01 dB
Display units: dBm, dBV, Vrms

Normalization
Normalization routines allow the single receiver channel to accurately measure scalar network parameters when swept spectrum measurement type is selected, or vector network parameters when swept network measurement type is selected. Measurement normalizations require the reference measurement to be taken first, using either quick normalization, which uses an internal source to receiver path, or transmission normalization, which can correct for additional cable, adapter, and fixture effects. Measurements are then referenced to that measurement as a ratio.

Input port
Input channels: 1
Return loss: >20 dB
Impedance: 50Ω, 1 MΩ (<60 pF shunt capacitance)
(75Ω with included BNC adapter or optional minimum loss pad)
Connector: Type-N

Source Specifications

Frequency specifications
(characteristic only)
Frequency range: 10 Hz to 150 MHz

Amplitude specifications
Amplitude range 50Ω output: +15 dBm to -54.9 dBm and off
Amplitude range 75Ω output: +13.2 dBm to -56.7 dBm and off, with included BNC adapter.
+9.3 dBm to -60.6 dBm and off, with minimum loss pad (option).

Amplitude resolution: 0.1 dB

Accuracy: Output amplitude accuracy is determined by the sum of absolute accuracy, dynamic accuracy, and frequency response.

Absolute amplitude accuracy: ± 1 dB
(at 300 kHz, +15 dBm output level)
Dynamic accuracy: Add 0.02 dB/dB below 15 dBm
(add to absolute accuracy)
Frequency response: ± 1 dB
(Variations relative to the level at 300 kHz)

Spurious products:
Harmonic products: < -28 dBc
Non-harmonic products: < -40 dBc

Noise: < -80 dBc/Hz
(for offsets greater than 500 Hz from the carrier)

Source port:
Return loss: > 20 dB
Impedance: 50Ω
(75Ω with included BNC adapter or optional minimum loss pad)
Connector: Type-N

Spectrum Measurements

All specifications apply from 10 Hz to 150 MHz and include 30 minute warm-up from ambient conditions unless otherwise noted. Typical performance is applicable over ± 5 °C from the temperature during the most recent autocalibration and is not warranted. Supplemental characteristics (identified as characteristic only) are non-warranted functional and feature information.

All spectrum measurement specifications apply when swept spectrum or narrowband zoom measurement type is selected and with the source turned off and low-distortion mode off unless otherwise noted.

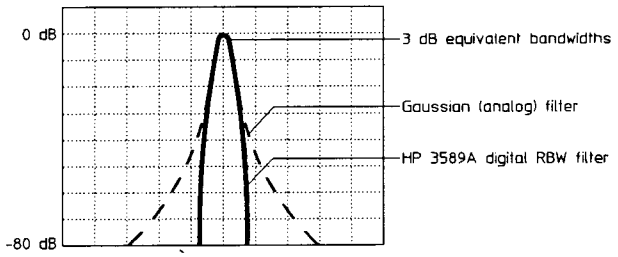
Frequency Specifications

Frequency span
(characteristic only)
Swept spans:
Range: 10 Hz to 150 MHz, and zero span
Resolution: 0.1 Hz
Accuracy: Greater of 0.1 Hz or 0.125% of span
Start/stop frequency: 0 Hz to 150 MHz

Narrowband zoom spans:
Range: 1.23 Hz to 40 kHz in x2 steps
Accuracy: ± 0.001% of span

Resolution bandwidth
Swept spectrum: 1.1 Hz to 17 kHz ± 10%

Narrowband zoom:
High-accuracy mode: 0.90% of span (11 mHz - 360 Hz)
High-resolution mode: 0.37% of span (4.5 mHz - 148 Hz)



HP 3589A digital RBW filter shape (solid line) compared with a standard (Gaussian) analog RBW filter of equivalent 3 dB bandwidth. Shape factor of the analog filter is approximately 11:1.

Bandwidth selectivity
(shape factor or ratio of -60 dB to -3 dB bandwidths)

Swept spectrum mode:
(see also filter comparison graph)
Manual sweep: < 4.0:1
Auto-coupled sweep: 4.3:1 (typical)
Auto-coupled oversweep: 5.1:1 (typical)

Narrowband zoom:
High-accuracy mode: 2.6:1
High-resolution mode: 9.1:1

Equivalent noise bandwidth
The equivalent noise bandwidth and 1 Hz normalization factor are available for the current RBW filter in the state setup table.

Narrowband zoom:
High-accuracy mode: 0.955% of span
High-resolution mode: 0.375% of span

Video bandwidth
Entered in frequency values which are coupled to the current RBW and are from (1.54 * RBW) to (0.012 * RBW) in seven steps, and off.

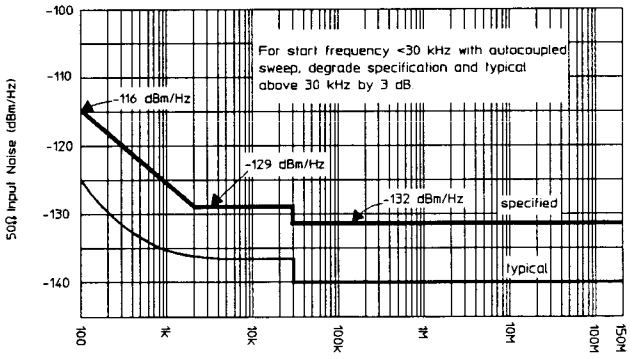
Amplitude Specifications

Dynamic range
Note: Spectrum dynamic range specifications apply with the source off.

A/D overload level: > 2 dB (relative to selected range)

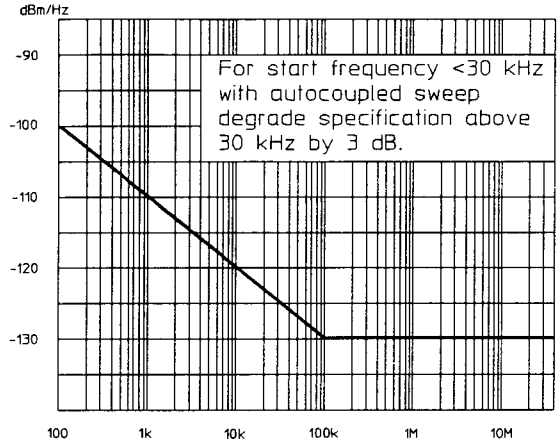
Noise level: (dBm/Hz using the noise marker function)

50Ω Input Noise



Specified for swept spectrum mode, with 50Ω input, range set to -20 dBm and low-distortion mode off. Degrade 10 dB if in low-distortion mode. For 75Ω input with included BNC adapter barrel degrade 2 dB, or with minimum loss pad degrade 6 dB.

1 MΩ Input Noise



Specified for swept spectrum mode with 1 MΩ input, range set to -33 dBV (100 kΩ termination) and low-distortion mode off. Degrade 10 dB if in low-distortion mode.

For narrowband zoom spans > 10 kHz, input noise is degraded by 4 dB.

Note: Equivalent noise bandwidth is narrower than 1 Hz for spans below 150 Hz with the narrowband zoom measurement type, providing additional reduction in noise from that shown. Noise is reduced by 10*Log[1/noise bandwidth] dBc relative to the graph.

Spurious responses

General spurious

Unless specifically mentioned in other spurious specifications, spurious responses are < -70 dBc (< -80 dBc typical) for signal levels equal to input range.

Harmonic distortion†

Harmonic distortion products are for a spectrally pure input signal with total input power level equal to the range and low distortion mode on.

50Ω and 75Ω inputs: < -80 dBc (< -90 dBc typical)
1 MΩ input: < -75 dBc (< -80 dBc typical)

Intermodulation distortion†

Intermodulation distortion products are with respect to two tones 6 dB below range and low-distortion mode on.
50 and 75Ω inputs: < -80 dBc (< -90 dBc typical)
1 MΩ input: < -75 dBc (< -80 dBc typical)

† Degrade distortion specification by 10 dB (5 dB for 1 MΩ input) when input frequency is less than 30 kHz. Degrade specification by 10 dB when low-distortion mode is off.

Residual responses

Residual responses are less than -110 dBm on the -20 dBm range. Degrade specification by 10 dB when low-distortion mode is on. Degrade 10 dB for 40 kHz spans in narrowband zoom mode.

Image, multiple, and out-of-band responses: < -70 dBc (< -80 dBc typical) where applied signal level = range.

Local oscillator feedthrough

Local oscillator feedthrough (appears as signal at dc) is >20 dB below range. Degrade specification by 10 dB when low-distortion mode is on.

Amplitude accuracy

Measurement accuracy is determined by the sum of full-scale absolute accuracy and scale fidelity (linearity). For measurements made at full-scale (signal level = range), only full-scale accuracy need be considered. Recalibration due to change in center or manual frequency is not required for the accuracy shown.

Example: To compute the typical cumulative accuracy for a signal of -45 dBm at 100 MHz with 50Ω full-scale range of -20 dBm and manual sweep, sum the typical full-scale absolute accuracy and scale fidelity, i.e., (0.2 dB + 0.02 dB) = 0.22 dB.

Full scale absolute accuracy

(applies over entire 0 ° to 55 °C temperature range)

Full scale absolute accuracy

	50Ω Input [dB]	50Ω Typical [dB]	75Ω Input† [dB]	1 MΩ Input [dB]
10 Hz - 100 Hz	± 2.5	± 1.0	± 2.5	± 2.5
100 Hz - 30 kHz	± 1.0	± 0.5	± 1.0	± 1.25
30 kHz - 300 kHz	± 0.5	± 0.2	± 0.8	± 0.6
300 kHz - 40 MHz	± 0.4	± 0.2	± 0.8	± 0.6
40 MHz - 150 MHz	± 0.5	± 0.2	± 0.8	—

Full-scale absolute accuracy at 300 kHz is ± 0.3 dB (0.1 dB typical) when input level is equal to the range.

† Using either included BNC adapter or optional minimum loss pad.

Accuracy is specified for manual frequency or for sweeps where sweep time is increased by a factor of four. Add ± 0.1 dB for autocoupled sweep times.

Narrowband zoom: Add the following errors to the full-scale absolute accuracy specifications when in narrowband zoom mode. (This compensates for "window flatness" errors that result from windowing during the FFT operation):

High-accuracy mode (flat-top window): ± 0.005 dB
High-resolution mode (Hanning window): +0, -1.5 dB

Scale fidelity

(linearity) maximum cumulative error of log scale:

Level†	Incremental‡	Typical
0 to -30 dB	<0.05 dB	0.02 dB
-30 to -40 dB	<0.1 dB	0.03 dB
-40 to -50 dB	<0.3 dB	0.05 dB
-50 to -60 dB	<0.5 dB	0.10 dB
-60 to -70 dB	<0.7 dB	0.10 dB
-70 to -80 dB	—	0.25 dB
-80 to -90 dB	—	0.25 dB
-90 to -100 dB	—	0.40 dB
-100 to -110 dB	—	0.70 dB
-110 to -120 dB	—	4.00 dB

Specified for frequencies >200 kHz.
† Relative to the specified range.
‡ Incremental deviation must be added to the other reference level accuracy specifications to obtain the total cumulative error.

Automatic calibration

Calibrations, which may be turned off, are periodically performed to compensate for time and temperature drift effects. No recalibration is necessary for changes in frequency parameters.

Sweep Characteristics

Trigger
(characteristic only)
HP-IB, internal free run, or external triggering is available for linear sweep and narrowband zoom. Trigger arming is manual or automatic.

Trigger latency (uncertainty between the trigger input and internal trigger identification):
Zero span and manual sweep: 4 μs (for 17 kHz RBW, increasing by factor of 2 for each lower RBW)
Narrowband zoom: $8 * 2^{40000/span}$ μs
Linear sweep: 20 μs (for 17 kHz RBW, increasing by factor of 2 for each lower RBW)

Trigger delay (HP-IB or external trigger only): 0 ms to the maximum gate length indicated for gated sweep. (See the gate length and trigger delay table in the gated sweep characteristics.)

Linear sweep
Measurement speed: (characteristic only)
Sweep rate, oversweep off: $RBW^2/2$ Hz/s
Sweep rate, oversweep on: $4 * (RBW^2/2)$ Hz/s

Note: Analog Gaussian RBW filters are usually swept at $RBW^2/2$ Hz/s (or slower) to limit the amplitude errors due to sweeping to <0.1 dB. The oversweep mode of the HP 3589A provides four times faster sweep time without increased error. To calculate sweep time, compute span/sweep rate.

Narrowband zoom
Measurement speed: >7 measurements/s (for spans ≥ 10 kHz)

Time record length: 400/span (Hz) second

Gated sweep
(with option 1D6) (characteristic only)
Gated sweep is not available in narrowband zoom mode.

Gate length and trigger delay:

RBW [Hz]	Gate length minimum [ms]	Gate length maximum [ms]	Edge trigger default delay † [ms]
17000	0.02	131	0.13
9100	0.04	131	0.2
4600	0.08	131	0.38
2300	0.16	131	0.76
1200	0.32	131	1.5
580	0.64	131	3.1
290	1.28	665	6.25
150	2.56	1,311	12.5
73	5.12	2,621	25
36	10.24	5,243	50
18	20.48	10,486	100
9.1	40.96	20,972	200
4.5	81.92	41,861	400
2.3	163.84	83,886	800
1.1	327.68	167,772	1600

† Filter settling time required to achieve accurate noise and amplitude measurements. Delay range is from 0 ms to the maximum gate length indicated (10 μs steps for 17 kHz RBW). Level trigger default delay is approximately 20% larger than the edge trigger default delay.

Edge trigger latency (uncertainty between the gate trigger input and internal trigger identification) is 10 μs (for 17 kHz to 580 kHz, increasing by factor of 2 for bandwidths below 580 kHz). Level trigger latency is equal to the minimum gate length indicated.

Network Measurements

Note: All specifications apply from 10 Hz to 150 MHz and include 30 minute warm-up from ambient conditions unless otherwise noted. Typical performance is applicable over ± 5 °C from the temperature during the most recent reference measurement and is not warranted. Supplemental characteristics (identified as characteristic only) are non-warranted functional and feature information.

All network measurement specifications apply when swept network measurement type is selected. Specifications apply to 50Ω to 75Ω only, unless otherwise noted.

Frequency Specification

Frequency span
(characteristic only)

Linear sweep:
Range: 10 Hz to 150 MHz, and zero span
Resolution: 0.1 Hz
Accuracy: Greater of 0.1 Hz or 0.125 % of span
Start/stop frequency: 0 Hz to 150 MHz

Log sweep:
Range: 10 Hz to 149.99999 MHz
Resolution: 0.1 Hz
Accuracy: 3%
Start/stop frequency: 10 Hz to 150 MHz

Resolution bandwidth
Range: 1.1 Hz to 17 kHz ± 10%

Bandwidth selectivity
(shape factor or ratio of -60 dB to -3 dB bandwidths)
Manual sweep: < 4.0:1

Amplitude Specifications

Dynamic range
A/D overload level: > 2 dB (relative to the selected range)

Sensitivity
Sensitivity is the dynamic range limitation due to noise level (measured in a 1 Hz bandwidth) and internal crosstalk between the source and receiver: (75Ω with included BNC adapter or optional minimum loss pad)

Impedance	10 Hz - 30 kHz	30 kHz - 40 MHz	40 MHz - 150 MHz
50/75Ω	80 dB	100 dB	100 dB
50/75Ω typical	85 dB	110 dB	110 dB
1 MΩ	75 dB	100 dB	—

General spurious
Unless specifically mentioned in other spurious specifications, spurious responses are < -80 dBc for signal levels equal to range.

Residual responses
Residual responses are less than -110 dBm on the -20 dBm range.

Local oscillator feedthrough
Local oscillator feedthrough (appears as signal at dc) is >20 dB below range.

Ratio Amplitude and Phase Specifications

Display range
Amplitude reference level: -1000 to +1000 dB
Amplitude display resolution: 0.001 to 100 dB/div
Amplitude marker resolution: 0.01 dB
Amplitude display units: dB
Phase reference level: -72000 deg to +72000 deg
Phase display resolution: 0.001 deg to 7200 deg/div
Phase marker resolution: 0.01 deg
Phase display units: deg

Accuracy
Dynamic accuracy:

Level† [dB]	Accuracy‡ [dB]	Accuracy‡ [deg]	Typical †† [dB]	Typical †† [deg]
0 to -5 dB	<0.05	<1.0	0.05	0.2
-5 to -30	<0.10	<1.5	0.10	0.5
-30 to -40	<0.15	<2.0	0.10	1.0
-40 to -50	<0.35	<3.0	0.10	1.0
-50 to -60	<0.55	<4.0	0.15	1.5
-60 to -70	<0.75	<6.0	0.15	2.5
-70 to -80	—	—	0.30	—
-80 to -90	—	—	0.30	—
-90 to -100	—	—	0.45	—
-100 to -110	—	—	0.75	—
-110 to -120	—	—	4.00	—

Specified for frequencies >200 kHz.
† Relative to the specified range.
‡ At stable temperature following a 2 hour warm-up, and within 5 minutes of normalization.
†† Typical within one minute of normalization.

Note: Drift due to changes in ambient temperature is less than ± 0.2 dB/°C and ± 2 °/°C. Time and temperature errors are periodically compensated for, with calibration intervals between 5 and 20 minutes. Calibration will not interrupt the current measurement.

Group Delay Specifications

(Group delay is not available with log sweep)

Group delay reference level: 0 s to ± 10 s
Group delay display resolution: 1 ps/div to 1 s/div
Group delay marker resolution: 0.01 ns
Group delay display units: seconds

Aperture frequency: 0.5% to 16% of span in 2x steps

Group delay accuracy:
Group delay accuracy = dynamic phase accuracy/(360*aperture frequency) ± 1 ns.

Sweep Characteristics

Trigger
(characteristic only)
HP-IB, internal free run, or external triggering is available for linear sweep. Trigger arming is manual or automatic.

Trigger latency (uncertainty between the trigger input and internal trigger identification):
Zero span and manual sweep: 16 μs (for 17, 9.1, and 4.6 kHz, increasing by factor of 2 for each lower RBW)
Linear and log sweep: 80 μs (for 17, 9.1, and 4.6 kHz, increasing by factor of 2 for each lower RBW)

Trigger delay (HP-IB or external trigger only): 0 ms to the maximum gate length indicated for gated sweep. (See the gate length and trigger delay table in the gated sweep characteristics.)

Linear sweep
Sweep time is uncoupled from the span and resolution bandwidth.

Log sweep
Log sweep uses a linear approximation to perform a log frequency sweep. Resolution bandwidths are selected automatically or manually.

Manual sweep
Measurements of data between display points use reference data that is the interpolated reference value obtained from the two adjacent display points. Display points (N) are at frequencies = start frequency + span/400 × N.

Gated sweep
(with option 1D6)(characteristic only)
Gating is available only with linear frequency sweep or manual frequency selected.

Gate length and trigger delay:

RBW [Hz]	Gate length minimum [ms]	Gate length maximum [ms]	Edge trigger default delay † [ms]
17000	0.08	131	0.13
9100	0.08	131	0.2
4600	0.08	131	0.38
2300	0.16	131	0.76
1200	0.32	131	1.5
580	0.64	131	3.1
290	1.28	665	6.25
150	2.56	1,311	12.5
73	5.12	2,621	25
36	10.24	5,243	50
18	20.48	10,486	100
9.1	40.96	20,972	200
4.5	81.92	41,861	400
2.3	163.84	83,886	800
1.1	327.68	167,772	1600

† Filter settling time required to achieve accurate noise and amplitude measurements. Delay range is from 0 ms to the maximum gate length indicated. Level trigger default delay is approximately 20% larger than the edge trigger default delay.

Edge and level trigger latency (uncertainty between the gate trigger input and internal trigger identification) is equal to the minimum gate length indicated.

General Characteristics

Note: All specifications apply from 10 Hz to 150 MHz and include 30 minute warm-up from ambient conditions unless otherwise noted. Supplemental characteristics (identified as characteristic only) are non-warranted functional and feature information.

Safety and environmental
Safety standards: CSA certified for Electronic Test and Measurement Equipment per CSA 22.2, no. 231

This product is designed for compliance to: UL1244, 2nd Edition and IEC348, 2nd Edition, 1978.

EMI/RFI standards: FTZ527 - Germany

Acoustics: LpA <70 dB

Temperature:
Operating: 5 ° to 50 °C
Storage (no disk in drive): -20 ° to 60 °C

Humidity, non-condensing:
Operating: 8% to 80% at 30 °C
Storage (no disk in drive): 5% to 95%

Altitude:
Operating: 2150 m (7,000 ft)
Storage: 4570 m (15,000 ft)

Calibration Interval: 1 year

Warm-up Time: 30 minutes

Power Requirements:
115 VAC operation: 90 - 132 Vrms, 47 - 440 Hz
230 VAC operation: 198 - 264 Vrms, 47 - 66 Hz
Maximum power dissipation: 450 VA

Weight:
Net: 28 kg (61 lbs)
Shipping: 38 kg (81 lbs)

Dimensions:
Height: 222 mm (8.75 in)
Width: 425.5 mm (16.75 in)
Depth: 630 mm (24.8 in)

Trigger/gate
(characteristic only)
Trigger/gate input:
Triggers on positive or negative TTL transition or contact closure or release from ground. For gated sweep (option 1D6) polarity is selectable for TTL edge or level.

Trigger/gate output: Produces a negative TTL transition at the internal trigger identification. For gated sweep (option 1D6) produces a high TTL level during the active gate window. Fanout is 3 TTL LS loads.

Reference
(characteristic only)
Reference output: 10 MHz at +3 dBm (nominal) 50Ω

External reference input: 1 MHz, 2 MHz, 5 MHz, or 10 MHz between -5 dBm and +10 dBm into 50Ω (nominal)

High stability reference oven output (option 1D5): 10 MHz at +10 dBm into 50Ω

Display
(characteristic only)
Number of horizontal axis points: 401
Formats: single, upper/lower, front/back, setup state
Display blanking: annotation, full

Frequency axis mirror and frequency and amplitude annotation correction for use with external down-converters and receivers.

Trace math
(characteristic only)
Operators: +, -, *, /, SQRT, CONJ
Operands: input, network function, data registers, constants, other functions, SQRT(NBW), $j\omega$

Trace math can be used to correct the data on each measurement. Uses include user units correction and normalizations. Noise data is automatically referred to a 1 Hz bandwidth by displaying a function defined as SPECT/SQRT(NBW) or to any desired bandwidth by displaying a function defined as (SPECT/SQRT(NBW))*SQRT(K1), where K1 is set to the desired bandwidth. SQRT(NBW) is a trace math argument that automatically uses the equivalent noise bandwidth of the current resolution bandwidth filter.

Corrected data for use with divider probes can be displayed by displaying a function defined as SPECT*K1, where K1 is set to the probe division ratio.

External keyboard
(characteristic only)
Compatible with PC-style 101 key keyboard model number HP C1405A and HP Keyboard cable part number 5081-2249 (DIN connector).

Interfaces
Active probe power: +15 Vdc, -12.6 Vdc; 150 mA maximum, suitable for HP probes

HP-IB:
HP-IB implementation of IEEE Std 488.1 and 488.2
SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C12, E2

Benchmarks (characteristic only):
Binary trace output: 120 ms/trace typical

Peripherals
HP-IB graphics printers (raster output only)
HP-IB plotters using HP-GL

Memory and data storage
(characteristic only)
Standard internal memory:
Non-volatile RAM: 64 Kbyte
Volatile RAM: 1 Mbyte (partitionable between HP Instrument BASIC program space and RAM disk)

Optional memory:
Volatile RAM Option 1C1: additional 2 Mbyte RAM

Disk drive: (Only internal disk drive supported).
The HP 3589A's internal disk drive can format only double-sided, double-density disks (720 Kbyte). It can also read and write single-sided disks that were formatted in a double-sided drive. It does not read, write or format high density (1.44 Mbyte) disks.

Benchmarks (characteristic only):
Trace memory size: 2850 bytes
State memory size: 3100 bytes

Standard data format utilities
(characteristic only)
Included on two 3 1/2-inch high-density (1.44 Mbyte) and two 5 1/4-inch high-density (1.2 Mbyte) floppy disks. The utilities run in MS-DOS 2.1 or greater on an IBM PC (AT or higher) or compatible. The utilities include LIF to DOS format conversions, conversion to standard data format (SDF), displaying data and instrument state information, and utilities for conversion to PC-MATLAB, MATRIXx, data set 58, and ASCII format.

HP 35689A/B Specifications

Note: All specifications apply from 100 kHz to 150 MHz and include 30 minute warm-up from ambient conditions unless otherwise noted. Typical performance is applicable over ± 5 °C from the temperature during the most recent reference measurement and is not warranted. All specifications apply without bias signals. Degrees are specified as deviation from linear phase. All ratio measurements require a valid reference measurement be taken.

Frequency range: 100 kHz to 150 MHz

Test port impedance:
HP 35689A: 50 Ω
HP 35689B: 75 Ω

Directivity: >40 dB

Frequency response:
Transmission (S_{21}, S_{12}): ± 1 dB, ± 5 deg
Reflection (S_{11}, S_{22}): ± 1 dB, ± 5 deg

Port match:
Return loss input/output port: > 20 dB
Equivalent test port (1, 2) match:
HP 35689A: 26 dB
HP 35689B: 24 dB

Reference path match:
Magnitude: typically ± 0.5 dB
Phase: typically ± 5 deg

Test port isolation: > 90 dB

Insertion loss:
RF input to test port 1 or 2:
HP 35689A: typically 13 dB
HP 35689B: typically 19 dB
RF input to output:
HP 35689A: typically 19 dB
HP 35689B: typically 31 dB

Test port reciprocity:
Transmission (S_{21}, S_{12}): typically ± 0.5 dB, ± 5 deg
Reflection (S_{11}, S_{22}): typically ± 0.5 dB, ± 5 deg

RF input maximum operating level: +25 dBm or 30 Vdc

RF input damage level: +27 dBm or ± 30 Vdc

Port 1 or 2 damage level: +27 dBm or ± 30 Vdc

DC bias range:
Typically ± 30 Vdc and ± 20 mA with some degradation of RF specifications; 200 mA damage level.

Spectrum port:
The spectrum port is provided as a convenient input when the HP 3589A is connected to the HP 35689A/B. For specified HP 3589A measurement performance, direct connection to the HP 3589A input connector is required.

Spectrum port damage level:
HP 35689A: See HP 3589A specifications
HP 35689B: Add 6 dB to HP 3589A specifications

Spectrum port insertion loss:
HP 35689A: <0.5 dB typical
HP 35689B: 5.7 dB typical (due to included minimum loss pad)

Programming: The HP 35689A/B are completely controlled through the HP 3589A using the HP 3589A interconnecting cable.

Power:
110/120 VAC operation:
90 - 132 Vrms, 47 - 440 Hz
220/240 VAC operation: 198 - 264 Vrms, 47 - 66 Hz
Maximum power dissipation: 70 VA

Weight:
Net: 7.8 kg (17 lb)
Shipping: 11.5 kg (25 lb)

Dimensions:
Height: 90 mm (3.5 in)
Width: 426 mm (16.75 in)
Depth: 584 mm (22.75 in)

Accessories included:
2 ea 190 mm (7.5 in) 50Ω cables with Type-N male connectors for connection to the HP 3589A (HP P/N 8120-4387)

1 ea Test set interconnect cable to HP 3589A
(HP P/N 35689-61612)

1 ea power cord

2

Preparing the HP 3589A and HP 35689A/B for Use

How to Use This Chapter

This chapter contains power requirements and operating environment information needed to install the HP 3589A Spectrum/Network Analyzer and the HP 35689A/B S-Parameter Test Set. Also included in this chapter are instructions for connecting the test set and keyboard to the analyzer, cleaning the screen, and information on storage and shipment.

Incoming Inspection

The HP 3589A Spectrum/Network Analyzer and HP 35689A/B S-Parameter Test Set were carefully inspected both mechanically and electrically before shipment. The instrument should be free of marks or scratches and, it should meet its published specifications upon receipt. For a list of the accessories shiped with each instrument see "Accessories" in chapter 1.

Inspect the instrument for physical damage incurred in transit. If the instrument was damaged in transit, save all packing materials, file a claim with the carrier, and call your Hewlett-Packard sales and service office.

Warning

If the instrument is mechanically damaged, the integrity of the protective earth ground may be interrupted. Do not connect the instrument to power if it is damaged.

Incoming Tests

Finish incoming inspection by testing the electrical performance of the instrument using the operation verification or performance tests in chapter 3, "Verifying Specifications." The performance tests verify that the instrument meets its performance specifications. The operation verification tests are a subset of the performance tests and verify the basic operating integrity of the instrument.

HP 3589A Power Requirements

The HP 3589A Spectrum/Network Analyzer can operate from a single-phase ac power source supplying voltages as shown in table 2-1. With all options installed, the analyzer's power consumption is less than 450 VA.

The line-voltage selector switch is set at the factory to match the most commonly used line voltage of the country of destination; the appropriate fuse is also installed. To check or change either the line-voltage selector switch or the fuse, see figure 2-1, table 2-1, and the following procedures.

Caution

Before applying ac line power to the HP 3589A Spectrum/Network Analyzer, ensure that the line-voltage selector switch (on the rear panel) is set for the proper line voltage and the correct line fuse is installed in the fuse holder.

Warning

Only a qualified service person, aware of the hazards involved, should measure the line voltage.

Table 2-1. Analyzer Line Voltage and Fuse Selection

AC Line Voltage		Selector Switch	Fuse	
Range	Frequency		HP Part Number	Type
90-132 Vrms	47-440	115	2110-0056	6A 250V Fast Acting
198-264 Vrms	47-66	230	2110-0003	3A 250V Fast Acting

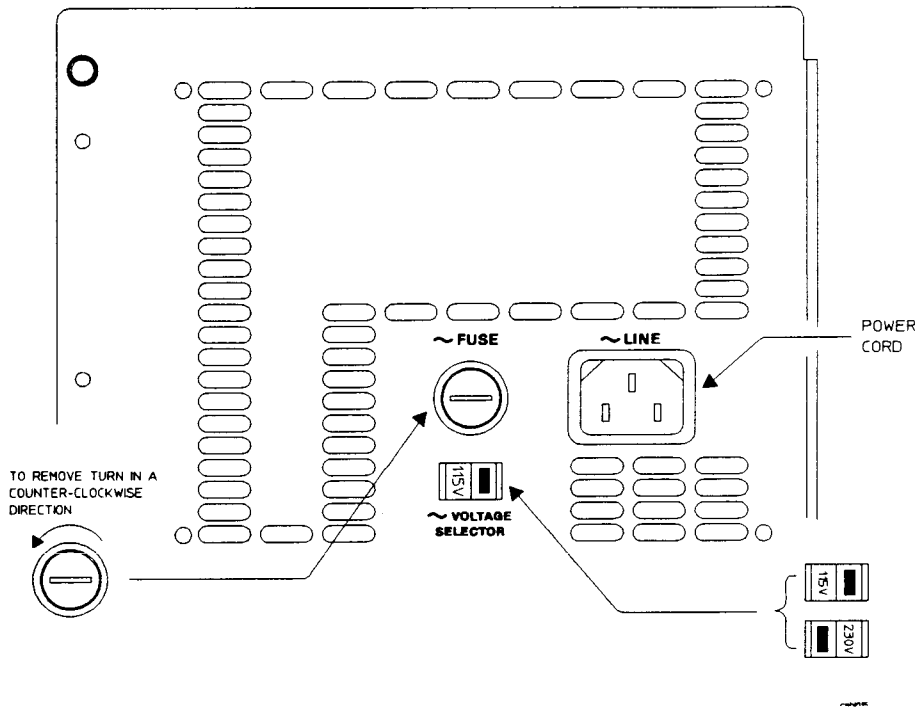


Figure 2-1. Analyzer Voltage Selection and Fuse Replacement

To change the line voltage selector switch:

1. Unplug the power cord from the analyzer.
2. Slide the line voltage selector switch (see figure 2-1) to the proper voltage (see table 2-1) and install the proper fuse for the voltage selected.

To change the fuse:

1. Unplug the power cord from the analyzer.
2. Using a coin or screw driver, turn the fuse holder cap counter-clockwise and remove when the fuse cap is free from the housing (see figure 2-1).
3. Pull the fuse from the fuse holder cap.
4. To reinstall, select the proper fuse (see table 2-1) and place in the fuse holder cap. Place the fuse holder cap in the housing and turn clockwise while pressing in.

HP 35689A/B Power Requirements

The HP 35689A/B S-Parameter Test Set can operate from a single-phase ac power source supplying voltages as shown in table 2-2. The test set's power consumption is less than 70 VA.

The line-voltage selector switch is set at the factory to match the most commonly used line voltage of the country of destination; the appropriate fuse is also installed. To check or change either the line-voltage selector switch or the fuse, see figure 2-2, table 2-2, and the following procedures.

Caution

Before applying ac line power to the HP 35689A/B S-Parameter Test Set, ensure that the line-voltage selector switch (on the rear panel) is set for the proper line voltage and the correct line fuse is installed in the fuse holder.

Warning

Only a qualified service person, aware of the hazards involved, should measure the line voltage.

Table 2-2. Test Set Line Voltage and Fuse Selection

AC Line Voltage		Selector Switch	Fuse	
Range	Frequency		HP Part Number	Type
90-132 Vrms	47-440	100/120	2110-0001	1A (normal blow) 250 VAC
198-264 Vrms	47-66	220/240	2110-0012	500 mA (normal blow) 250 VAC

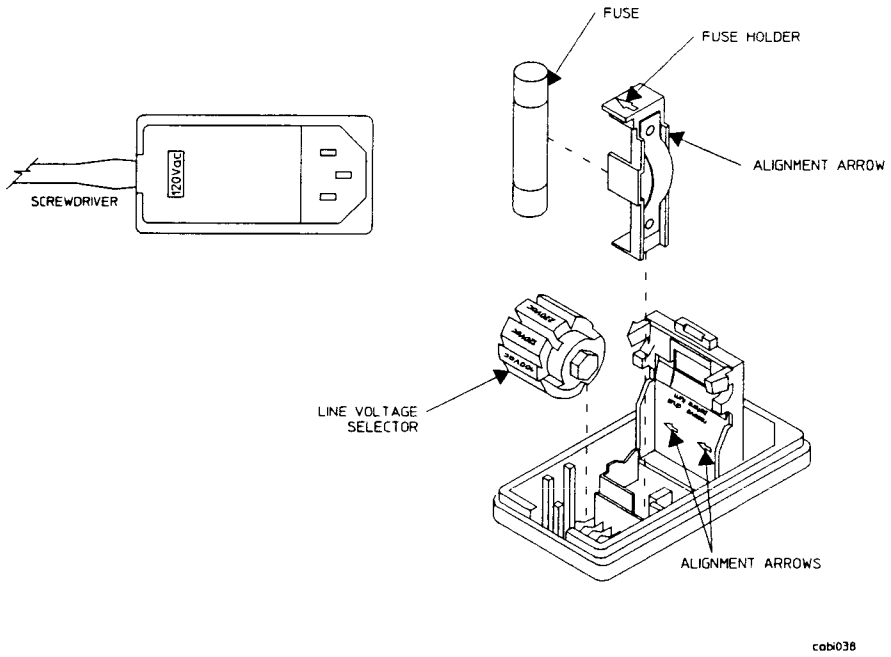


Figure 2-2. Test Set Voltage Selection and Fuse Replacement

To change the line voltage selector switch:

1. Unplug the power cord from the test set.
2. Using a small screw driver, pry open the power selector cover (see figure 2-2).
3. Remove the cylindrical line voltage selector.

Caution Do not rotate the cylindrical line voltage selector without first removing from the power selector. The selector will be damaged if it is rotated while installed.

---

4. Position the cylindrical line voltage selector so the required voltage (see table 2-1) will be facing out of the power selector, then reinstall.
5. Close the power selector by pushing firmly on the black cover.
6. Check that the correct line voltage appears through the power selector cover.
7. Verify that the fuse has the correct rating for the voltage selected (ref. table 2-2). Use the next set of instructions to change the fuse.

To change the fuse:

1. Unplug the power cord from the test set.
2. Using a small screw driver, pry open the power selector cover (see figure 2-2).
3. Pull the white fuse holder out of the power selector and remove the fuse from the fuse holder.
4. To reinstall, select the proper fuse (see table 2-2), and place in the fuse holder. Align the white arrow on top of the fuse holder with the white arrow on the power selector cover. All three arrows should point in the same direction. Install the fuse holder in the top slot. Push the fuse holder into the power selector.
5. Close the power selector by pushing firmly on the black cover.
6. As a safety precaution, check that the correct line voltage appears through the window in the power selector cover.

Power Cable and Grounding Requirements

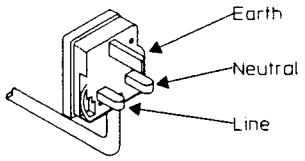
On the analyzer's HP-IB connector, pin 12 and pins 18 through 24 are tied to earth ground and the HP-IB cable shield. The instrument's frame, chassis, covers, all exposed metal surfaces including the connectors' outer shell are connected to protective earth ground.

Warning  **DO NOT interrupt the protective earth ground or "float" the instrument. This action could expose the operator to potentially hazardous voltages.**

The instrument is equipped with a three-conductor power cord that grounds the instrument when plugged into an appropriate receptacle. The type of power cable plug shipped with each instrument depends on the country of destination. See figure 2-3 for the available power cables and plug configurations.

Warning  **The power cable plug must be inserted into an outlet provided with a protective earth terminal. Defeating the protection of the grounded instrument cabinet can subject the operator to lethal voltages.**

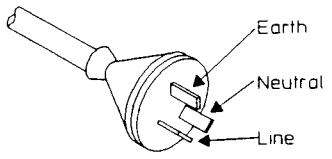
United Kingdom
Option 900



PLUG*: BS 1363A
CABLE*: HP 8120-1351

220V-5A
OPERATION

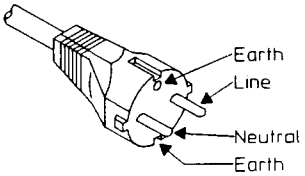
Australia/New Zealand
Option 901



PLUG*: NZSS 198/AS C112
CABLE*: HP 8120-1369

220V-6A
OPERATION

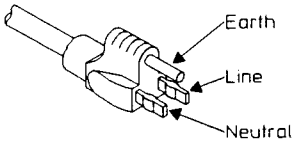
Continental Europe
Option 902



PLUG*: CEE7-V11
CABLE*: HP 8120-1689

220V-6A
OPERATION

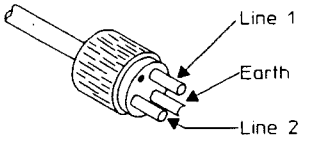
North America
Option 903



PLUG*: NEMA 5-15P
CABLE*: HP 8120-1378

125V-10A**
OPERATION

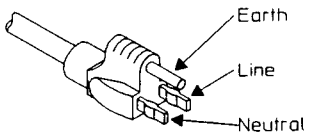
North America
Option 904



PLUG*: NEMA-G-15P
CABLE*: HP 8120-0698

250V-5A**
OPERATION

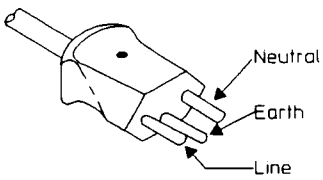
Japan
Option 918



PLUG*: MITI 41-9692
CABLE*: HP 8120-4753

125V-12A
OPERATION

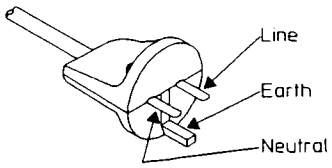
Switzerland
Option 906



PLUG*: SEV 1011.1959-24507
TYPE 12
CABLE*: HP 8120-2104

220V-6A
OPERATION

Denmark
Option 912



PLUG*: DHCR 107
CABLE*: HP 8120-2956

220V-6A
OPERATION

Figure 2-3. Power Cables

Operating Environment

The operating and storage environment specifications for the instrument are listed in chapter 1, "Introducing the HP 3589A and HP 35689A/B."

Warning  **To prevent potential fire or shock hazard, do not expose the instrument to rain or other excessive moisture.**

Protect the instrument from moisture and temperatures or temperature changes that cause condensation within the instrument.

Caution  Use of the HP 3589A Spectrum/Network Analyzer in an environment containing dirt, dust, or corrosive substances will drastically reduce the life of the disk drive and the flexible disks. The disks should be stored in a dry, static-free environment.

Instrument Cooling

Cooling air enters the HP 3589A Spectrum/Network Analyzer through both sides and exhausts through the rear panel. Install the analyzer to allow free circulation of cooling air.

HP-IB System Interface Connections

The HP 3589A Spectrum/Network Analyzer is compatible with the Hewlett-Packard Interface Bus (HP-IB). The HP-IB is Hewlett-Packard's implementation of IEEE Standard 488.2. The analyzer is connected to the HP-IB by connecting an HP-IB interface cable to the connector located on the rear panel. Total allowable transmission path length is 2 meters times the number of devices or 20 meters, whichever is less. Operating distances can be extended using an HP-IB Extender.

For additional HP-IB programming information, see the *HP 3589A HP-IB Programmer's Reference.*

Caution

The analyzer contains metric threaded HP-IB cable mounting studs as opposed to English threads. Use only metric threaded HP-IB cable lockscrews to secure the cable to the analyzer. Metric threaded fasteners are black, while English threaded fasteners are silver.

Installation

The HP 3589A Spectrum/Network Analyzer and HP 35689A/B S-Parameter Test Set are shipped with plastic feet in place, ready for use as portable bench instruments. The plastic feet are shaped to make full-width modular instruments self-align when they are stacked. To install the analyzer in an equipment cabinet, follow the instructions shipped with its rack mount kit, HP part number 35660-86010. To install the test set in an equipment cabinet, follow the instructions shipped with its rack mount kit, HP part number 5062-3975.

Connecting an External Frequency Reference

The analyzer may be connected to an external 1, 2, 5, or 10 MHz frequency reference. The frequency reference's amplitude must be greater than –5 dBm and less than +10 dBm. The analyzer's frequency reference input is labeled EXT REF IN and is located on the analyzer's rear panel. If EXT REF IN is not connected to a frequency reference, the analyzer uses its internal 10 MHz reference. To connect an external frequency reference to the analyzer, connect the frequency reference to EXT REF IN using a BNC cable.

Connecting the Optional High Stability Frequency Reference

Analyzers with the optional high stability frequency reference have a BNC connector on the rear panel labeled OVEN REF OUT. If OVEN REF OUT is not connected to EXT REF IN, the analyzer uses its internal 10 MHz reference. To connect the high stability frequency reference to the analyzer, connect OVEN REF OUT to EXT REF IN using the supplied coax BNC-to-coax BNC connector (HP part number 1250-1499). See figure 2-4.

Note

The high stability frequency reference requires approximately fifteen minutes to warm up. During this warm-up period, the output of the high stability frequency reference is turned off and the analyzer uses its internal 10 MHz reference.

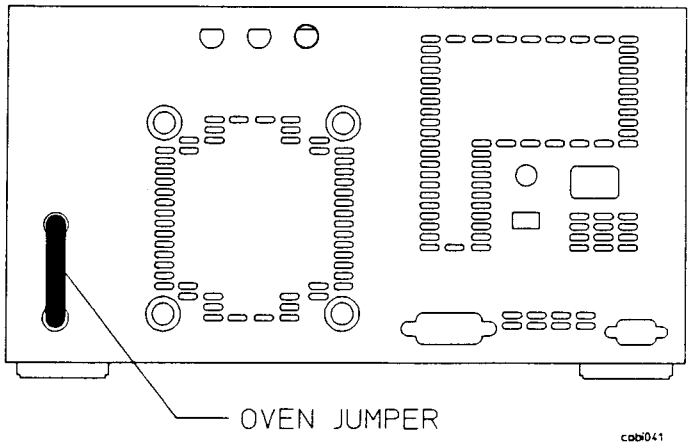


Figure 2-4. Connecting the High Stability Frequency Reference

Connecting the Optional Keyboard

To connect the PC Style Keyboard to the HP 3589A Spectrum/Network Analyzer do the following:

1. Set the analyzer's power switch to STANDBY (⏻).
2. Connect the round plug on the keyboard cable to the KEYBOARD connector on the analyzer's front panel. Make sure to align the plug with the connector pins (see figure 2-5) .
3. Connect the other end of the keyboard cable to the keyboard.

Caution

Do not connect or disconnect the keyboard cable with the line power turned ON (I). Connecting or disconnecting the keyboard while power is applied may damage the keyboard or the analyzer.

In addition to the U.S. English keyboard, the HP 3589A Spectrum/Network Analyzer supports U.K. English, German, French, Italian, Spanish, and Swedish. Use only the Hewlett-Packard approved keyboard for this product. Hewlett-Packard does not warrant damage or performance loss caused by a non-approved keyboard. See table 1-3 for part numbers of approved Hewlett-Packard keyboards.

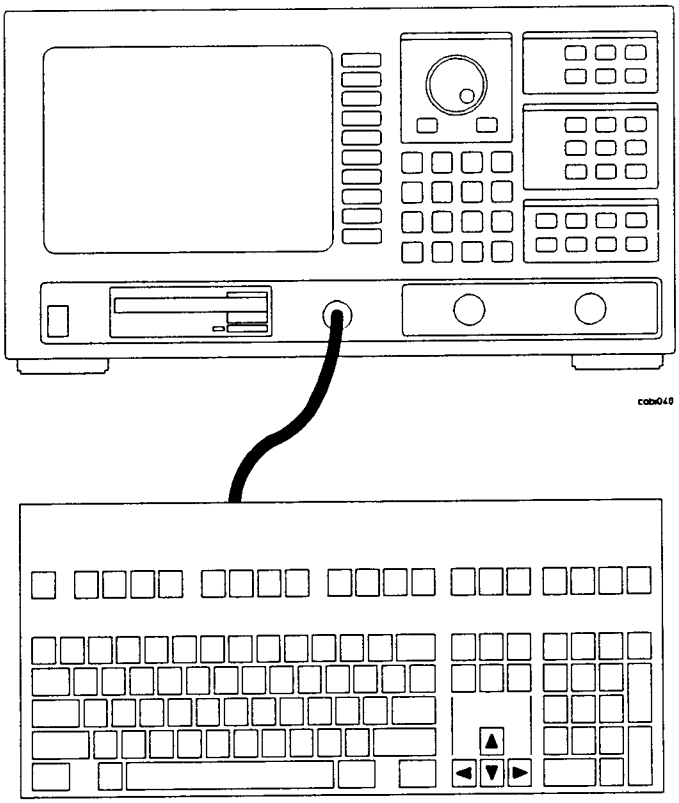


Figure 2-5. Connecting the Keyboard

4. To configure your analyzer for a keyboard other than U.S. English, press [**Special Fctn**], [NON-VOL SETUP], [KEYBOARD SETUP]. Then press the appropriate softkey to select the language.

Note

Configuring your analyzer to use a different keyboard only ensures that the analyzer recognizes the proper keys for that particular keyboard. Configuring your analyzer to use another keyboard *does not* localize the on-screen annotation or the analyzer's online HELP facility.

The keyboard remains active *even when the analyzer is not in alpha entry mode*. This means that you can operate the analyzer using the external keyboard rather than the front panel. Pressing the appropriate keyboard key does the same thing as pressing a hardkey or a softkey on the analyzer's front panel.

Connecting the S-Parameter Test Set

To connect the HP 35689A/B S-Parameter Test Set to the HP 3589A Spectrum/Network Analyzer do the following:

1. Set the power switch on both instruments to STANDBY (⏻).
2. Place the analyzer on top of the test set (see figure 2-6).
3. Using the interconnect cable, connect PORT 1 (analyzer's rear panel) to 3589 INTERCONNECT (test set's rear panel).

Caution 

Do not connect or disconnect the interconnect cable with the line power turned ON (|). Connecting or disconnecting the analyzer from the test set while power is applied may damage the analyzer or test set.

---

4. Using one of the RF connecting cables, connect OUTPUT (test set's front panel) to INPUT (analyzer's front panel).
5. Using the other RF connecting cable, connect INPUT (test set's front panel) to SOURCE (analyzer's front panel).

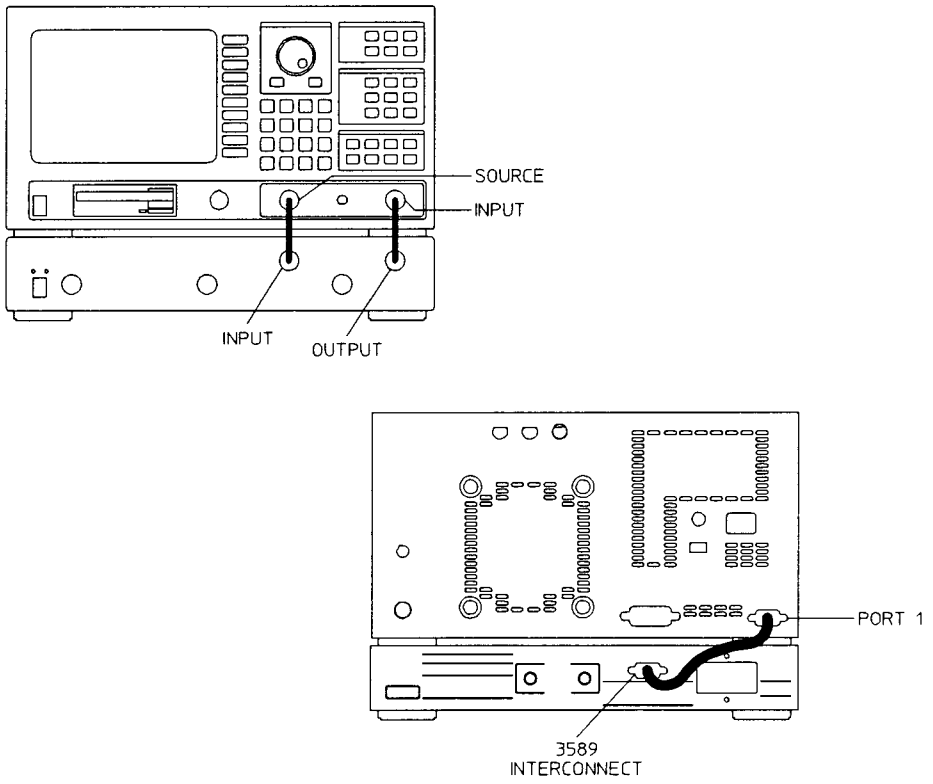


Figure 2-6. S-Parameter Test Set Connections

Turning the Instrument On

First, apply proper line power to the instrument, then press the rocker-switch in the lower left-hand corner of the instrument to ON (I). The analyzer requires about 35 seconds to test memory and self-calibrate.

For measurement specific information or other operating information, see the *HP 3589A Operator's Guide* or other appropriate manual. See the documentation map included with the analyzer for information on which document contains the information you need.

Screen (CRT) Cleaning

The HP 3589A Spectrum/Network Analyzer's screen is covered with a plastic diffuser screen (this is not removable by the operator). Under normal operating conditions, the only cleaning required will be an occasional dusting. However, if a foreign material adheres itself to the screen, set the power switch to STANDBY (⏻), remove the power cord, dampen a soft, lint-free cloth with a mild detergent mixed in water, and carefully wipe the screen.

Caution

Do not apply any water mixture directly to the screen or allow moisture to go behind the front panel. Moisture behind the front panel will severely damage the instrument.

To prevent damage to the screen, do not use cleaning solutions other than the above.

Need Assistance?

If you need assistance, contact your nearest Hewlett-Packard Sales and Service Office listed in the HP Catalog, or contact your nearest regional office listed at the back of this guide. If you are contacting Hewlett-Packard about a problem with your instrument, please provide the following information:

- Model number:
- Serial number:†
- Options:
- Firmware version:‡
- Date the problem was first encountered:
- Circumstances in which the problem was encountered:
- Can you reproduce the problem?
- What effect does this problem have on you?

† Press [**Special Fctn**], [NON-VOL SETUP], [SERIAL NUMBER] to display this information for the HP 3589A Spectrum/Network Analyzer.

‡ Press [**Special Fctn**], [NON-VOL SETUP], [VERSION] to display this information for the HP 3589A Spectrum/Network Analyzer.

Storage and Shipment

Storage

Store the instrument in a clean, dry, and static free environment. For other requirements, see environmental specifications in chapter 1, "Introducing the HP 3589A and HP 35689A/B."

Shipment

Caution

When transporting the HP 3589A Spectrum/Network Analyzer, insert the plastic disk protector, part number HP 5061-2819, into the disk drive to prevent damage.

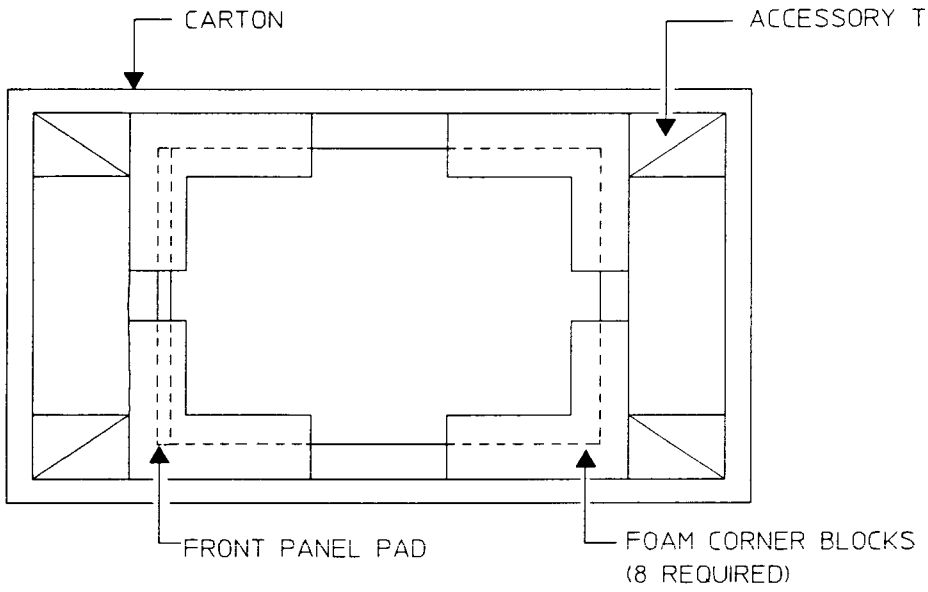


Figure 2-7. Repacking for Shipment

- Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices, see figure 2-7. If the instrument is being returned to Hewlett-Packard for service, attach a tag describing the type of service required, the return address, model number, and full serial number. Also, mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

- If it is necessary to package the instrument in a container other than original packaging, observe the following (use of other packaging is not recommended):

  - Protect the front panel with cardboard and wrap the instrument in heavy paper or anti-static plastic.

  - Use a double-wall carton made of at least 350-pound test material and cushion the instrument to prevent damage.

  - Identify the shipment as above and mark FRAGILE.

Caution

Do not use styrene pellets in any shape as packing material for the instrument. The pellets do not adequately cushion the instrument and do not prevent the instrument from shifting in the carton. In addition, the pellets create static electricity that can damage electronic components.

3

Verifying Specifications

How to Use This Chapter

This chapter tells you how to use the *HP 3589A Semiautomated Performance Test Disk* and the *HP 35689A/B Semiautomated Performance Test Disk.* These performance test disks contain programs that semiautomate the operation verification tests and performance tests for the HP 3589A Spectrum/Network Analyzer and the HP 35689A/B S-Parameter Test Set.

First review this chapter, then follow the directions in "Testing the HP 3589A" (starting on page 3-8) or "Testing the HP 35689A/B" (starting on page 3-45).

Safety Considerations

Although the HP 3589A Spectrum/Network Analyzer and HP 35689A/B S-Parameter Test Set are designed in accordance with international safety standards, this manual contains information, cautions, and warnings that must be followed to ensure safe operation and to keep the instrument in safe condition. The operation verification and performance test procedures must be performed by trained service personnel who are aware of the hazards involved (such as fire and electrical shock).

Warning

Any interruption of the protective (grounding) conductor inside or outside the instrument, or disconnection of the protective earth terminal can expose operators to potentially dangerous voltages.

Under no circumstances should an operator remove any covers, screws, shields or in any other way access the interior of the HP 3589A Spectrum/Network Analyzer or HP 35689A/B S-Parameter Test Set. There are no operator controls inside the instrument.

Overview

The *HP 3589A Semiautomated Performance Test Disk* contains a program (ITM_3589A) and four procedure files (OP_VERIFY, ALT_OPVER, PERFORMAN, and ALT_PERF) that are used to verify the performance of the HP 3589A Spectrum/Network Analyzer. ITM_3589A is the test manager program. OP_VERIFY and ALT_OPVER are the operation verification procedure files. PERFORMAN and ALT_PERF are the performance test procedure files. OP_VERIFY and PERFORMAN require a milliwatt power meter to do the amplitude accuracy and flatness test. ALT_OPVER and ALT_PERF are the alternate procedure files and do not require a milliwatt power meter.

The *HP 35689A/B Semiautomated Performance Test Disk* contains a program (ITM_35689) and four procedure files (A_OPVER, B_OPVER, A_PERF, and B_PERF) that are used to verify the performance of the HP 35689A/B S-Parameter Test Set. ITM_35689 is the test manager program. A_OPVER is the operation verification procedure file for the HP 35689A, and B_OPVER is the operation verification procedure file for the HP 35689B. A_PERF is the performance test procedure file for the HP 35689A, and B_PERF is the performance test procedure file for the HP 35689B.

The procedure files contain an ordered list of tests, and each test contains one or more measurements. Since the program reads the procedure files, the disk must remain in the disk drive during testing.

There are two types of keys on the HP 3589A Spectrum/Network Analyzer — hardkeys and softkeys.

- Hardkeys are front-panel buttons whose functions are always the same. Hardkeys have a label printed directly on the key itself. Throughout this guide, they are printed like this: [**Hardkey**]

- Softkeys are keys whose functions change with the analyzer's current menu selection. A softkey's function is indicated by a video label to the left of the key (on the edge of the analyzer's screen). Throughout this guide, softkeys are printed like this: [SOFTKEY]

- Some softkeys toggle through different settings. Toggle softkeys have a highlighted word in their label that changes with each press of the softkey. Throughout this guide, toggle softkeys are depicted as they appear after you press the softkey. For example, [AUTO CAL **ON** OFF] means to press [AUTO CAL ON OFF] until the word ON is highlighted.

If you do not have a keyboard connected to the analyzer, use the numeric key pad and the alpha keys when the program prompts you to type in information. See the analyzer's help text for a description of the alpha keys.

If a test fails, contact your local Hewlett-Packard sales and service office or have a qualified service technician see chapter 4, "Troubleshooting the HP 3589A and HP 35689A/B," in the *HP 3589A and HP 35689A/B Service Guide.*

Features of the Program

- The program can automatically create a printout similar to the test records at the back of this chapter.
- The program can beep when equipment connections need to be changed.
- The program can start the test sequence at any test in the operation verification or performance test list.
- The program can stop after each measurement or alternatively, only if a failure occurs.
- The program can be run in manual mode.

Test Duration

For the HP 3589A Spectrum/Network Analyzer, the operation verification tests require approximately 1 hour to complete and the performance tests require approximately 3 hours to complete in semiautomated mode.

For the HP 35689A/B S-Parameter Test Set, the operation verification tests require approximately 45 minutes to complete and the performance tests require approximately 1 hour to complete in semiautomated mode.

Caution 

Before applying line power to the instrument or testing its electrical performance, see chapter 2, "Preparing the HP 3589A and HP 35689A/B for Use."

Calibration Cycle

To verify that the HP 3589A Spectrum/Network Analyzer and HP 35689A/B S-Parameter Test Set are meeting their published specifications, do the performance tests every 12 months.

Recommended Test Equipment

The equipment needed for operation verification and performance tests is listed in table 1-5 , 1-6 and 1-7. Other equipment may be substituted for the recommended model if it meets or exceeds the listed critical specifications.

Also, if you want the test record to be automatically printed, you need an HP-IB printer. If you do not have an HP-IB printer you must record the results of each test in the test records located near the end of this chapter. These test records may be reproduced without written permission of Hewlett-Packard.

Note

If you want the printer to automatically leave top and bottom margins on every page, enable perforation skip mode (see your printer's manual for directions).

Program Controlled Test Equipment

This program automatically controls the following instruments using HP-IB commands. If you use a test instrument other than those shown here, the program prompts you to set the instrument state during testing.

Table 3-1. Program Controlled Test Equipment

Test Equipment	Recommended Model
Synthesizer	HP 3326A HP 3325A (alternate) HP 3325B (alternate)
Synthesizer/Level Generator	HP 3335A
Digital Multimeter	HP 3458A
Synthesized Signal Generator	HP 8663A HP 8662A (alternate)
Spectrum Analyzer	HP 8568B HP 8568A (alternate)
Power Meter	HP 438A HP 436A (alternate)

Measurement Uncertainty

A table starting on page 3-73 lists the measurement uncertainty and ratio for each performance test using the recommended test equipment. The ratios listed for the recommended test equipment meet the requirements of U.S. MIL-STD-45662A. The table also provides a place to record the measurement uncertainty and ratio for each performance test using equipment other than the recommended test equipment. The table may be reproduced without written permission of Hewlett-Packard.

Operation Verification and Performance Tests

The operation verification tests give a high confidence level (>90%) that the instrument is operating properly and within specifications. The operation verification tests are a subset of the performance tests. The operation verification tests should be used for incoming and after-repair inspections. The performance tests provide the highest level of confidence and are used to verify that the instrument conforms to its published specifications. Some repairs require a performance test to be done after the repair (see chapter 6, "Replacing Assemblies" in the *HP 3589A and HP 35689A/B Service Guide* for this information). The following table lists all the tests and shows which tests are included in each semiautomated procedure file.

Table 3-2. Tests Used in Semiautomated Procedure Files

HP 3589A Tests	PERFORMAN	ALT_PERF	OP_VERIFY	ALT_OPVER
Local Oscillator Feedthrough	YES	YES	YES	YES
Phase Noise	YES	YES	YES	YES
Residual Responses	YES	YES	YES	YES
Noise Level	YES	YES	YES	YES
Frequency Accuracy	YES	YES	YES	YES
Spurious Responses	YES	YES	YES	YES
Image Responses	YES	YES	YES	YES
Input Harmonic Distortion	YES	YES	YES	YES
Intermodulation Distortion	YES	YES	no	no
Source Response	YES	no	YES	no
Amplitude Accuracy and Flatness	YES	no	YES	no
Alt_Amp Accuracy and Flatness	no	YES	no	YES
Reference Level Accuracy	YES	YES	YES	YES
Dynamic Accuracy	YES	YES	no	no
Source Dynamic Accuracy	YES	YES	YES	YES
Input Return Loss	YES	YES	no	no
Source Return Loss	YES	YES	no	no
Source Harmonic Distortion	YES	YES	YES	YES
Source Spurious Responses	YES	YES	YES	YES
Source Noise	YES	YES	YES	YES
HP 35689A/B Tests	**PERFORMAN**		**OP_VERIFY**	
Directivity and Source Match	YES		YES	
Reflection	YES		YES	
Transmission	YES		YES	
Isolation	YES		no	
Return Loss	YES		no	

Specifications and Performance Tests

The following tables list specifications and the performance test or tests that verify each specification.

Table 3-3. HP 3589A Specifications and Performance Tests

Specification	Performance Test
General Specifications	
Frequency Specifications	
Frequency Accuracy	Frequency Accuracy
Stability	Phase Noise
Amplitude Specifications	
Input port	Input Return Loss
Source Specifications	
Amplitude specifications	Source Dynamic Accuracy
	Source Response
	Source Harmonic Distortion
	Source Spurious Responses
	Source Noise
	Source Return Loss
Spectrum Measurements	
Amplitude Specifications	
Dynamic range	Noise Level
Spurious responses	
General spurious	Spurious Responses
Harmonic distortion	Input Harmonic Distortion
Intermodulation distortion	Intermodulation Distortion
Residual responses	Residual Responses
	Image Responses
Local oscillator feedthrough	Local Oscillator Feedthrough
Full scale amplitude accuracy	Amplitude Accuracy and Flatness
	Alt_Amp Accuracy and Flatness
	Reference Level Accuracy
Network Measurements	
Ratio Amplitude and Phase Specifications	
Accuracy	Dynamic Accuracy

Table 3-4. HP 35689A/B Specifications and Performance Tests

Specification	Performance Test
Directivity	Directivity and Source Match
Frequency response	
Transmission	Transmission
Reflection	Reflection
Port match	
Return loss input/output port	Return Loss
Equivalent test port match	Directivity and Source Match
Test port isolation	Isolation

Testing the HP 3589A

To test the HP 3589A Spectrum/Network Analyzer, follow the directions in "How to Load the ITM_3589A Program" then continue with one of the following:

- "How to Run the ITM_3589A Program in Semiautomated Mode"
- "How to Run the ITM_3589A Program Without a Printer"
- "How to Run the ITM_3589A Program in Manual Mode"

How to Load the ITM_3589A Program

1. Set the HP 3589A Spectrum/Network Analyzer's power switch to STANDBY (⏻), then connect the analyzer, test instruments, and printer using HP-IB cables.

2. If you have the PC Style Keyboard, connect the keyboard to the analyzer using the keyboard cable (see "Connecting the Optional Keyboard" in chapter 2).

Caution

Do not connect or disconnect the keyboard cable with the line power turned ON (I). Connecting or disconnecting the keyboard while power is applied may damage the keyboard or the analyzer.

3. Insert the *HP 3589A Semiautomated Performance Test Disk* into the analyzer's disk drive, then set the power switch to ON (I).

4. After the analyzer finishes its power-up calibration routine, press the following keys:

   [**Local/HP-IB**]
   [SYSTEM CONTROLLR]
   [**Save/Recall**]
   [DEFAULT DISK]
   [INTERNAL DISK]
   [CANCEL/RETURN]
   [CATALOG **ON** OFF]

5. Using the marker knob, highlight the line that reads ITM_3589A.

6. Press the following keys:

   [RECALL MORE]
   [RECALL PROGRAM]
   [ENTER]

7. After the recall program is done, press the following keys:

   [**BASIC**]
   [RUN]

8. Now go to one of the following procedures to continue.

   "How to Run the ITM_3589A Program in Semiautomated Mode" (see page 3-10)
   "How to Run the ITM_3589A Program Without a Printer" (see page 3-13)
   "How to Run the ITM_3589A Program in Manual Mode" (see page 3-15)

How to Run the ITM_3589A Program in Semiautomated Mode

Note

You must have an HP-IB printer connected to your system to run the program in semiautomated mode. If you do not have a printer, see "How to Run the ITM_3589A Program Without a Printer" later in this chapter.

For information about the program's softkeys, see "Softkey Descriptions" starting on page 3-66.

1. Press the following keys and when the program prompts you, type in the information for the title page of the test record and press [ENTER]:
   [TITLE PAGE]
   [TEST FACILITY]
   [FACILITY ADDRESS]
   [TESTED BY]
   [REPORT NUMBER]
   [CUSTOMER]
   [MORE]
   [OPTIONS]
   [DATE]
   [TEMP]
   [HUMIDITY]
   [LINE FREQUENCY]
   [RETURN]
2. Press the following keys and when the program prompts you, type in the equipment configuration information.

Note

Use the following to determine HP-IB addresses:

100 × (interface select code) + (primary address)

The interface select code for the test equipment and printer is 7 (for example, if the primary address is 8, the HP-IB address is 708).

Note

When entering the calibration due date, only four characters are displayed on the screen. However, you can enter up to nine characters and they will be printed.

[EQUIP CONFIG]
[SIGNAL GEN]
[SYNTH]
[SYNTH/LVL GEN]
[ANALYZER]
[MORE]
[MULTIMETER]
[POWER METER]
[POWER SENSOR]
[DIR BRIDGE]
[STEP ATTEN]
[MORE]
[FREQ STD]
[mW-POWER METER]
[21 MHz FILTER]
[50 MHz FILTER]
[RETURN]

3. Press the following keys and type in the printer address when the program prompts you:

   [TEST CONFIG]
   [PRINTER ADDRESS]
   [PROCEDURE]
   [OP_VERIFY], [ALT_OPVER], [PERFORMAN] or [ALT_PERF]
   [STOP AFTER]
   [LIMIT FAILURE] or [NONE]
   [RETURN]

4. Press the following keys to start the test:

   [START TESTING]
   [START BEGINNING]

Note

When you select [START BEGINNING], the data is written to a file on the disk and printed only after all tests are done. When you select [START MIDDLE] or [ONE TEST], the data is printed immediately after each measurement.

5. Now follow the directions on the display.

Note

The directions on the display briefly tell you how to connect test equipment. For a description of each test and detailed illustrations of equipment setup, see "HP 3589A Test Descriptions and Equipment Setup" starting on page 3-17.

If you want to pause the program and return the HP 3589A Spectrum/Network Analyzer to front panel control, press [**BASIC**]. To continue the program, press [**BASIC**] [CONTINUE]. If you changed any instrument setup states, press [RESTART TEST] to ensure accurate measurement results.

How to Run the ITM_3589A Program Without a Printer

1. Write in the information needed on the title page of the "HP 3589A Performance Test Record" or the "HP 3589A Operation Verification Test Record" (located near the end of this chapter).

2. Press the following keys and when the program prompts you, type in the model number and HP-IB address:

Note

Use the following to determine HP-IB addresses:

100 × (interface select code) + (primary address)

The interface select code for the test equipment is 7 (for example, if the primary address is 8, the HP-IB address is 708).

[EQUIP CONFIG]
[SIGNAL GEN]
[SYNTH]
[SYNTH/LVL GEN]
[ANALYZER]
[MULTIMETER]
[POWER METER]
[MORE]
[STEP ATTEN]
[RETURN]

3. Press the following keys:

[TEST CONFIG]
[PROCEDURE]
[OP_VERIFY], [ALT_OPVER], [PERFORMAN] or [ALT_PERF]
[STOP AFTER]
[EACH MEASUREMENT]
[RETURN]

4. Press the following keys to start the test:

[START TESTING]
[START BEGINNING]

5. Now follow the directions on the display and record every measurement result in the "HP 3589A Performance Test Record" or the "HP 3589A Operation Verification Test Record."

Note

The directions on the display briefly tell you how to connect test equipment. For a description of each test and detailed illustrations of equipment setup, see "HP 3589A Test Descriptions and Equipment Setup" starting on page 3-17.

If you want to pause the program and return the HP 3589A Spectrum/Network Analyzer to front panel control, press [**BASIC**]. To continue the program, press [**BASIC**] [CONTINUE]. If you changed any instrument setup states, press [RESTART TEST] to ensure accurate measurement results.

How to Run the ITM_3589A Program in Manual Mode

Note

Use this procedure if you want to run the program in manual mode. You will be prompted to setup all test equipment and you can check the analyzer's setup state after each measurement.

1. Press the following keys and when the program prompts you, set all HP-IB addresses to 0:

   [EQUIP CONFIG]
   [SIGNAL GEN]
   [SYNTH]
   [SYNTH/LVL GEN]
   [ANALYZER]
   [MULTIMETER]
   [POWER METER]
   [MORE]
   [STEP ATTEN]
   [RETURN]

2. Press the following keys:

   [TEST CONFIG]
   [PROCEDURE]
   [OP_VERIFY], [ALT_OPVER], [PERFORMAN] or[ALT_PERF]
   [STOP AFTER]
   [EACH MEASUREMENT]
   [RETURN]

3. Press the following keys to start the test:

   [START TESTING]
   [START BEGINNING]

4. Now follow the directions on the display and after every measurement do the following:

   a. Record the measurement result in the "HP 3589A Performance Test Record" or the "HP 3589A Operation Verification Test Record" (located near the end of this chapter).

   b. If you want to view the analyzer's setup state, press [**Format**] [SETUP STATE]. To continue the program, press [**BASIC**] [CONTINUE].

Note

If you changed any instrument setup states, press [RESTART TEST] instead of [CONTINUE] to ensure accurate measurement results.

Note

The directions on the display briefly tell you how to connect test equipment. For a description of each test and detailed illustrations of equipment setup, see "HP 3589A Test Descriptions and Equipment Setup."

HP 3589A Test Descriptions and Equipment Setup

Local Oscillator Feedthrough

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its spurious responses specification for local oscillator (LO) feedthrough. In this test, the analyzer measures the LO feedthrough, which appears as a signal at 0 Hz. This test requires no external equipment.

Phase Noise

Operation Verification — Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its frequency stability specification for noise sidebands. In this test, the analyzer uses its internal 10 MHz calibration signal as a clean signal source for measuring phase noise. This test requires no external equipment.

Residual Responses

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its spurious responses specification for residual responses. In this test, the analyzer measures the residual responses of the power line frequency and its harmonics, the power supply switching frequency, the reference frequencies, and the oscillator harmonics.

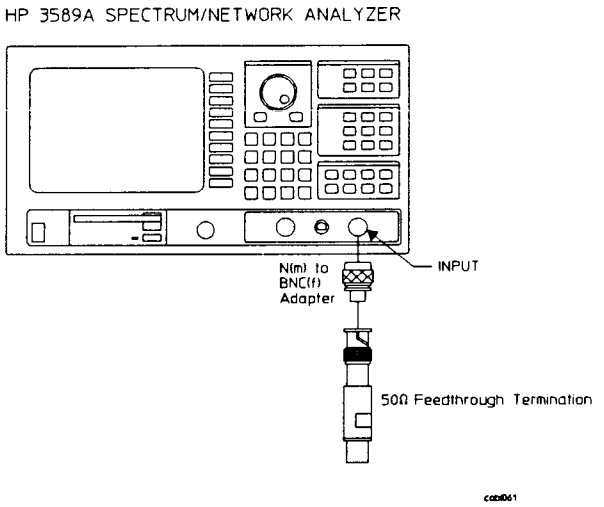


Figure 3-1. Residual Responses Test Setup

Noise Level

Operation Verification – Yes

For Operation Verification, this test checks fewer frequencies than the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its dynamic range specification for noise level. In this test, the analyzer's noise level marker function measures the noise level. The noise level is measured using the receiver's 50Ω input path, with low distortion mode on and off, and using the 1 MΩ input path.

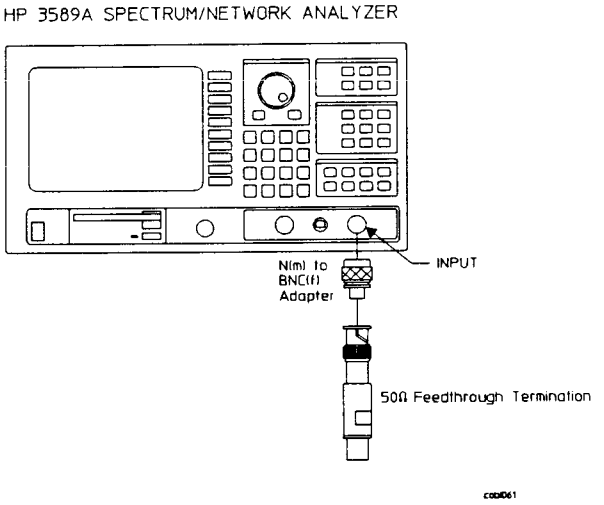


Figure 3-2. Noise Level Test Setup #1

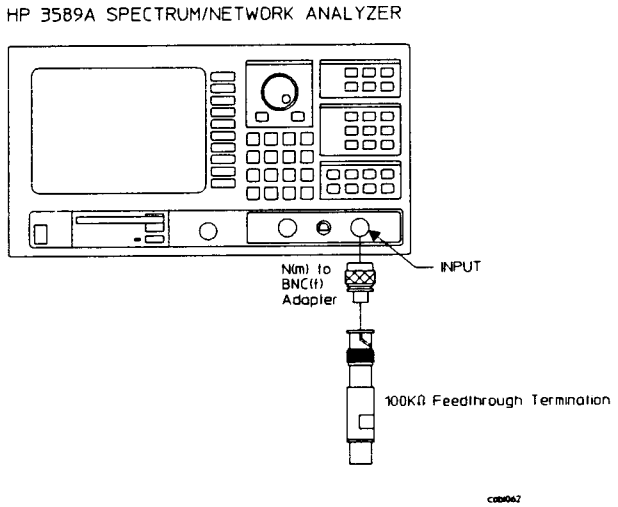


Figure 3-3. Noise Level Test Setup #2

Frequency Accuracy

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its frequency accuracy specification. In this test, the analyzer's counter function measures an accurate 100 MHz signal. The frequency limits are then calculated using the number of days since the last frequency reference adjustment.

Note

The HP 3589A Spectrum/Network Analyzer must be on for 48 hours before performing this test.

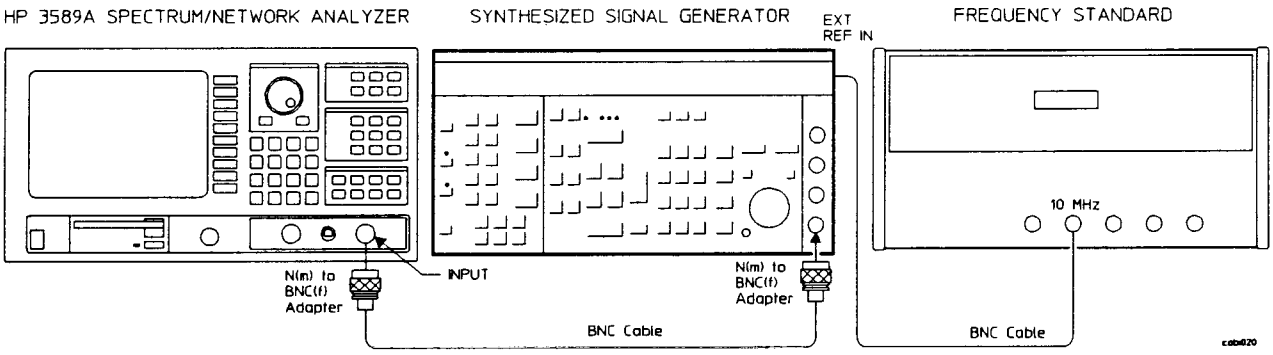


Figure 3-4. Frequency Accuracy Test Setup

Spurious Responses

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its general spurious responses specification. In this test, the analyzer measures spurious responses such as, API spurs, step loop spurs, sum loop spurs, and LO sideband spurs. The analyzer first measures a signal from the signal generator, establishing a reference level. Then, using its offset marker, the analyzer measures the spur.

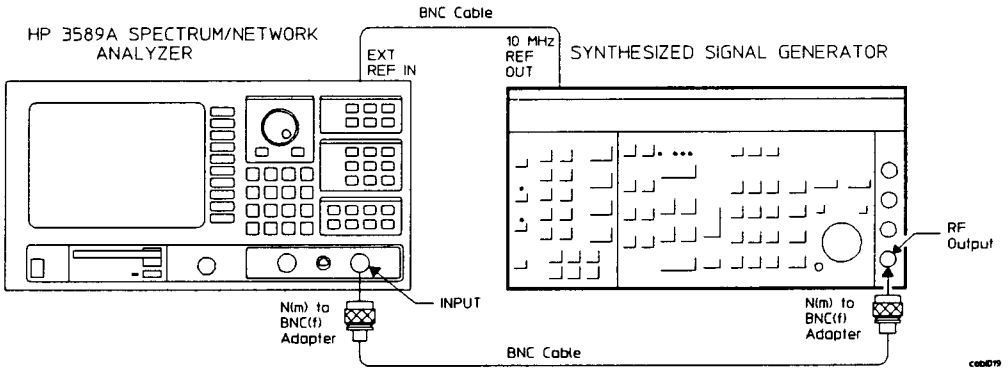


Figure 3-5. Spurious Responses Test Setup

Image Responses

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its spurious responses specification for image responses. In this test, the analyzer measures the IF image spurs. The analyzer first measures a signal from the signal generator, establishing a reference level. Then, using its offset marker, the analyzer measures the image spurs.

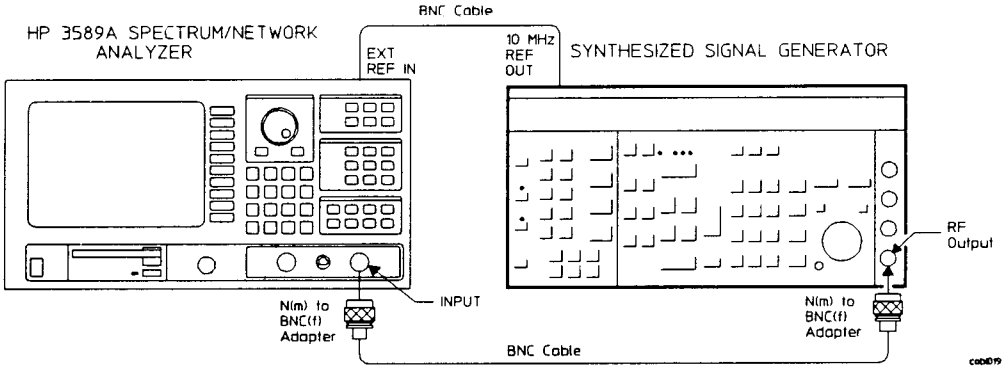


Figure 3-6. Image Responses Test Setup

Input Harmonic Distortion

Operation Verification – Yes

For Operation Verification, this test checks harmonic distortion using only the receiver's 50Ω input path with low distortion mode on.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its spurious responses specification for harmonic distortion. In this test, a low pass filter attenuates the harmonics of a signal from the synthesizer/level generator. The analyzer then measures the signal, establishing a reference level. Then, using its offset marker, the analyzer measures the second and third harmonics. Harmonic distortion is measured using the receiver's 50Ω input path, with low distortion mode on and off, and using the 1 MΩ input path.

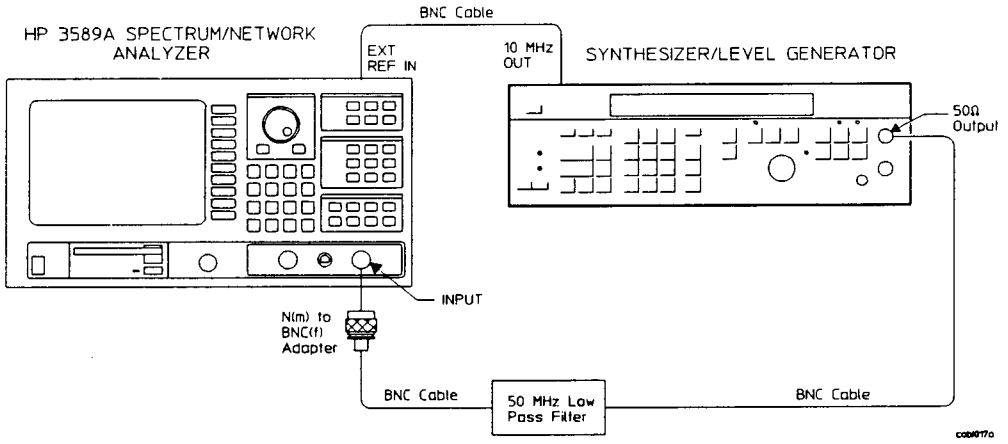


Figure 3-7. Input Harmonic Distortion Test Setup #1

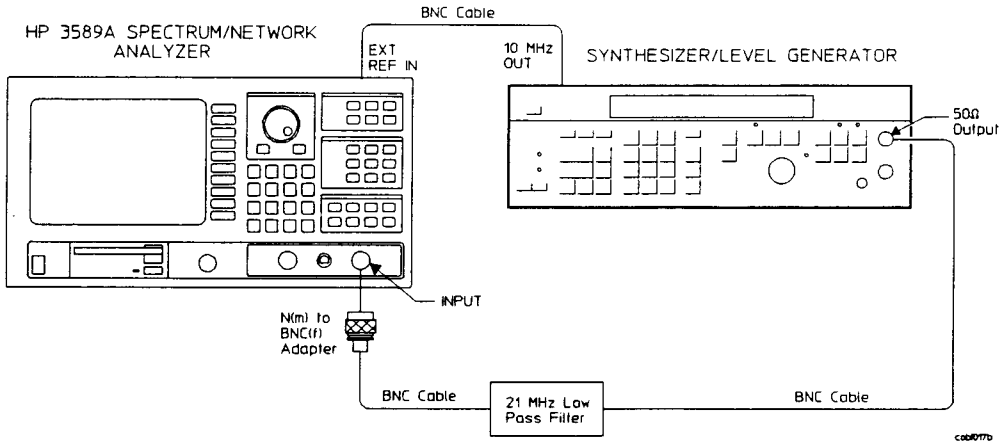


Figure 3-8. Input Harmonic Distortion Test Setup #2

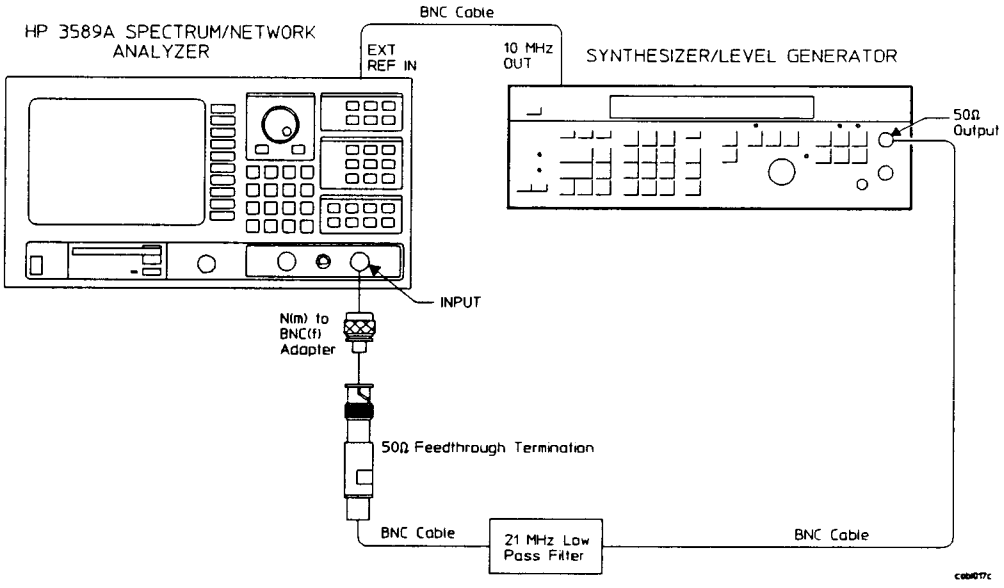


Figure 3-9. Input Harmonic Distortion Test Setup #3

Intermodulation Distortion

Operation Verification – No

This test is not required for Operation Verification.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its spurious responses specification for intermodulation distortion. In this test, a 50Ω directional bridge mixes two signals. The 10 dB amplifiers and the 10 dB attenuators are used to isolate the synthesizer/level generator from the synthesized signal generator. The resulting modulated signal is measured by the analyzer, establishing a reference level. Then, using its offset marker, the analyzer measures the second and third order intermodulation products (the sum and difference frequencies). Intermodulation distortion is measured using the receiver's 50Ω input path, with low distortion mode on and off, and using the 1 MΩ input path.

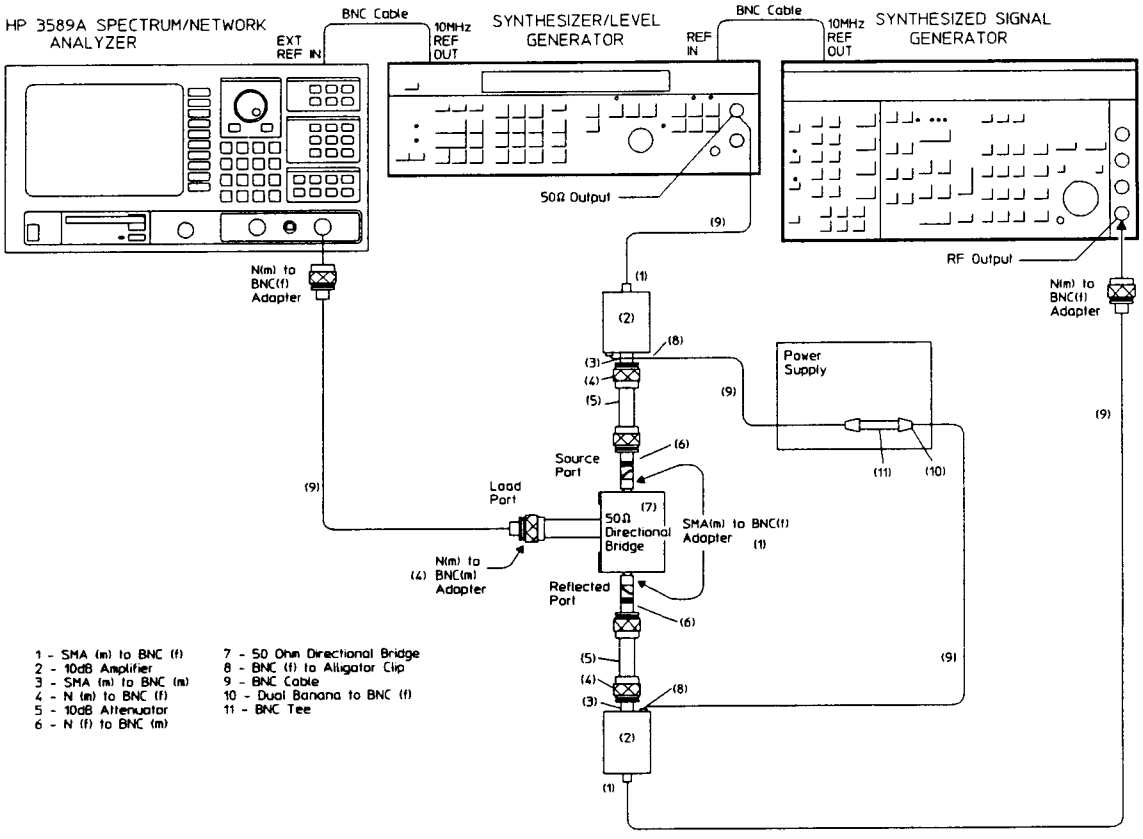


Figure 3-10. Intermodulation Distortion Test Setup #1

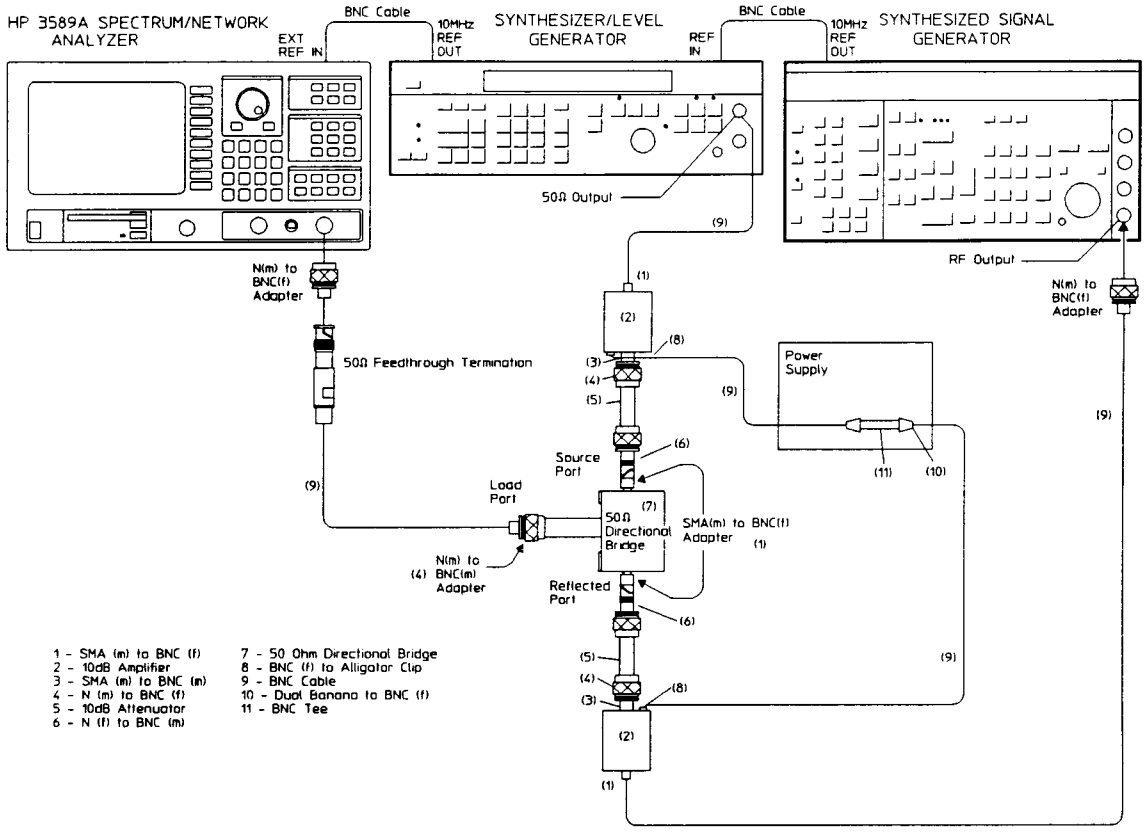


Figure 3-11. Intermodulation Distortion Test Setup #2

Source Response

Operation Verification – Yes

For Operation Verification, this test checks fewer frequencies than the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its source amplitude specifications for absolute amplitude accuracy and frequency response. In this test, a multimeter measures the analyzer's source from 10 Hz to 100 kHz and a power meter measures the analyzer's source from 300 kHz to 150 MHz. The value measured at 300 kHz is used to calculate the lower and upper limit specifications for all frequencies, except 300 kHz.

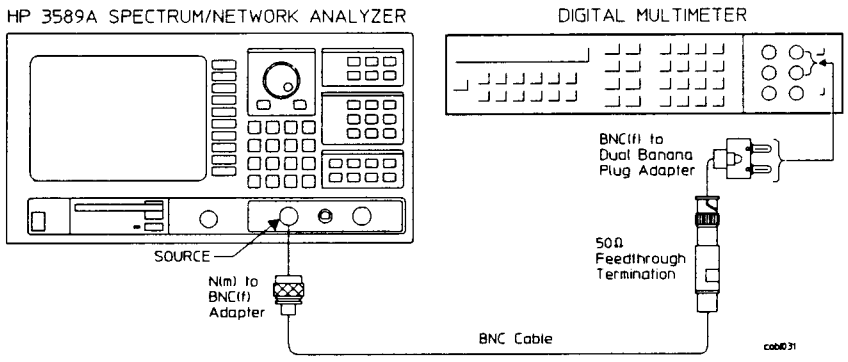


Figure 3-12. Source Response Test Setup #1

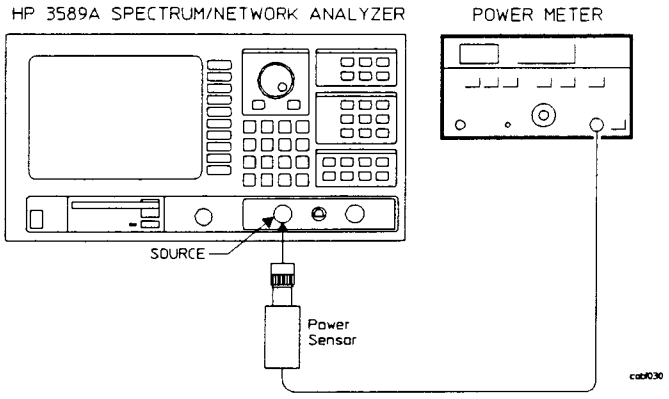


Figure 3-13. Source Response Test Setup #2

Amplitude Accuracy and Flatness

Operation Verification — Yes

For Operation Verification, this test checks input flatness using only the receiver's 50Ω input path.

Warning

This procedure requires the covers to be removed and must be performed by trained service personnel who are aware of the hazards involved (such as fire and electrical shock).

The HP 3589A Spectrum Analyzer is a Safety Class 1 instrument (provided with a protective earth terminal). Although this instrument has been designed in accordance with international safety standards, this procedure contains information, cautions and warnings that must be followed to ensure safe operation and retain the HP 3588A Spectrum Analyzer in safe operating condition.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its amplitude specifications for full scale absolute accuracy. In this test, the analyzer measures the power splitter and cable errors at four spans and stores the results in its internal data registers. A milliwatt power meter provides correction to the source, maintaining 0 dBm at the power sensor input. Then the analyzer measures the flatness of each frequency span. Using its internal math functions, the analyzer corrects for any errors caused by the power splitter and cables. This test checks the input flatness from 10 Hz to 150 MHz in the 50Ω input path and from 10 Hz to 40 MHz in the 1 MΩ input path.

Note

The "Alt_Amp Accuracy and Flatness" test does not require a milliwatt power meter. Perform either this test and "Source Response" or "Alt_Amp Accuracy and Flatness."

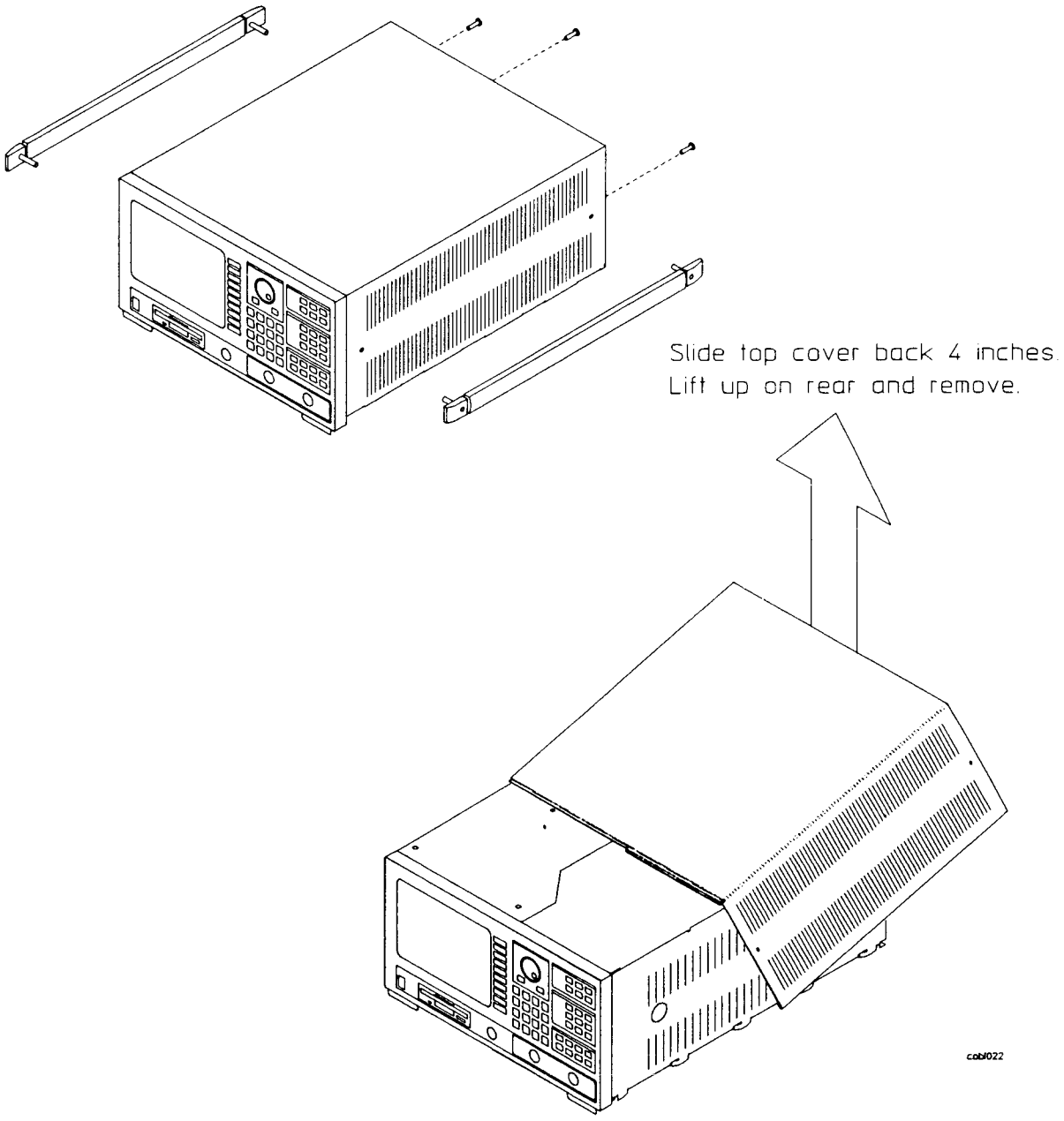


Figure 3-14. Removing Top Cover

Warning **When replacing the handle assemblies, be careful to position properly and attach firmly. If improperly attached, the handles could come off when lifting the analyzer, causing personal injury.**

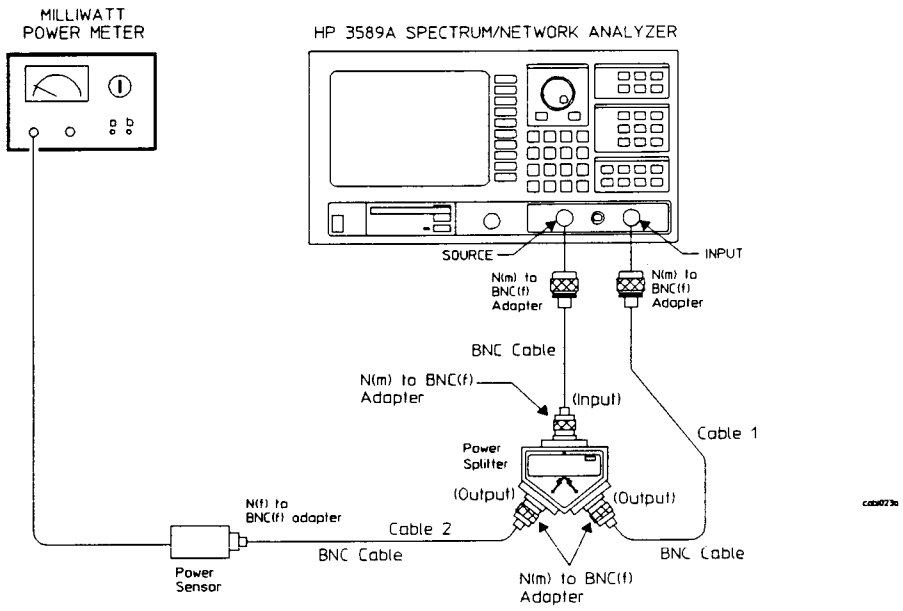


Figure 3-15. Amplitude Accuracy and Flatness Test Setup #1

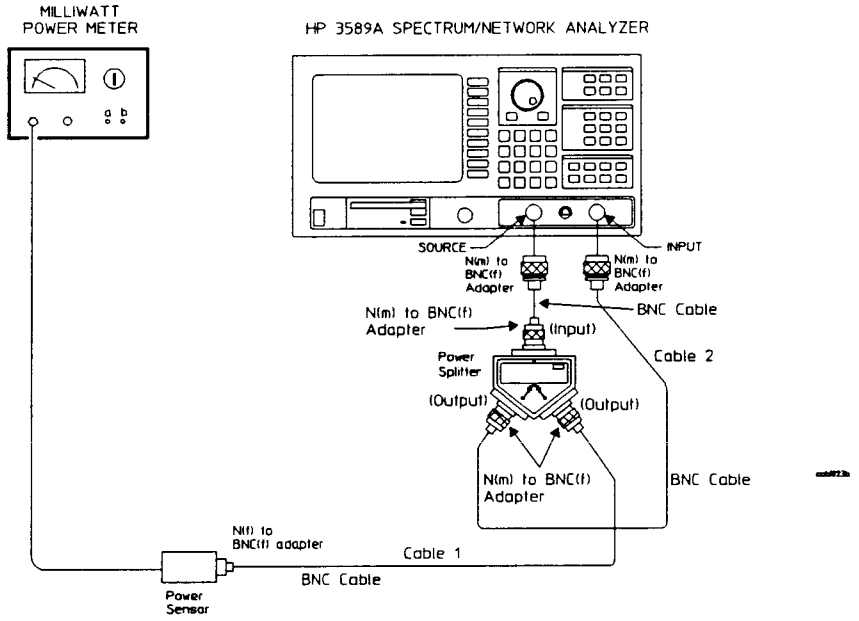


Figure 3-16. Amplitude Accuracy and Flatness Test Setup #2

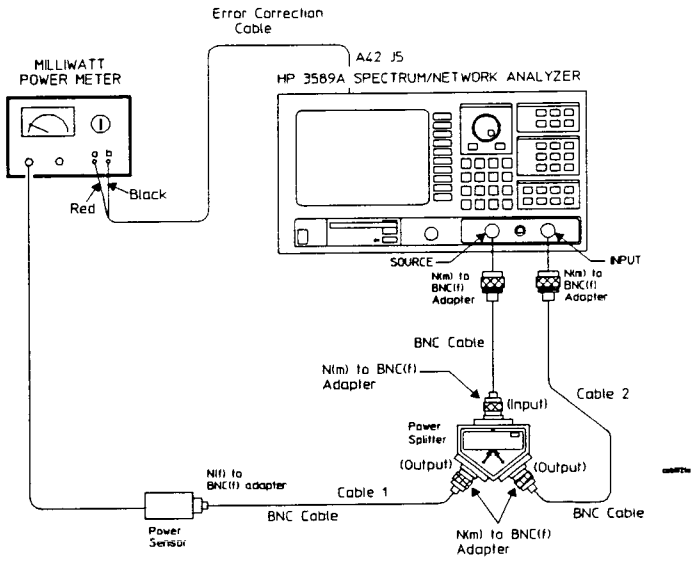


Figure 3-17. Amplitude Accuracy and Flatness Test Setup #3

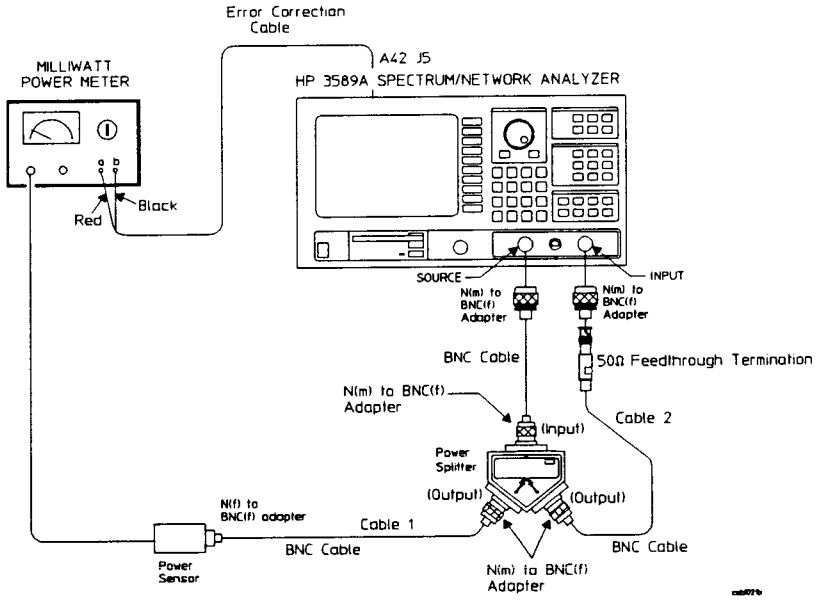


Figure 3-18. Amplitude Accuracy and Flatness Test Setup #4

Note

A calibration failure will occur if the HP 3589A Spectrum/Network Analyzer does an internal calibration while the error correction cable is connected to A42 J5. Make sure to disconnect the error correction cable before pressing [**Preset**], [SINGLE CAL], [AUTO CAL **ON** OFF], or before cycling power.

Alt_Amp Accuracy and Flatness

Operation Verification – Yes

For Operation Verification, this test checks input flatness using only the receiver's 50Ω input path.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its amplitude specification for full scale absolute accuracy and its source amplitude specification for absolute amplitude accuracy and frequency response. In this test, the analyzer generates and measures a signal from 10 Hz to 150 MHz using the receiver's 50Ω input path and from 10 Hz to 40 MHz using the 1 MΩ input path. The source amplitude levels measured in the Source Response test are subtracted from the levels measured in this test for the 50Ω input path. These levels are subtracted from the levels measured for the 1 MΩ input path. Then for specified frequency ranges in both the 50Ω and 1 MΩ input paths, the largest negative error is subtracted from the largest positive error, resulting in the frequency response error.

Note

This test is an alternate for the "Source Response" and "Amplitude Accuracy and Flatness" tests. Perform either this test or both the "Source Response" and "Amplitude Accuracy and Flatness" tests.

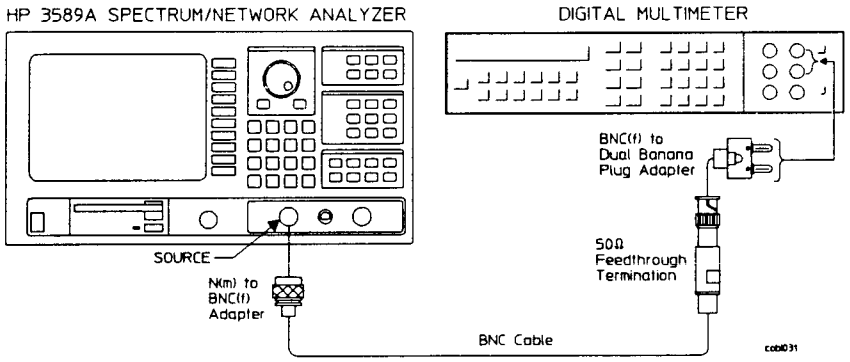


Figure 3-19. Alt_Amp Accuracy and Flatness Test Setup #1

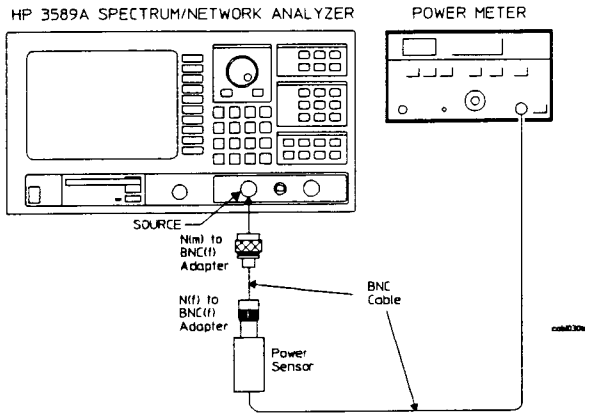


Figure 3-20. Alt-Amp Accuracy and Flatness Test Setup #2

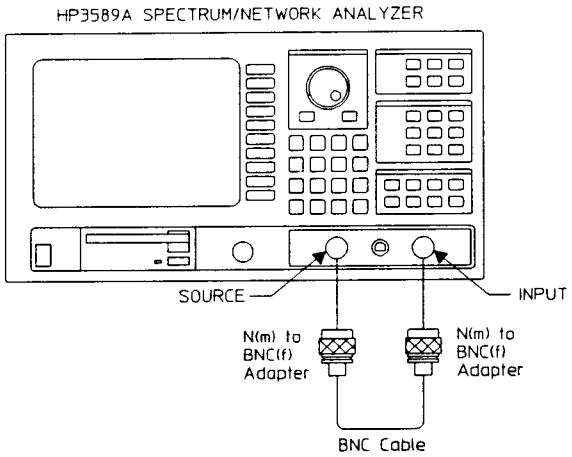


Figure 3-21. Alt-Amp Accuracy and Flatness Test Setup #3

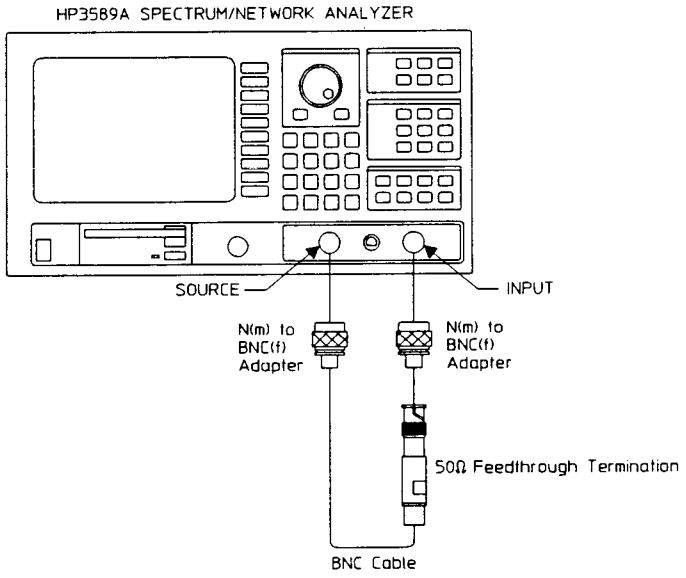


Figure 3-22. Alt-Amp Accuracy and Flatness Test Setup #4

Reference Level Accuracy

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its amplitude specification for full scale absolute accuracy. In this test, the synthesizer is adjusted to an exact amplitude level at 300 kHz. The analyzer's range is set to the amplitude level and the signal is measured. Then the receiver's input range is subtracted from the measured value. This test checks the calibrated level accuracy at five levels from –20 to +20 dBm.

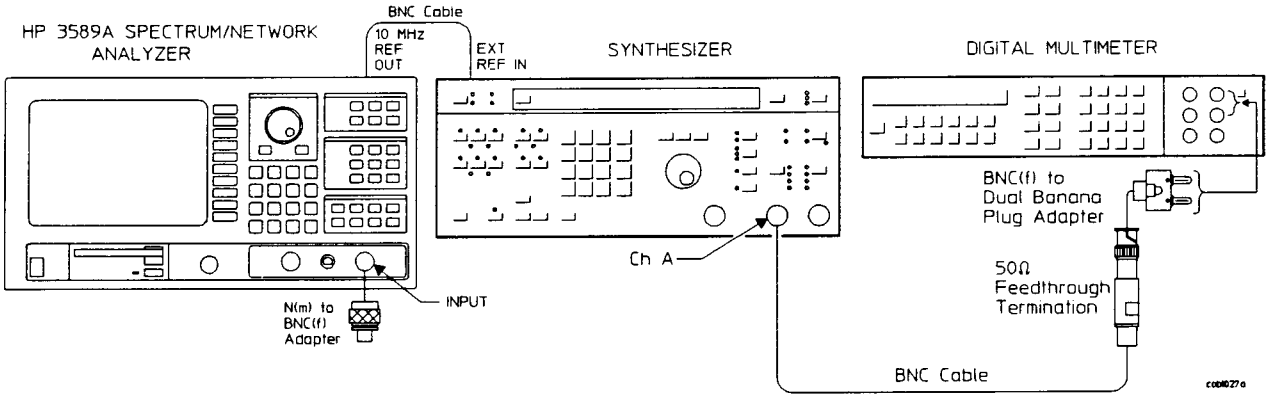


Figure 3-23. Reference Level Accuracy Test Setup #1

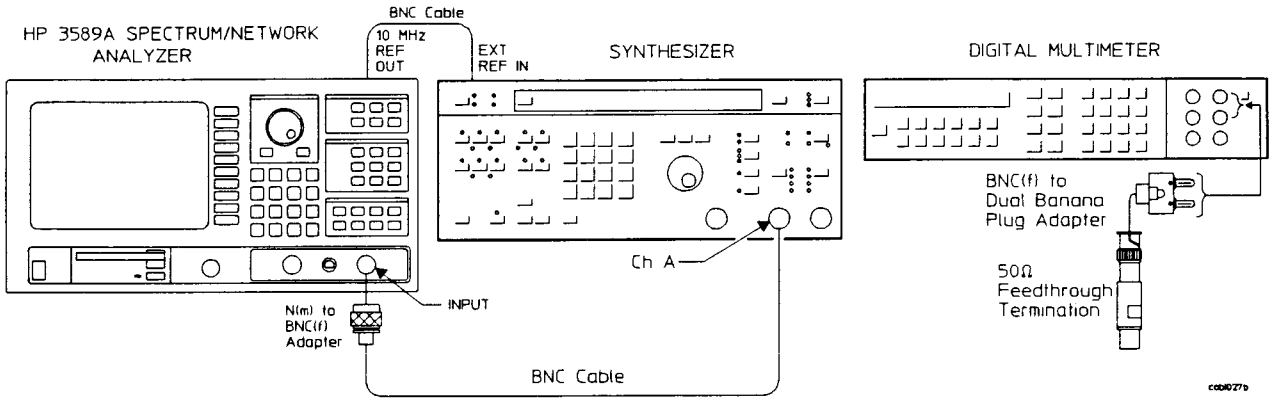


Figure 3-24. Reference Level Accuracy Test Setup #2

Dynamic Accuracy

Operation Verification – No

This test is not required for Operation Verification.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its ratio amplitude and phase specification for dynamic accuracy. This test checks dynamic accuracy at 7 amplitude levels at 300 kHz.

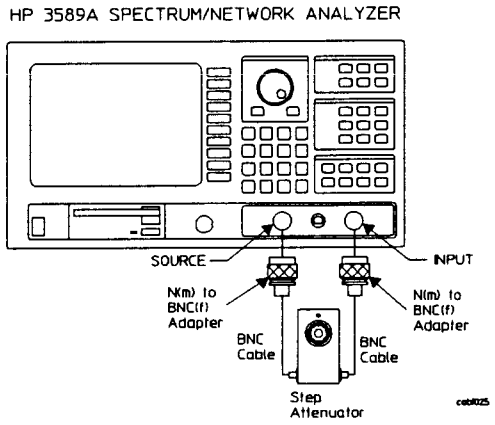


Figure 3-25. Dynamic Accuracy Test Setup

Source Dynamic Accuracy

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its source amplitude specification for dynamic accuracy. In this test, a step attenuator attenuates the source output by 20 dB, establishing a reference level. Then, the source internally attenuates the output, and the step attenuator's attenuation is decreased by the same amount. Using the offset marker, the analyzer measures the source output again. This value minus the correction for the step attenuator error is the source dynamic accuracy. This test checks dynamic accuracy at 300 kHz for all of the fixed attenuation pads and two attenuation levels in the variable attenuation circuit.

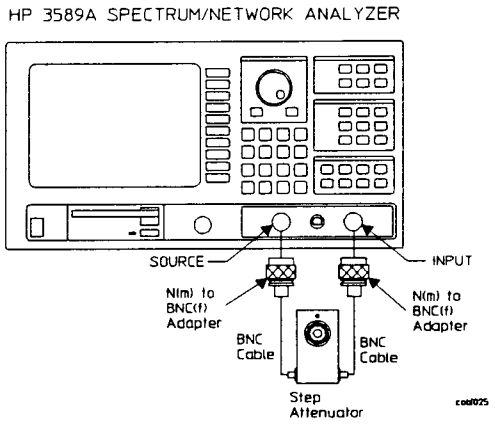


Figure 3-26. Source Dynamic Accuracy Test Setup

Input Return Loss

Operation Verification – No

This test is not required for Operation Verification.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its amplitude input port specification for return loss. In this test, a signal generator provides a signal to the source port of the 50Ω directional bridge. A spectrum analyzer measures the change that occurs to the directional bridge's reflected port when the HP 3589A analyzer's input is connected to the directional bridge's load port. This test checks the input return loss at all attenuator settings at 100 MHz and 150 MHz.

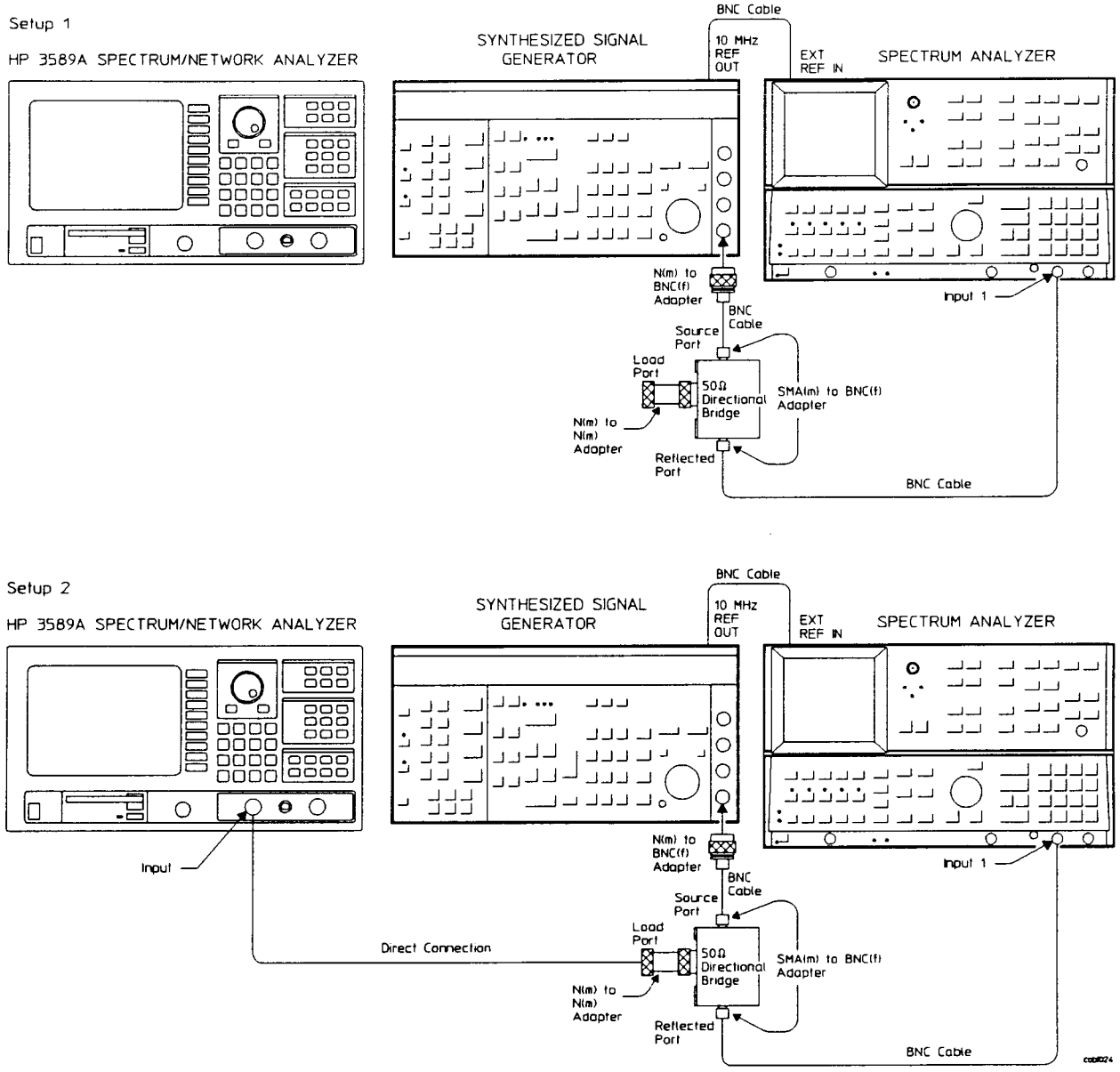


Figure 3-27. Input Return Loss Setups

Source Return Loss

Operation Verification – No

This test is not required for Operation Verification.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its source amplitude specification for return loss. In this test, a signal generator provides a signal to the source port of a 50Ω directional bridge. A spectrum analyzer measures the change that occurs to the directional bridge's reflected port when the HP 3589A analyzer's source is connected to the directional bridge's load port. This test checks the source return loss for 6 source amplitudes at 60 MHz, 120 MHz, and 150 MHz.

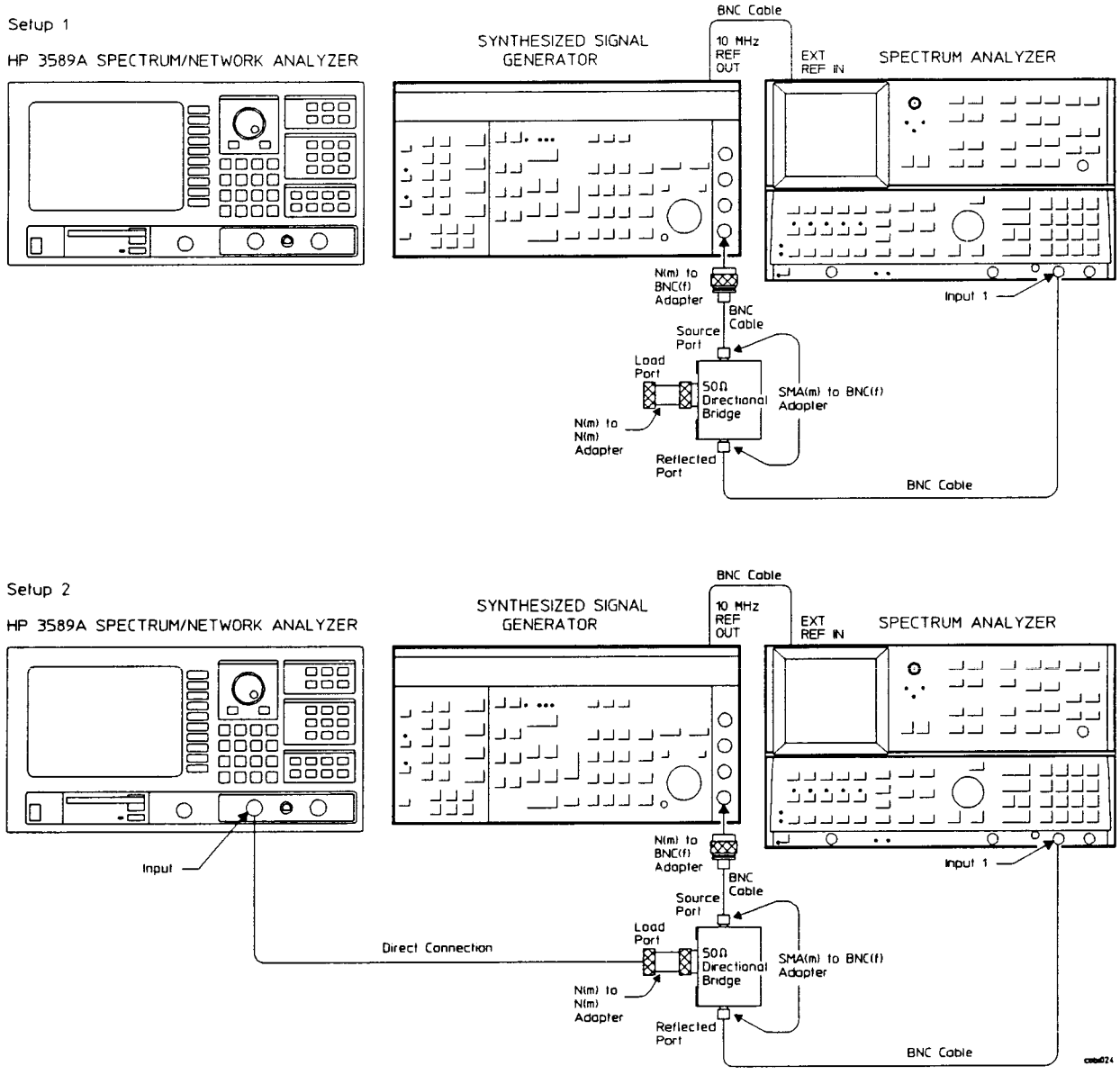


Figure 3-28. Source Return Loss Test Setups

Source Harmonic Distortion

Operation Verification – Yes

For Operation Verification, this test checks fewer frequencies than the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its source amplitude specification for harmonic products. In this test, a spectrum analyzer measures the source output, establishing a reference level. The spectrum analyzer then measures the second and third harmonic relative to the reference level.

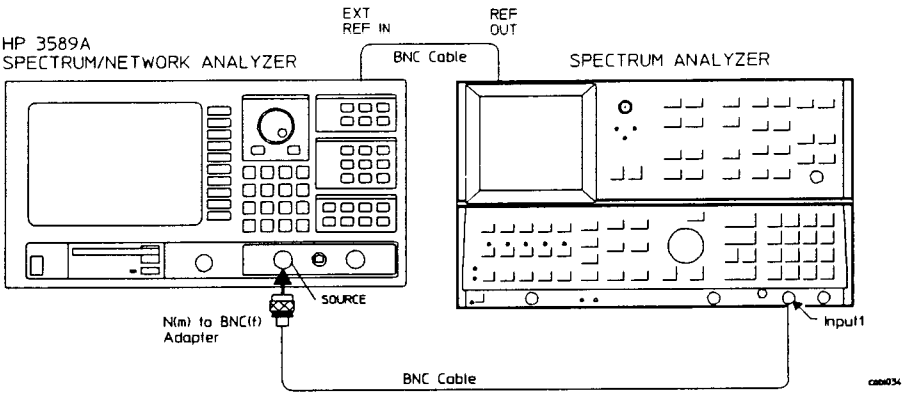


Figure 3-29. Source Harmonic Distortion Test Setup

Source Spurious Responses

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its source amplitude specification for non-harmonic products. In this test, a spectrum analyzer measures the source's output, establishing a reference level. The spectrum analyzer then measures a spur relative to the reference level.

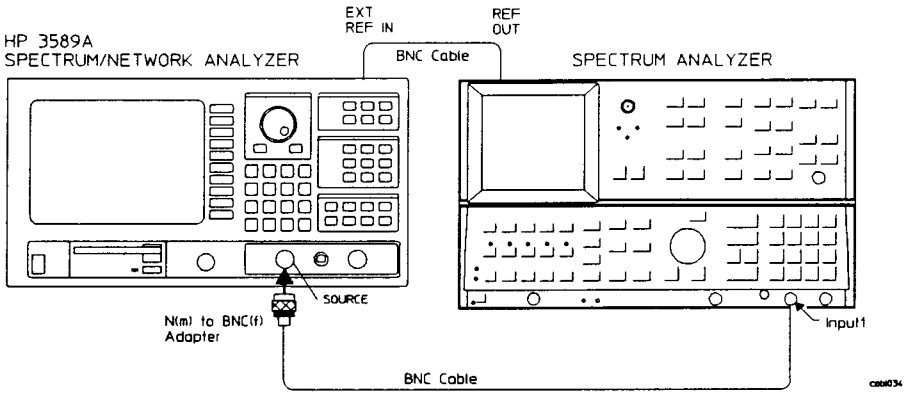


Figure 3-30. Source Spurious Responses Test Setup

Source Noise

Operation Verification – Yes

For Operation Verification, this test checks fewer frequencies than the Performance Test.

This test verifies that the HP 3589A Spectrum/Network Analyzer meets its source amplitude specification for noise. In this test, a spectrum analyzer measures the HP 3589A analyzer's source, establishing a reference level. Then, using its noise marker function, the spectrum analyzer measures the source at six offset frequencies. The spectrum analyzer's noise marker function normalizes the marker value to a 1 Hz bandwidth.

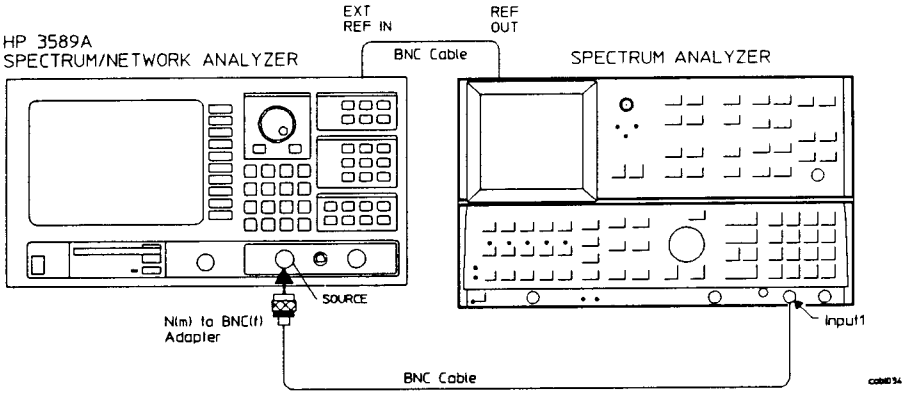


Figure 3-31. Source Noise Test Setup

Testing the HP 35689A/B

To test the HP 35689A/B S-Parameter Test Set, follow the directions in "How to Load the ITM_35689 Program" then continue with one of the following:

- "How to Run the ITM_35689 Program in Semiautomated Mode" (see page 3-47)
- "How to Run the ITM_35689 Program Without a Printer" (see page 3-49)
- "How to Run the ITM_35689 Program in Manual Mode" (see page 3-50)

Note The HP 35689A/B S-Parameter Test Set is tested using a calibrated HP 3589A Spectrum/Network Analyzer.

How to Load the ITM_35689 Program

1. Set the power switch on the HP 35689A/B S-Parameter Test Set and HP 3589A Spectrum/Network Analyzer to STANDBY (⏻). Connect the analyzer, and printer using HP-IB cables. Connect the HP 35689A/B to the HP 3589A (see "Connecting the S-Parameter Test Set" in chapter 2).

2. If you have the PC Style Keyboard, 1F0 - IF6, connect the keyboard to the analyzer using the keyboard cable (see "Connecting the Optional Keyboard" in chapter 2).

Caution Do not connect or disconnect the keyboard cable with the line power turned ON (I). Connecting or disconnecting the keyboard while power is applied may damage the keyboard or the analyzer.

3. Insert the *HP 35689A/B Semiautomated Performance Test Disk* into the analyzer's disk drive, then set the analyzer's power switch to ON (I).

4. After the analyzer finishes its power-up calibration routine, press the following keys:

   [Local/HP-IB]
   [SYSTEM CONTROLLR]
   [Save/Recall]
   [DEFAULT DISK]
   [INTERNAL DISK]
   [CANCEL/RETURN]
   [CATALOG **ON** OFF]

5. Using the marker knob, highlight the line that reads ITM_35689.

6. Press the following keys:

   [RECALL MORE]
   [RECALL PROGRAM]
   [ENTER]

7. After the recall program is done, press the following keys:

   [**BASIC**]
   [RUN]

8. Now go to one of the following procedures to continue.

   "How to Run the ITM_35689 Program in Semiautomated Mode" (see page 3-47)
   "How to Run the ITM_35689 Program Without a Printer" (see page 3-49)
   "How to Run the ITM_35689 Program in Manual Mode" (see page 3-50)

How to Run the ITM_35689 Program in Semiautomated Mode

Note

You must have an HP-IB printer connected to your system to run the program in semiautomated mode. If you do not have a printer, see "How to Run the ITM_35689 Program Without a Printer" later in this chapter.

For information about the program's softkeys, see "Softkey Descriptions" starting on page 3-65.

1. Press the following keys and when the program prompts you, type in the information for the title page of the test record and press [ENTER]:

   [TITLE PAGE]
   [TEST FACILITY]
   [FACILITY ADDRESS]
   [TESTED BY]
   [REPORT NUMBER]
   [CUSTOMER]
   [MORE]
   [OPTIONS]
   [DATE]
   [TEMP]
   [HUMIDITY]
   [LINE FREQUENCY]
   [RETURN]

2. Press the following keys and when the program prompts you, type in the equipment configuration information.

Note

Use the following to determine HP-IB addresses:

100 × (interface select code) + (primary address)

The interface select code for the test equipment and printer is 7 (for example, if the primary address is 8, the HP-IB address is 708).

Note

When entering the calibration due date, only four characters are displayed on the screen. However, you can enter up to nine characters and they will be printed.

[EQUIP CONFIG]
[NETWORK ANALYZER]
[Z0 TERMINATI]
[DIR BRIDGE]
[RETURN]

3. Press the following keys and type in the printer address when the program prompts you:

[TEST CONFIG]
[PRINTER ADDRESS]
[PROCEDURE]
[A_OPVER], [B_OPVER], [A_PERF], or [B_PERF]
[STOP AFTER]
[LIMIT FAILURE] or [NONE]
[RETURN]

4. Press the following keys to start the test:

[START TESTING]
[START BEGINNING]

Note

When you select [START BEGINNING], the data is written to a file on the disk and printed only after all tests are done. When you select [START MIDDLE] or [ONE TEST], the data is printed immediately after each measurement.

5. Now follow the directions on the display.

Note

The directions on the display briefly tell you how to connect test equipment. For a description of each test and detailed illustrations of equipment setup, see "HP 35689A/B Test Descriptions and Equipment Setup" starting on page 3-51.

If you want to pause the program and return the HP 3589A Spectrum/Network Analyzer to front panel control, press [**BASIC**]. To continue the program, press [**BASIC**] [CONTINUE]. If you changed any instrument setup states, press [RESTART TEST] to ensure accurate measurement results.

How to Run the ITM_35689 Program Without a Printer

1. Write in the information needed on the title page of the "HP 35689A/B Performance Test Record" or the "HP 35689A/B Operation Verification Test Record" (located near the end of this chapter).

2. Press the following keys:

   [TEST CONFIG]
   [PROCEDURE]
   [A_OPVER], [B_OPVER], [A_PERF], or [B_PERF]
   [STOP AFTER]
   [EACH MEASUREMENT]
   [RETURN]

3. Press the following keys to start the test:

   [START TESTING]
   [START BEGINNING]

4. Now follow the directions on the display and record every measurement result in the "HP 35689A/B Performance Test Record" or the "HP 35689A/B Operation Verification Test Record."

Note

The directions on the display briefly tell you how to connect test equipment. For a description of each test and detailed illustrations of equipment setup, see "HP 35689A/B Test Descriptions and Equipment Setup" starting on page 3-51.

If you want to pause the program and return the HP 3589A Spectrum/Network Analyzer to front panel control, press [**BASIC**]. To continue the program, press [**BASIC**] [CONTINUE]. If you changed any instrument setup states, press [RESTART TEST] to ensure accurate measurement results.

How to Run the ITM_35689 Program in Manual Mode

Note

Use this procedure if you want to run the program in manual mode. You will be prompted to setup all test equipment and you can check the analyzer's setup state after each measurement.

1. Press the following keys:

   [TEST CONFIG]
   [PROCEDURE]
   [A_OPVER], [B_OPVER], [A_PERF], or [B_PERF]
   [STOP AFTER]
   [EACH MEASUREMENT]
   [RETURN]

2. Press the following keys to start the test:

   [START TESTING]
   [START BEGINNING]

3. Now follow the directions on the display and after every measurement do the following:

   a. Record the measurement result in the "HP 35689A/B Performance Test Record" or the "HP 35689A/B Operation Verification Test Record" (located near the end of this chapter).

   b. If you want to view the analyzer's setup state, press [**Format**] [SETUP STATE]. To continue the program, press [**BASIC**] [CONTINUE].

Note

If you changed any instrument setup states, press [RESTART TEST] to ensure accurate measurement results.

The directions on the display briefly tell you how to connect test equipment. For a description of each test and detailed illustrations of equipment setup, see "HP 35689A/B Test Descriptions and Equipment Setup" starting on page 3-51.

HP 35689A/B Test Descriptions and Equipment Setup

Directivity and Source Match

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 35689A/B S-Parameter Test Set meets its directivity and port source match specifications.

The HP 35689A/B is connected to the Network Analyzer. The HP 3589A is used to measure the Port 1 and Port 2 reflections from open, short and Z_0 terminations for both magnitude and phase. The source match is then calculated using the following equation.

$$e_{11} = \frac{\Gamma_{open} + \Gamma_{short} - 2(\Gamma_{z_0})}{\Gamma_{open} - \Gamma_{short}}$$

The equation used to calculate the directivity is ...

$$\text{directivity} = \frac{\Gamma_{z_0}}{\Gamma_{short}}$$

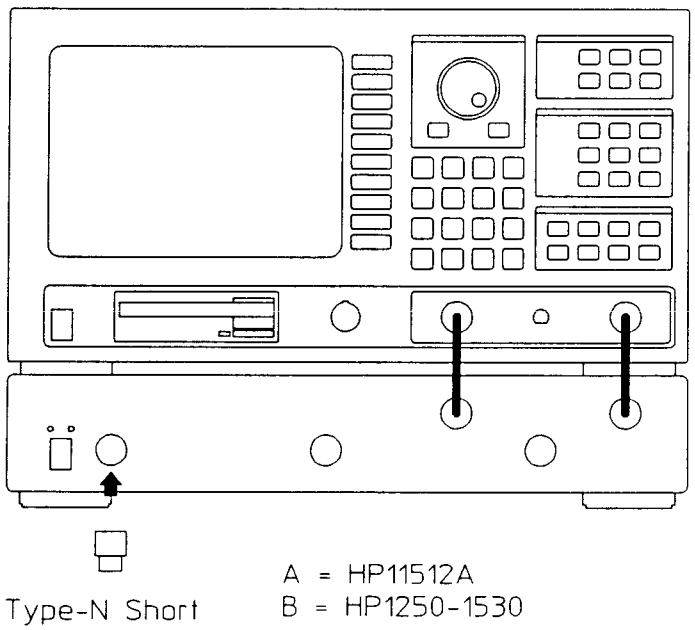


Figure 3-32. Directivity and Source Match Test Setup #1

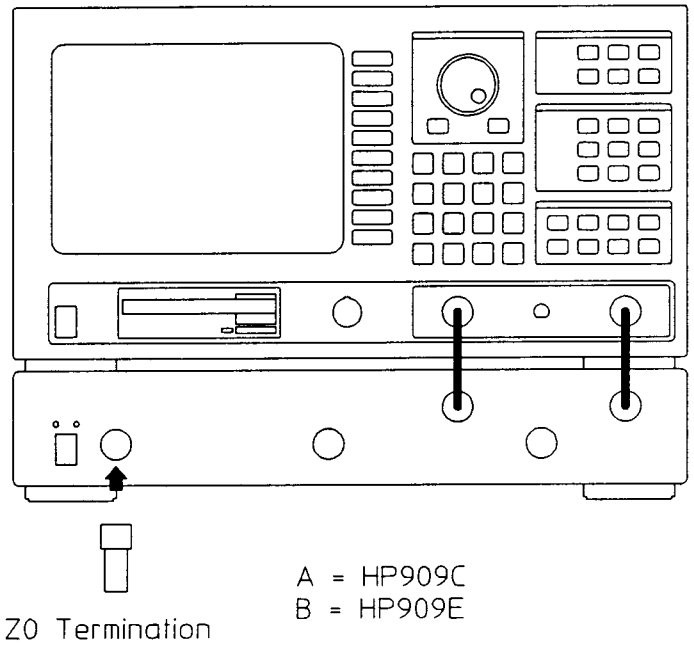


Figure 3-33. Directivity and Source Match Test Setup #2

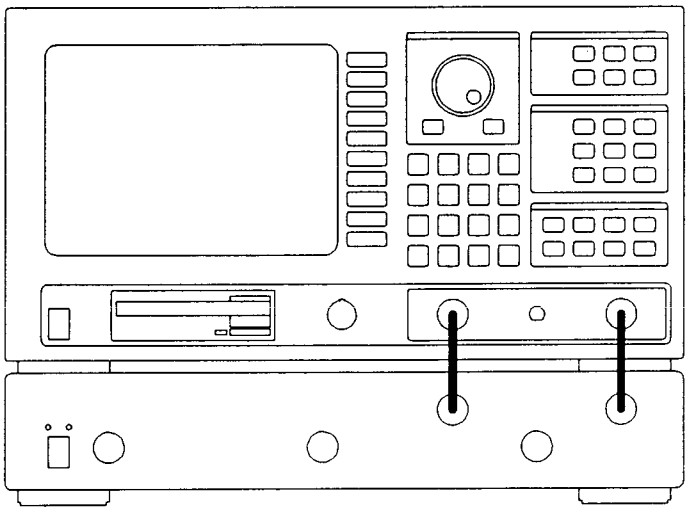


Figure 3-34. Directivity and Source Match Test Setup #3

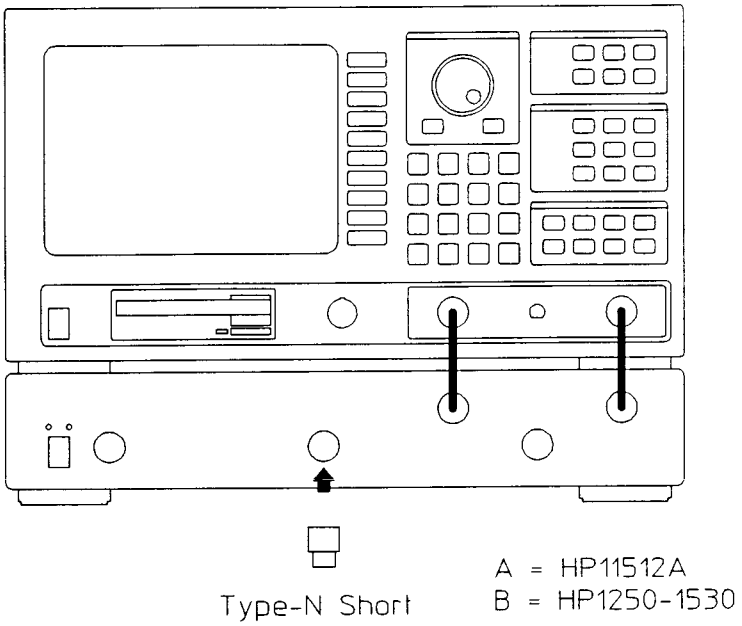


Figure 3-35. Directivity and Source Match Test Setup #4

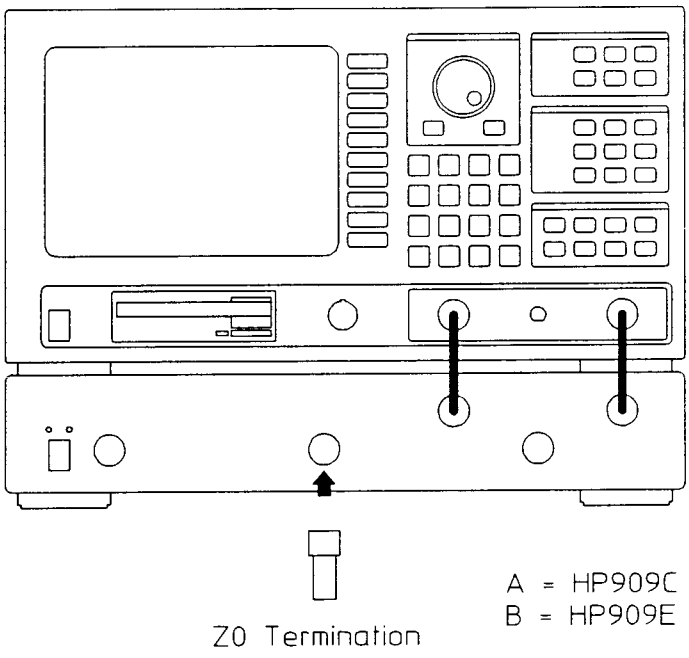


Figure 3-36. Directivity and Source Match Test Setup #5

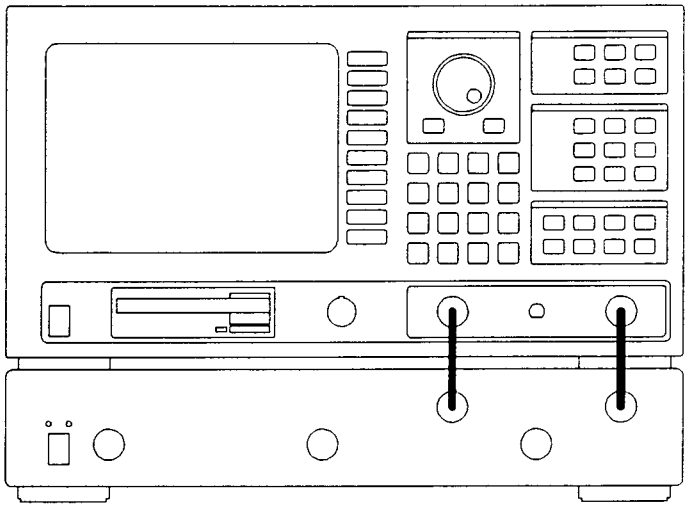


Figure 3-37. Directivity and Source Match Test Setup #6

Reflection

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 35689A/B S-Parameter Test Set meets its reflection specification for frequency response.

The HP 35689A/B reflection frequency response is measured using a Network Analyzer to measure the return loss of a short.

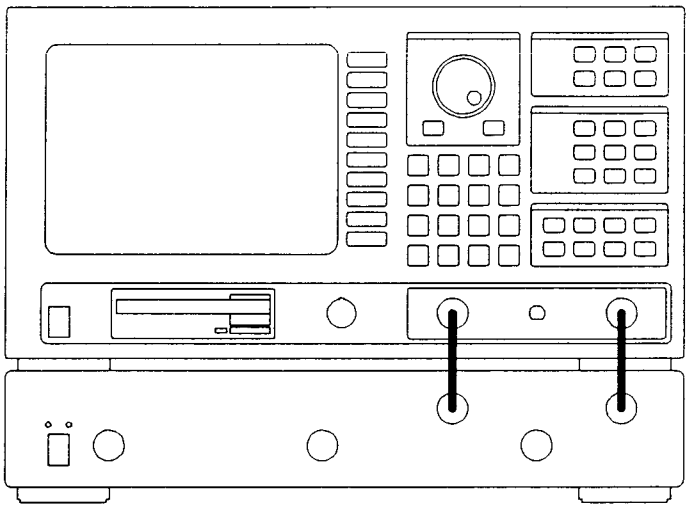


Table 3-38. Reflection Test Setup #1

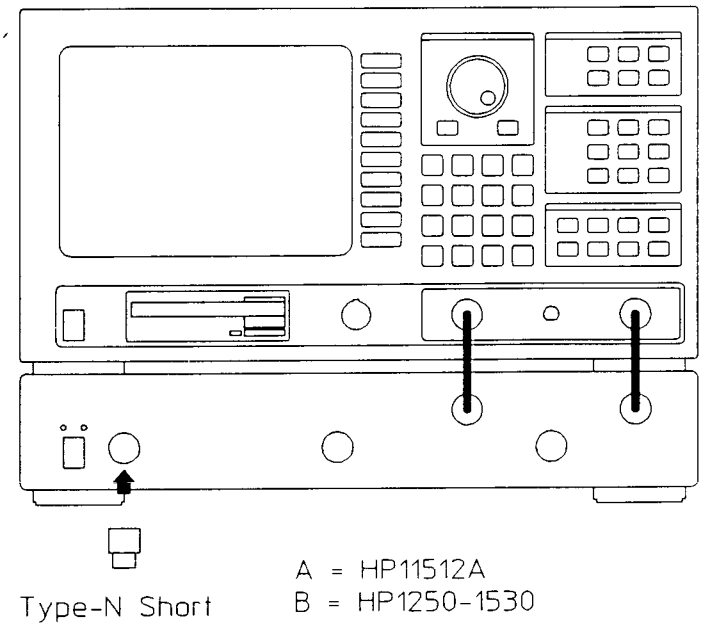


Table 3-39. Reflection Test Setup #2

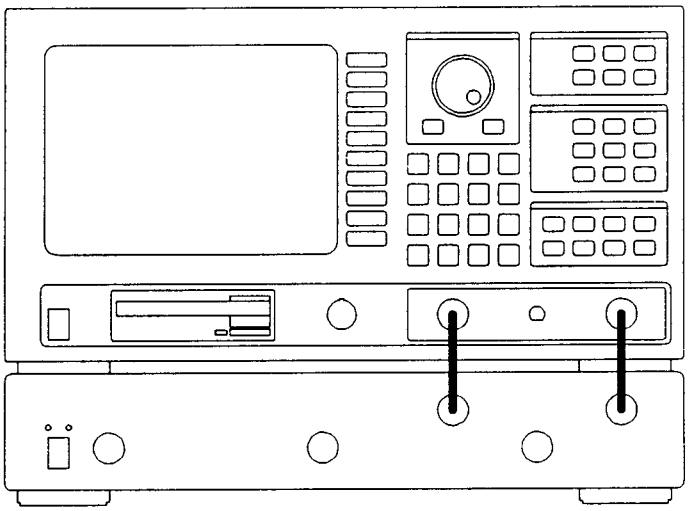


Table 3-40. Reflection Test Setup #3

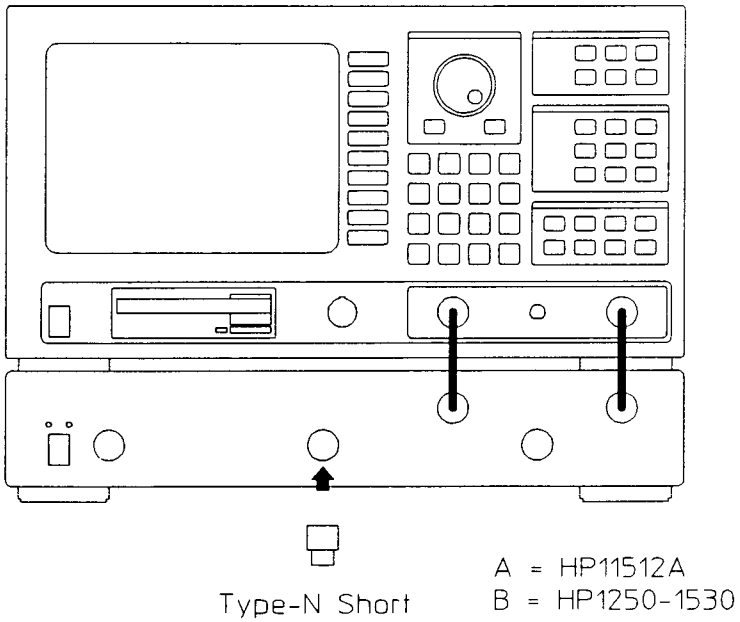


Table 3-41. Reflection Test Setup #4

Transmission

Operation Verification – Yes

For Operation Verification, this test is the same as the Performance Test.

This test verifies that the HP 35689A/B S-Parameter Test Set meets its transmission specification for frequency response.

The HP 35689A/B Transmission Frequency Response is the frequency response of the RF port to transmission measuring port, referenced to the output port, with an ideal through between port 1 and port 2. The measurment is made by first measuring the response of the cable used to connect the HP 35689A/B RF ports. The Network Analyzer is then used to measure the total frequency response of the HP 35689A/B RF to transmission port through the cable measured above. The reference and transmission ports on the Network Analyzer are then switched and the measurement repeated.

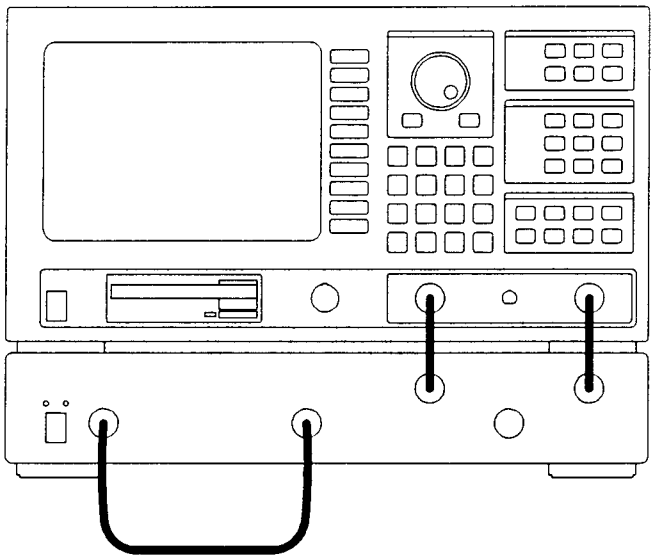


Figure 3-42. Transmission Test Setup #1

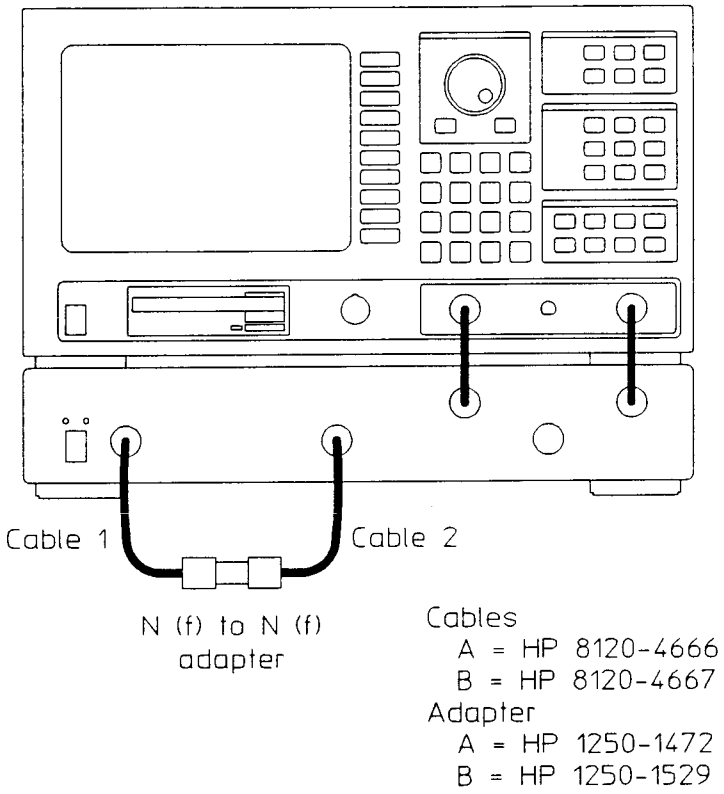


Figure 3-43. Transmission Test Setup #2

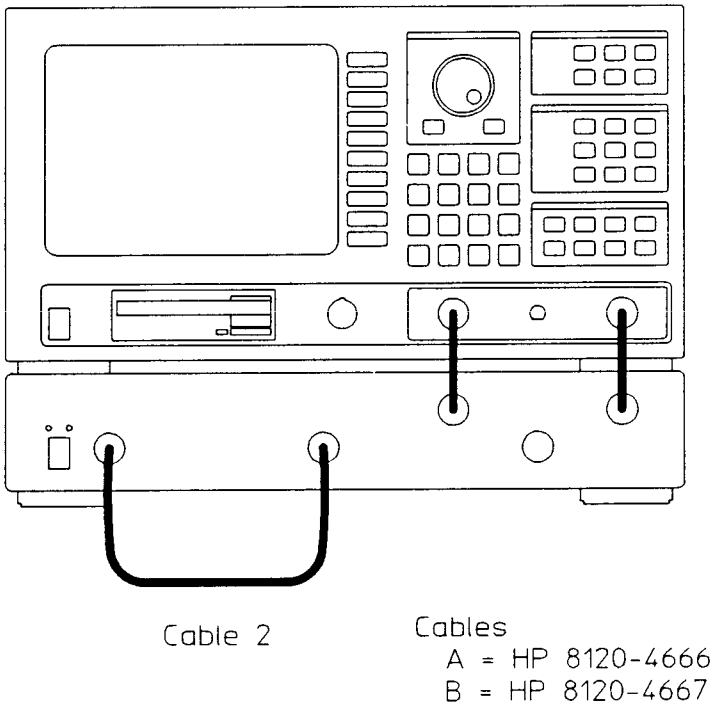


Figure 3-44. Transmission Test Setup #3

Isolation

Operation Verification – No

This test is not required for Operation Verification.

This test verifies that the HP 35689A/B S-Parameter Test Set meets its test port isolation specification.

The Test Port Isolation is measured by connecting a Z_0 cable between the Test Ports and storing a transmission measurement as a reference. The two Test Ports are then terminated in a Z_0 load and a transmission measurement taken. The ratio of the Through measurement to the Z_0 measurement is a measure to Test Port Isolation.

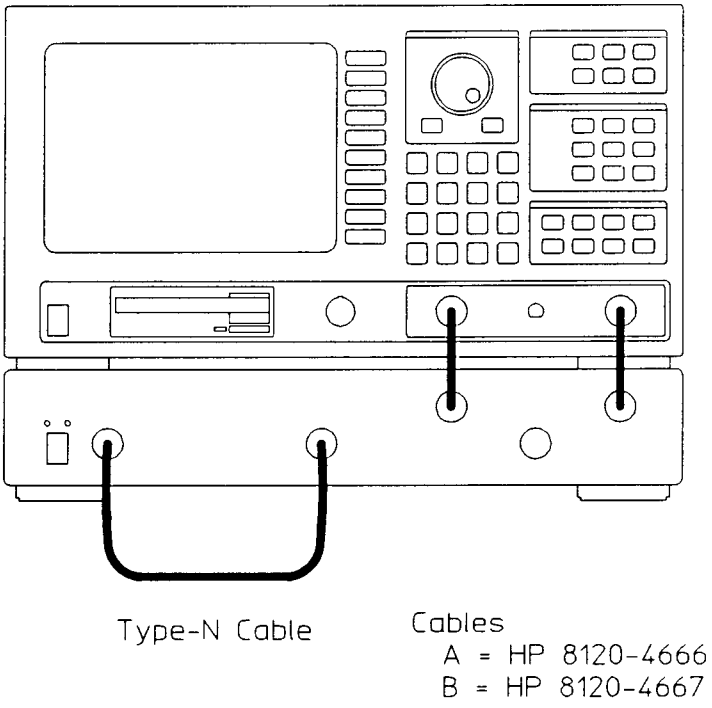


Figure 3-45. Isolation Test Setup #1

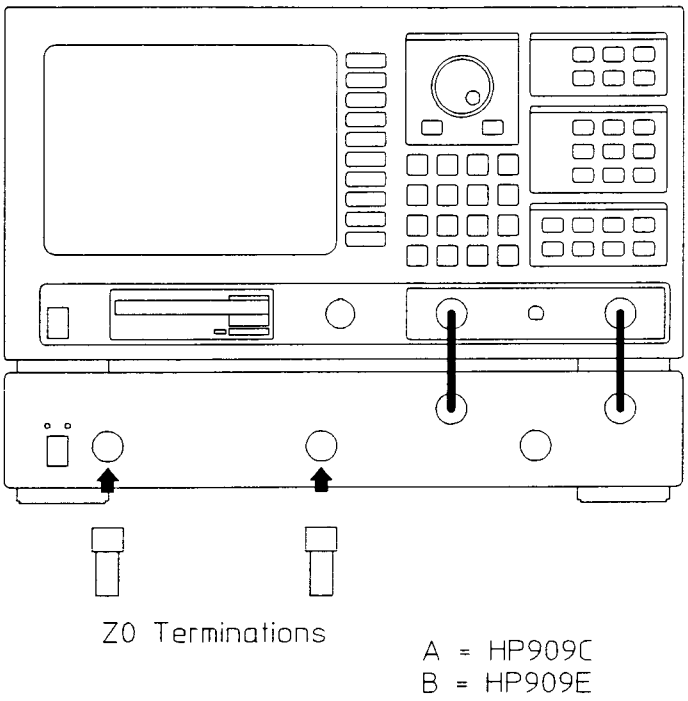


Figure 3-46. Isolation Test Setup #2

Return Loss

Operation Verification – No

This test is not required for Operation Verification.

This test verifies that the HP 35689A/B S-Parameter Test Set meets its port match return loss specification.

With all critical ports on the HP 35689A/B terminated in their characteristic impedance, the RF port return loss is measured using a 35677-63502 Directional Bridge.

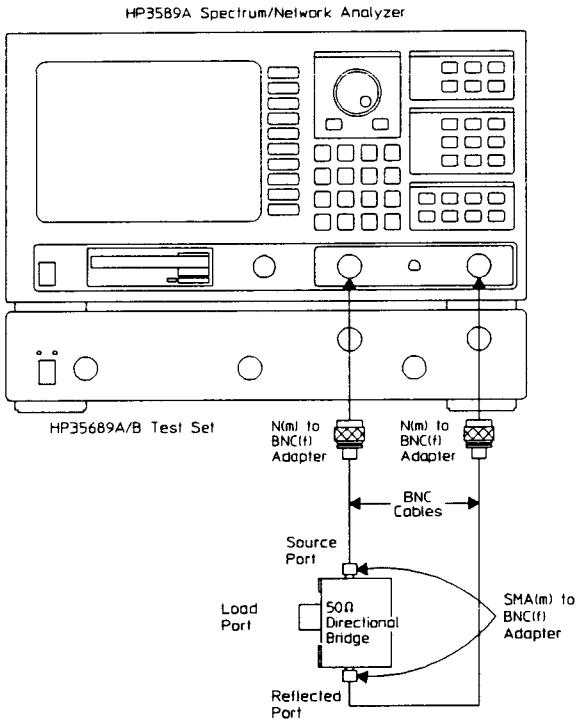


Figure 3-47. Return Loss Test Setup #1

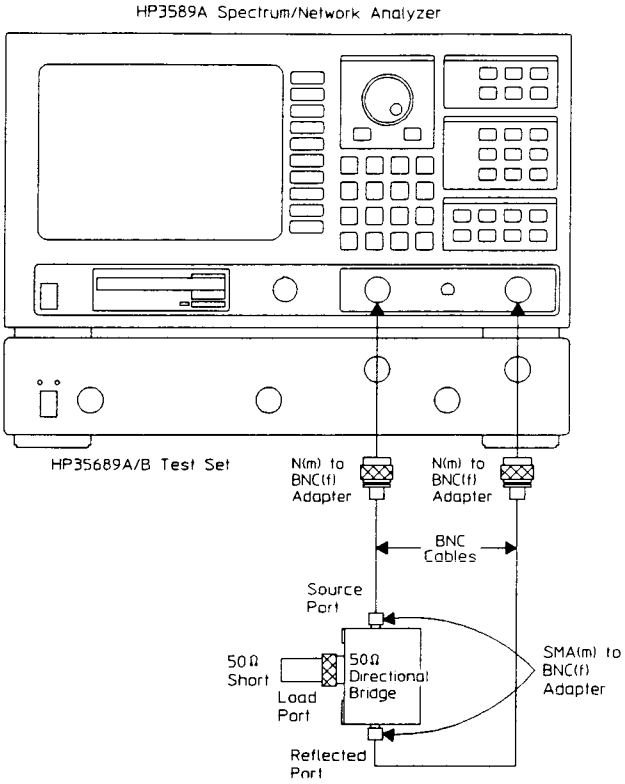


Figure 3-48. Return Loss Test Setup #2

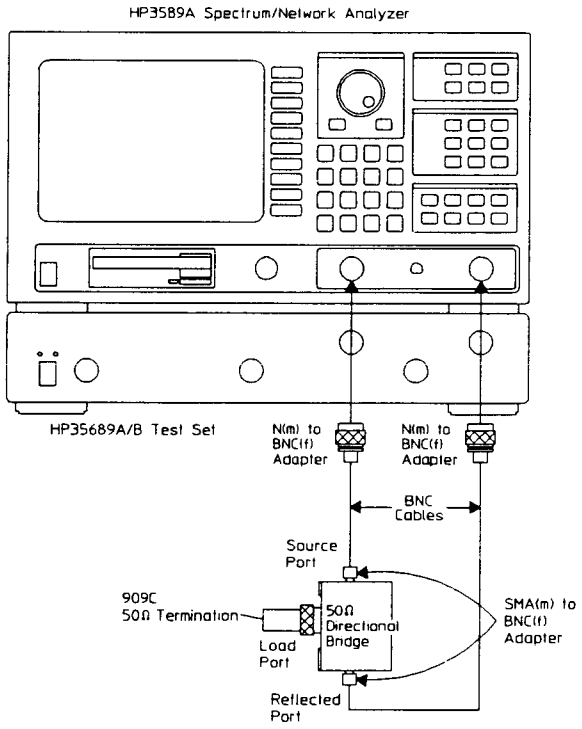


Figure 3-49. Return Loss Test Setup #3

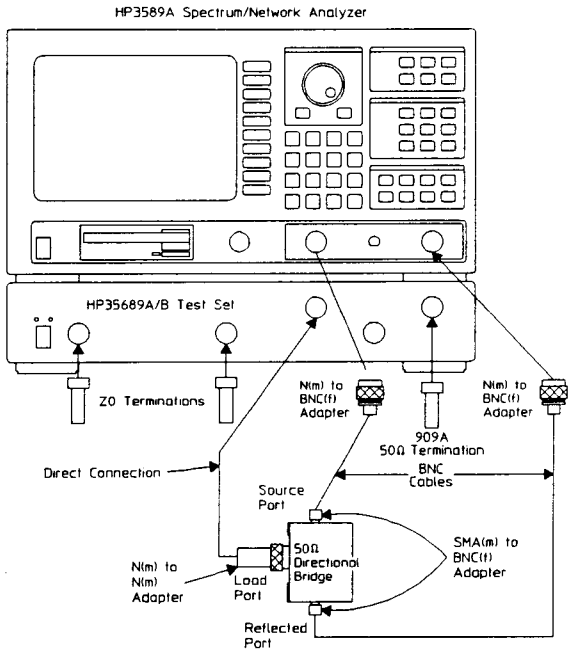


Figure 3-50. Return Loss Test Setup #4

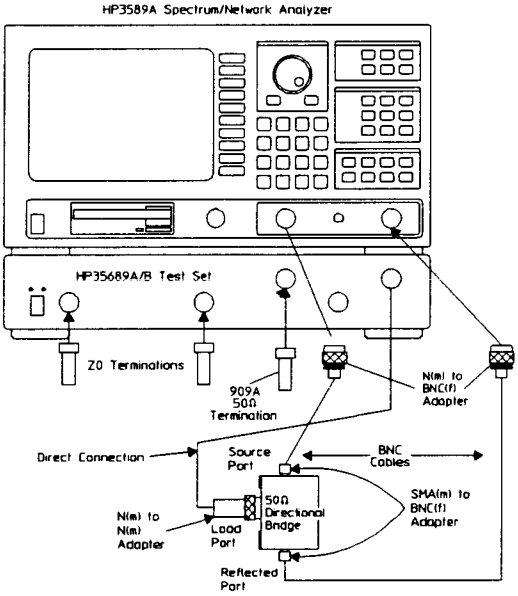


Figure 3-51. Return Loss Test Setup #5

Softkey Descriptions

Note

If you do not have a keyboard connected to the analyzer, use the numeric key pad and the alpha keys to enter names or numbers. See the analyzer's help text for a description of the alpha keys.

Main Menu

Load and run the ITM_3589A or ITM_35689 program to display the following softkeys:

[START TESTING] Press [START TESTING] to display a menu that allows you to start testing with any test or to select just one test in the list. Before pressing this softkey, use [TEST CONFIG] and [EQUIP CONFIG].

[TEST CONFIG] Press [TEST CONFIG] to display the test configuration and a menu that allows you to enter the procedure, stop conditions, beeper prompt, and HP-IB address for the analyzer and printer.

[EQUIP CONFIG] Press [EQUIP CONFIG] to display the test equipment configuration and a menu that allows you to enter the model number, calibration due date, serial number, and HP-IB address for each test instrument.

[TITLE PAGE] Press [TITLE PAGE] to display the test record title page information and a menu that allows you to enter information for the instrument.

[STOP ITM] Press [STOP ITM] to stop the program.

Start Testing Menu

In the main menu of either the ITM_3589A or ITM_35689 program press [START TESTING] to display the following softkeys:

Note

When you select [START BEGINNING], the data is written to a file on the disk and printed only after all tests are done. When you select [START MIDDLE] or [ONE TEST], the data is printed immediately after each measurement.

[START BEGINNING]	Press [START BEGINNING] to print the test record title page information and to start the selected test procedure at the beginning.
[START MIDDLE]	Press [START MIDDLE] to display a list of all the tests in the selected procedure. Testing starts with the test you select and continues through the remainder of the tests in the list.
[ONE TEST]	Press [ONE TEST] to display all the tests in the selected procedure. The test you select is the only test performed.
[RETURN]	Press [RETURN] to return to the main menu.

Start a test to display the following softkeys:

[STOP TESTING]	Press [STOP TESTING] to stop the test and return to the main menu.
[RESTART TEST]	Press [RESTART TEST] to start the current test over. Any connection prompts are repeated.
[RESTART MEAS]	Press [RESTART MEAS] to start the current measurement over.

The following softkeys also appear when the program is waiting for you to press [CONTINUE]:

[STOP BEEPING]	Press [STOP BEEPING] to turn off the beeper prompt for the remainder of this measurement.
[CONTINUE]	Press [CONTINUE] to continue testing after following the directions on the display.

Test Configuration Menu

Note

Use the following to determine HP-IB addresses:

100 × (interface select code) + (primary address)

The interface select code for the printer and test equipment is 7 (for example, if the primary address is 8, the HP-IB address is 708).

In the main menu of the ITM_3589A program press [TEST CONFIG] to display the test configuration and the following softkeys:

[HP 3589A ADDRESS] Press [HP 3589A ADDRESS] to enter the HP-IB address for the HP 3589A Spectrum/Network Analyzer.

[PRINTER ADDRESS] Press [PRINTER ADDRESS] to enter the HP-IB address for the printer. To disable the printer, set the printer address to 0.

[PROCEDURE] Press [PROCEDURE] to select the operation verification procedure (OP_VERIFY), the alternate operation verification procedure (ALT_OPVER), the performance test procedure (PERFORMAN), or the alternate performance test procedure (ALT_PERF).

[STOP AFTER] Press [STOP AFTER] to select stop after limit failure, stop after each measurement, or do not stop after a limit failure or measurement. If [Limit Failure] is selected, the program stops after the failing measurement is displayed, but before it is printed. At this point you can continue on and print the failing measurement or restart the measurement.

[BEEPER] Press [BEEPER] to toggle the beeper on the off. When the beeper is on, the program beeps approximately every 2 minutes while waiting for you to follow the directions on the display and press [CONTINUE].

[RETURN] Press [RETURN] to return to the main menu.

In the main menu of the ITM_35689 program press [TEST CONFIG] to display the test configuration and the following softkeys:

[PRINTER ADDRESS] Press [PRINTER ADDRESS] to enter the HP-IB address for the printer. To disable the printer, set the printer address to 0.

[PROCEDURE] Press [PROCEDURE] to select the HP 35689A operation verification procedure (A_OPVER), the HP 35689B operation verification procedure (B_OPVER), the HP 35689A performance test procedure (A_PERF), or the HP 35689B performance test procedure (B_OPVER).

[STOP AFTER] Press [STOP AFTER] to select stop after limit failure, stop after each measurement, or do not stop after a limit failure or measurement. If [Limit Failure] is selected, the program stops after the failing measurement is displayed, but before it is printed. At this point you can continue on and print the failing measurement or restart the measurement.

[BEEPER] Press [BEEPER] to toggle the beeper on the off. When the beeper is on, the program beeps approximately every 2 minutes while waiting for you to follow the directions on the display and press [CONTINUE].

[RETURN] Press [RETURN] to return to the main menu.

Equipment Configuration Menu

In the main menu of the ITM_3589A program press [EQUIP CONFIG] to display the test equipment configuration and the following softkeys:

Note

If you select [Other] for model, the program prompts you to type in a model, serial number, and calibration due date but not an HP-IB address.

When entering the calibration due date, only four characters are displayed on the screen. However, you can enter up to nine characters and they will be printed.

[SIGNAL GEN]	Press [SIGNAL GEN] to enter the model, serial number, HP-IB address, and calibration due date for the signal generator.
[SYNTH]	Press [SYNTH] to enter the model, serial number, HP-IB address, and calibration due date for the frequency synthesizer.
[SYNTH/LVL GEN]	Press [SYNTH/LVL GEN] to enter the model, serial number, HP-IB address, and calibration due date for the synthesizer/level generator.
[ANALYZER]	Press [ANALYZER] to enter the model, serial number, HP-IB address, and calibration due date for the analyzer.
[SAVE SETUP]	Press [SAVE SETUP] to save the current equipment configuration to a file for future recall.
[RECALL SETUP]	Press [RECALL SETUP] to recall an equipment configuration that was previously saved using [SAVE SETUP].
[MORE]	Press [MORE] to display the next page.
[RETURN]	Press [RETURN] to return to the main menu.
[MULTIMETER]	Press [MULTIMETER] to enter the model, serial number, HP-IB address, and calibration due date for the voltmeter.
[POWER METER]	Press [POWER METER] to enter the model, serial number, HP-IB address, and calibration due date for the power meter.
[POWER SENSOR]	Press [POWER SENSOR] to enter the model, serial number, and calibration due date for the power sensor.
[DIR BRIDGE]	Press [DIR BRIDGE] to enter the model, serial number, and calibration due date for the directional bridge.
[STEP ATTEN]	Press [STEP ATTEN] to enter the model, serial number, calibration due date, and error correction data for the step attenuator.

[MORE]	Press [MORE] to display the next page.
[RETURN]	Press [RETURN] to return to the main menu.
[FREQ STD]	Press [FREQ STD] to enter the model, serial number, and calibration due date for the frequency standard.
[mW-POWER METER]	Press [mW-POWER METER] to enter the model, serial number, and calibration due date for the milliwatt power meter. This test instrument is not used in the alternate operation verification or alternate performance test procedures.
[21 MHz FILTER]	Press [21 MHz FILTER] to enter the model, serial number, and calibration due date for the 21 MHz low pass filter.
[50 MHz FILTER]	Press [50 MHz FILTER] to enter the model, serial number, and calibration due date for the 50 MHz low pass filter.
[MORE]	Press [MORE] to display the first page.
[RETURN]	Press [RETURN] to return to the main menu.

In the main menu of the ITM_35689 program press [EQUIP CONFIG] to display the test equipment configuration and the following softkeys:

[NETWORK ANALYZER]	Press [NETWORK ANALYZER] to enter the model, serial number, and calibration due date for the HP 3589A Spectrum/Network Analyzer.
[Z0 TERMINATI]	Press [Z0 TERMINATI] to enter the model, serial number, and calibration due date for the Z0 Termination.
[DIR BRIDGE]	Press [DIR BRIDGE] to enter the model, serial number, and calibration due date for the directional bridge.

Title Page Menu

In the main menu of either the ITM_3589A or ITM_35689 program press [TITLE PAGE] to display the title page information and the following softkeys:

Note The title page information is printed at the beginning of the test procedure.

[TEST FACILITY]	Press [TEST FACILITY] to enter the name or number of the testing entity.
[FACILITY ADDRESS]	Press [FACILITY ADDRESS] to enter the address of the testing entity.
[TESTED BY]	Press [TESTED BY] to enter the name or number of the person performing the test.
[REPORT NUMBER]	Press [REPORT NUMBER] to enter the analyzer's report number.
[CUSTOMER]	Press [CUSTOMER] to enter the name or number of the person requesting the test.
[SERIAL NUMBER]	Press [SERIAL NUMBER] to enter the analyzer's serial number.
[MORE]	Press [MORE] to display the next page.
[RETURN]	Press [RETURN] to return to the main menu.
[OPTIONS]	Press [OPTIONS] to enter the analyzer's options.
[DATE]	Press [DATE] to enter the test date.
[TEMP]	Press [TEMP] to enter the temperature of the environment during the test.
[HUMIDITY]	Press [HUMIDITY] to enter the humidity of the environment during the test.
[LINE FREQUENCY]	Press [LINE FREQUENCY] to enter the power line frequency.
[MORE]	Press [MORE] to display the first page.
[RETURN]	Press [RETURN] to return to the main menu.

Measurement Uncertainty

Table 3-5. HP 3589A Measurement Uncertainty

Performance Test	Using Recommended Test Equipment		Using Other Test Equipment	
	Measurement Uncertainty	Ratio	Measurement Uncertainty	Ratio
Local Oscillator Feedthrough	NA[1]	NA[1]	NA[1]	NA[1]
Phase Noise	NA[1]	NA[1]	NA[1]	NA[1]
Residual Responses	NA[1]	NA[1]	NA[1]	NA[1]
Noise Level	NA[1]	NA[1]	NA[1]	NA[1]
Frequency Accuracy (following adjustment)	± 0.000003 ppm	>10:1		
Spurious Responses Typical scale fidelity Test signal spurious responses: <120 MHz 120 to 150 MHz	 ± 0.25 dB <–90 dBc <–100 dBc	NA[2]		NA[2]
Image Responses Typical scale fidelity Test signal spurious responses: <120 MHz 120 to 150 MHz	 ± 0.25 dB <–90 dBc <–100 dBc	NA[2]		NA[2]
Input Harmonic Distortion Typical scale fidelity Test signal harmonics	 ± 0.25 dB <–100 dBc	NA[2]		NA[2]
Intermodulation Distortion Typical scale fidelity Typical test signals distortion	 ± 0.25 dB <–86 dBc	NA[2]		NA[2]

[1] internal test
[2] open-ended specification
[3] root-sum-squares calculation method

Table 3-5. HP 3589A Measurement Uncertainty (continued)

Performance Test	Using Recommended Test Equipment		Using Other Test Equipment	
	Measurement Uncertainty	Ratio	Measurement Uncertainty	Ratio
Source Response				
10 Hz				
100 Hz	± 0.011 dB	>10:1		
1 kHz	± 0.010 dB	>10:1		
10 kHz	± 0.010 dB	>10:1		
30 kHz	± 0.011 dB	>10:1		
100 kHz	± 0.012 dB	>10:1		
300 kHz	± 0.017 dB	>10:1		
500 kHz	± 0.109 dB[3]	8.1:1		
1 MHz	± 0.109 dB[3]	8.1:1		
2 MHz	± 0.109 dB[3]	8.1:1		
5 MHz	± 0.109 dB[3]	8.1:1		
10 MHz	± 0.087 dB[3]	10:1		
25 MHz	± 0.089 dB[3]	9.9:1		
40 MHz	± 0.089 dB[3]	9.9:1		
55 MHz	± 0.092 dB[3]	9.6:1		
70 MHz	± 0.092 dB[3]	9.6:1		
85 MHz	± 0.092 dB[3]	9.6:1		
100 MHz	± 0.092 dB[3]	9.6:1		
120 MHz	± 0.098 dB[3]	9.1:1		
135 MHz	± 0.098 dB[3]	9.1:1		
150 MHz	± 0.098 dB[3]	9.1:1		
	± 0.098 dB[3]	9.1:1		
Amplitude Accuracy and Flatness				
50Ω				
10 to 100 Hz	± 0.035 dB	>10:1		
100 Hz to 30 kHz	± 0.035 dB	>10:1		
30 kHz to 50 MHz	± 0.035 dB	>10:1		
50 MHz to 100 MHz	± 0.045 dB	10:1		
100 MHz to 150 MHz	± 0.060 dB	>10:1		
1 MΩ				
10 to 100 Hz	± 0.035 dB	>10:1		
100 Hz to 30 kHz	± 0.035 dB	>10:1		
30 kHz to 40 MHz	± 0.035 dB	>10:1		

[1] internal test
[2] open-ended specification
[3] root-sum-squares calculation method

Table 3-5. HP 3589A Measurement Uncertainty (continued)

Performance Test	Using Recommended Test Equipment		Using Other Test Equipment	
	Measurement Uncertainty	Ratio	Measurement Uncertainty	Ratio
Alt_Amp Accuracy and Flatness				
50Ω				
10 Hz	± 0.011 dB	>10:1		
100 Hz	± 0.010 dB	>10:1		
1 kHz	± 0.010 dB	>10:1		
10 kHz	± 0.011 dB	>10:1		
30 kHz	± 0.012 dB	>10:1		
100 kHz	± 0.017 dB	>10:1		
300 kHz	± 0.109 dB[3]	4.3:1		
500 kHz	± 0.109 dB[3]	4.3:1		
1 MHz	± 0.109 dB[3]	4.3:1		
2 MHz	± 0.109 dB[3]	4.3:1		
5 MHz	± 0.097 dB[3]	5.4:1		
10 MHz	± 0.089 dB[3]	5.3:1		
25 MHz	± 0.089 dB[3]	5.3:1		
40 MHz	± 0.092 dB[3]	5.1:1		
55 MHz	± 0.092 dB[3]	5.1:1		
70 MHz	± 0.092 dB[3]	5.1:1		
85 MHz	± 0.092 dB[3]	5.1:1		
100 MHz	± 0.098 dB[3]	4.8:1		
120 MHz	± 0.098 dB[3]	4.8:1		
135 MHz	± 0.098 dB[3]	4.8:1		
150 MHz	± 0.098 dB[3]	4.8:1		
1 MΩ				
10 Hz	± 0.011 dB	>10:1		
100 Hz	± 0.010 dB	>10:1		
1 kHz	± 0.010 dB	>10:1		
10 kHz	± 0.011 dB	>10:1		
30 kHz	± 0.012 dB	>10:1		
100 kHz	± 0.017 dB	>10:1		
300 kHz	± 0.109 dB[3]	5.1:1:		
500 kHz	± 0.109 dB[3]	5.1:1:		
1 MHz	± 0.109 dB[3]	5.1:1:		
2 MHz	± 0.109 dB[3]	5.1:1:		
5 MHz	± 0.097 dB[3]	6.4:1		
10 MHz	± 0.089 dB[3]	6.2:1		
25 MHz	± 0.089 dB[3]	6.2:1		
40 MHz	± 0.092 dB[3]	6.0:1		
Reference Level Accuracy	± 0.036 dB	8:1		

[1] internal test
[2] open-ended specification
[3] root-sum-squares calculation method

Table 3-5. HP 3589A Measurement Uncertainty (continued)

Performance Test	Using Recommended Test Equipment		Using Other Test Equipment	
	Measurement Uncertainty	Ratio	Measurement Uncertainty	Ratio
Dynamic Accuracy				
–10 to –30 dB	± 0.02 dB	4.9:1		
–40 dB	± 0.02 dB	7.4:1		
–50 dB	± 0.03 dB	>10:1		
–60 dB	± 0.03 dB	>10:1		
–70 dB	± 0.03 dB	>10:1		
Source Dynamic Accuracy				
10 dB pad	± 0.02 dB	9.8:1		
20 dB pad	± 0.02 dB	>10:1		
Input Return Loss	± 0.9 dB	NA[2]		NA[2]
Source Return Loss	± 0.9 dB	NA[2]		NA[2]
Source Harmonic Distortion	± 2.5 dB	NA[2]		NA[2]
Source Spurious Responses	± 1.5 dB[3]	NA[2]		NA[2]
Source Noise	± 1.65 dB[3]	NA[2]		NA[2]

[1] internal test
[2] open-ended specification
[3] root-sum-squares calculation method

Table 3-6. HP 35689A/B Measurement Uncertainty

Performance Test	Using Recommended Test Equipment		Using Other Test Equipment	
	Measurement Uncertainty	Ratio	Measurement Uncertainty	Ratio
Directivity and Source Match	± 0.15dB	NA[1]		
Reflection	Magnatude ± 0.05dB Phase ± 1.0 deg	>10:1 5:1		
Transmission	Magnatude ± 0.05dB Phase ± 1.0 deg	>10:1 5:1		
Isolation	± 0.7dB	NA[1]		
Return Loss	± 0.9dB	NA[1]		

[1] open ended specification

HP 3589A Performance Test Record

Test Facility_____

Facility Address_____

Tested By_____

Report Number_____

Customer Name_____

Serial Number_____

Installed Options_____

Date_____

Temperature_____

Humidity_____

Power Line Frequency_____

Serial Number:_____Report Number:_____Test Date:__/__/__

Test Instruments Used

Instrument	Model	Trace Number	Cal Due
Signal Generator			
Synthesizer			
Synthesizer/Level Generator			
Analyzer			
Multimeter			
Power Meter			
Power Sensor			
Step Attenuator			
Directional Bridge			
21 MHz Filter			
50 MHz Filter			
Frequency Standard			
Milliwatt Power Meter			

Serial Number:_____ Report Number:_____ Test Date:___/___/___

Local Oscillator Feedthrough

Measurement	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
Feedthrough, –20 dBm range	–40		

Phase Noise

Measurement	Upper Limit (dB/Hz)	Measured Value (dB/Hz)	Pass/Fail
1 kHz Offset	–105		

Residual Responses

Measurement	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
60 Hz	–110		
120 Hz	–110		
180 Hz	–110		
12.5 kHz	–110		
24.7623 kHz	–110		
35.7134 kHz	–110		
100 kHz	–110		
187.5 kHz	–110		
250 kHz	–110		
10 MHz	–110		

Serial Number:_____Report Number:_____Test Date:__/__/__

Noise Level

Measurement	Upper Limit (dBm/Hz)	Measured Value (dBm/Hz)	Pass/Fail
50 ohm, 150 MHz	–132		
50 ohm, 140 MHz	–132		
50 ohm, 120 MHz	–132		
50 ohm, 71 MHz	–132		
50 ohm, 19 MHz	–132		
50 ohm, 5.3 MHz	–132		
50 ohm, 53 kHz	–132		
50 ohm, 5.3 kHz	–129		
50 ohm, 530 Hz	–124		
50 ohm, low distortion, 150 MHz	–122		
50 ohm, low distortion, 140 MHz	–122		
50 ohm, low distortion, 120 MHz	–122		
50 ohm, low distortion, 71 MHz	–122		
50 ohm, low distortion, 19 MHz	–122		
50 ohm, low distortion, 5.3 MHz	–122		
50 ohm, low distortion, 53 kHz	–122		
50 ohm, low distortion, 5.3 kHz	–119		
50 ohm, low distortion, 530 Hz	–114		
1 Mohm, 40 MHz	–110		
1 Mohm, 10.1 MHz	–110		
1 Mohm, 101 kHz	–110		
1 Mohm, 10.1 kHz	–100		
1 Mohm, 1.1 kHz	–90		
1 Mohm, 110 Hz	–80		

Frequency Accuracy

Measurement	Lower Limit (MHz)	Upper Limit (MHz)	Measured Value (MHz)	Pass/Fail
Accuracy @ 100 MHz				

Serial Number:_____Report Number:_____Test Date:__/__/__

Spurious Responses

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
Sum Reference, 10.8 MHz	–70		
Step combiner, 9.8 MHz	–70		
Step combiner, 149.8 MHz	–70		
API 1, 95.8125 MHz	–70		
API 1, 95.8129 MHz	–70		
API 1, 100.7925 MHz	–70		
API 1, 100.7929 MHz	–70		
API 2, 100.7925 MHz	–70		
API 3, 100.7925 MHz	–70		
API 4, 100.7925 MHz	–70		
Upper 3 MHz Sum Loop Sideband	–70		
Lower 3 MHz Sum Loop Sideband	–70		
Upper 10.123 kHz Sideband	–70		
Lower 10.123 kHz Sideband	–70		
100 kHz Sideband	–70		

Image Responses

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
40 MHz	–70		
60 MHz	–70		
61 MHz	–70		

Serial Number:_____Report Number:_____Test Date:__/__/__

Input Harmonic Distortion

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
47.265018 MHz, 2nd harmonic	–70		
47.265018 MHz, 3rd harmonic	–70		
47.265018 MHz, 2nd harmonic, low dist.	–80		
47.265018 MHz, 3rd harmonic, low dist.	–80		
18.816541 MHz, 2nd harmonic	–70		
18.816541 MHz, 3rd harmonic	–70		
18.816541 MHz, 2nd harmonic, low dist.	–80		
18.816541 MHz, 3rd harmonic, low dist.	–80		
18.816541 MHz, 2nd harmonic, 1 Mohm	–65		

Serial Number:_____ Report Number:_____ Test Date:___/___/___

Intermodulation Distortion

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
2nd order sum, 134 Hz offset	–70		
2nd order difference, 134 Hz offset	–70		
3rd order, 134 Hz offset	–70		
2nd order sum, 2.841 kHz offset	–70		
2nd order difference, 2.841 kHz offset	–70		
3rd order, 2.841 kHz offset	–70		
2nd order sum, 60 kHz offset	–70		
2nd order difference, 60 kHz offset	–70		
3rd order, 60 kHz offset	–70		
2nd order sum, 134 Hz offset, low dist.	–80		
2nd order diff, 134 Hz offset, low dist.	–80		
3rd order, 134 Hz offset, low dist.	–80		
2nd order sum, 2.841 kHz offset, low dist.	–80		
2nd order diff, 2.841 kHz offset, low dist.	–80		
3rd order, 2.841 kHz offset, low dist.	–80		
2nd order sum, 60 kHz offset, low dist.	–80		
2nd order diff, 60 kHz offset, low dist.	–80		
3rd order, 60 kHz offset, low dist.	–80		
2nd order, 134 Hz offset, 1 Meg Input	–65		
3rd order, 134 Hz offset, 1 Meg Input	–65		
2nd order, 2.841 kHz offset, 1 Meg Input	–65		
3rd order, 2.841 kHz offset, 1 Meg Input	–65		
2nd order, 60 kHz offset, 1 Meg Input	–65		
3rd order, 60 kHz offset, 1 Meg Input	–65		

Serial Number:_____Report Number:_____Test Date:__/__/__

Source Response †

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/Fail
Source Accuracy @ 300 kHz	14 dBm	16 dBm	dBm	
Source Min. from 300 kHz	–1 dB	1 dB	dB	
Source Max. from 300 kHz	–1 dB	1 dB	dB	

† This test is not included in the ALT_PERF or ALT_OPVER procedure files.

Amplitude Accuracy and Flatness†

Measurement	Lower Limit (dBm)	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
50 Ohm 30 kHz to 150 MHz maximum	–0.5	0.5		
50 Ohm 30 kHz to 150 MHz minimum	–0.5	0.5		
50 Ohm 300 kHz to 40 MHz maximum	–0.4	0.4		
50 Ohm 300 kHz to 40 MHz minimum	–0.4	0.4		
50 Ohm 100 Hz to 30 kHz maximum	–1	1		
50 Ohm 100 Hz to 30 kHz minimum	–1	1		
50 Ohm 10 Hz to 100 Hz maximum	–2.5	2.5		
50 Ohm 10 Hz to 100 Hz minimum	–2.5	2.5		
1 MOhm 30 kHz to 40 MHz maximum	–0.6	0.6		
1 MOhm 30 kHz to 40 MHz minimum	–0.6	0.6		
1 MOhm 100 Hz to 30 kHz maximum	–1.25	1.25		
1 MOhm 100 Hz to 30 kHz minimum	–1.25	1.25		
1 MOhm 10 Hz to 100 Hz maximum	–2.5	2.5		
1 MOhm 10 Hz to 100 Hz minimum	–2.5	2.5		

† This test is not included in the ALT_PERF or ALT_OPVER procedure files.

Serial Number:_____Report Number:_____Test Date:__/__/__

Alt_Amp Accuracy and Flatness†

Measurement	Lower Limit (dBm)	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
Source Accuracy @ 300 kHz	14	16		
Source Min. from 300 kHz	–1	1		
Source Max. from 300 kHz	–1	1		
50 Ohm 30 kHz to 150 MHz maximum	–0.5	0.5		
50 Ohm 30 kHz to 150 MHz minimum	–0.5	0.5		
50 Ohm 300 kHz to 40 MHz maximum	–0.4	0.4		
50 Ohm 300 kHz to 40 MHz minimum	–0.4	0.4		
50 Ohm 100 Hz to 30 kHz maximum	–1	1		
50 Ohm 100 Hz to 30 kHz minimum	–1	1		
50 Ohm 10 Hz to 100 Hz maximum	–2.5	2.5		
50 Ohm 10 Hz to 100 Hz minimum	–2.5	2.5		
1 MOhm 30 kHz to 40 MHz maximum	–0.6	0.6		
1 MOhm 30 kHz to 40 MHz minimum	–0.6	0.6		
1 MOhm 100 Hz to 30 kHz maximum	–1.25	1.25		
1 MOhm 100 Hz to 30 kHz minimum	–1.25	1.25		
1 MOhm 10 Hz to 100 Hz maximum	–2.5	2.5		
1 MOhm 10 Hz to 100 Hz minimum	–2.5	2.5		

† This test is not included in the PERFORM or OP_VERIFY procedure files.

Reference Level Accuracy

Measurement	Lower Limit (dBm)	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
–20 dBm range	–20.3	–19.7		
–10 dBm range	–10.3	–9.7		
0 dBm range	–0.3	0.3		
10 dBm range	9.7	10.3		
20 dBm range	19.7	20.3		

Serial Number:_____Report Number:_____Test Date:__/__/__

Dynamic Accuracy

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/Fail
Amplitude @ –10 dB	–0.1 dB	0.1 dB	dB	
Phase @ –10 dB	–1.5 deg	1.5 deg	deg	
Amplitude @ –20 dB	–0.1 dB	0.1 dB	dB	
Phase @ –20 dB	–1.5 deg	1.5 deg	deg	
Amplitude @ –30 dB	–0.1 dB	0.1 dB	dB	
Phase @ –30 dB	–1.5 deg	1.5 deg	deg	
Amplitude @ –40 dB	–0.15 dB	0.15 dB	dB	
Phase @ –40 dB	–2 deg	2 deg	deg	
Amplitude @ –50 dB	–0.35 dB	0.35 dB	dB	
Phase @ –50 dB	–3 deg	3 deg	deg	
Amplitude @ –60 dB	–0.55 dB	0.55 dB	dB	
Phase @ –60 dB	–4 deg	4 deg	deg	
Amplitude @ –70 dB	–0.75 dB	0.75 dB	dB	
Phase @ –70 dB	–6 deg	6 deg	deg	

Serial Number:_____Report Number:_____Test Date:__/__/__

Source Dynamic Accuracy

Measurement	Lower Limit (dB)	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
10 dB attenuator	–0.2	0.2		
10 dB DAC attenuator	–0.2	0.2		
20 dB A attenuator	–0.4	0.4		
20 dB B attenuator	–0.4	0.4		
20 dB DAC attenuator	–0.4	0.4		

Input Return Loss

Measurement	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
20 dBm range, 100 MHz	–20		
10 dBm range, 100 MHz	–20		
0 dBm range, 100 MHz	–20		
-10 dBm range, 100 MHz	–20		
-20 dBm range, 100 MHz	–20		
20 dBm range, 150 MHz	–20		
10 dBm range, 150 MHz	–20		
0 dBm range, 150 MHz	–20		
-10 dBm range, 150 MHz	–20		
-20 dBm range, 150 MHz	–20		

Serial Number:_____Report Number:_____Test Date:___/___/___

Source Return Loss

Measurement	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
15 dBm output, 60 MHz	–20		
5 dBm output, 60 MHz	–20		
-5 dBm output, 60 MHz	–20		
-15 dBm output, 60 MHz	–20		
-25 dBm output, 60 MHz	–20		
-35 dBm output, 60 MHz	–20		
15 dBm output, 120 MHz	–20		
5 dBm output, 120 MHz	–20		
-5 dBm output, 120 MHz	–20		
-15 dBm output, 120 MHz	–20		
-25 dBm output, 120 MHz	–20		
-35 dBm output, 120 MHz	–20		
15 dBm output, 150 MHz	–20		
5 dBm output, 150 MHz	–20		
-5 dBm output, 150 MHz	–20		
-15 dBm output, 150 MHz	–20		
-25 dBm output, 150 MHz	–20		
-35 dBm output, 150 MHz	–20		

Serial Number:_____Report Number:_____Test Date:__/__/__

Source Harmonic Distortion

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
100 kHz, 2nd harmonic	–28		
100 kHz, 3rd harmonic	–28		
1 MHz, 2nd harmonic	–28		
1 MHz, 3rd harmonic	–28		
10 MHz, 2nd harmonic	–28		
10 MHz, 3rd harmonic	–28		
50 MHz, 2nd harmonic	–28		
50 MHz, 3rd harmonic	–28		
75 MHz, 2nd harmonic	–28		

Serial Number:_____Report Number:_____Test Date:__/__/__

Source Spurious Responses

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
10.1875 MHz	–40		
101.1875 MHz	–40		
101.375 MHz	–40		
10.3875 MHz	–40		

Source Noise

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
8.0125 MHz, 512 Hz offset	–80		
8.0125 MHz, 2.56 kHz offset	–80		
8.0125 MHz, 12.801 kHz offset	–80		
8.0125 MHz, 64.006 kHz offset	–80		
8.0125 MHz, 320.031 kHz offset	–80		
8.0125 MHz, 1.600156 MHz offset	–80		
140.0125 MHz, 512 Hz offset	–80		
140.0125 MHz, 2.56 kHz offset	–80		
140.0125 MHz, 12.801 kHz offset	–80		
140.0125 MHz, 64.006 kHz offset	–80		
140.0125 MHz, 320.031 kHz offset	–80		
140.0125 MHz, 1.600156 MHz offset	–80		

HP 3589A Operation Verification Test Record

Test Facility_____

Facility Address_____

Tested By_____

Report Number_____

Customer Name_____

Serial Number_____

Installed Options_____

Date_____

Temperature_____

Humidity_____

Power Line Frequency_____

Serial Number:_____Report Number:_____Test Date:__/__/__

Test Instruments Used

Instrument	Model	Trace Number	Cal Due
Signal Generator			
Synthesizer			
Synthesizer/Level Generator			
Analyzer			
Multimeter			
Power Meter			
Power Sensor			
Step Attenuator			
Directional Bridge			
21 MHz Filter			
50 MHz Filter			
Frequency Standard			
Milliwatt Power Meter			

Serial Number:_____Report Number:_____Test Date:___/___/___

Local Oscillator Feedthrough

Measurement	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
Feedthrough, –20 dBm range	–40		

Phase Noise

Measurement	Upper Limit (dB/Hz)	Measured Value (dB/Hz)	Pass/Fail
1 kHz Offset	–105		

Residual Responses

Measurement	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
60 Hz	–110		
120 Hz	–110		
180 Hz	–110		
12.5 kHz	–110		
24.7623 kHz	–110		
35.7134 kHz	–110		
100 kHz	–110		
187.5 kHz	–110		
250 kHz	–110		
10 MHz	–110		

Serial Number:_____Report Number:_____Test Date:__/__/__

Noise Level

Measurement	Upper Limit (dBm/Hz)	Measured Value (dBm/Hz)	Pass/Fail
50 ohm, 150 MHz	–132		
50 ohm, 120 MHz	–132		
50 ohm, 19 MHz	–132		
50 ohm, 530 Hz	–124		
50 ohm, low distortion, 150 MHz	–122		
50 ohm, low distortion, 120 MHz	–122		
50 ohm, low distortion, 19 MHz	–122		
50 ohm, low distortion, 530 Hz	–114		
1 Mohm, 40 MHz	–110		
1 Mohm, 10.1 kHz	–100		
1 Mohm, 110 Hz	–80		

Frequency Accuracy

Measurement	Lower Limit (MHz)	Upper Limit (MHz)	Measured Value (MHz)	Pass/Fail
Accuracy @ 100 MHz				

Serial Number:_____Report Number:_____Test Date:__/__/__

Spurious Responses

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
Sum Reference, 10.8 MHz	–70		
Step combiner, 9.8 MHz	–70		
Step combiner, 149.8 MHz	–70		
API 1, 95.8125 MHz	–70		
API 1, 95.8129 MHz	–70		
API 1, 100.7925 MHz	–70		
API 1, 100.7929 MHz	–70		
API 2, 100.7925 MHz	–70		
API 3, 100.7925 MHz	–70		
API 4, 100.7925 MHz	–70		
Upper 3 MHz Sum Loop Sideband	–70		
Lower 3 MHz Sum Loop Sideband	–70		
Upper 10.123 kHz Sideband	–70		
Lower 10.123 kHz Sideband	–70		
Lower 100 kHz Sideband	–70		

Image Responses

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
40 MHz	–70		
60 MHz	–70		
61 MHz	–70		

Serial Number:_____Report Number:_____Test Date:__/__/__

Input Harmonic Distortion

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
47.265018 MHz, 2nd harmonic, low dist.	–80		
47.265018 MHz, 3rd harmonic, low dist.	–80		
18.816541 MHz, 2nd harmonic, low dist.	–80		
18.816541 MHz, 3rd harmonic, low dist.	–80		

Source Response†

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/Fail
Source Accuracy @ 300 kHz	14 dBm	16 dBm	dBm	
Source Min. from 300 kHz	–1 dB	1 dB	dB	
Source Max. from 300 kHz	–1 dB	1 dB	dB	

† This test is not included in the ALT_PERF or ALT_OPVER procedure files.

Amplitude Accuracy and Flatness†

Measurement	Lower Limit (dBm)	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
50 Ohm 30 kHz to 150 MHz Maximum	–0.5	0.5		
50 Ohm 30 kHz to 150 MHz Minimum	–0.5	0.5		
50 Ohm 300 kHz to 40 MHz Maximum	–0.4	0.4		
50 Ohm 300 kHz to 40 MHz Minimum	–0.4	0.4		
50 Ohm 100 Hz to 30 kHz Maximum	–1	1		
50 Ohm 100 Hz to 30 kHz Minimum	–1	1		
50 Ohm 10 Hz to 100 Hz Maximum	–2.5	2.5		
50 Ohm 10 Hz to 100 Hz Minimum	–2.5	2.5		

† This test is not included in the ALT_PERF or ALT_OPVER procedure files.

Serial Number:_____ Report Number:_____ Test Date:__/__/__

Alt_Amp Accuracy and Flatness†

Measurement	Lower Limit (dBm)	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
Source Accuracy @ 300 kHz	14	16		
Source Min. from 300 kHz	–1	1		
Source Max. from 300 kHz	–1	1		
50 Ohm 30 kHz to 150 MHz maximum	–0.5	0.5		
50 Ohm 30 kHz to 150 MHz minimum	–0.5	0.5		
50 Ohm 300 kHz to 40 MHz maximum	–0.4	0.4		
50 Ohm 300 kHz to 40 MHz minimum	–0.4	0.4		
50 Ohm 100 Hz to 30 kHz maximum	–1	1		
50 Ohm 100 Hz to 30 kHz minimum	–1	1		
50 Ohm 10 Hz to 100 Hz maximum	–2.5	2.5		
50 Ohm 10 Hz to 100 Hz minimum	–2.5	2.5		

† This test is not included in the PERFORM or OP_VERIFY procedure files.

Reference Level Accuracy

Measurement	Lower Limit (dBm)	Upper Limit (dBm)	Measured Value (dBm)	Pass/Fail
–20 dBm Range	–20.3	–19.7		
–10 dBm Range	–10.3	–9.7		
0 dBm Range	–0.3	0.3		
10 dBm Range	9.7	10.3		
20 dBm Range	19.7	20.3		

Source Dynamic Accuracy

Measurement	Lower Limit (dB)	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
10 dB attenuator	–0.2	0.2		
10 dB DAC attenuator	–0.2	0.2		
20 dB A attenuator	–0.4	0.4		
20 dB B attenuator	–0.4	0.4		
20 dB DAC attenuator	–0.4	0.4		

Serial Number:_____Report Number:_____Test Date:__/__/__

Source Harmonic Distortion

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
100 kHz, 2nd harmonic	–28		
100 kHz, 3rd harmonic	–28		
50 MHz, 2nd harmonic	–28		
50 MHz, 3rd harmonic	–28		

Source Spurious Responses

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
10.1875 MHz	–40		
101.1875 MHz	–40		
101.375 MHz	–40		
10.3875 MHz	–40		

Source Noise

Measurement	Upper Limit (dBc)	Measured Value (dBc)	Pass/Fail
8.0125 MHz, 512 Hz offset	–80		
8.0125 MHz, 64.006 kHz offset	–80		

HP 35689A/B Performance Test Record

Test Facility_____

Facility Address_____

Tested By_____

Report Number_____

Customer Name_____

Serial Number_____

Installed Options_____

Date_____

Temperature_____

Humidity_____

Power Line Frequency_____

Test Instruments Used

Instrument	Model	Trace Number	Cal Due
Spectrum/Network Analyzer			
Directional Bridge			
Z0 Termination			

Serial Number:_____Report Number:_____Test Date:__/__/__

Directivity and Source Match (HP 35689A)

Measurement	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
Port 1 Directivity	–40		
Port 1 Source Match	–26		
Port 2 Directivity	–40		
Port 2 Source Match	–26		

Directivity and Source Match (HP 35689B)

Measurement	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
Port 1 Directivity	–40		
Port 1 Source Match	–24		
Port 2 Directivity	–40		
Port 2 Source Match	–24		

Reflection

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/Fail
S11 Magnitude	–1 dB	1 dB	dB	
S11 Phase	–5 deg	5 deg	deg	
S22 Magnitude	–1 dB	1 dB	dB	
S22 Phase	–5 deg	5 deg	deg	

Transmission

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/Fail
S21 Magnitude	–1 dB	1 dB	dB	
S21 Phase	–5 deg	5 deg	deg	
S12 Magnitude	–1 dB	1 dB	dB	
S12 Phase	–5 deg	5 deg	deg	

Serial Number:_____Report Number:_____Test Date:___/___/___

Isolation

Measurement	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
S21 Isolation	–90		
S12 Isolation	–90		

Return Loss

Measurement	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
Input, S11	–20		
Input, S22	–20		
Input, Reference	–20		
Output, S11	–20		
Output, S22	–20		
Output, Reference	–20		

HP 35689A/B Operation Verification Test Record

Test Facility_____

Facility Address_____

Tested By_____

Report Number_____

Customer Name_____

Serial Number_____

Installed Options_____

Date_____

Temperature_____

Humidity_____

Power Line Frequency_____

Test Instruments Used

Instrument	Model	Trace Number	Cal Due
Spectrum/Network Analyzer			
Z0 Termination			

Serial Number:_____Report Number:_____Test Date:__/__/__

Directivity and Source Match (HP 35689A)

Measurement	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
Port 1 Directivity	–40		
Port 1 Source Match	–26		
Port 2 Directivity	–40		
Port 2 Source Match	–26		

Directivity and Source Match (HP 35689B)

Measurement	Upper Limit (dB)	Measured Value (dB)	Pass/Fail
Port 1 Directivity	–40		
Port 1 Source Match	–24		
Port 2 Directivity	–40		
Port 2 Source Match	–24		

Reflection

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/Fail
S11 Magnitude	–1 dB	1 dB	dB	
S11 Phase	–5 deg	5 deg	deg	
S22 Magnitude	–1 dB	1 dB	dB	
S22 Phase	–5 deg	5 deg	deg	

Transmission

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/Fail
S21 Magnitude	–1 dB	1 dB	dB	
S21 Phase	–5 deg	5 deg	deg	
S12 Magnitude	–1 dB	1 dB	dB	
S12 Phase	–5 deg	5 deg	deg	

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