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Errata

Title & Document Type:

Manual Part Number:

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HP References in this Manual

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

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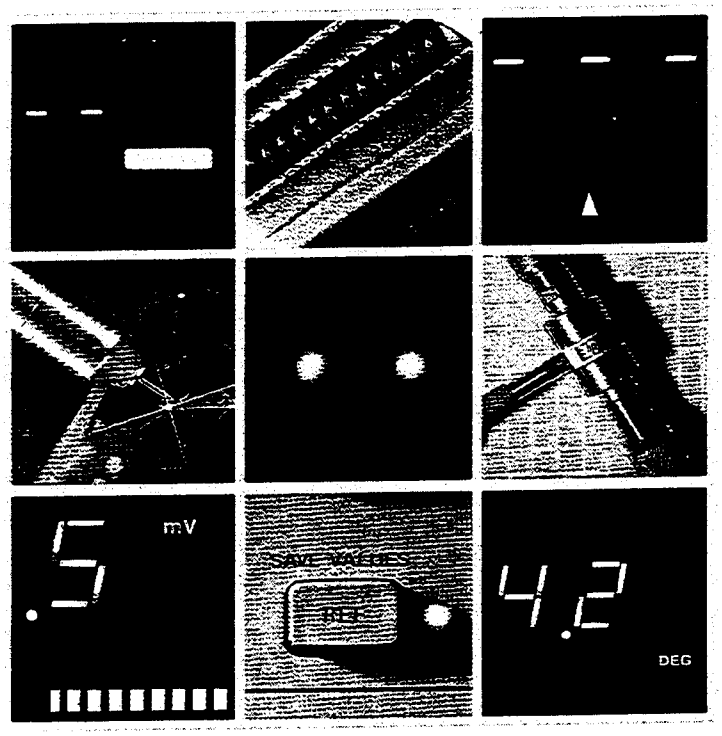
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Product Note 8508-1

HP 8508A Vector Voltmeter User's Guide

HEWLETT PACKARD

ADK4



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ATTENTION
Static Sensitive
Devices

Don't zap your input probes!

The probes of the HP 8508A are susceptible to damage from electro-static discharge (ESD). Comply with the following precautions to help avoid damage to your probes.

Anti-static precautions

Never touch the tip of the probe.

Eliminate ESD on the body by wearing a snug-fitting ground strap that is connected to earth ground through a 1M ohm resistor.

Eliminate ESD on the work surface by using a grounded anti-static bench mat. Optional floor mats provide an extra measure of protection especially in areas with floor carpet. Never use this product on a carpeted work surface unless the carpet is of a conductive type specifically designed to eliminate ESD.

Do not introduce ESD into the Device Under Test (DUT) while using the probes. If an unprotected person touches a part of the DUT, a static surge could damage the DUT as well as the probes.

Always refit the protective cover when the probe is not in use.

Mechanical abuse

The tips of the probes are fragile and can break if the probe is dropped.

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Section 1

Introduction

This User's Guide is a simplified operating guide to the HP 8508A Vector Voltmeter, and is designed as an introduction to the instrument. Typical measurements are illustrated using step-by-step procedures.

More detailed operating and programming information is given in the HP 8508A Operating and Service Manual (HP part number 08508-90000).

Product description

The HP 8508A Vector Voltmeter is a dual-channel, autoranging receiver which measures the voltages of two CW signals and the phase difference between them. The following diagram shows the vector relationship between two signals at the same frequency and the way that one is used as a phase reference in the HP 8508A.

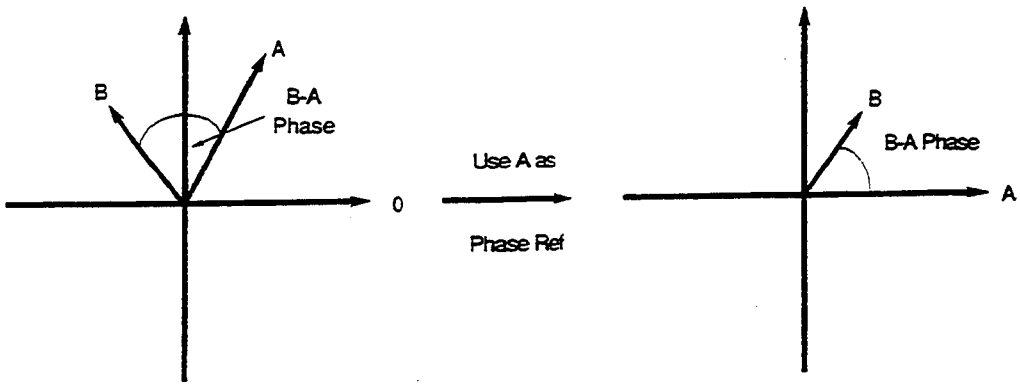


Figure 1. Vector Signals

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The measurements are either of a single channel or the ratio between the two channels, and the results displayed as voltage or power (in linear or log units), normalized magnitude and phase angle, or real and imaginary components. In addition the HP 8508A has built-in procedures for simple network analysis. The HP 8508A has two configurations - the first providing two high impedance probe inputs with a frequency range from 100kHz to 1GHz, and the second providing two 50ohm type-N connector inputs with a frequency range of 300kHz to 2GHz. The configuration can be changed by replacing the instrument's input module.

Applications

The HP 8508A is used in applications where vector signal information is required at low cost - particularly in the design, manufacture or service of RF assemblies. The HP 8508A is a simple, high-sensitivity receiver and can be used with any source, including one that is part of the device to be tested. Its built-in HP-IB interface for programming allows it to be used as an economical tool in automated production environments.

Typical measurements include voltage, power, gain or loss, impedance and phase matching. Measurements can be made either from the input to the output of the device, or by probing within the device. Other measurements include transmission and reflection - procedures that include test system calibration against known standards.

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Equipment required

A typical setup includes a source (which may be part of the device to be tested), a reference path and a measurement path. Cables, adapters and other accessories required depend on the application. A list of common accessories for use with the HP 8508A is shown in Appendix A. The following diagram shows a typical setup.

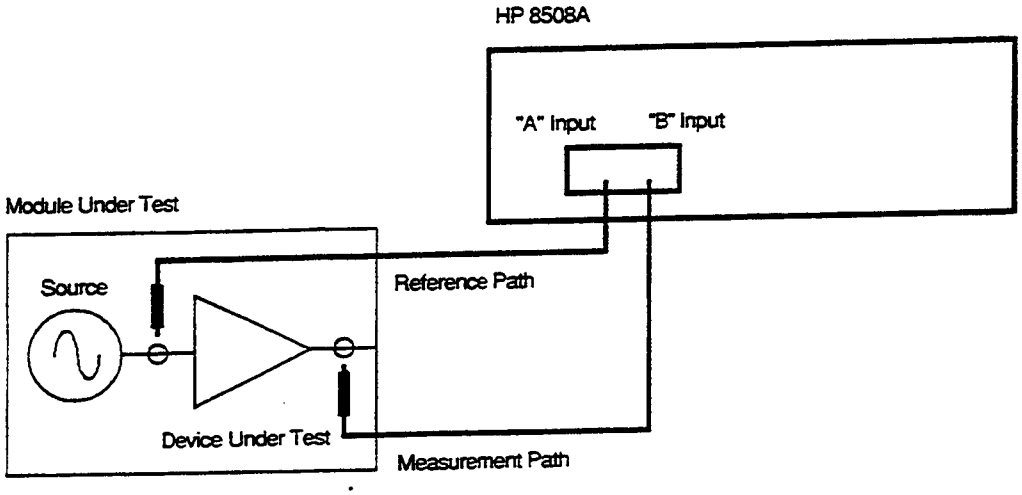


Figure 2. Typical Probing Set-up

In order for the source to be suitable for use with the HP 8508A, it has to meet certain specifications. It must produce a stable CW signal at the frequency of interest, with no modulation.

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Section 2

Getting started

To introduce you to the main functions of the HP 8508A, we'll go through a few simple measurements. You will learn to make single channel voltage and power measurements and measure the vector ratio between two voltages.

Any unmodulated RF signal in the frequency range 100k to 1GHz can be used as a source for these measurements. This includes a source that is part of a larger device under test.

This diagram shows all the keys you will need to make the measurements, along with the step numbers in the example.

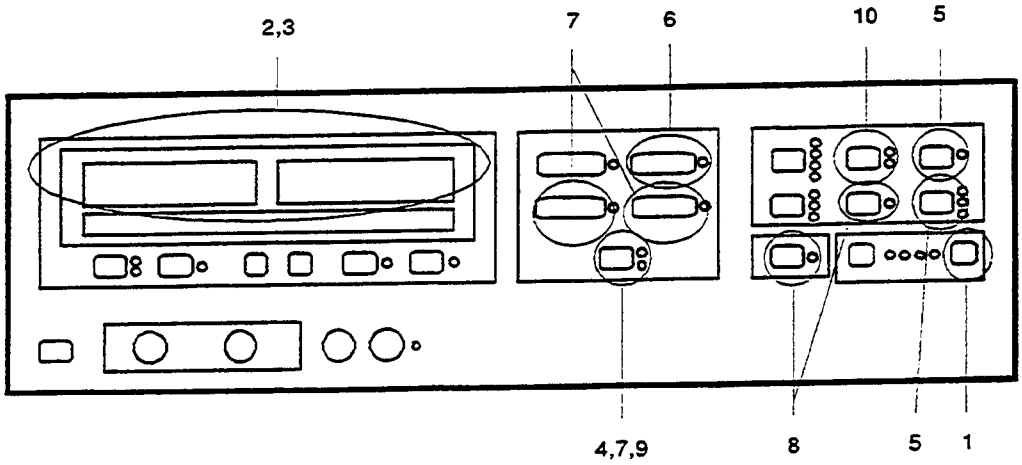


Figure 3. Front Panel

Operator's notes

In the descriptions throughout this Guide, keys on the instrument are described by writing the key name in square brackets, for example [PRESET].

Keys that have multiple selections are described by writing "select", followed by the key name in square brackets, then the required function in **bold** type, for example "Select [REFL MEAS] **SWR**". When you press this type of key, the next valid state will be selected. Press the key the required number of times to light the LED beside the state requested. Some selections are only available in combination with other keys, so don't worry if all the selections are not available.

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Some keys have a primary and alternative function. The alternative function key labels appear in blue on the front panel. These functions are described by showing [SHIFT] then the function name (which appears in blue on the front panel) - for example, the "Save Reference" function is described as press [SHIFT] then [SAVE REF]. Instrument functions do not display "OFF" or "AUTO". These modes are selected when no other indication appears.

1. PRESET

Before beginning a new measurement, press [PRESET] to return the HP 8508A to a known state. The following list shows the preset condition:

MEASUREMENTS
MEASUREMENTS A.....ON
DISPLAY 1.....UNITS

DISPLAYS
METER SELECT.....OFF
LOCK RANGE.....AUTO
MAG RANGE.....AUTO
HOLD VALUE.....OFF
DISPLAY 1.....mV
DISPLAY 2.....blank

FUNCTIONS
REF.....OFF
FORMAT.....MAG, ANGLE
REFL MEAS.....OFF
REF SELECT.....OFF
POWER MEAS.....OFF
SYSTEM IMPD.....50 ohm

2. UNLOCKED INDICATOR

Check that there is no input to the probes. With no input signal, the A UNLOCKED indicator should be ON and DISPLAY 1 (the left display) should indicate underrange (- - -).

NOTE: If there are high level radiated signals present, DISPLAY 1 may give a reading. This reading is caused by the un-terminated probe acting as an antenna. It will not affect the instrument's ability to make measurements on your circuit.

3. SINGLE-CHANNEL MEASUREMENT - A

The A probe is used as a reference by the HP 8508A, and must be connected for the instrument to function. The signal level should be around 100mV.

Connect the A probe to the source and turn on the output. The A UNLOCKED indicator should go OFF and DISPLAY 1 should show the source output voltage.

4. VOLTAGE UNITS

Select [DISPLAY] **dB** to have the HP 8508A compute and display the voltage in dBμV.

5. POWER MEASUREMENT

Press [POWER MEAS] to display power in dBm in a 50ohm system. The conversion of voltage to power uses the value set with the [SYSTEM IMPD] key, the default value being 50 ohms.

Press [POWER MEAS] again to return to the voltage measurement mode.

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6. SINGLE-CHANNEL MEASUREMENT - B

Most measurements with the HP 8508A will be done using the B probe, leaving the A probe in place as a reference. The B channel is much more sensitive since the A channel already provides the signal to which the instrument is locked.

Press [B] to display the B input voltage in Display 2. (The A reading remains in Display 1 unless you turn it off by pressing the [A] key. The A probe must still be connected in order to keep the instrument locked.) Display 2 shows the B channel residual noise level - less than 10μV when the probe is terminated, with no signal input.

7. DUAL-CHANNEL MEASUREMENT

The HP 8508A can display the ratio of the signals in its two channels.

Connect the two probes to the source output using a tee, as shown in the following diagram.

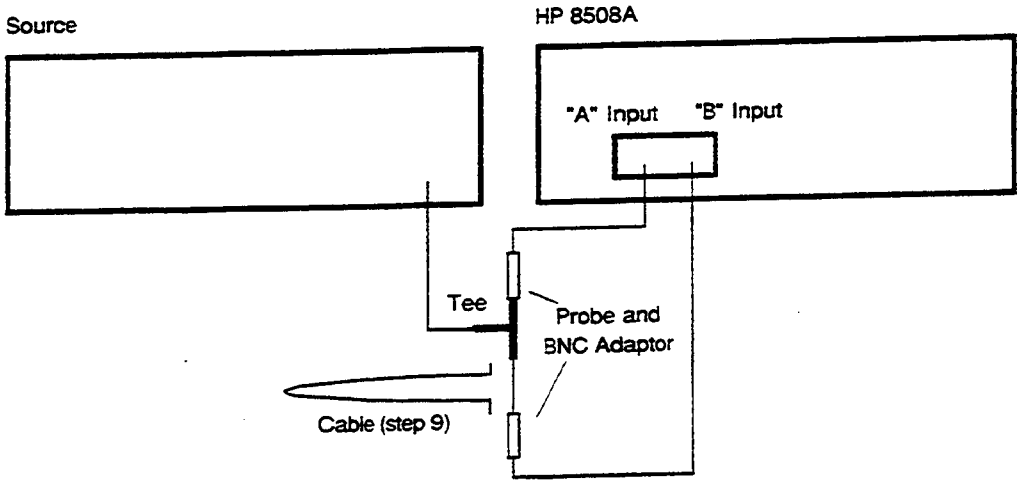


Figure 4. Two Probe Connection

Select [DISPLAY] **UNITS** to display the levels as voltages. (The A and B voltages in Displays 1 and 2 respectively should read approximately the same value.) Press [B/A MAG] to show the voltage ratio of B to A in Display 1. The reading should be approximately 1.0. Press [B-A PHASE] to display the input phase difference in Display 2. The reading should be approximately 0 deg.

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8. SET A REFERENCE Press [SHIFT] then [SAVE REF] to store the current measurement as a reference and normalize readings to the saved reference value. The displays should now read exactly 1.0 magnitude, and 0.0 deg phase.

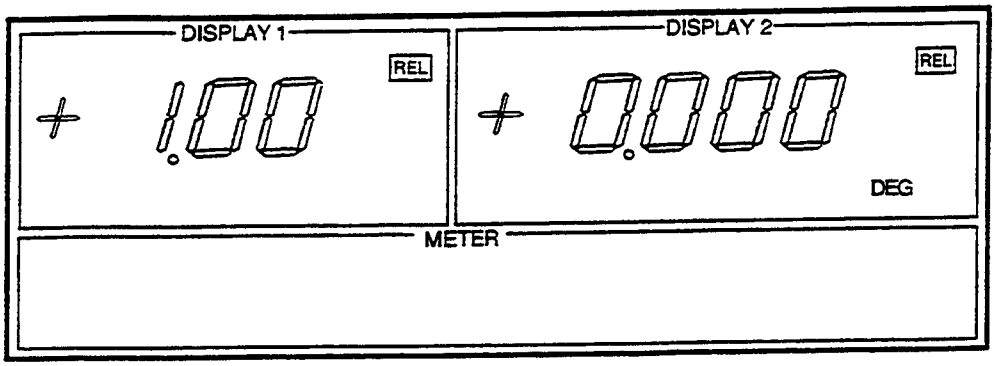


Figure 5. Displays

9. RELATIVE MEASUREMENT Now insert the cable as shown in Figure 4. The readings are now of the voltage ratio and phase difference caused by the cable, using the reference set in step 8. Select [DISPLAY] **dB** to read the cable insertion loss in dB. The phase difference can be used to calculate the cable's electrical length.

10. REAL AND IMAGINARY Instead of magnitude and phase, you can show the measurement results as real and imaginary components. Select [FORMAT] **REAL & IMAG** to see results in this form.

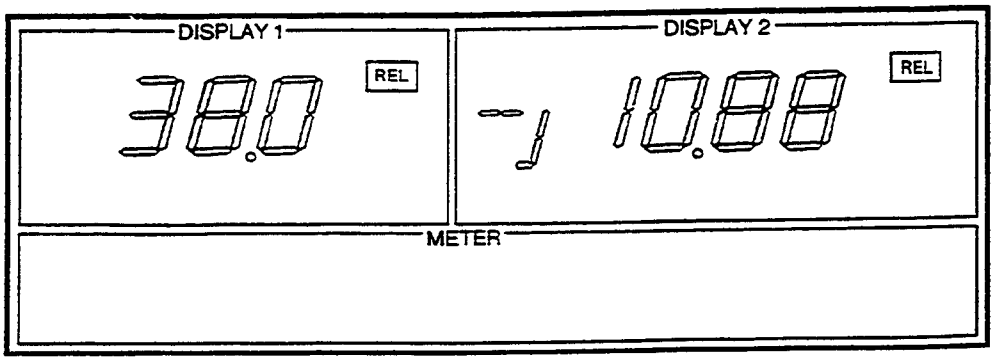


Figure 6. Displays

You've made voltage measurements (A and B) and a vector ratio measurement (B/A MAG, B-A PHASE), and normalized the ratio to a reference. Now go on to explore some more uses of the HP 8508A in the next section.

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Basic measurements

a. Measurements with probes

For this section, let's take an example of making measurements on a printed circuit board buffer amplifier. It is part of a 50MHz source assembly, and has a gain of approximately 14dB.

Probing at the input of the amplifier (the output of the oscillator) will allow us to find a reference signal and probing at the output of the amplifier will give the amplifier gain. We'll use the integral source as the stimulus, so the amplifier will be tested under normal operating conditions.

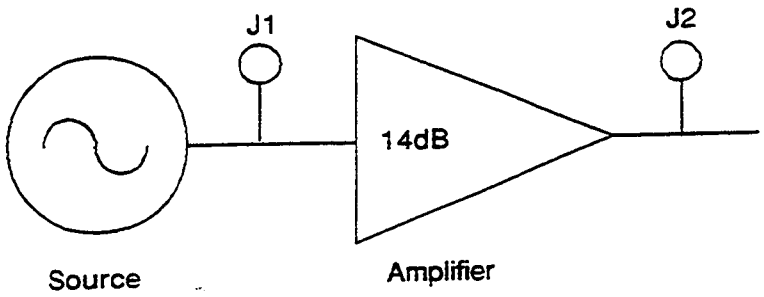


Figure 7. Test Assembly With Measurement Points

Since the circuit impedance is 50 ohms, and the measurements are at relatively low frequencies, we can neglect the loading effects of the probe tips on the circuit response. For more sensitive applications, the HP 11576A 10:1 Divider or HP 10216A Isolator accessories can be used with the probes to minimize loading effects and hence reduce measurement errors.

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Measurement details

1. Connect both probes at point "J1" (the amplifier input) in the circuit. Press [PRESET] to return the HP 8508A to a known starting state.

2. Check that the circuit under test is powered up and that the HP 8508A A UNLOCKED indicator is off. Press [B/A MAG] and [B-A PHASE] to display vector ratio.

3. Select [DISPLAY] **dB** to measure the amplifier's gain as a log ratio. Press [SHIFT] then [SAVE REF] to store the reference and set the ratio displays to magnitude 0.0dB and phase 0 degrees.

4. Move the B probe to point "J2" (the amplifier output) and measure the gain and phase change. Change the frequency of the oscillator over its operating range and check the frequency response variation. In a circuit with adjustable gain, the HP 8508A METER display is an aid to tuning. (Use of the meter display is covered in the next example.)

b. Measurements in a 50 ohm system

50 ohm measurements can be made directly when the HP 8508A is fitted with the type-N HP 85082A Input Module, or by using adapters with the probes of the HP 85081A Input Module. HP 11536A Probe Tees are available separately or as part of the HP 11570A Accessory Kit. The following diagram shows how to connect the probe adapters to make 50 ohm measurements.

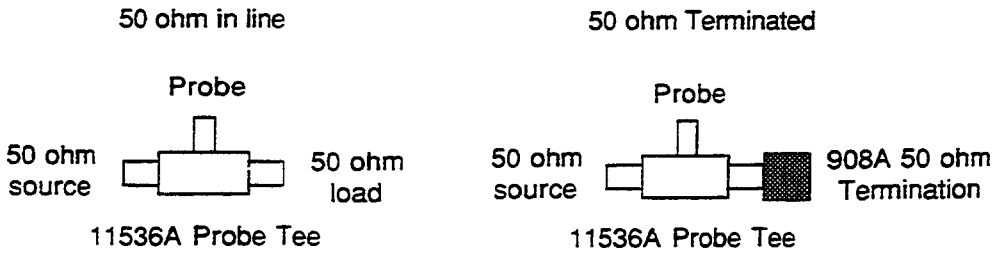


Figure 8. Probe to 50ohm Options

In this example, we'll measure the 3dB point of a low-pass filter that cuts off at around 50MHz. The circuit includes a source, and a power splitter which we'll use to obtain a reference signal. The filter is preceded by a 6dB pad to minimize out-of-band reflection problems.

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Measurement details

1. Connect the equipment as shown below. Press [PRESET] to get the instrument to a known state. then [B] to measure the filter output.

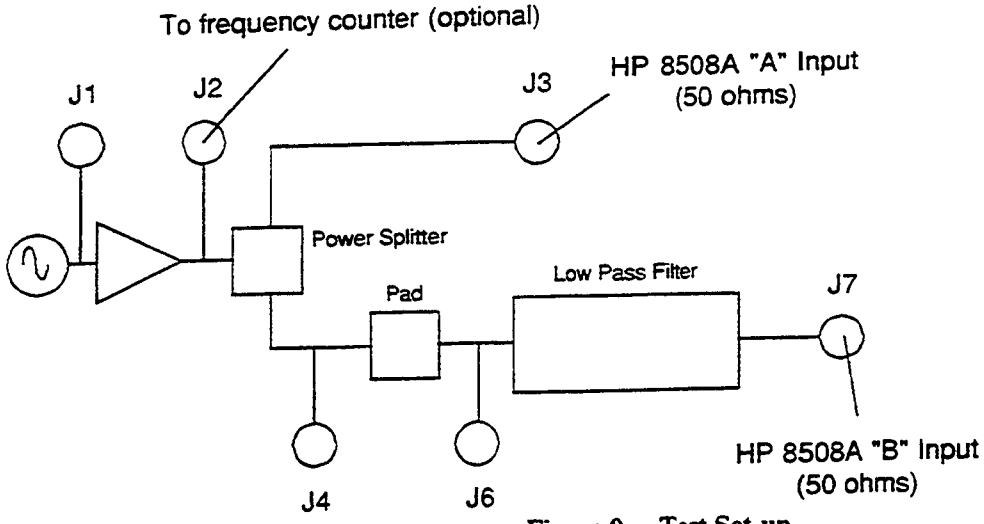


Figure 9. Test Set-up

2. Select [METER SELECT] **DISP2** to activate the bar on the B voltage, then tune the source frequency for a maximum to set the source in the filter passband.

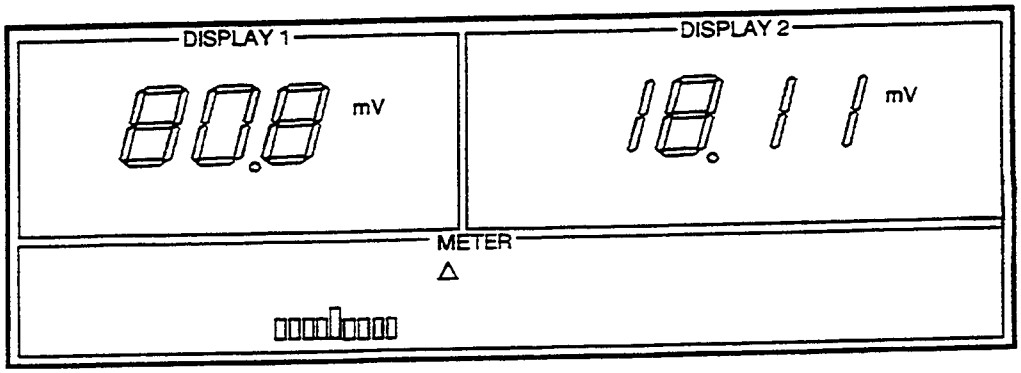


Figure 10. Meter Display

3. Press [B/A MAG] to measure the amplitude ratio, and select [DISPLAY] **dB** to display a log ratio.

4. Press [SHIFT] then [SAVE REF] to store the current reading, zero the magnitude reading and refer future measurements to the filter passband.

5. Now increase the source frequency until the display reads -3dB. Note the source frequency. This is the filter 3dB cutoff frequency.

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Advanced measurements

In this section we'll cover some simple network analysis measurements using the HP 8508A and a companion source. We'll cover both transmission and reflection measurements to show how some of the intelligence of the HP 8508A can be used to make your measurements easier. The measurement examples will use 50 ohm devices - refer to Section 3b "Measurements in a 50 ohm system" for details of configuring the HP 8508A for 50 ohm inputs.

a. Transmission

One good use of a CW receiver such as the HP 8508A is in the measurement of gain as a function of input level. The HP 8508A can display B/A as a ratio, so effects caused by changing input level can be seen directly.

To illustrate this we'll measure the 1dB gain compression point of a 50MHz, 14dB gain amplifier. Since the output at gain compression is specified to be 10dBm, we'll use an HP 8491A 10dB attenuator at the output of the amplifier to minimize measurement errors due to high signal levels.

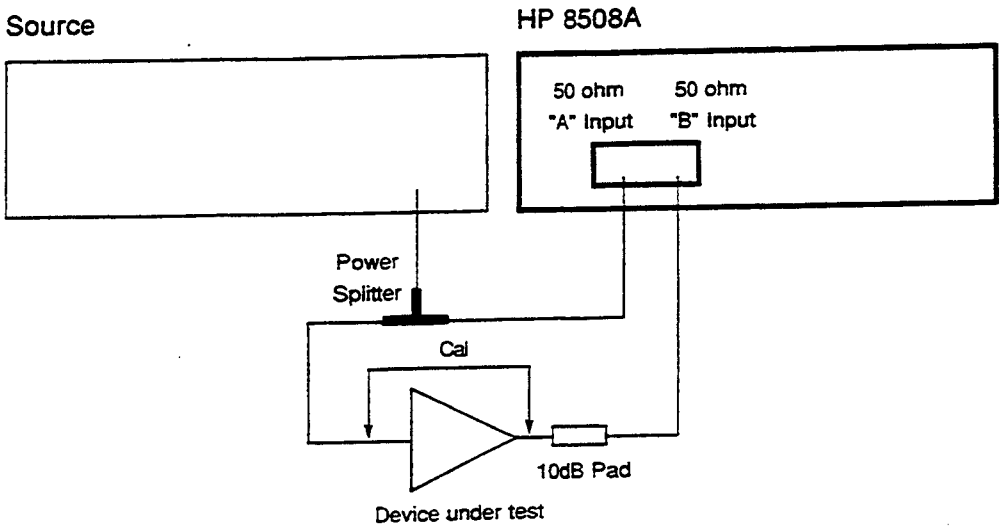


Figure 11. Transmission Test Set-up

1. Connect the A and B inputs to the power splitter. Set the source output level in the normal operating range of the amplifier. Set the source output frequency to 50MHz. Press [PRESET] to return the HP 8508A to a known state.

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2. Press [B/A MAG] to measure the magnitude ratio. Select [DISPLAY] **dB** to measure log gain. Press [SHIFT] then [SAVE REF] to store the current measurement, zero the display and remove splitter and input effects.

3. Connect the amplifier between the splitter and the B input and measure and note the gain.

4. Press [SHIFT] then [SAVE REF] to store and use this (nominal) gain as a reference and reset the reading to 0dB.

5. Increase the source output level until the HP 8508A reads -1dB. The amplifier is now operating at its gain compression point.

6. Press [REF] to remove the reference offset. Press [A] to measure the input voltage (dBμV), and [POWER MEAS] to convert the reading to dBm. Since the splitter is symmetrical, the measured power at the A input will be the same as at the amplifier input to within the tracking specifications of the power splitter.

b. Reflection The measurement of small reflections in high frequency RF systems requires careful consideration. At low levels, reflections from the device under test can be masked by leakage signals in the measuring equipment, so to make the measurement accurately, we'll need to use a high directivity reflection bridge or directional coupler. We'll use a short circuit as a calibration standard, and measure the return loss of a precision termination.

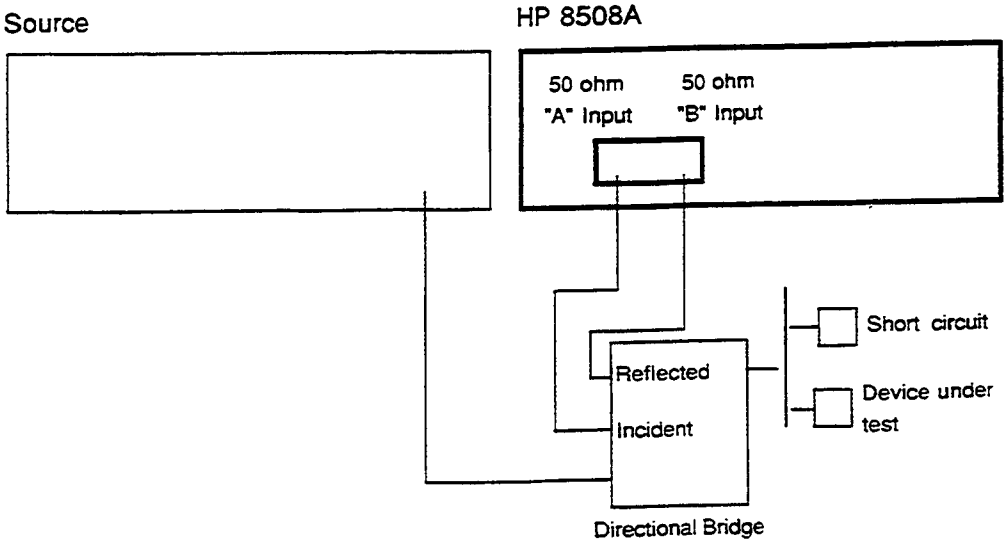


Figure 12a. Bridge Test Set-up

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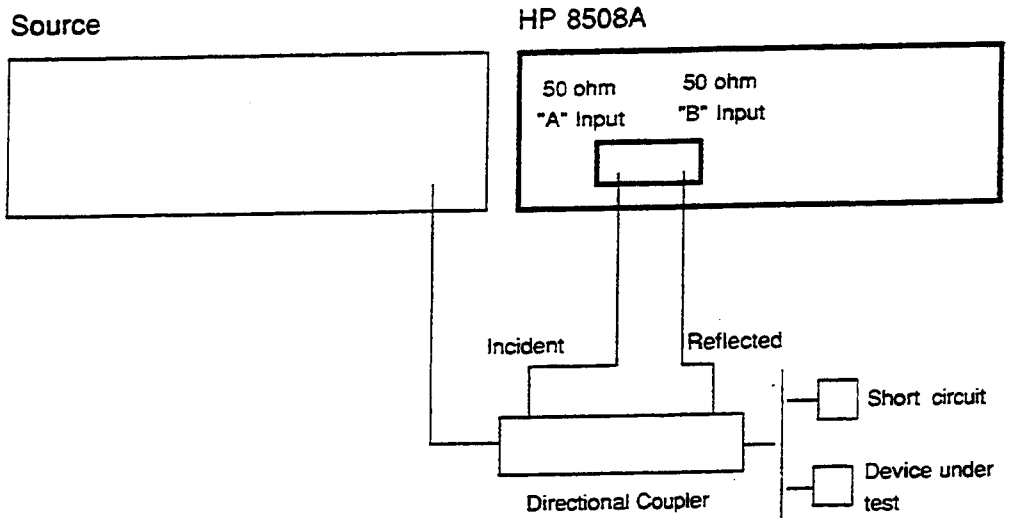


Figure 12b. Coupler Test Set-up

1. Connect the A and B inputs to the bridge or splitter as shown in one of the above diagrams (depending on the equipment you have available). Set the source power to 0dBm and frequency to the test frequency.

2. Connect a short circuit to the test port as the calibration standard. Press [PRESET] to return the HP 8508A to a known state. Select [REFL MEAS] ρ, $\angle$ to measure reflection coefficient.

3. Select [REF SELECT] **SHORT** to use a short circuit as the calibration standard. Select [DISPLAY] **dB** to measure the reflection as return loss in dB. Press [SHIFT] then [SAVE REF] to store the current measurement and display a return loss of 0dB and angle 180 degrees.

4. Remove the calibration standard and connect the termination to be measured. Read the return loss directly.

The HP 8508A has conversions built in to allow you to read results in normalized impedance for use with Smith charts. To make the conversion, select [REFL MEAS] **Z**, and [SYSTEM IMPD] **NORM**. There is no need to recalibrate since the new display is computed from the same reference measurements as before.

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c. Other functions

This is a short description of other functions in the HP 8508A that you will find useful. Full details are in the Operating Manual.

Key	Function	Use
[HOLD VALUE]	Freeze display at last reading when signal disappears.	Circuit probing, especially on dense circuits where the probe can easily slip to another track.
[REF SELECT] LOAD	Use a termination as the calibration standard for reflection measurements.	Allows the use of a simple tee to make approximate reflection measurements at frequencies up to 100MHz.
[LOCK RANGE]	Overrides automatic selection of frequency lock range.	Faster lock in automatic systems and to ensure the same state when making repetitive measurements near a range boundary.
[MAG RANGE]	Overrides automatic selection of magnitude display range.	To eliminate excess display resolution and to control the rear panel output range when using auxiliary equipment.
[CAL TEST]	Control test output and perform internal calibration.	To allow an operator to optimize instrument performance and to control the test output when performing confidence tests.
[DIR ANLG OUT]	Lock instrument state.	Fast response using rear panel outputs for narrowband sweeps.
[SHIFT][DELAY]	Converts phase difference to delay.	Allows single point measurements of delay.

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Section 5

Automatic measurements

This section of the User's Guide is designed to introduce you to the remote operation of the HP 8508A. All the functions of the HP 8508A, with the exception of the LINE switch, can be operated remotely. Appendix A has details of all the programming commands and results formats.

The BASIC language programming example below demonstrates the use of the HP 8508A in a simple stimulus response measurement system. The program uses an HP 9000 Series 300 Computer and BASIC 4.0 (or later) language system. The source commands shown are for the HP 8657A Synthesized Signal Generator.

1. Connect the equipment as shown in the diagram below. Switch on all the equipment except the computer.

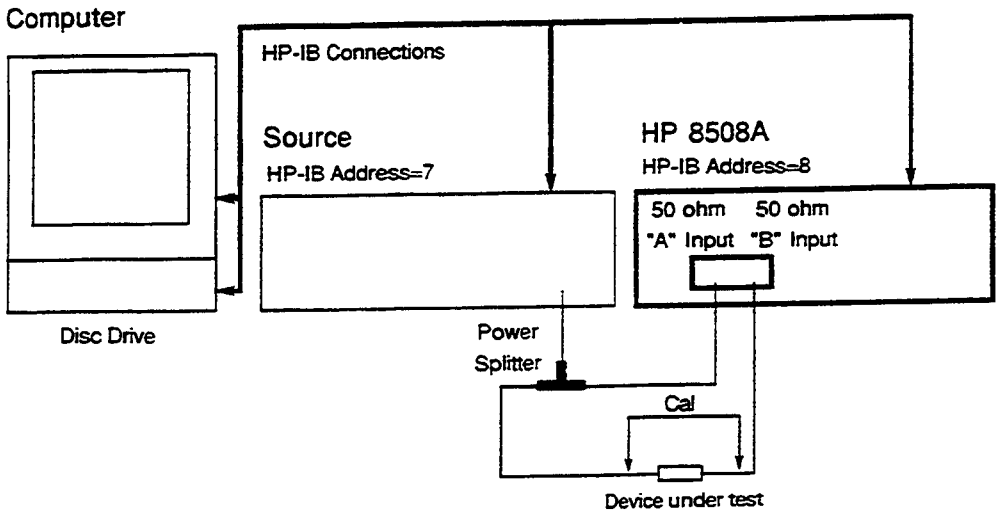


Figure 13. Automatic Test Set-up

2. On the HP 8508A, press [SHIFT] then [ADDRESS] to display the HP-IB address. The program assumes that the address is set to 8. If the address is different, use the STEP keys to reset it.

3. On the HP 8657A, press [SHIFT] then [ADRS] to display the HP-IB address. The programs throughout this section assume that the address is set to 7. If the address is different, use the DATA ENTRY keys to reset it.

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4. Switch on the computer and load the BASIC language SYSTEM. For more information on the computer language system, consult the computer and language operating manuals. Load the following binaries:

HPIB CS80 ERR IO GRAPH

Note: If you are using an HP 9121 single-sided disc drive, load driver "DISC" instead of "CS80".

5. Type in the program contained in Program listing. It describes a complete measurement - a first run to characterize the system response and a second with the device in place to make measurements and plot the results on the computer screen.

6. Run the program. Connect the calibration path when requested and press the CONTINUE softkey on the computer. The magnitude and phase data is stored to be summed with the measurement data later. When the program pauses, insert the device and press the CONTINUE softkey to make the measurement. The results are plotted on the computer screen.

Program Explanation

Lines 10 to 100: Assign array variables, fix start, stop and step frequencies (in MHz) and source power level in dBm. Declare I/O paths to the instruments. Set angle units to degrees and turn off graphics display.
Lines 120 to 210: Measurement control and operator interface.
Line 220: Switch off source output after test.
Lines 240 and 250: Plot axes and results.
Lines 310 to 390: Step generator and receiver - measure system response and store data.
Lines 410 to 480: Measure device response and add to calibration run data.
Lines 540 to 590: Define initial setup of HP 8508A. The measurement is configured and will be executed on receipt of a "trigger" command.
Lines 610 to 630: Define initial setup of source. The source is set to minimum output power and all modulation is turned off.
Lines 650 to 690: Set source frequency and power.
Lines 710 to 750: Trigger HP 8508A and take results.
Lines 770 to 950: Draw and label axes on the computer screen.
Lines 970 to 1070: Plot magnitude and phase responses.

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Program listing

```
10   DIM Freq(50),Mag_cal(50),Phase_cal(50),Mag(50),Phase(50)
20   Fstart=10
30   Fstop=100
40   Fstep=10
50    No_of_steps=INT((Fstop-Fstart)/Fstep)
60   Power=0
70  ASSIGN @Vvm TO 708
80  ASSIGN @Siggen to 707
90  DEG
100  GRAPHICS OFF
110 !
120 DISP "Connect for calibration - press CONTINUE when ready"
130 PAUSE
140 DISP "Measuring - calibration run"
150 GOSUB Cal_run
160 !
170 DISP "Connect device - press CONTINUE when ready"
180 PAUSE
190 DISP "Measuring - dut run"
200 GOSUB Meas_run
210 DISP ""
220 CALL Init_siggen(@Siggen)
230 !
240  CALL  Draw_axes(Fstart,Fstop,Fstep,No_of_steps)
250  CALL  Plot_results(No_of_steps,Freq(*),Mag(*),Phase(*))
260 !
270 STOP
280 !
290 ! ********** Subroutines **********
300 !
310 Cal_run: !
320     CALL  Init_siggen(@Siggen)
330     CALL  Setup_vvm(@Vvm)
340       FOR  Point=0  TO  No_of_steps
350       Freq(Point)=Fstart+Point*Fstep
360     CALL  Set_siggen(@Siggen,Freq(Point),Power)
370     CALL  Measure(@Vvm,Mag_cal(Point),Phase_cal(point))
380 NEXT  Point
390   RETURN
400 !
410 Meas_run: !
420     FOR Point=0 TO No_of_steps
430       CALL Set_siggen(@Siggen,Freq(Point),Power)
440       CALL Measure(@Vvm,Mag_meas,Phase_meas)
450        Mag(Point)=Mag_meas-Mag_cal(Point)
460        Phase(Point)=Phase_meas-Phase_cal(Point)
470    NEXT Point
480   RETURN
490 !
500 END
510 !
520 ! ********** Subprograms **********
530 !
540 SUB Setup_vvm(@Vvm)
550    CLEAR @Vvm
560     OUTPUT @Vvm:"TRIGGER:SOURCE BUS"
570    OUTPUT @Vvm:"FORMAT LOG"
580    OUTPUT @Vvm:"SENSE TRANSMISSION"
590 SUBEND
600 !
610 SUB Init_Siggen(@Siggen)
620   OUTPUT @Siggen;"AP-127DM AO0DB AM S4 FM S4 RP"
630 SUBEND
640 !
650 SUB Set_siggen(@Siggen,Freq,Level)
660    IMAGE "FR".K,"MZ AP".K,"DM"
670    OUTPUT @Siggen USING 660:Freq,Level
680   WAIT .120
690 SUBEND
700 !
710  SUB  Measure(@Vvm,Mag_meas,Phase_meas)
720   TRIGGER @Vvm
730   OUTPUT @Vvm: "FETCH?"
740   ENTER @Vvm:Mag_meas,Phase_meas
750 SUBEND
760 !
770  SUB  Draw_axes(Fstart,Fstop,Fstep,No_of_steps)
780   GRAPHICS OFF
790   GINIT
800   CSIZE=3
810    WINDOW  Fstart-Fstep,Fstop+.5*Fstep,-350,200
820   CLIP Fstart,Fstop,-180,180
830   AXES Fstep,20,Fstart,0
840    CLIP  Fstart-Fstep,Fstop+.5*Fstep,-280,200
850   MOVE Fstart-.5*Fstep,-150
860    LDIR 90
870     LABEL "Mag (10dB/div), phase (20deg/div)"
880    MOVE  (Fsart+Fstop)/2-Fstep,-200
890    LDIR 0
900     LABEL "Frequency (MHz)"
910   FOR  Freq=Fstart+Fstep  TO  Fstop  STEP  Fstep
920      MOVE Freq-.03*No_of_steps*Fstep,-25
930     LABEL Freq
940   NEXT Freq
950 SUBEND
960 !
970  SUB  Plot_results(No_of_steps,Freq(*),Mag(*),Phase(*))
980   GRAPHICS ON
990   For Point=1 to No_of_steps
1000    LINE TYPE 1
1010       MOVE Freq(Point-1),2*Mag(Point-1)
1020       DRAW Freq(Point),2*Mag(Point)
1030    LINE TYPE 4
1040       MOVE Freq(Point-1),Phase(Point-1)
1050       DRAW Freq(Point),Phase(Point)
1060   NEXT Point
1070 SUBEND
```


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Changing the program

You can change the frequency range and step size by changing the variables in lines 20 to 40. If the number of points exceeds 51, you'll need to increase the size of the data storage arrays to suit. To measure a number of devices using a single calibration run, just add a loop back to the instruction for connecting the device after plotting is complete. To make return loss measurements, use a reflection test set in place of the power splitter - no change to the program is required if you use a short circuit as the calibration device.

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Appendix A

Recommended accessories

Probing adapters	Description	Freq. range	Use
	10:1 Divider HP 11576A	dc to 100MHz	For measuring high level signals with probes, and for reducing loading effects on sensitive circuits.
	Isolator HP 10216A	dc to 1GHz	Reduce phase error due to changing test point impedance.
	Probe Tee HP 11536A	dc to 1GHz	Adapts probes for in-line measurements in 50 ohm systems.
	BNC Adapter HP 10218A	dc to 1GHz	Converts probe tip to BNC (m) connector.
	Spanner Tip Assy HP 5060-0549		Probe tip protector and ground lead.

50 ohm measurement accessories	HP Model	Freq. range	Description
	Power Splitter HP 11552-60009	0.1 to 110MHz	2 way, 2 resistor splitter for ratio measurements.
	Power Splitter HP 11549A	dc to 1GHz	2 way, 2 resistor splitter for ratio measurements.
	Power Splitter HP 11850C	dc to 3GHz	3 way, 3 resistor splitter for ratio measurements.
	Directional Bridge HP 8721A	dc to 110MHz	Directional splitter/combiner for reflection measurements.
	Directional Coupler HP 778D	100MHz to 2GHz	Dual directional coupler for reflection measurements.
	Directional Coupler HP 774D	215MHz to 450MHz	Reduced frequency range dual directional coupler.
	Directional Coupler HP 775D	450MHz to 940MHz	Reduced frequency range dual directional coupler.
	Directional coupler HP 776D	940MHz to 1.9GHz	Reduced frequency range dual directional coupler.
	Transmission/ Reflection Test Set HP 85044A	300kHz to 3GHz	Combined splitter and reflection bridge. Test port APC-7

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HP Model	Freq. range	Description
Termination HP 908A	dc to GHz	50 ohm Termination, type-N (m).
N(m) to N(m) Adapter HP 1250-1475		
N(f) to N(f) Adapter HP 1250-1472		
APC-7 to N(f) Adapter HP 11524A		
APC-7 to N(m) Adapter HP 11525A		

75 ohm measurement accessories

HP Model	Freq. range	Description
Directional Bridge HP 8721A opt 008	dc to 110MHz	Directional splitter/combiner for reflection measurements.
Transmission/ Reflection Test Set HP 85044B	300kHz to 2GHz	Combined splitter and reflection bridge. Inputs 50 ohm test port 75ohm type-N (f). There are 1 each HP 11852A Minimum Loss Pads supplied.
Minimum Loss Pad HP 11852B	dc to 2GHz	Converts between 50 and 75 ohm impedances. Connectors 50 ohm type-N (f). 75 ohm type-N (m).
N(m) to N(m) Adapter HP 1250-1528		
N(f) to N(f) Adapter HP 1250-1529		
N(m) to BNC(f) Adapter HP 1250-1535		

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Appendix B

HP-IB capability

Here's a brief description of the HP-IB programming capability. For more detailed information, consult IEEE standard 488-1987.

Identification	Function	Capability
SH1	Source Handshake	Complete.
AH1	Accepter Handshake	Complete.
T6	Talker	Basic talker, serial poll, no Talk Only, Unaddress if MLA.
TE0	Extended Talker	None.
L4	Listener	Basic listener, no Listen Only, Unaddress if MTA.
LE0	Extended Listener	None.
SR1	Service Request	Complete.
RL1	Remote Local	Complete.
PP0	Parallel Poll	None.
DC1	Device Clear	Complete.
DT1	Device Trigger	Complete.
C0	Controller	None.

HP-IB Results Formats

Data returned by the HP 8508A from measurement results is always in the form

<+>/<->D.DDDE<+>/<->DD<term>

and is always in fundamental units (volts, ohms, watts, etc.).

The terminator **<term>** depends on the data requested, as follows:

<term> is a comma (,) where another data item follows as part of the same result.
<term> is a semicolon (;) where the data item completes a result and another result follows.
<term> is a carriage-return, linefeed <cr>,<lf> where the data item is the last or only part of a result.

HP-IB Command Set

The HP-IB commands used in the HP 8508A conform to the standards set by document IEEE 488.2-1987, "Codes, Formats, Protocols and Common Commands for use with ANSI/IEEE Std 488.1, 22 January 1987".

For full details on the use of the commands, consult the Operating and Service Manual and the standards documents. The Command Set table gives a list of the commands.

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Command Set

Description	Query (1)	Command Header (2)	Parameter (3)
Averaging Value	y	AVERage:COUNt	<nrf>
Capability	y	CAPability?	
Clear Status	n	*CLS	
Configure Measurement	n	SENSe	<meas>{,<meas>}(4)
Correction		CORRection	
		:DATA	
Normalize A	y	:A	<nrf>
Normalize B	y	:B	<nrf>
Normalize Phase	y	:PHASe	<nrf>
Normalize Impedance	y	:IMPedance	ON|OFF|1|0
Termination	y	:TERMination	SHORT|OPEN|Z0
Perform Normalization	n	:PERForm	
Normalization State	y	:STATe	ON|OFF|1|0
Direct Analog Output	y	DANalog	ON|OFF|1|0
Display State	y	DISPlay :STATe	ON|OFF|1|0
Fetch Results	y	FETCh?	
Continuous readings	y	:CONTinuous	
Format	y	FORMat	LINear|LOGarithmic| POLar|RECTangular| CARTesian
Frequency		FREQuency	
Band	y	:BAND	<nrf>
Auto Ranging	y	:AUTO	ON|OFF|1|0
Identification	y	*IDN?	
Input		INPut	
Impedance	y	:IMPedance	<nrf>
Module Type	y	:POD?	
Measure	y	MEASure?	<meas>{,<meas>}(4)
Operation Complete	y	*OPC	
Reset	n	*RST	
Self Test	y	*TST?	
Service Request Enable	y	*SRE	<nrf>
Standard Event Enable	y	*ESE	
Standard Event Register	y	*ESR?	<nrf>
Status Byte Request	y	*STB?	
Status Control		STATus	
Operation Status Register		:OPERation	
Event Register	y	:EVENt?	(7)
Condition Register	y	:CONDition?	(7)
Enable Mask	y	:ENABle	<nrf>(7)
Positive Transition Filter	y	:PTRansition	<nrf>(7)
Negative Transition Filter	y	:NTRansition	<nrf>(7)
System		SYSTEM	
Error Register	y	:ERRor?	NUMeric|STRing
Key	y	:KEY	<nrf>
Trigger	n	*TRG	
Trigger Setup		TRIGger	
Source	y	:SOURce	BUS|FREErun
Wait-to-continue	n	*WAI	

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NOTES

(1) Commands that allow a query option are indicated by "y". Commands where the query is mandatory are shown with the query question mark in the Command Header column in addition.

(2) Letters in CAPITALS are required. The remainder of the command can be added if desired for legibility. Commands can be sent either in upper or lower case.

(3) <nrf> indicates Numeric Real Format

(4) <meas> indicates AVOLtage|BVOLtage|APOWer|BPOWer|BAlPHASe|TRANSmission|
GDELay|SWR|RHO|Y|Z|CORE

(5) Status Byte bit usage is as follows:
- bit 4 Message Available
- bit 5 Standard Even Status Register summary bit
- bit 6 Requext for Service
- bit 7 Operation Status Register summary bit

Other bits unused.

(6) Standard Event Register bit usage is as follows:
- bit 0 Operation Complete
- bit 2 Query Error
- bit 3 Self-test Error
- bit 4 Execution Error
- bit 5 Command Error

Other bits unused.

(7) Operation Status Register bit usage is as follows:
- bit 0 Calibrating
- bit 2 Ranging (unlocked)
- bit 4 Measuring
- bit 5 Awaiting Trigger

Other bits unused.

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