

# **11613B CALIBRATOR**

## **SERIAL NUMBERS**

This manual applies directly to 11613B calibrators with serial number prefix 2713A.

For additional information about serial numbers, refer to INSTRUMENTS COVERED BY MANUAL in Section 1.

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**Microfiche Part Number 11613-90012**

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**Agilent Technologies**

# Notice

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## Hewlett-Packard to Agilent Technologies Transition

This documentation supports a product that previously shipped under the Hewlett-Packard company brand name. The brand name has now been changed to Agilent Technologies. The two products are functionally identical, only our name has changed. The document still includes references to Hewlett-Packard products, some of which have been transitioned to Agilent Technologies.



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By internet, phone, or fax, get assistance with all your test and measurement needs.

### Table 1-1 Contacting Agilent

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**United States**  
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**Latin America**  
(tel) (305) 269 7500  
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(tel) (+31) 20 547 2323  
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(fax) (+64) 4 495 8950

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(tel) (+81) 426 56 7832  
(fax) (+81) 426 56 7840

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(fax) (+61) 3 9210 5947

### Asia Call Center Numbers

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Singapore	1-800-375-8100	(65) 836-0252
Malaysia	1-800-828-848	1-800-801664
Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
India	1-600-11-2929	000-800-650-1101

## **CERTIFICATION**

*Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.*

## **WARRANTY**

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of delivery. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

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*For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.*

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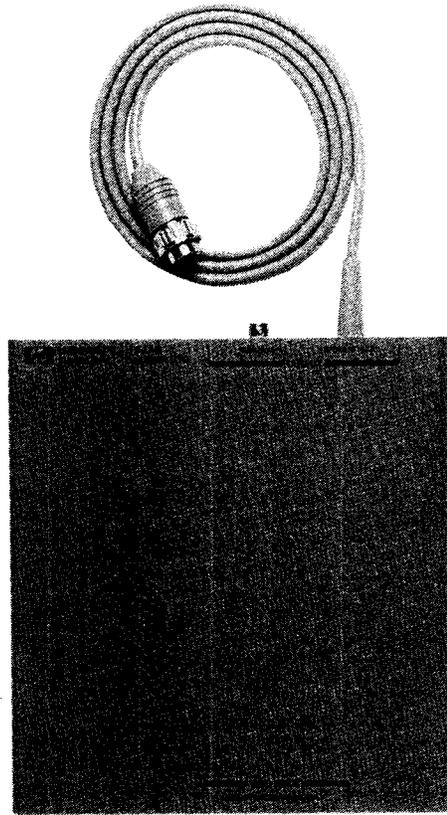
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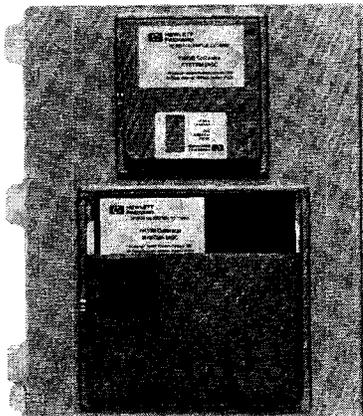
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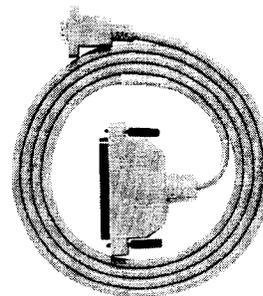
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**HP 11613B Calibrator**



**Software Disc Set**  
(HP Part No. 111613-10002)



**GPIO Interface Cable**  
(HP Part No. 11613-60007)

*Figure 1-1. HP 11613B Calibrator and Accessories*

## Section 1. General Information

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### INTRODUCTION

This manual contains both general and specific information that will enable you to use the HP 11613B calibrator. In order to perform specific functions with the calibrator, follow the directions in, "Using the HP 11613B".

This section, "General Information", will supply you with the following information:

- How to begin using the HP 11613B.
- What instruments are covered by this manual.
- Description of the calibrator.
- Operating precautions, safety considerations and warranty restrictions.
- National Bureau of Standards (NBS) traceability.
- Initial inspection procedures and packaging requirements.
- Environmental considerations.
- Additional equipment required.

### USING THE HP 11613B

Section 2, "Getting Started", contains information on the basic operation and setup configurations. The HP 11613B has been designed to perform the functions listed below.

- To check for the proper operation of the HP 11613B, turn to Section 6, "Operator's Check".
- To calibrate or check the calibration of an HP 8757A network analyzer, turn to Section 3, "Using the HP 11613B with the HP 8757A".
- To calibrate or check the calibration of an HP 8756A network analyzer, turn to Section 4, "Using the HP 11613B with the HP 8756A".
- To calibrate or check the calibration of an HP 8755A/B/C network analyzer, turn to Section 5, "Using the HP 11613B with the HP 8755A/B/C".
- To troubleshoot the HP 11613B, turn to Section 7, "Service".

## INSTRUMENTS COVERED BY MANUAL

You will find a two-part serial number on the instrument. The first four digits and the letter are the serial number prefix. The last five digits are the sequential suffix which is unique to each calibrator. The contents of this manual apply directly to calibrators with the same serial number prefix as the one on the title page under the heading SERIAL NUMBERS.

If the serial prefix of your calibrator is not listed on the title page, your instrument differs from those documented in this manual. The differences are documented in the yellow *Manual Changes Supplement* supplied with the manual.

To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest manual changes supplement as it may contain replacement information as well as change information. The supplement for this manual is keyed to the manual's print date and part number (on the title page) and is available on request from Hewlett-Packard.

You can order this manual in microfiche form as HP Part No. 11613-90012. With the manual (in 4 x 6 inch microfilm transparency format) you will also receive the latest manual changes supplement.

## DESCRIPTION AND OPERATING CHARACTERISTICS OF THE INSTRUMENT

**NOTE:** For the purpose of this manual, the following definitions apply:

- The National Bureau of Standards (NBS) traceable HP 11613B specifications are shown in *Figure 1-2* of this manual.
- Calibrator attenuation is stated in terms of voltage dB.
- The HP 8755A/B/C system consists of an HP 8755A/B/C and detector as specified in the *Amplitude Accuracy* performance test in the *HP 8755A/B/C Operating and Service Manual*.
- The HP 8756A/57A system consists of HP 8756A/57A and detector as specified in the *Dynamic Power Accuracy* performance test of the *HP 8756A/57A Operating and Service Manuals*.
- The NBS traceable HP 8756A/57A system specification is dynamic power accuracy.

The HP 11613B consists of an electronic calibrator and software. In conjunction with an HP 200 or 300 series controller, this accessory will calibrate the inputs of an HP 8756A or HP 8757A scalar network analyzer in approximately five minutes. After the input is calibrated with the HP 11613B, that input with a properly operating detector will meet the system dynamic power accuracy specification. The HP 11613B is also useful in calibrating the HP 8755A/B/C. A real-time plot of dynamic accuracy is displayed on the computer to facilitate adjustment of the logger boards.

Included with the calibrator are two software discs that contain four programs each. One program is used for the HP 8757A, one for the HP 8756A, and one for the HP 8755A/B/C. The program for the 8755A/B/C is useful only for adjusting the logger response and not for performance testing of the offset switches. Also included is an overhead program that allows selection of any of the above programs.

**NOTE:** Portions of this manual apply only when using the HP 8757A network analyzer. Most service or operation verification checks require the use of an HP 8757A analyzer and will not operate when using an HP 8756A or HP 8755A/B/C.

Figure 1-2 shows the NBS traceable absolute voltage attenuation error and the HP traceable tracking limit of the HP 11613B. The NBS traceable voltage attenuation error is greater than the HP traceable tracking limit because the NBS traceable attenuation error calculation includes cumulative measurement uncertainties. These uncertainties reflect the rigorous procedures required to establish NBS traceability of the calibrator, given its accuracy and dynamic range. Passing the "Operator's Check" as described in Section 6 of this manual will verify, within the limits of the test equipment used, that the HP 11613B meets its NBS traceable specification.

The HP traceable tracking limit shows the maximum tracking variation between HP 11613B calibrators. This limit demonstrates the repeatability with which all HP 11613Bs calibrate the analyzer's inputs. To verify that the HP 11613B meets its tracking specification, return the calibrator to HP for calibration.

## **OPERATING PRECAUTIONS**

### **The Calibrator**

The calibrator is a precision electronic instrument. You need observe only normal precautions in handling and operating it.

### **The Software Discs**

With the calibrator are two discs with identical information: one 3.5 inch and one 5.25 inch disc. The 3.5 inch disc is formatted as a single sided disc so it will work in both single and double sided disc drives. Although they are high quality discs, all discs are subject to wear. Hewlett-Packard recommends that you copy the disc that matches your disc drive. Store the original in a safe place and use the copy.

### **Safety Considerations**

The voltages in this calibrator do not warrant more than normal caution for operator safety.

### **Warranty Restrictions**

The warranty is void if you, the user, open the instrument case or replace or adjust any components.

## **NATIONAL BUREAU OF STANDARDS (NBS) TRACEABILITY**

### **NBS Traceability of the HP 11613B**

The HP 11613B calibrator is traceable to NBS standards through an HP 11613 transfer standard. The HP 11613 transfer standard is an HP 11613 calibrator that has been characterized with specialized NBS traceable test equipment in the HP Calibration Laboratory. Figure 1-2 shows the NBS traceable absolute voltage attenuation error. Figure 1-3 relates voltage attenuation (dB) to power level (dBm). For example, 80 dB of calibrator attenuation relates to a detector input power level of approximately  $-34$  dBm.

NBS traceability of the HP 11613B is maintained by the requirement that only HP facilities adjust, repair or recalibrate the instrument. The HP 11613B should be recalibrated at twenty-four month intervals when used and stored in the recommended **operating** environment; more often when not stored in the recommended operating environment.

## NBS Traceability of HP 8756A/57A System

Passing the HP 8756A/57A *Dynamic Power Accuracy* performance test with NBS traceable attenuators verifies that the HP 8756A/57A system is NBS traceable.

Within one year of being calibrated with an HP 11613B, an HP 8756A/57A input will contribute to the HP 8756A/57A system a minimal error at power levels of  $> -40$  dBm. Detector variations contribute the major part of system errors. Thus, with a calibrated analyzer input, any detector which passes the *Dynamic Power Accuracy* test with a 0.1 dB margin will meet the system specification when used with any analyzer input calibrated with the same HP 11613B. For inputs calibrated with different calibrators, the margin is 0.15 dB. Detectors which pass the *Dynamic Power Accuracy* test by less than these margins should be used with that input only. The above does not apply to the HP 8755A/B/C which should be tested with each detector assigned to a specific input.

## INITIAL INSPECTION

Inspect the shipping container (including cushioning material) for damage. If it is damaged, keep it until you have (1) checked the contents for completeness and (2) checked the calibrator mechanically and electrically. The contents are listed in Table 1-2.

Electrical performance checks are in Section 6 of this manual. If the calibrator does not pass the electrical performance tests, refer to the troubleshooting procedures in Section 7. If the calibrator fails the electrical tests, or is damaged, defective, or incomplete, keep the shipping materials and notify both the carrier and the nearest Hewlett-Packard office. The HP office will arrange for repair or replacement of the calibrator without waiting for settlement of the claim.

## Packaging

Ideally, each calibrator should be repackaged in the original factory package if reshipping is required. Containers and materials identical to those used by the factory are available through Hewlett-Packard offices. Alternatively, comparable packaging materials may be used. In any case, please observe the following guidelines:

- a. Wrap the calibrator in heavy paper or anti-static plastic. If shipping to an HP Office or Service Center, complete and attach a service tag (HP Part No. 9320-3896, see Section 6 of the *HP 8756A/57A Service manual*).
- b. Use sufficient shock absorbing material on all sides of the HP 11613B to provide a thick, firm cushion and prevent movement.
- c. Seal the shipping container securely and mark it **FRAGILE**.

In any correspondence, refer to the calibrator by full model and serial number.

## ENVIRONMENTAL CONSIDERATIONS

### Operation

To make valid calibrations or calibration checks of the HP 8756A/57A, the HP 11613B must be operated in temperatures from  $+20^{\circ}\text{C}$  to  $+30^{\circ}\text{C}$  and in an environment that will not cause internal condensation. It may be operated at altitudes up to 4,572 meters (15,000 feet).

## Storage and Shipment

The HP 11613B may be shipped or stored in temperatures from  $-40^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$  and at altitudes up to 15,240 meters (50,000 feet). It should be protected from environmental conditions that may cause internal moisture condensation. Note that if the HP11613B is stored at extreme temperatures, it should be recalibrated more often than every 24 months.

## ADDITIONAL EQUIPMENT REQUIRED

Table 1-3 lists additional equipment and accessories required for use with the HP 11613B. The table notes which items are required to verify the performance of the calibrator and which are required to operate it. Other equipment may be substituted if its specifications meet or exceed the specifications listed in the critical specifications column.

*Table 1-1. Operating and Physical Characteristics*

<b>Maximum Output Level:</b>	$4.9 \pm 0.065\text{V}$ (true RMS, 250 kHz bandwidth)
<b>Signal Symmetry:</b>	$50 \pm 2\%$ duty cycle
<b>Signal Frequency:</b>	$27,778 \pm 12$ Hz
<b>Signal Waveform:</b> Peak to peak Rise time (10%-90%) Overshoot	$10.6 \pm 0.5\text{V}$ $3.4 \pm 0.4 \mu\text{s}$ negligible (with high impedance load)
<b>Connector Types:</b>	BNC (f), 5-pin audio, 9-pin GPIO interface
<b>Dimensions:</b> Cabinet Cable length GPIO cable length	4 cm high x 18.5 cm wide x 20 cm deep (1.5" x 7.3" x 7.8") 122 cm (48") 200 cm (80")
<b>Weight:</b> Net Shipping	0.9 kg (2 lb) 2.3 kg (5 lb)

**NOTE:** Unless otherwise noted, all specifications apply from  $+20^{\circ}\text{C}$  to  $+30^{\circ}\text{C}$ .

*Table 1-2. Contents of HP 11613B Calibrator*

Item	Check if Present
HP 11613B calibrator	_____
Manual binder	_____
3.5 inch software disc	_____
5.25 inch software disc	_____
GPIO interface cable	_____

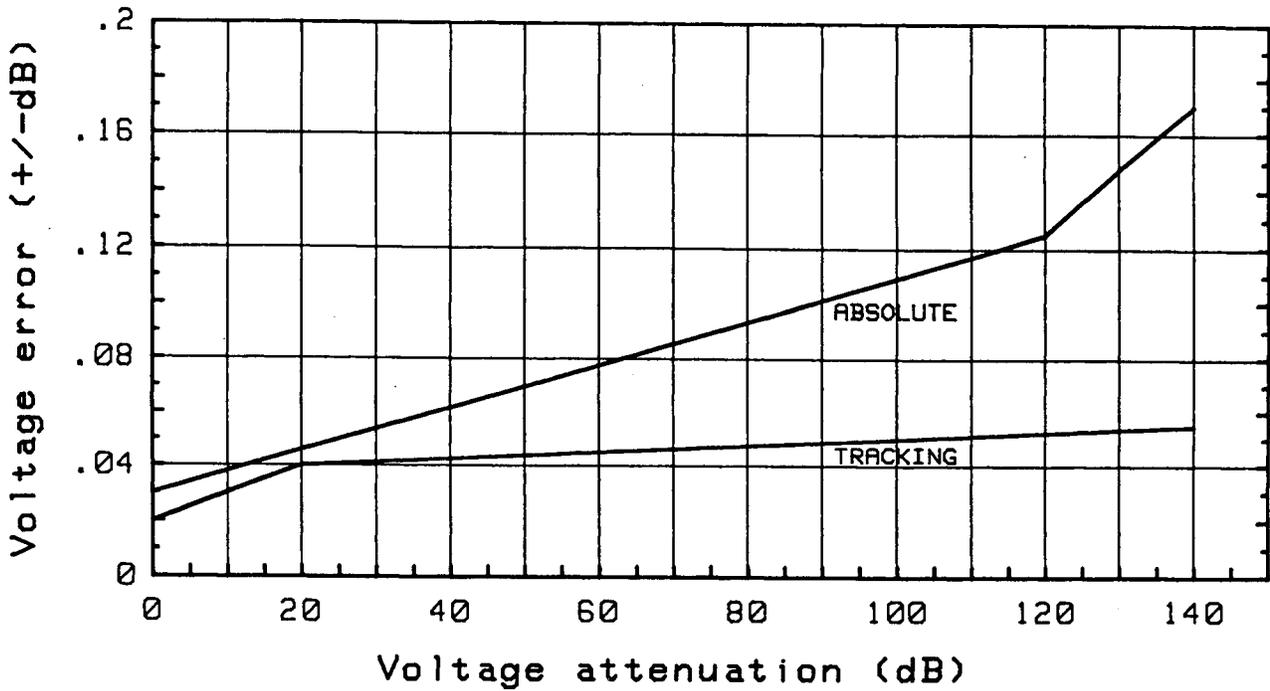


Figure 1-2. HP11613B Attenuation Accuracy

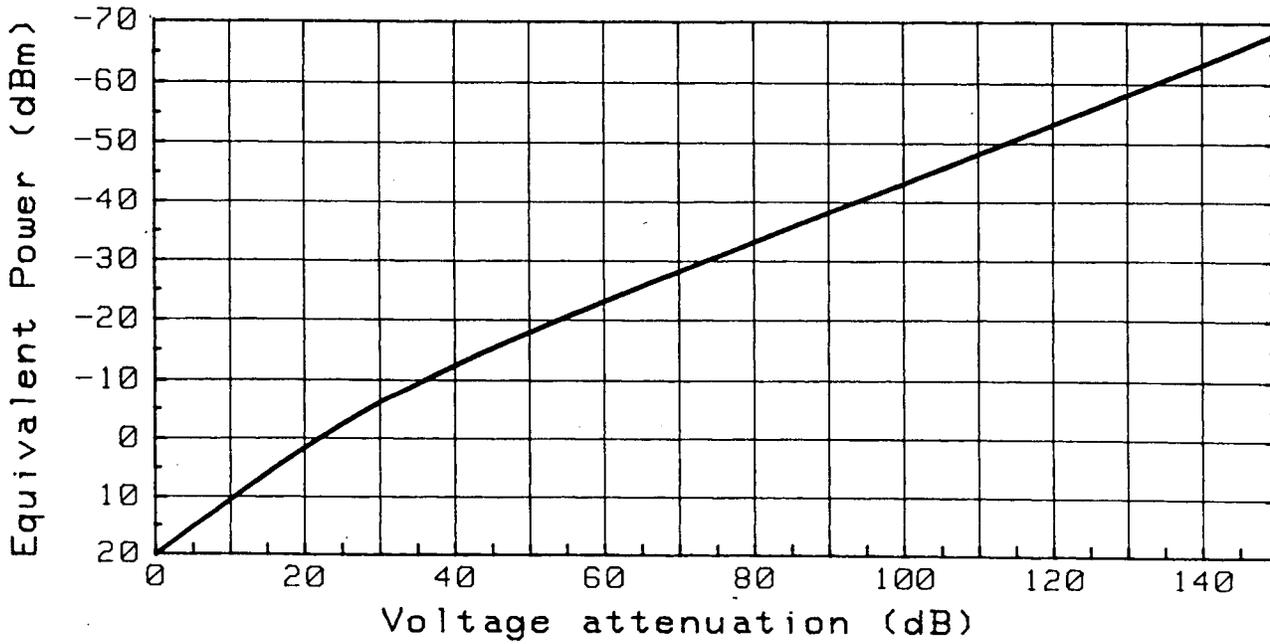


Figure 1-3. Voltage Attenuation vs. Equivalent Detector Input Power

Table 1-3. Additional Equipment Required

Equipment	Critical Specifications	HP Part or Model Number	Use
Counter	Edge-triggered	HP 5316A	Op
Digital voltmeter	No substitute	HP 3456A	Op
**Digital voltmeter	Compatible w/program	HP 3455/56/57/78	CC
Oscilloscope	None	HP 1740A/41A	Op
Controller	HP series 200 or 300 <sup>1</sup>	any	Op, CC
Oper. language	HP BASIC 2.0 or above <sup>2</sup>	any	Op, CC
*GPIO interface	No substitute	HP 98622A	CC
HP-IB cables	IEEE 488 compatible	HP 10833	Op, CC
**Extension cable HP 8755	No substitute	5060-0303	CC
BNC cable	Dual banana plug-BNC (m)	HP 11001A	Op, CC
BNC cables	(m)-(m)	HP 11086A	Op, CC
BNC tee	(m)-(f)-(f)	1250-0781	Op
**Voltmeter test leads	With clips	any	CC
Disc drive	3.5" or 5.25", compatible with controller	Op, CC	

1. Requires up to 150 kbytes of memory in addition to that required by the operating language.
2. If using BASIC 3.0 or above, see note following Section 2 Introduction.

Op stands for Operator's Check.

CC stands for Calibration and Calibration Check.

\* Required only if testing the HP 8756A or HP 8755A/B/C.

\*\* Required only if testing the HP 8755A/B/C.



## Section 2. Getting Started

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### INTRODUCTION

This section describes how to load and run the software, illustrates the basic operation setup and lists the basic equipment required.

### BASIC OPERATION SETUP

#### Description

The basic operation setup and the equipment required appear in Figure 2-1a, 2-1b, and 2-1c. When testing the HP 8756A or 8757A, connect the controller to the analyzer's HP-IB port; **NOT** the system interface port.

If testing an HP 8755A/B/C, it may be necessary to connect an extension cable from the display mainframe to the HP 8755A/B/C so that the boards are accessible. Then connect the positive lead of a voltmeter to the appropriate test point on the A6 board for the input channel being tested (IN A, IN B, or IN R). Connect the negative lead of the voltmeter to chassis ground.

Any HP graphics printer may be connected to the HP-IB so that hard copy plots may be generated, however, if using an HP 9876A printer, do not apply power to the printer until you are ready to dump graphics. If power is applied while the analyzer is transferring data to the computer, an error will most likely be generated. This error is not recoverable and the program must be re-run.

#### Addresses and Configurations

Before beginning, verify the following addresses are set.

HP 8756A or 8757A:	16
Voltmeter (if used):	22
Printer (if used):	01
GPIO select code:	12
HP-IB select code:	7

If you are testing the HP 8756A or 8755A/B/C, it may be necessary to set the configuration switches on the HP 98622A GPIO interface card. Refer to Figure 2-2 for location of these switches.

Configuration Switch	Switch Setting	
Interface Select Code: 12	01100	
Interrupt Level: 3	00	
Data-in Clock source: don't care	XXXXXX	refer to 98622 manual for restrictions
Option Select:	111111	
Invert Dout, Invert Din, Full Handshake, Invert PSTS, Invert PFLG, Invert PCTL		
Other options:		
Dout Clear Jumper: Don't care		
Burst Jumper: Don't care		
PCTL Delay: Default (250nS)		

## Connecting the HP 11613B

The HP 11613B calibrator has three connectors: 8756A/8757A, MONITOR, and GPIO. The 8756A/8757A cable, which is also used with the HP 8755A/B/C, terminates in an audio 5-pin connector and mates with the audio 5-pin jack on the front panel of the analyzer. The MONITOR output is a standard BNC jack and mates with a standard BNC cable. This output is provided for testing purposes only and is not used in normal operation. The GPIO port is used only when testing the HP 8756A or 8755A/B/C. It is a 9 pin connector designed to mate with the GPIO cable provided and connects to the GPIO interface card (HP 98622A) in the computer. This cable allows the computer to control the attenuation stages in the HP 11613B. The HP 8757A can control the calibrator through one of the pins of the 8756/8757A cable and therefore does not need the GPIO connection.

To operate the HP 11613B, connect its 8756A/8757A cable to the front panel of the analyzer under test. If testing an HP 8756A or 8755A/B/C also connect the GPIO interface cable from the calibrator to the HP 98622A GPIO card. Connect the MONITOR output **only when performing the "Operator's Check with the HP 8757A"** (as specified in that procedure).

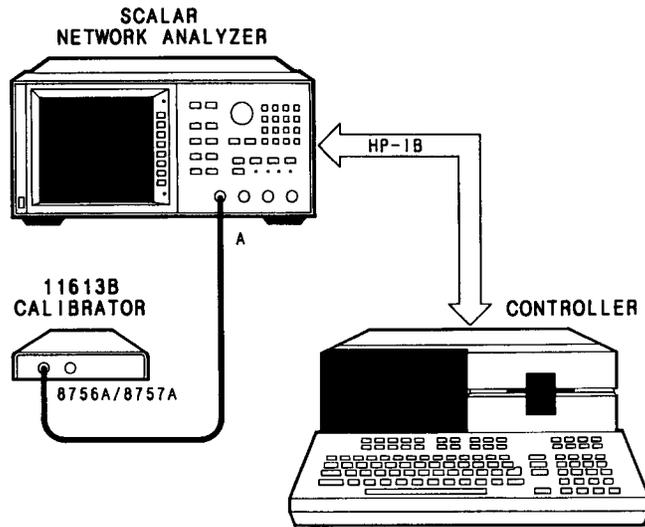
When testing the HP 8756A or 8755A/B/C, the calibrator handshakes the data sent to it from the GPIO interface. In order for the handshaking circuitry to function, the HP 11613B must be plugged into the analyzer from which it receives its power. If the calibrator is disconnected from the analyzer for more than a few seconds while the program is running, a GPIO timeout error may result.

**NOTE:** The calibrator will not function with an HP 8757A if the GPIO cable is left connected to the GPIO interface (HP 98622A) even if the interface board is removed from the computer. Always disconnect at least one end of the GPIO cable if testing an HP 8757A.

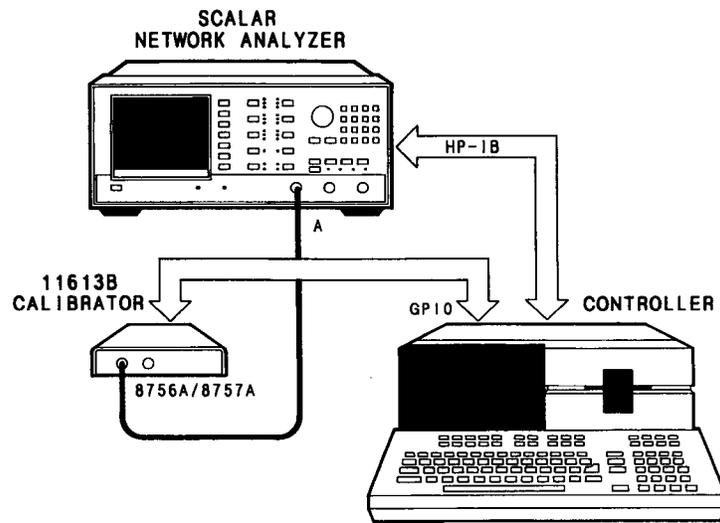
**NOTE:** Do not place the HP 11613A near strong sources of electrical interference such as monitors, switching power supplies, or printers.

## Power Requirements

Power is supplied to the calibrator by the analyzer through the cable when it is connected to one of the network analyzer's front panel input jacks.

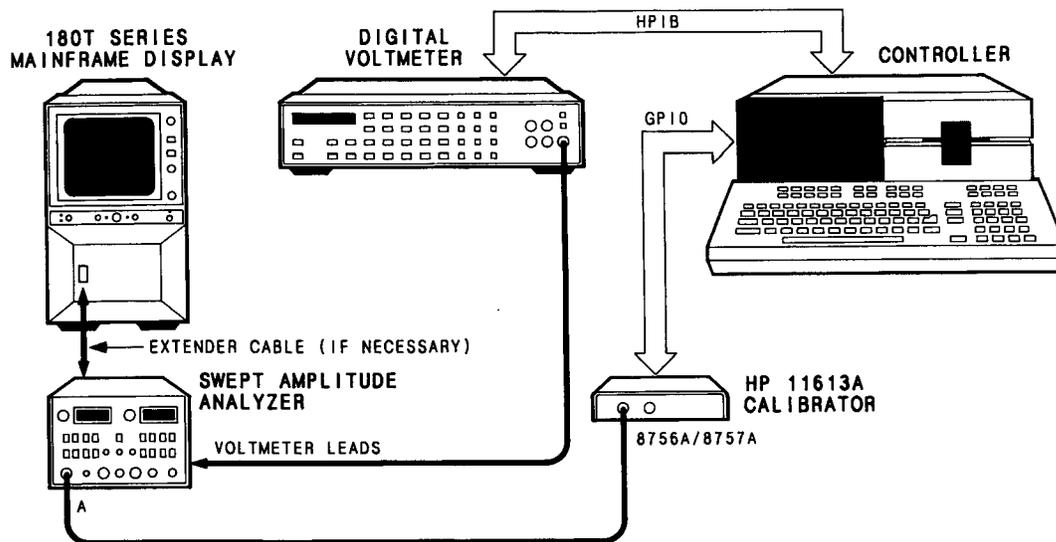


a) HP 8757A Operation Setup



b) HP 8756A Operation Setup

Figure 2-1. Basic Operation Setup (1 of 2)



c) HP 8755A/B/C Operation Setup

Figure 2-1. Basic Operation (2 of 2)

## Equipment Required

Analyzer .....	HP 8756A, 8757A, or 8755A/B/C
Calibrator .....	HP 11613B
Controller .....	HP 200 or 300* series computer with 3.5 or 5.25 inch disc drive
Operating language .....	BASIC 2.0 or above
Software .....	supplied with the HP 11613B
GPIB interface (for 8756A/55A/B/C) .....	HP 98622A
Voltmeter (for 8755A/B/C) .....	HP 3455, 3456, 3457, or 3478
Extension cable (for 8755) .....	5060-0303

**\*NOTE:** Some minor display anomalies (cosmetic only and does not affect program operation) may be visible with a 300 series controller unless it uses a display compatibility interface board (HP 98546A) with a medium resolution monochrome display.

## Loading the Program

Load the operating language, BASIC, into the controller. If you are using BASIC 3.0 or above, load the binary programs (which reside on the BASIC Language Extension Disc) as indicated:

You must load the following BIN files with BASIC 3.0 or greater:

- HP-IB: required for the HP-IB interface
- IO: required for interfacing with IO resources
- GRAPH: provides commonly used graphics statements.

Additionally you may need or want these BIN files with BASIC 3.0 or greater:

GPIO: required if using the GPIO interface (for 8756A or 8755A/B/C)

GRAPHX: for use with color displays

CS80: for CS80 disc drives

DISC: for non-CS80 external disc drives

KBD: for use of HP 46060A mouse with HP 46020A/21A keyboard.

ERR: for written error messages.

Load the HP 11613B program "CAL" from the supplied disc that fits your disc drive. Press **[RUN]**. With some versions of BASIC, an error message will briefly appear just after the program starts; disregard it. The computer will then prompt you for the analyzer model to be tested. Select the softkey which corresponds to the correct model. The computer will then load and run the correct program.

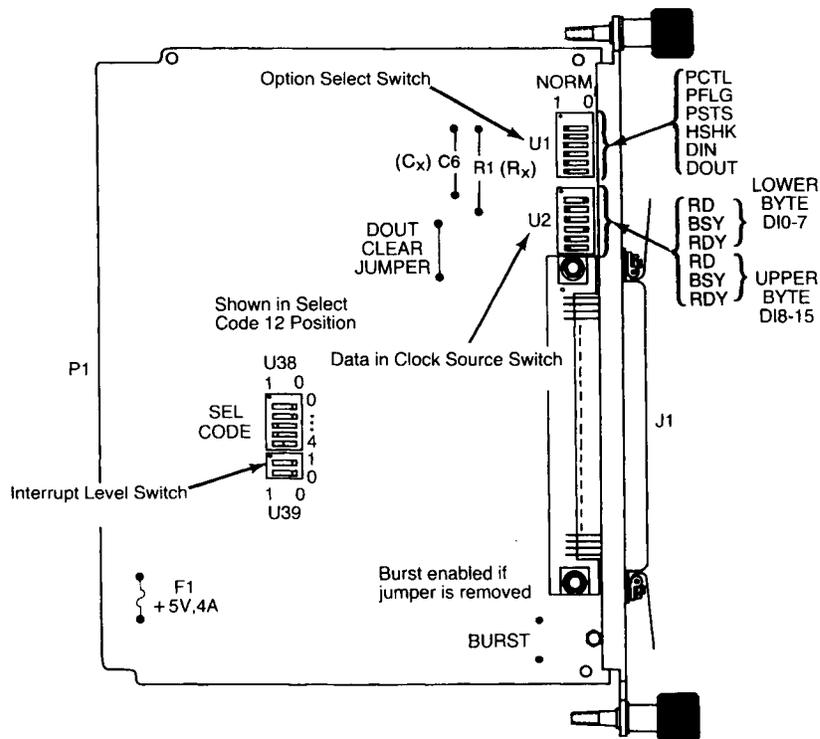


Figure 2-2. GPIO Interface Card



## Section 3. Using the HP 11613B with the HP 8757A

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### INTRODUCTION

This section explains how to use the HP 11613B to calibrate and to check the calibration of the HP 8757A scalar network analyzer. Also included is a section on troubleshooting the HP 8757A. Note that NBS traceability of the HP 8757A is confirmed by passing the *Dynamic Power Accuracy* performance test using NBS traceable attenuators as described in the *HP 8757A Operating and Service Manuals*. This section also describes the procedure to check the calibration identification information of each HP 8757A input. Much of the information which would normally appear in this section resides in the software supplied with the calibrator itself. Thus to operate the calibrator, you need only connect it as shown in Figure 3-1 and respond to the CRT prompts.

### RUNNING THE PROGRAM FOR THE HP 8757A

Once the "CAL" program has been loaded (as described in Section 2) and the HP 8757A analyzer selection has been made, the computer will load and run the calibration program for the HP 8757A. With some versions of BASIC an error message will briefly appear just after the program starts; disregard it. Follow the prompts on the controller CRT until "HP 11613 CALIBRATOR MAIN MENU" appears there. Refer to the *Software Menu Map, Table 3-1*, and the sections noted below to see how to enter the different routines. Variations on the basic operation setup and the equipment required are noted with CRT prompts and in this manual.

- To calibrate an input, perform the procedure, Calibration of the HP 8757A.
- To check the calibration of an input, perform the procedure, Check of the HP 8757A Calibration.
- To check the calibration identification information of the HP 8757A, perform the procedure, ID Check of the HP 8757A.

Table 3-1. HP 11613B Software Menu Map

HP 11613B Calibrator Menu Levels		
Level 1	Level 2	Description
QUIT		Presets HP 8757A, terminates program.
OP CHECK	PRIOR SIG TST  3456 TST 8757 TST	Verifies proper operation of HP 11613B. Returns to menu level 1. Sets output of HP 11613B to approximately 10.6 Vp-p for waveform tests. Verifies HP 11613B using HP 3456A DVM. Verifies HP 11613B using HP 8757A.
CAL 8757	PRIOR 8757 ID CAL ALL CAL ONE CHK ALL CHK ONE	Calibrates or checks HP 8757A with HP 11613B. Returns to menu level 1. Displays HP 8757A identification information. Calibrates all HP 8757A inputs. Calibrates any one input. Checks all inputs for calibration. Checks any one input for calibration.
SET LVL		Sets output of HP 11613B to 0 dB [about 10.6 Vp-p]. Any level, in 0.5 dB steps, over a 154.5 dB range, may then be set with the controller keyboard knob or the softkeys below. Returns to menu level 1. Sets HP 8757A to local mode. Sets calibrator output to -154.5 dB. Sets calibrator output to 0.0 dB. Decreases output level by 5 dB. Increases output level by 5 dB. Decreases output level by 0.5 dB. Increases output level by 0.5 dB.
NEW 8757	PRIOR LOCAL MIN SIG MAX SIG -5 dB +5 dB -.5dB +.5dB	For use when a different HP 8757A is connected. This key initializes the HP 8757A and the computer system variables and returns to menu level 1.

## CALIBRATION OF THE HP 8757A

**NOTE:** Do not connect anything to the MONITOR jack during these procedures.

### Description

When you use the HP 11613B to calibrate or check the calibration of an HP 8757A input, the controller first will run the "Self Check" routine of the calibrator. This routine compares similar internal attenuators. Next, the output of the HP 11613B is attenuated from 0 dB to 140 dB in 0.5 dB steps while the controller takes readings from the HP 8757A and plots the data. These readings are used to create a table which characterizes the input being calibrated. The table is loaded in non-volatile HP 8757A memory when two test points inside the network analyzer are jumpered.

### Equipment

Calibrator .....	HP 11613B
Controller .....	HP 200 or 300 series computer with 3.5 or 5.25 inch disc drive
Operating language .....	BASIC 2.0 or above
Software .....	Supplied with the HP 11613B

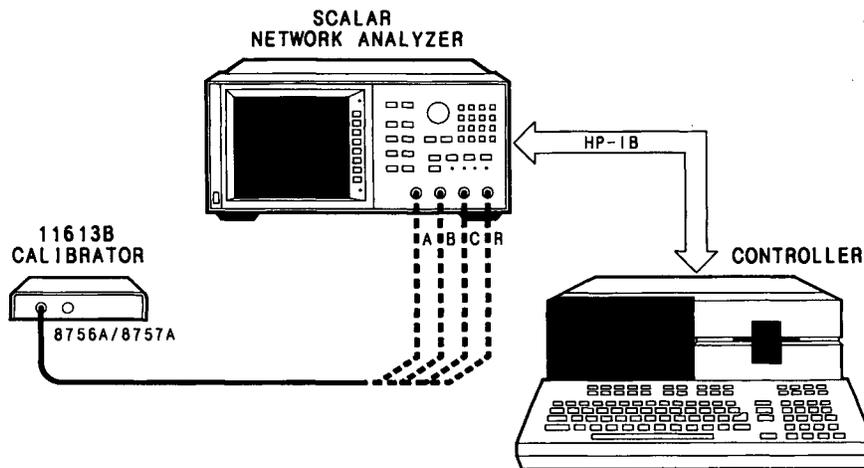


Figure 3-1. HP 8757A Calibration Setup

### Procedure

1. Connect the equipment as shown in Figure 3-1 and allow one hour for warm-up of the network analyzer. Observe the operating temperature limits. During this time, leave all of the covers of the HP 8757A on.
2. Load BASIC and the HP 11613B software into the controller and RUN the program (refer to "Loading the Program" in Section 2, as required).
3. When the "HP 11613B CALIBRATOR MAIN MENU" appears on the controller CRT, press [CAL 8757] to enter the "HP 8757 CALIBRATION MENU".

- On the controller, press **[CAL ALL]** or **[CAL ONE]** to calibrate all or one of the inputs. The calibrator will perform a "Self Check" and an Initialization. In the "Cal All" mode, following the "Self Check", first input A, then B and C (option 001 only) and R will be calibrated.

If the "Self Check" fails, as indicated by an "ABSOLUTE LEVEL OUTPUT ERROR" or "INCONSISTENT STAGE ERROR" message, try to calibrate another input of the network analyzer. The failure may be caused by either the HP 11613B or the HP 8757A.

If all of the network analyzer's inputs have failed to pass the "Self Check", perform the "Operator's Check" as indicated in Section 6.

- When the calibrator passes the "Self Check", the controller will automatically initialize the system and generate the calibration data for the input(s) desired. The controller generates the data by attenuating the 27.8 kHz signal from 0 dB to 140 dB in 0.5 dB steps. At each level of attenuation, the controller takes readings from the HP 8757A. These readings are used to create a table which characterizes the HP 8757A input being used. The readings are also plotted as normalized data. The normalized data is displayed on the CRT as a graph of "UNCORRECTED LOG DATA" and should be similar to Figure 3-2. Refer to Figure 1-2 to relate attenuation (dB) to power (dBm).

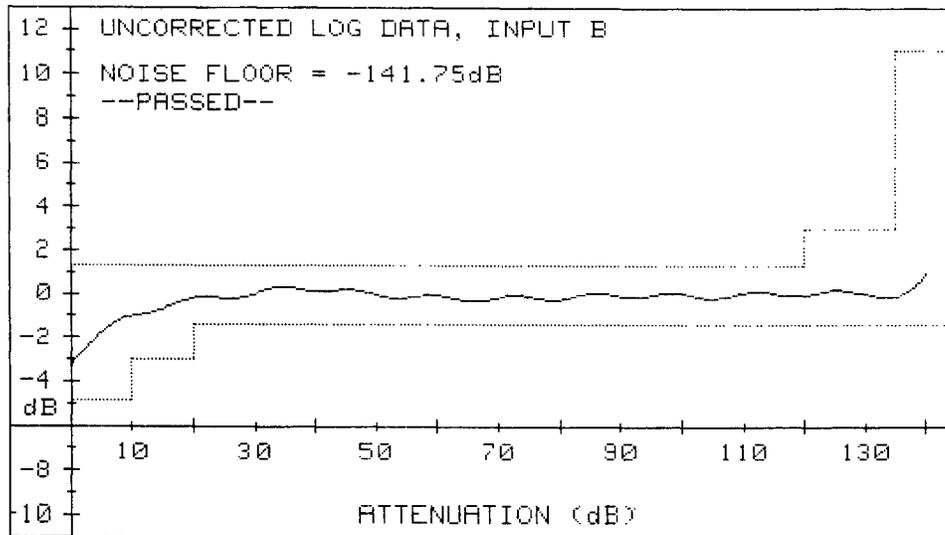


Figure 3-2. Typical Uncorrected Log Data Plot

- To store the calibration data in the network analyzer, press the softkey **[YES]** when prompted. (At this point the calibration data resides in the controller memory.) After the next prompt, enter the date (in MM/DD/YY format) and press **[ENTER]**. If the date displayed is correct, press the softkey **[YES]** to continue; otherwise press the softkey **[NO]** and enter the date. Then enter any four ASCII characters to identify your test site or initials and press **[ENTER]** again. HP Service offices will enter their four digit entity code.
- Remove the top cover of the HP 8757A by disengaging the captive screw on its upper rear edge.
- Refer to Figure 3-3 and **carefully** use a jumper to connect test point L WP (A3TP1) to L READ (A3TP2) of the HP 8757A when prompted. To minimize the possibility of data loss, first connect the jumper to L WP and then L READ. Use caution, do not short either test point to ground. Shorting either test point to ground may necessitate cycling the HP 8757A power switch to return to an operational state.

Connecting the jumper and pressing the **[CONTINUE]** softkey when prompted enables the controller to load the calibration data into nonvolatile memory of the HP 8757A.

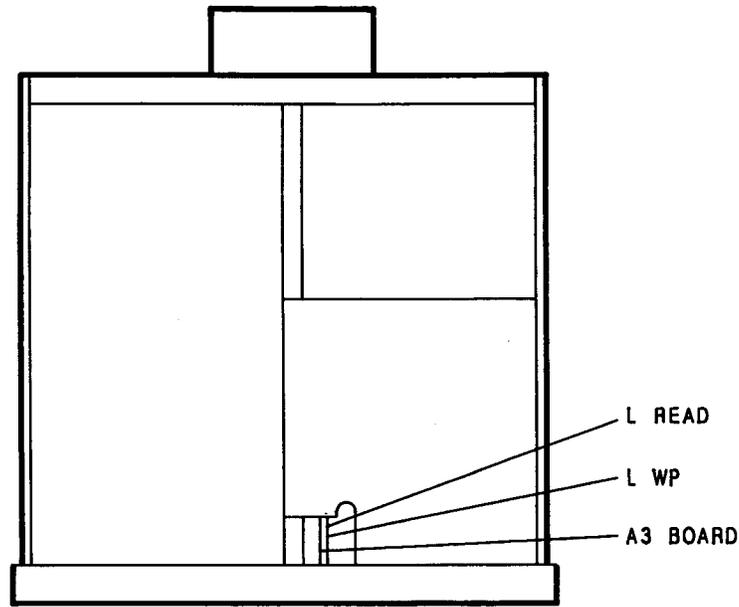


Figure 3-3. Location of HP 8757A Test Points L WP and L READ

9. When prompted, disconnect the jumper first from L READ and then from L WP. Replace the cover of the network analyzer. The network analyzer input(s) selected in step 4 are now calibrated.
10. This concludes the procedure, "Calibration of the HP 8757A". Remember that NBS traceability of the HP 8757A is confirmed by passing the *Dynamic Power Accuracy* performance test using NBS traceable attenuators as described in the *HP 8757A Operating and Service Manuals*. To check the validity of the calibration data stored in the network analyzer, continue with the next procedure. To terminate the program, press **[PRIOR]** and **[QUIT]**.
11. If the calibration procedure did not end successfully with a return to the "HP 8757 CALIBRATION MENU", and if a failure message was displayed, the HP 11613B or the HP 8757A input may be faulty. In general, an abrupt change in the plotted data suggests a calibrator error while a smooth transition into the "OUT OF SPEC" region suggests a faulty log amplifier.

Try to calibrate another input. If you cannot calibrate any input, perform the "Operator's Check" as described in Section 6 and then troubleshoot any faulty inputs. Explanations of calibration failure messages are listed at the end of this section.

## CHECK OF THE HP 8757A CALIBRATION

### Description

This procedure uses the HP 11613B to verify the calibration of an HP 8757A. First a "Self Check" of the HP 11613B is performed: similar internal attenuators are compared. Next, the output of the HP 11613B is attenuated from 0 dB to 140 dB in 0.5 dB steps while the controller takes readings from the HP 8757A. The controller compares the readings to expected readings and plots the difference. Thus the plot shows the errors of the HP 8757A input being checked.

### Equipment

Calibrator .....	HP 11613B
Controller .....	HP 200 or 300 series computer with 3.5 or 5.25 inch disc drive
Operating language .....	BASIC 2.0 or above
Software .....	Supplied with the HP 11613B

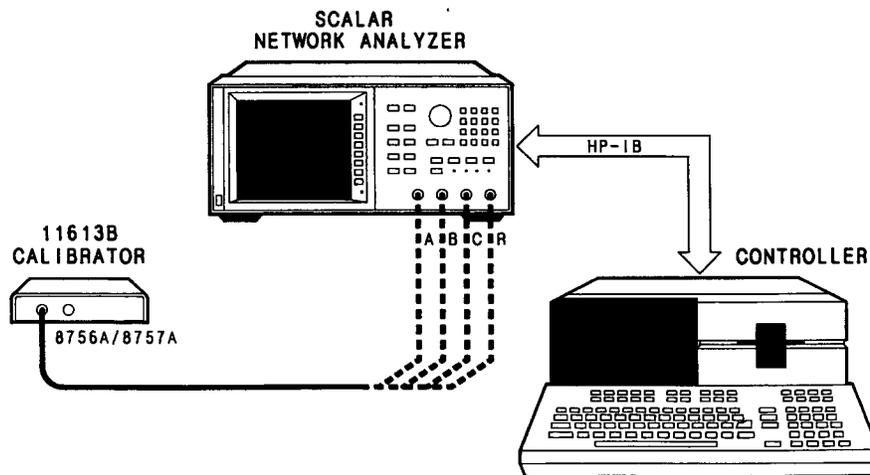


Figure 3-4. HP 8757A Calibration Setup

### Procedure

1. Connect the equipment as in Figure 3-4. Allow one hour warm-up.
2. In the "HP 11613B CALIBRATOR MAIN MENU", press **[CAL 8757]** and then press **[CHK ALL]** or **[CHK ONE]** to check all or one of the network analyzer inputs.
3. If you selected **[CHK ALL]**, the calibrator will first check input A, then B and C and R. If you selected **[CHK ONE]**, press the softkey corresponding to the input you want to check. Follow the CRT prompts. Note that the calibrator must be connected to the input being checked.
4. The calibrator will perform a "Self Check" and an "Initialization". If the calibrator passes the "Self Check", the controller will automatically initialize the system and check the calibration data.

If the calibrator fails the "Self Check", as indicated by an "ABSOLUTE LEVEL OUTPUT ERROR" or "INCONSISTENT STAGE ERROR" message, either the HP 11613B or the HP 8757A is faulty. Try to check the calibration of another input. If all of the network analyzer inputs have failed the self check, perform the "Operator's Check" as indicated in Section 6 to verify that the HP 11613B is operating properly.

5. The calibration data check begins by measuring and displaying the absolute error with the calibrator attenuation set at 21 dB. It also measures and displays the level of the noise floor. It then graphs calibration data errors of the input and indicates PASSED or FAILED. It will repeat this sequence for all three (four with option 001) inputs if you selected **[CHK ALL]**.

The input under test meets specifications when the displayed errors are within the limit lines. Note that the accuracy of the system (an HP 8757A input and detector or bridge) is confirmed by passing the *Dynamic Power Accuracy* performance test as outlined in the *HP 8757A Operating and Service Manuals*.

6. If the HP 8757A input has failed the calibration check, assuming the HP 11613B has passed the "Operator's Check", the input should be recalibrated.

Errors that are outside the limit lines indicate that the input does not meet specifications although the system (an HP 8757A input and detector or bridge) may be within specifications. In this situation, you may want to confirm the accuracy of the system by performing the *Dynamic Power Accuracy* performance test as outlined in the *HP 8757A Operating and Service Manuals*.

7. At the end of this procedure, the "HP 8757 CALIBRATION MENU" will be displayed. This completes the procedure, "Check of the HP 8757A Calibration". Press **[PRIOR]** and then **[QUIT]** to terminate the program. Remember that NBS traceability of the HP 8757A is confirmed by passing the *Dynamic Power Accuracy* performance test as described in the *HP 8757A Operating and Service Manuals*.

## ID CHECK OF THE HP 8757A

### Description

This procedure displays, on the controller CRT, the current firmware revision number and serial number of the HP 8757A. It also displays the date and location of calibration (if available) for each HP 8757A input.

### Equipment

Controller ..... HP 200 or 300 series computer with  
3.5 or 5.25 inch disc drive  
Operating language ..... BASIC 2.0 or above  
Software ..... Supplied with the HP 11613B

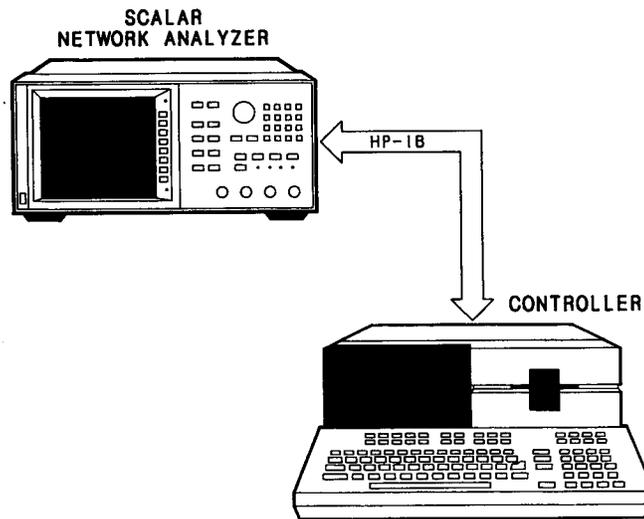


Figure 3-5. HP 8757A Calibration Setup

### Procedure

1. Connect the equipment as in Figure 3-5.
2. Perform the steps in the procedure, "Loading the Program" (Section 2), and then press **[CAL 8757]** if the controller CRT is not now displaying the "HP 8757 CALIBRATION MENU".
3. Press the **[8757 ID]** softkey.
4. The controller CRT should display this information:

CURRENT FIRMWARE REVISION IS: x.x

CURRENT SERIAL NUMBER IS: xxxxx

INP A	INP B	INP C	INP R
LOCATION	LOCATION	LOCATION	LOCATION
MM/DD/YY	MM/DD/YY	MM/DD/YY	MM/DD/YY

**NOTE:** The location and date information fields will display "N/A" if that information has not been entered previously.

5. If the controller CRT displays "All EEPROM DATA IS UNDEFINED", the HP 8757A calibration data has been lost or corrupted. Recalibrate all of the network analyzer inputs.
6. Press the **[CONTINUE]** softkey to return to the "HP 8757 CALIBRATION MENU". Press the **[PRIOR]** and then the **[QUIT]** softkeys to terminate the program.
7. This concludes the procedure, "ID Check of the HP 8757A".

## CALIBRATION FAILURE MESSAGES

The calibration failure messages are listed alphabetically in Table 3-2. Messages which begin with punctuation or numbers are listed last.

*Table 3-2. Calibration Failure Messages Listing (1 of 2)*

### **ABSOLUTE LEVEL OUT OF SPEC AT -21dB:**

The HP11613B attenuation has been set to 21 dB and measured by the HP8757A. This measurement has been compared to the calibration data of the HP8757A and differs by more than 0.1 dB. The error is probably due to drift of the HP8757A. Recalibrate it.

### **ABSOLUTE LEVEL OUTPUT ERROR IN THE HP 11613 or HP 8757:**

The calibrator has been measured by the HP8757A at its maximum and minimum output. The measurements as uncorrected data (bits) are out of range. The HP8757A caused the error (assuming the HP11613B passed the "Operator's Check").

### **BAD CHECKSUM WAS FOUND:**

Calibration data errors in the HP8757A nonvolatile memory produce checksum errors. Recalibrate the HP8757A. Failing that, the memory may need servicing.

### **CAN'T WRITE TO EEPROM FOR INPUT X:**

(X=A, B, C or R) The controller was not able to write to the HP8757A nonvolatile memory. Check the jumper between LREAD and LWP. The memory may have failed.

### **COMPUTATION ERROR OCCURRED DURING MEASUREMENT:**

Some of the measured data was out of range. Check all connections and repeat.

### **ERROR RELATIVE TO 21dB ATTEN. OUT AT . . . :**

Measurements are made relative to 21 dB attenuation setting of the HP11613B. A measurement using the HP8757A calibration table is out of spec. Recalibrate the network analyzer.

### **HP-IB TIME-OUT ERROR; CHECK INSTRUMENTS!:**

Check the HP-IB connections and addresses and repeat the procedure.

### **HP 11613 NOT CONNECTED TO INPUT X:**

(X=A, B, C or R) The HP11613B has been set to maximum output level at input X and the HP8757A has failed to measure that signal. The program has concluded that the calibrator is not connected to input X. If the calibrator is properly connected, either the HP8757A or the HP11613B may have failed.

### **HP 8757 NOT FOUND AT ADDRESS 716:**

Confirm that the HP8757A is set to address 16 by pressing its [LOCAL] and [8757] keys. Check the HP-IB connections.

Table 3-2. Calibration Failure Messages Listing (2 of 2)

**LOG AMP AUTOZERO OUT OF SPEC :**

The log amplifier has been set to output its autozero level. That level is incorrect. Suspect the HP 8757A log amplifier or ADC board.

**LOG AMP SLOPE OUT OF SPEC (IN BITS PER dB) :**

The calibrator output has been attenuated in 0.5 dB steps and measured by the HP 8757A. The measured slope did not match the expected slope of approximately 200 bits/dB. Refer to the *HP 8757A Service Manual* to troubleshoot the log amplifier.

**LOG AMP TEMPERATURE REFERENCE OUT OF SPEC :**

The log amplifier has been set to output its temperature reference voltage to the ADC. The ADC did not register the proper value. This error implies a log amp or ADC failure in the HP 8757A.

**MAXIMUM SIGNAL READING OUT OF SPEC :**

The calibrator has been set to its maximum output level. That level has been measured as ADC bits in the HP 8757A and is incorrect. The HP 8757A log amplifier gain is probably incorrect.

**NOISE FLOOR > -139dB; MEASURED . . . :**

The HP 11613B has been set to its minimum output level and the noise floor has been measured by the HP 8757A. The noise floor is too high. To determine the source of the noise, enter the [SET LVL] routine (the software menu map is Table 3-1). Select the input in question and then press [MIN SIG] and [LOCAL]. Observe the trace on the HP 8757A. If the noise level decreases when you disconnect the calibrator, the calibrator is noisy and should be returned for repair. If the noise level does not decrease, a noisy log amplifier is probable. Refer to the *HP 8757A Service Manual*.

**NORMALIZED DATA OUT OF SPEC AT . . . :**

The calibrator output has been attenuated from 0 dB to about -140 dB in 0.5 dB steps and measured at the output of the HP 8757A log amplifier. The slope of the HP 8757A log amplifier has been subtracted from the measured output to yield normalized data. The data points listed on the controller CRT are out of limits. See Section 6 for additional information.

**STAGES DENOTED BY ``\*\*\*\*\*'' ARE INCONSISTENT :**

Similar stages of attenuation in the calibrator have been measured by the HP 8757A. The unexpected differences usually point to a problem in the network analyzer. Refer to, "Troubleshooting HP 8757A Operation Failures".

**TRACE NOISE > 4 BITS AT 21 dB ATTENUATION :**

The calibrator has been set to output its signal with 21 dB of attenuation. When the HP 8757A measured the trace noise at this level, it found an error. The source of the error is probably a noisy log amplifier. Refer to the *HP 8757A Service Manual*.

**.5dB STEP CHANGE OUT OF SPEC :**

Log amplifier slope failure probable. Refer to, "Troubleshooting HP 8757A Operation Failures".

## Troubleshooting the HP 8757A with the HP 11613B

### GENERAL INFORMATION

The HP 11613B is a powerful tool for troubleshooting HP 8757A problems. Its successful use depends on these conditions:

- a. The system (calibrator, network analyzer, computer, disc drive, auxiliary instruments) is correctly configured.
- b. The calibrator itself is operating properly as indicated by its having passed the "Operator's Check".

There are three situations when you may detect potential problems with the HP 8757A:

1. During a check of the HP 8757A calibration.
2. During a calibration of the HP 8757A.
3. During the normal operation of the HP 8757A as a network analyzer.

Procedures to troubleshoot the HP 8757A in each of these situations follow.

### TROUBLESHOOTING HP 8757A CALIBRATION CHECK FAILURES

The first step in troubleshooting calibration check failures is to recalibrate the appropriate analyzer input(s). After recalibration, repeat the calibration check procedure. If after recalibration, the calibration check fails, refer to "Troubleshooting HP 8757A Operation Failures".

### TROUBLESHOOTING HP 8757A CALIBRATION FAILURES

Calibration failures are usually hardware failures; primarily failures of a log amplifier board (90% probability) or of the analog-to-digital (ADC) board. To distinguish a log amplifier failure from an ADC failure during calibration, calibrate another input. Each HP 8757A input has its own log amplifier board and its own sample and hold circuit on the ADC board. All the log amplifiers use the one ADC board.

If any input can be calibrated when another cannot, suspect the log amplifier and its associated input amplifier on the ADC board. Refer to Figures 3-6 through 3-13 to see the Uncorrected Log Data plots and failure messages associated with different log amplifier failures. Figure 3-4 is a typical plot of a normal input. Refer to Table 3-2 for additional information as required.

If no input can be calibrated, suspect the ADC board or the power supplies. Refer to Table 3-2 for additional information.

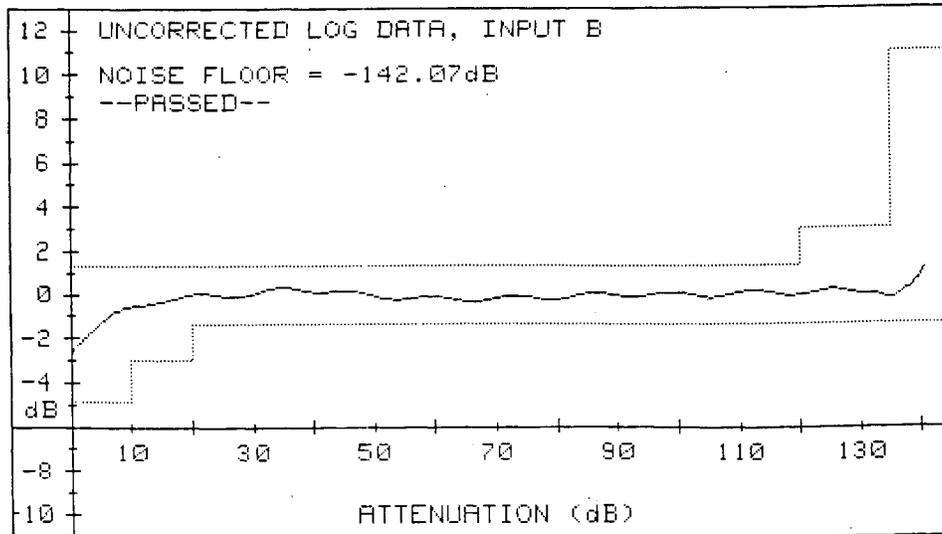
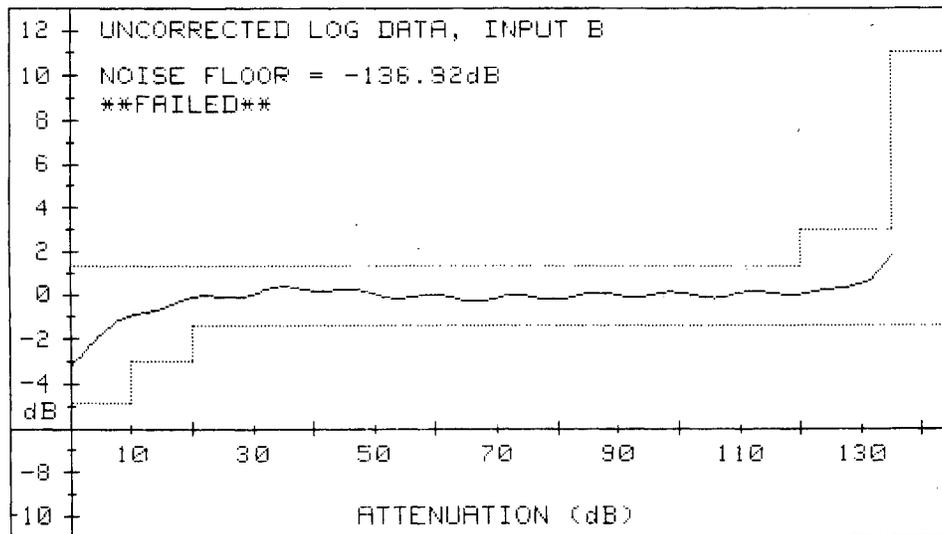


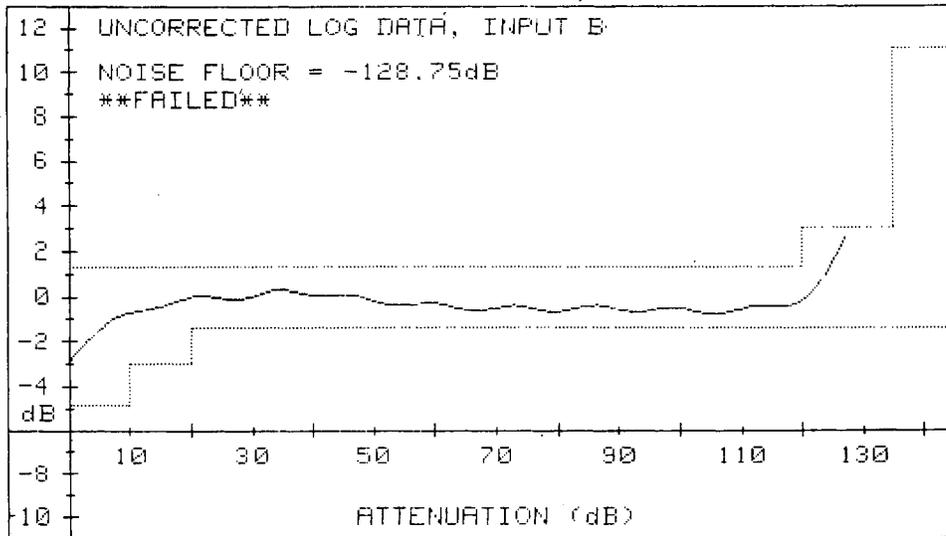
Figure 3-6. Typical Plot of Normal Input



LOG CAL OF INPUT B FAILED FOR:

- 1: MAXIMUM SIGNAL READING OUT OF SPEC  
MEASURED = 28344 EXPECTED >29876 BITS
- 2: NOISE FLOOR >= -139dB; MEASURED = -136.92dB

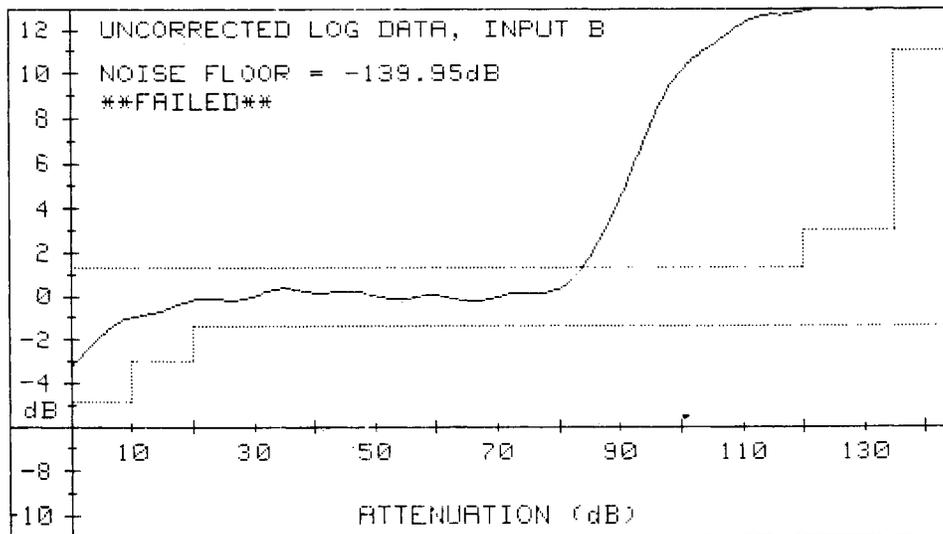
Figure 3-7. Plot of Log Amplifier with U11B Failure



LOG CAL OF INPUT B FAILED FOR:

- 1: MAXIMUM SIGNAL READING OUT OF SPEC  
MEASURED = 25724 EXPECTED >29876 BITS
- 2: NOISE FLOOR >= -139dB; MEASURED = -128.75dB

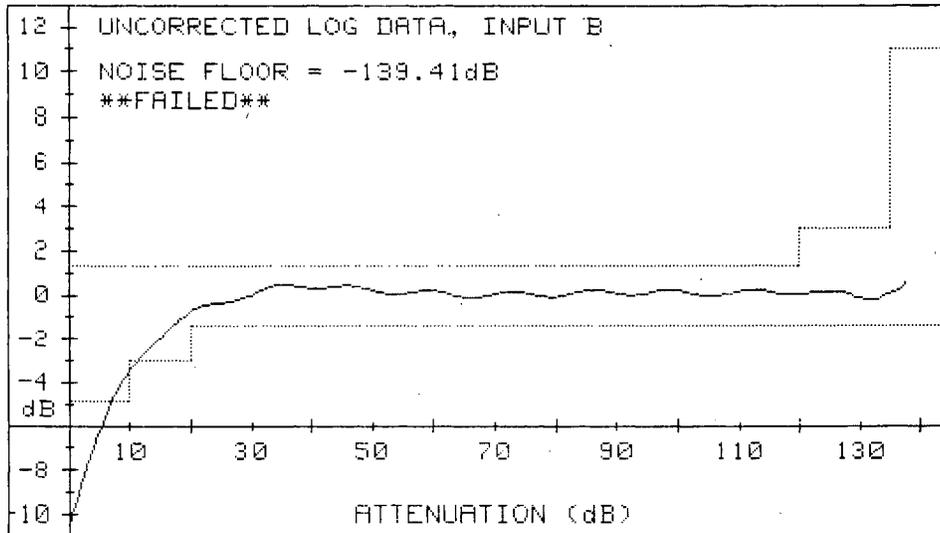
**Figure 3-8. Plot of Log Amplifier with U11A Failure**



LOG CAL OF INPUT B FAILED FOR:

- 1: MAXIMUM SIGNAL READING OUT OF SPEC  
MEASURED = 28264 EXPECTED >29876 BITS
- 2: LOG AMP SLOPE OUT OF SPEC (IN BITS PER dB)  
MEASURED =171.48 EXPECTED = 200 +4/-5
- 3: .5DB STEP CHANGE OUT OF SPEC AT 83.5dB  
MEASURED =66BITS EXPECTED =100 +/- 30
- 4: NORMALIZED DATA OUT OF SPEC AT 84dB  
MEASURED =1.37dB

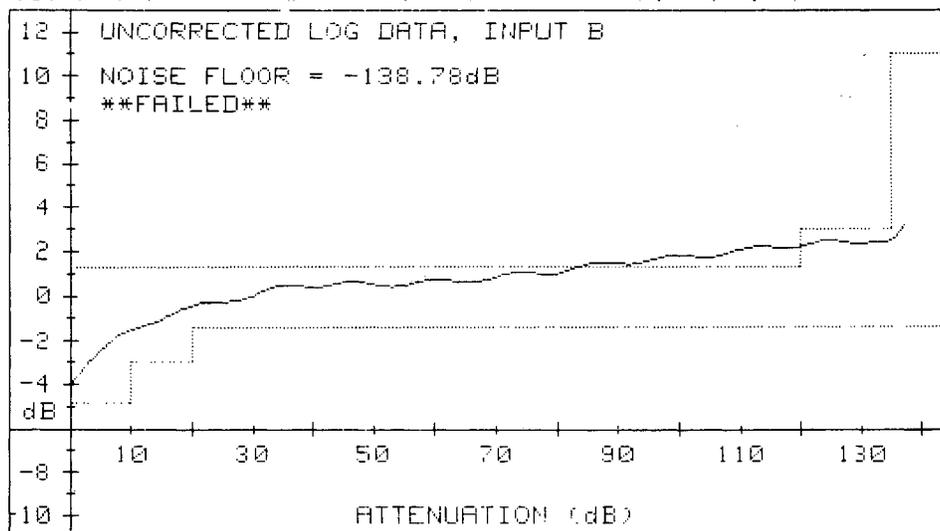
**Figure 3-9. Plot of Log Amplifier with Open C43**



LOG CAL OF INPUT B FAILED FOR:

- 1: MAXIMUM SIGNAL READING OUT OF SPEC  
MEASURED = 29380 EXPECTED >29876 BITS
- 2: NORMALIZED DATA OUT OF SPEC AT 0dB  
MEASURED = -10.488dB
- 3: .5DB STEP CHANGE OUT OF SPEC AT 5.5dB  
MEASURED = 27BITS EXPECTED = 90 +/- 45

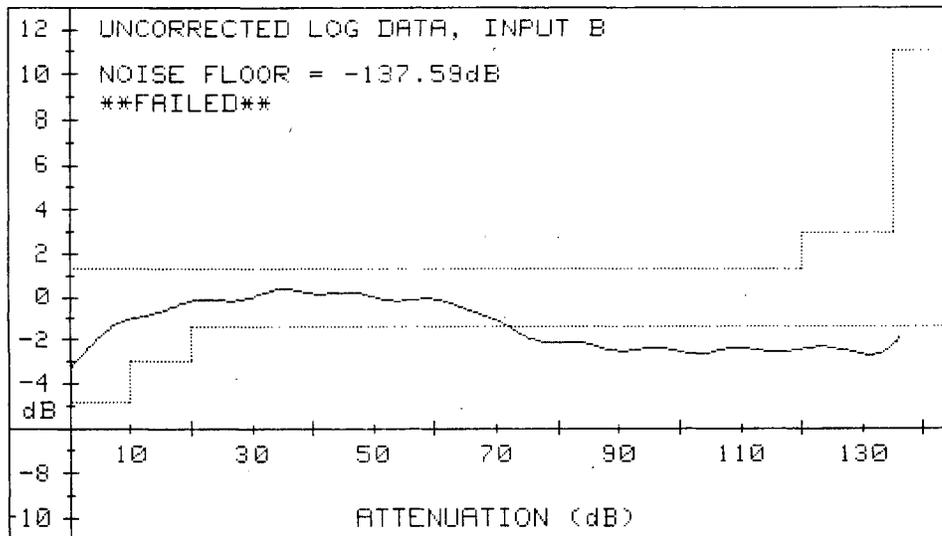
Figure 3-10. Plot Log Amplifier with U9B Failure



LOG CAL OF INPUT B FAILED FOR:

- 1: LOG AMP SLOPE OUT OF SPEC (IN BITS PER dB)  
MEASURED = 194.93 EXPECTED = 200 +/- 5
- 2: NORMALIZED DATA OUT OF SPEC AT 84.5dB  
MEASURED = 1.395dB
- 3: NOISE FLOOR >= -139dB; MEASURED = -138.78dB

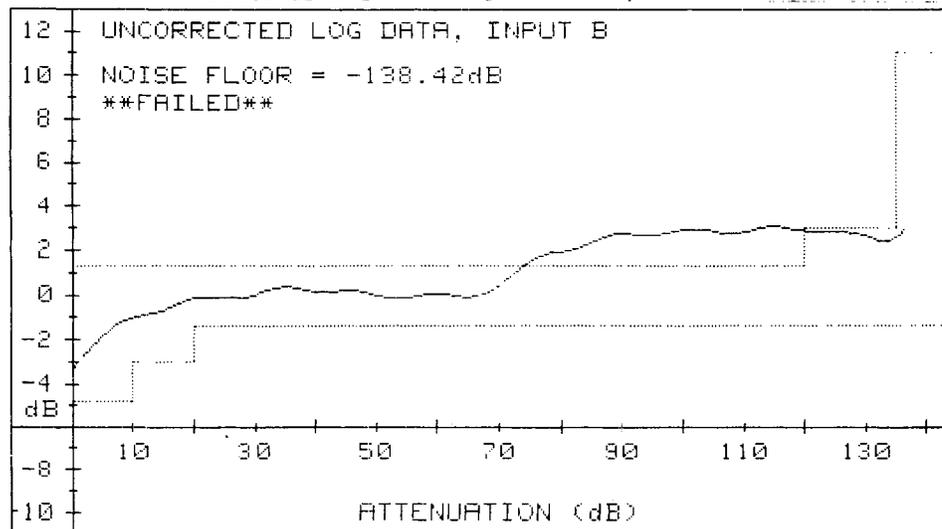
Figure 3-11. Plot of Log Amplifier with U2A = 75% Normal Gain



LOG CAL OF INPUT B FAILED FOR:

- 1: LOG AMP SLOPE OUT OF SPEC (IN BITS PER dB)  
MEASURED = 205.16      EXPECTED = 200 +/-5
- 2: NORMALIZED DATA OUT OF SPEC AT 72dB  
MEASURED = -1.385dB
- 3: NOISE FLOOR >= -139dB; MEASURED = -137.59dB

**Figure 3-12. Plot of Log Amplifier with U2A = 140% Normal Gain**



LOG CAL OF INPUT B FAILED FOR:

- 1: LOG AMP SLOPE OUT OF SPEC (IN BITS PER dB)  
MEASURED = 193.76      EXPECTED = 200 +/-5
- 2: NORMALIZED DATA OUT OF SPEC AT 74.5dB  
MEASURED = 1.425dB
- 3: NOISE FLOOR >= -139dB; MEASURED = -138.42dB

**Figure 3-13. Plot of Log Amplifier with 6.3 Vref = 6.0V**

## TROUBLESHOOTING HP 8757A OPERATION FAILURES

### GENERAL INFORMATION

The calibrator "SET LVL" routine is an efficient tool for diagnosing HP 8757A problems. By using the softkeys or the knob on the computer keyboard, you can vary the output signal of the calibrator. This enables you to use it as a signal generator and to monitor signal levels through the HP 8757A.

### HP 11613B SET LVL Routine

In this routine, near the bottom of the CRT screen, you should see:

LVL=                      EXPECT=                      MEAS=

LVL= indicates the signal level output of the calibrator; its range from 0 dB (maximum signal, no attenuation) to -154.5 dB.

EXPECT= indicates the dBm level the network analyzer is expected to measure for a given LVL= input. For LVL=0 dB, EXPECT=20.02 dBm.

MEAS= indicates the dBm level that the network analyzer actually measures. The network analyzer sees the calibrator as an HP 11664A detector.

**NOTE:** Except for LVL= 0 dB (where the log amplifiers saturate), the EXPECT= and MEAS= values typically should be within 0.1 dB in a working calibrated HP 8757A. However, below LVL= -130 dB, the HP 8757A noise floor will increasingly cause the EXPECT= and MEAS= readings to diverge.

### Troubleshooting Procedure

1. Load BASIC and the HP 11613B software program and run the program as described in Section 2, "Loading the Program".
2. Connect the equipment as shown in Figure 2-1a.
3. When the "HP 11613 CALIBRATOR MAIN MENU" appears on the controller CRT, press [SET LVL] and select the detector input being used. The controller CRT will display eight softkeys with a brief explanation of each.
4. To check the response of the log amplifier output, remove the top cover and the log amplifier enclosure cover of the network analyzer.
5. Use a DVM (set at DC mode) to measure the voltage at TP9 of the log amplifier associated with the input being used (A7 for input A, A8 for input B, A9 for input C, and A10 for input R). TP9 is the uppermost rear testpoint on the board. Use TP5 for ground. They are labeled on the board and illustrated in *Figure 8-32, A7 Component Locations Diagram* of the *HP 8757A Service Manual*.

Vary the LVL setting with the softkeys or knob as desired. Compare the voltage measured at TP9 with typical values in Table 3-3.

Table 3-3. LVL Settings vs. Typical TP9 Voltages

LVL (dB)	TP9 (volts)	LVL (db)	TP9 (volts)
0	+7.5	-80	-0.4
-10	+6.7	-90	-1.4
-20	+5.7	-100	-2.4
-30	+4.7	-110	-3.4
-40	+3.7	-120	-4.4
-50	+2.7	-130	-5.4
-60	+1.6	-140	-6.4
-70	+0.6		

6. If the voltage readings at TP9 are good, but you suspect the network analyzer still has a problem, refer to the *HP 8757A Operating and Service Manual Service Section, A4 Analog-to-Digital Converter* to troubleshoot the ADC board.

**NOTE:** Select the softkey [LOCAL] on the computer keyboard to observe the signal on the network analyzer CRT rather than on the computer CRT. Note that this mode allows you to vary the display of the network analyzer with its front panel keys, but you cannot vary the signal level of the calibrator. The HP 11613B output level may change if you either disconnect and reconnect the calibrator or if you press the [PRESET] or [CONFIG SYSTEM] keys on the HP 8757A.

7. Press [CONTINUE] to return to the "SET LEVEL" routine.
8. Press [PRIOR] and then [QUIT] to terminate the program.

## Section 4. Using the HP 11613B with the HP 8756A

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### INTRODUCTION

This section explains how to use the HP 11613B to calibrate and to check the calibration of the HP 8756A scalar network analyzer. Note that NBS traceability of the HP 8756A is confirmed by passing the *Dynamic Power Accuracy* performance test using NBS traceable attenuators as described in the *HP 8756A Operating and Service Manuals*. Much of the information which would normally appear in this section resides in the software supplied with the calibrator itself. Thus to operate the calibrator, you need only connect it as shown in Figure 4-1 and respond to the CRT prompts.

### RUNNING THE PROGRAM FOR THE HP 8756A

**NOTE:** If using BASIC 3.0 or above, ensure that the binary file "GPIO" is already loaded in the computer, otherwise the computer will not recognize the GPIO interface and "ERROR 163" will be generated.

Once the "CAL" program has been loaded and the HP 8756A analyzer selection has been made as described in Section 2, the computer will load and run the calibration program for the HP 8756A. With some versions of BASIC, an error message will briefly appear just after the program starts; disregard it. Follow the prompts on the controller CRT until "HP 11613 CALIBRATOR MAIN MENU" appears there. Refer to the *Software Menu Map, Table 4-1*, and the sections noted below to see how to enter the different routines. Variations on the basic operation setup and the equipment required are noted with CRT prompts and in this manual.

Table 4-1. HP 11613B Software Menu Map

HP 11613B Calibrator Menu Levels		
Level 1	Level 2	Description
OP CHECK		Verifies proper operation of HP 11613B.
ADJUST		Allows real time adjustment of the logger board while viewing results on the computer.
	NewInput	Allows selection of new input channel.
	UPDATE/HOLD	Update will refresh the trace on each power sweep. Hold will plot each trace without erasing previous traces.
	SCALE	Allows full scale viewing of +/- 1, 5, or 10 dB.
	ERASE	Erases trace(s) and starts over.
	STEP = n	Allows selection of 1, 2, or 5 dB step size.
STORE	MainMenu	Calibrates HP 8756A with HP 11613B. Returns to menu level 1.
VERIFY		Checks the calibration of the HP 8756A. Corrected or Uncorrected data may be viewed.
	CORRECTD/ UNCORRTD	
	MainMenu	Returns to Main Menu.
SET LVL		Sets output of HP 11613B to 0 dB [about 10.6 Vp-p]. Any level, in 1.0 dB steps, over a 150 dB range, may then be set with the keyboard's knob or the softkeys below.
	MainMenu	Returns to menu level 1.
	MIN SIG	Sets calibrator output to -150 dB.
	MAX SIG	Sets calibrator output to 0.0 dB.
	-5dB	Decreases output level by 5 dB.
	+5dB	Increases output level by 5 dB.
	-1dB	Decreases output level by 1 dB.
	+1dB	Increases output level by 1 dB.

To calibrate an input, perform the "STORE" procedure.

To check the calibration of an input, perform the "VERIFY" procedure.

## CALIBRATION OF THE HP 8756A

**NOTE:** Do not connect anything to the MONITOR jack during these procedures.

### Description

When you use the HP 11613B to calibrate or check the calibration of an HP 8756A input, the controller first will run the "Self Check" routine of the calibrator. This routine compares similar internal attenuators. Next, the output of the HP 11613B is attenuated from 0 dB to -130 dB in 1 dB steps while the controller takes readings from the HP 8756A and plots the data. These readings are used to create a table which characterizes the input being calibrated. The table is loaded in non-volatile HP 8756A memory when two test points inside the network analyzer are jumpered.

### Equipment

Calibrator .....	HP11613B
Controller .....	HP 200 or 300 series computer with 3.5 or 5.25 inch disc drive
GPIO Interface Card .....	HP 98622A
Operating language .....	BASIC 2.0 or above
Software .....	Supplied with the HP 11613B
GPIO cable .....	Supplied with the HP 11613B

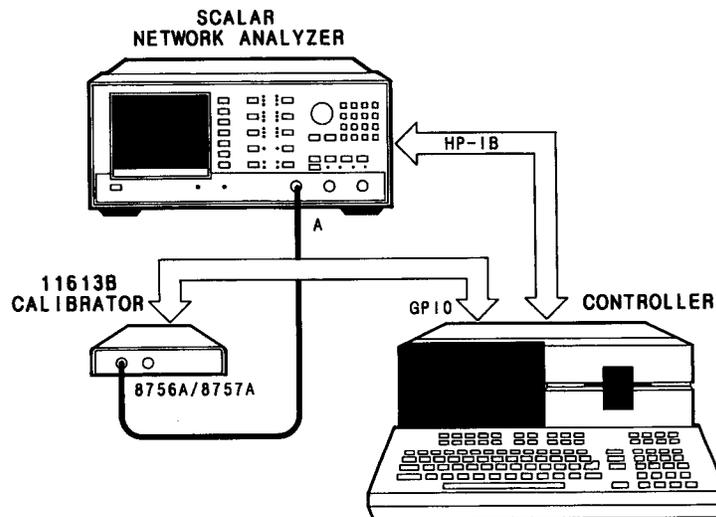


Figure 4-1. HP 8756A Calibration Setup

### Procedure

1. Connect the equipment as shown in Figure 4-1 and allow one hour for warm-up of the network analyzer. Observe the operating temperature limits. During this time, leave all of the covers of the HP 8756A on.

**Time saving hint:** If all three inputs are to be calibrated, first connect a jumper as described in step 6 and press [PRESET] on the HP 8756A. This will prevent the program from asking the operator to repeatedly connect and disconnect the jumper for each input. This will eliminate all existing CAL constants even if verified as good.

2. Load BASIC and the HP 11613B software into the controller and RUN the HP 8756A program (refer to "Loading the Program", Section 2, as required).
3. When the "HP 8756A MAIN MENU" appears on the controller CRT, press [STORE] to enter the "STORE MENU".
4. On the controller, select the input to be calibrated (A, B, or R).

If the "Self Test" has not been performed since the program was run, the calibrator will perform a "Self Check". If the "Self Check" fails, as indicated by an "ABSOLUTE LEVEL OUTPUT ERROR" or "INCONSISTENT STAGE ERROR" message, try to calibrate another input of the network analyzer. The failure may be caused by either the HP 11613B or the HP 8756A. If all of the network analyzer's inputs have failed to pass the "Self Check", perform the "Operator's Check" as indicated in Section 6.

5. When the calibrator passes the "Self Check", the controller will automatically initialize the system and generate the calibration data for the input desired. The controller generates the data by attenuating the 27.8 kHz signal from 0 dB to 130 dB in 1 dB steps. At each level of attenuation, the controller takes readings from the HP 8756A. These readings are used to create a table which characterizes the HP 8756A input being used. This uncorrected data is displayed on the CRT as a graph of dB error vs. dBm, similar to Figure 4-2. There is no error checking of the uncorrected data. Instead, the computer will ask the user if the correction data for the displayed trace should be stored.

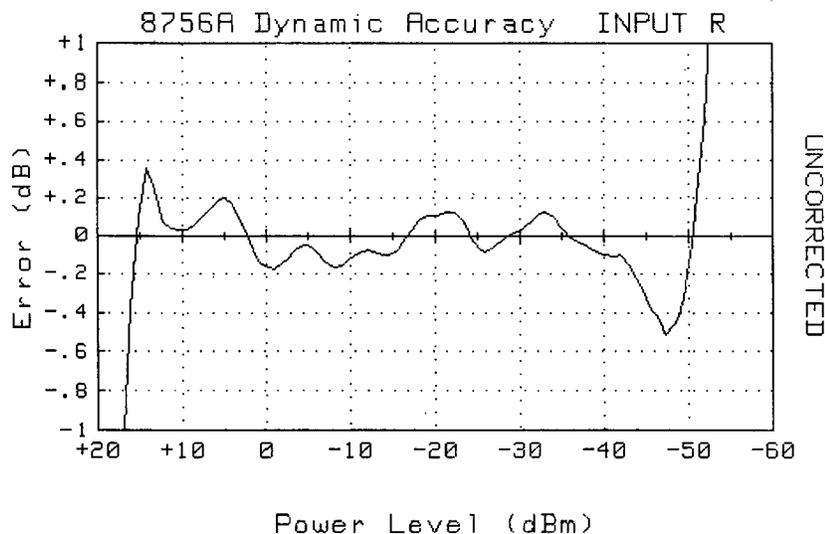


Figure 4-2. Typical Uncorrected Log Data Plot for the HP 8756A

6. To store the calibration data in the network analyzer, select the softkey [YES] when prompted. (At this point the calibration data still resides in the controller memory.) Remove the top cover of the HP 8756A by disengaging the captive screw on its upper rear edge. Refer to Figure 4-3 and **carefully** use a jumper to connect test point WP (A3TP4) to +5V (A3TP5) of the HP 8756A when prompted. Take care: do not short either test point to ground. Shorting either test point to ground may necessitate cycling the HP 8756A power switch to return to an operational state. Connecting the jumper and selecting the [CONTINUE] softkey when prompted enables the controller to load the calibration data into nonvolatile memory of the HP 8756A.

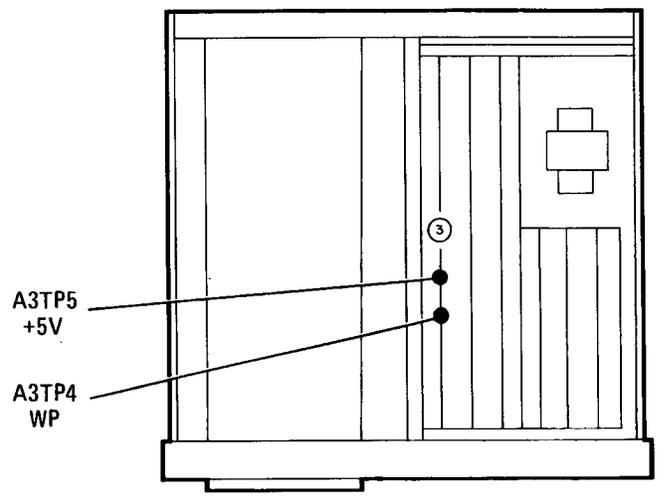


Figure 4-3. Location of HP 8756A Test Points WP and +5V

7. When prompted, disconnect the jumper. The network analyzer input selected in step 4 is now calibrated. The computer will now take data again and re-plot the results but this time it will use the correction data just stored. Normally this will produce a trace that is essentially flat. If all 3 inputs have not yet been calibrated, press **[PRIOR MENU]** and select the next input to be calibrated. If the calibration is complete, replace the logger and top cover of the HP 8756A.
8. This concludes the procedure, "Calibration of the HP 8756A". Remember that NBS traceability of the HP 8756A is confirmed by passing the *Dynamic Power Accuracy* performance test using NBS traceable attenuators as described in the *HP 8756A Operating and Service Manuals*.

## VERIFICATION OF THE HP 8756A

**NOTE:** Do not connect anything to the MONITOR jack during these procedures.

### Description

A verification of the HP 8756A will check the validity of the existing calibration constants already stored in the analyzer. When you use the HP 11613B to verify the calibration of an HP 8756A input, the controller first will run the "Self Check" routine of the calibrator if it has not been performed previously. This routine compares similar internal attenuators. Next the output of the HP 11613B is attenuated from 0 dB to -130 dB in 1 dB steps while the controller takes readings from the HP 8756A and plots the data.

### Equipment

Calibrator .....	HP 11613B
Controller .....	HP 200 or 300 series computer with 3.5 or 5.25 inch disc drive
GPIO Interface Card .....	HP 98622A
Operating language .....	BASIC 2.0 or above
Software .....	Supplied with the HP 11613B
GPIO cable .....	Supplied with the HP 11613B

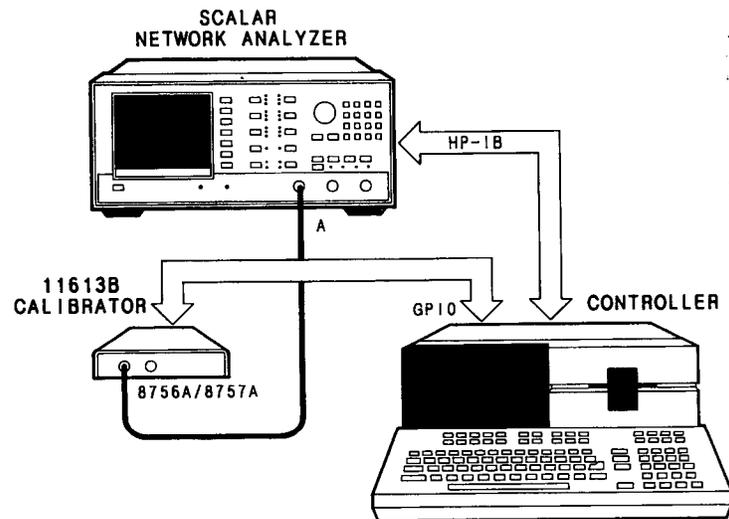


Figure 4-4. HP 8756A Calibration Setup

### Procedure

1. Connect the equipment as shown in Figure 4-4 and allow one hour for warm-up of the network analyzer. Observe the operating temperature limits. During this time leave all of the covers of the HP 8756A on.
2. Load BASIC and the HP 11613B software into the controller and RUN the HP 8756A program (refer to "Loading the Program", Section 2, as required).
3. When the "HP 8756A MAIN MENU" appears on the controller CRT, press [VERIFY] to enter the "VERIFY MENU".

4. On the controller, select the input to be calibrated (A, B, or R).

If the "Self Test" has not been performed since the program was run, the calibrator will perform a "Self Check". If the "Self Check" fails, as indicated by an "ABSOLUTE LEVEL OUTPUT ERROR" or "INCONSISTENT STAGE ERROR" message, try to verify another input of the network analyzer. The failure may be caused by either the HP 11613B or the HP 8756A. If all of the network analyzer's inputs have failed to pass the "Self Check", perform the "Operator's Check" as indicated in Section 6.

5. When the calibrator passes the "Self Check", the controller will automatically initialize the system and generate the data for the input desired. The controller generates the data by attenuating the 27.8 kHz signal from 0 dB to 130 dB in 1 dB steps. At each level of attenuation, the controller takes readings from the HP 8756A. This data is displayed on the CRT as a graph of dB error vs. dBm, similar to Figure 4-2. Normally the program plots corrected data although the user can choose to look at uncorrected data by pressing the indicated softkey. Once plotted and if corrected data was taken, the trace is then shifted so that the specification reference point (normally 0dBm) is normalized to zero error. This is done because the HP 8756A is specified only for a relative change in power, not for absolute power accuracy.
6. At this point the computer is in the "Verification Plot Menu". In this menu, the operator has five choices.
  - a. The specification reference point can be changed by the user from +10 to -40dBm in 10dB increments using the softkeys [**←REF**] or [**REF →**]. For each change in the reference point, the computer will offset the displayed trace so that the error at the reference point is zero. Regardless of which point is chosen, the trace must always lie between the two specification lines or the analyzer is in need of recalibration. The offset value is always shown at the bottom of the display.
  - b. The offset may be set to zero so that absolute accuracy may be displayed. Note that absolute accuracy is not specified and therefore the trace may be outside the specification lines. To return to the proper offset again, press the [**SCALE = 1**] softkey.
  - c. The displayed graph may be scaled to +/- 10dB instead of +/- 1dB in order to view results that may be outside the normal limits using the softkey [**SCALE = 10**].
  - d. If a printer was connected at the time the program was run, the softkey [**HardCopy**] will dump the graphics to the printer.
  - e. The entire trace may be shifted up or down using the computer's knob, if available.
  - f. The softkey [**PRIOR MENU**] will exit the Plot Menu.

## USING THE SET LEVEL FEATURE

The set level [**SET LVL**] feature allows the user to manually adjust the output of the HP 11613B from 0dB (approx. 10.6Vpp) to -150dB in 1dB increments. This signal is applied to one of the HP 8756A inputs and the resulting output is read from the HP-IB and displayed on the computer's CRT along with the attenuator setting and the expected reading. This feature is most useful in troubleshooting the analyzer. The output level may be varied using the softkeys or by rotating the knob, if available.

The measured (or actual) reading is taken using the correction constants stored in the HP 8756A. In a properly calibrated instrument, the expected and measured values should track closely from -50 to +13 dBm where the limitations and/or noise of the logger boards will cause increasing divergence of the two values.

## USING THE ADJUST FEATURE

The adjust feature allows the user to make adjustments on the logger boards and immediately see the results of the adjustment. Because the calibration constants effectively eliminates the need for any adjustments on the logger boards, this feature is usually not needed. However, if one or more parts are replaced, adjustments to the logger may be necessary to achieve a satisfactory noise floor that can then be properly calibrated.

**NOTE:** It is critical that the +15 and -12.6 volt power supplies be properly adjusted to within 50mV before any adjustment is made.

In this mode the HP 11613B is rapidly incremented through its range of 0dB to 122dB (+20dBm to -55dBm) in 5 dB steps. The results are plotted on screen as the data is being taken. Only uncorrected data with a minimal amount of averaging is taken and displayed. The trace is updated approximately every two seconds. The user can select a smaller step size of 2 or 1dB steps. The limits of the displayed graph can be expanded to +/-5 or 10dB. The noise floor of the log amplifier is displayed below the graph.

Another useful feature in this mode is the Update/Hold key. In the "Update" mode, the previous trace is erased before the new one is plotted so that only one trace is visible at a time. In the "Hold" mode, the previous traces are not erased as each new trace is drawn. This allows the user to easily view any possible drift in the system.

When adjusting the log amplifier board, use the following information to guide the adjustments.

The OFFSET pot will raise or lower the entire trace (it will affect the entire dynamic range)

The GAIN pot will affect the slope of the curve. It has the most effect at the high power end of the trace and its effect decreases to near zero at the low power end of the trace.

SHAPING ADJ pot #1 has the most effect at the high end with its effect decreasing to zero at -5dBm.

SHAPING ADJ pot #2 has the most effect at the high end with its effect decreasing to zero at -15dBm.

SHAPING ADJ pot #3 has the most effect at the high end with its effect decreasing to zero at -20dBm

Generally, it is easiest to first adjust the logger board with the gain and offset pots to obtain a reasonably flat trace from -15 to -50 dBm. Then adjust the high end from +15 to -20 dBm using the three SHAPING ADJ pots. The log amplifier must be adjusted so that the noise floor is < -51 dBm. After initial adjustment, change the step size to 1 dB and view the entire trace. Data should typically be within  $\pm 0.35$  dB between +10 dBm and -40dBm, and within  $\pm 0.6$  dB between -40 dBm and -50 dBm. After adjusting the logger board, the HP 8756A must be calibrated as in the procedure "Calibration of the HP 8756A."

## Section 5. Using the HP 11613B with the HP 8755A/B/C

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### INTRODUCTION

This section explains how to use the HP 11613B to calibrate the log amplifier boards of the HP 8755A/B/C network analyzer. Note that NBS traceability of the HP 8755A/B/C is confirmed by passing the *Amplitude Accuracy* performance test using NBS traceable attenuators as described in the *HP 8755A/B/C Operating and Service Manuals*. Much of the information which would normally appear in this section resides in the software supplied with the calibrator itself. Thus to operate the calibrator, you need only connect it as shown in Figure 5-1 and respond to the CRT prompts.

### RUNNING THE PROGRAM FOR THE HP 8755A/B/C

**NOTE:** If using BASIC 3.0 or above, ensure that the binary file **GPIO** is already loaded in the computer, otherwise the computer will not recognize the GPIO interface.

Once the "CAL" program has been loaded and the 8755 analyzer selection has been made as described in Section 2, the computer will load and run the calibration program for the HP 8755A/B/C. With some versions of BASIC an error message will briefly appear just after the program starts; disregard it. Follow the prompts on the controller CRT until "HP 11613 CALIBRATOR MAIN MENU" appears there. Refer to the *Software Menu Map, Table 5-1*, and the sections noted below to see how to enter the different routines. Variations on the basic operation setup and the equipment required are noted with CRT prompts and in this manual.

### VOLTMETER CONFIGURATION

An HP-IB voltmeter is used to measure the log amplifier's response to the HP 11613B output. This output is located before any offset is introduced, so the position of the offset switches on the HP 8755A/B/C do not matter and therefore are not tested. The output is scaled using  $-50$  mV/dB with 0 volts corresponding to 0 dBm.

Any of the HP voltmeters listed on page 5-3 may be used. The program will request that one of these be selected. The HP 3457A uses HP-SL commands to program the voltmeter, so selecting this choice should work on any future voltmeters also using HP-SL. The voltmeter is connected to the HP 8755A/B/C A6 board. The positive lead is connected to the testpoint corresponding to the input channel to be tested (**IN A**, **IN B**, or **IN R**). The negative lead of the voltmeter should be connected to chassis ground.

In order to connect the voltmeter to these testpoints, the top of the HP 8755A/B/C must be accessible. For the horizontal format display mainframes, the top cover of the mainframe may simply be removed. For the vertical format mainframes, an extender cable (HP P/N 5060-0303) is required to access the top of the HP 8755A/B/C.

Table 5-1. HP 11613B Software Menu Map

HP 11613B Calibrator Menu Levels for the HP 8755A/B/C		
Level 1	Level 2	Description
OP CHECK ADJUST		Verifies proper operation of HP 11613B.
		Allows real time adjustment of the logger board while viewing results on the computer.
SET LVL	UPDATE/HOLD	UPDATE will refresh the trace on each power sweep and HOLD will plot each trace without erasing previous traces.
	SCALE	Allows full scale viewing of +/- 1, 5, or 10 dB.
	ERASE	Erases trace(s) and starts over.
	STEP = n	Allows selection of 1, 2, or 5 dB step size.
	Hard Copy	Dumps plot to printer at end of sweep.
	Main Menu	Returns to Main Menu.
		Sets output of HP 11613B to 0 dB [about 10.6 Vp-p]. Any level, in 1.0 dB steps, over a 150 dB range, may then be set with the controller keyboard knob or the softkeys below.
	Main Menu	Returns to menu level 1.
	MIN SIG	Sets calibrator output to -150 dB.
	MAX SIG	Sets calibrator output to 0.0 dB.
	-5dB	Decreases output level by 5 dB.
	+5dB	Increases output level by 5 dB.
	-1dB	Decreases output level by 1 dB.
+1dB	Increases output level by 1 dB.	

## CALIBRATION OF THE HP 8755A/B/C

**NOTE:** Do not connect anything to the MONITOR jack during these procedures.

### Description

When you use the HP 11613B to calibrate an HP 8755A/B/C input, the controller will first run the "Self Check" routine of the calibrator. This routine checks maximum and minimum output levels, and then compares similar internal attenuators. The adjust routine allows real time viewing of the dynamic accuracy so that adjustments are easier to make.

### Equipment

Calibrator .....	HP 11613B
Controller .....	HP 200 or 300 series computer with 3.5 or 5.25 inch disc drive
GPIO Interface Card .....	HP 98622A
Voltmeter .....	HP 3455A, 3456A, 3457A, or 3478A
Operating language .....	BASIC 2.0 or above
Software .....	Supplied with the HP 11613B
GPIO cable .....	Supplied with the HP 11613B
Extension Cable .....	HP Part No. 5060-0303
Display Mainframe .....	HP 180 Series

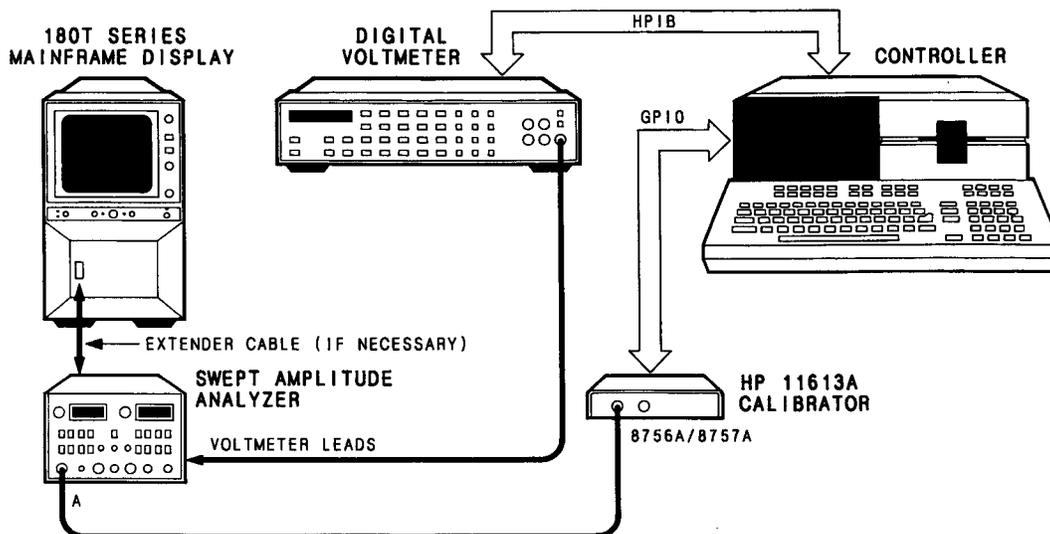


Figure 5-1. HP 8755A/B/C Calibration Setup

### Procedure

1. Connect the equipment as shown in Figure 5-1 and as described in "Voltmeter Configuration" and allow one hour for warm-up. Observe the operating temperature limits. During this time leave all of the covers of the HP 8755A/B/C on.
2. Load BASIC and the HP 11613B software into the controller and RUN the HP 8755 program (refer to "Loading the Program", Section 2, as required).
3. When the "HP 8755A/B/C MAIN MENU" appears on the controller CRT, press [ADJUST] to enter the adjustment routine.

If the "Self Test" has not been performed since the program was run, the calibrator will perform a "Self Check". If the "Self Check" fails, as indicated by an "ABSOLUTE LEVEL OUTPUT ERROR" or "INCONSISTENT STAGE ERROR" message, try to check another input of the network analyzer. The failure may be caused by either the HP 11613B or the HP 8755A/B/C. If all of the network analyzer's inputs have failed to pass the "Self Check", and the voltmeter leads are connected correctly, perform the "Operator's Check" as indicated in Section 6.

## USING THE ADJUST FEATURE

The adjust feature allows the user to make adjustments on the logger boards and immediately see the results of the adjustment.

**NOTE:** It is critical that the +15 and -12.6 volt power supplies in the mainframe be properly adjusted to within 50 mV.

In this mode the HP 11613B is rapidly incremented through its range of 0 dB to 122 dB (+20 dBm to -55 dBm) in 5 dB steps. The results are plotted on screen as the data is being taken. The trace is updated every two seconds. The user can select a smaller step size of 2 or 1 dB steps. The limits of the displayed graph can be expanded to +/-5 or 10 dB. A typical graph is shown in Figure 5-2; the noise floor of the log amplifier is displayed below the graph.

Another useful feature in this mode is the Update/Hold key. In the "Update" mode, the previous trace is erased before the new one is plotted so that only one trace is visible at a time. In the "Hold" mode, the previous traces are not erased as each new trace is drawn. This allows the user to easily view any possible drift in the system. If a printer is connected to the HP-IB when the program was run, the softkey **[Hard Copy]** will be visible. Selecting this softkey will request the computer to dump the plot to the printer at the end of the power sweep. Selecting this softkey again (before the plot is made) will cancel the request.

## ADJUSTMENT OF THE LOG AMPLIFIER

When adjusting the log amplifier board, use the following information to guide the adjustments.

The OFFSET pot will raise or lower the entire trace (it will affect the entire dynamic range).

The GAIN pot will affect the slope of the curve. It has the most effect at the high power end of the trace and its effect decreases to near zero at the low power end of the trace.

SHAPING ADJ pot #1 has the most effect at the high end with its effect decreasing to zero at  $-5$  dBm.

SHAPING ADJ pot #2 has the most effect at the high end with its effect decreasing to zero at  $-15$  dBm.

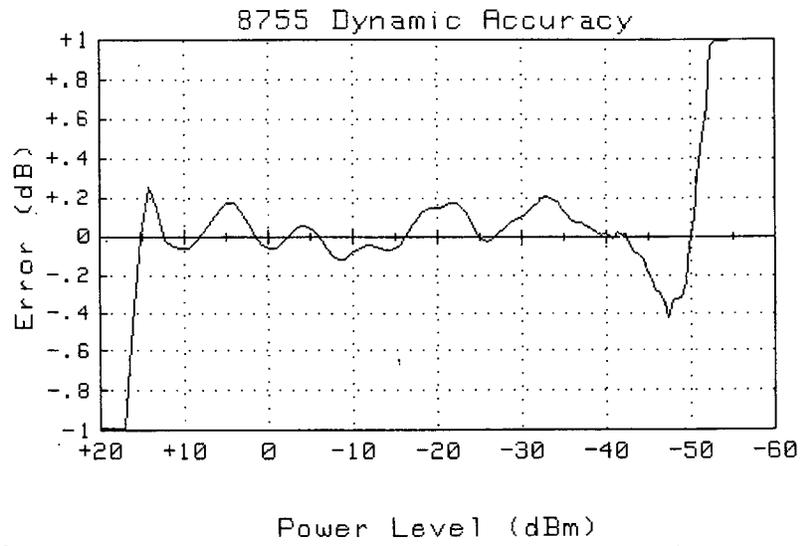
SHAPING ADJ pot #3 has the most effect at the high end with its effect decreasing to zero at  $-20$  dBm.

Generally it is easiest to first adjust the logger board with the gain and offset pots to obtain a reasonably flat trace from  $-15$  to  $-50$  dBm. Then adjust the high end from  $+15$  to  $-20$  dBm using the three SHAPING ADJ pots. The log amplifier must be adjusted so that the noise floor is  $< -51$  dBm. After the initial adjustment, change the step size to 1 dB and view the entire trace. The data should typically be within  $\pm 0.35$  dB between  $+10$  and  $-40$  dBm, and within  $\pm 0.6$  dB between  $-40$  and  $-50$  dBm.

## USING THE SET LEVEL FEATURE

The set level [SET LVL] feature allows the user to manually adjust the output of the HP 11613B from 0 dB (approx. 10.6 Vpp) to  $-150$  dB in 1 dB increments. This signal is applied to one of the HP 8755A/B/C inputs and the resulting voltage output of the log amplifier board is read from the voltmeter, converted to dB, and displayed on the computer's CRT along with the attenuator setting and the expected reading in dBm. This feature is most useful in troubleshooting the analyzer. The output level may be varied using the softkeys or by rotating the knob, if available.

The measured voltage from the output of the log amplifier is converted to dB using a scale of  $-50$  mV/dB with 0V equalling 0 dBm. In a properly calibrated instrument, the expected and measured values should track within 0.6dB from  $+10$  to  $-50$  dBm where the limitations of the logger boards will cause increasing divergence of the two values.



**Figure 5-2. Typical Plot of the HP 8755A/B/C Dynamic Accuracy**

## Section 6. Operator's Check

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**NOTE:** Most of these operator checks require an HP 8757A network analyzer and will not operate using the HP 8756A or 8755A/B/C. However, a brief portion of this test is performed automatically during the HP 8756A and 8755A/B/C tests in order to provide some confidence that the HP 11613B is operating properly.

### INTRODUCTION

The "Operator's Check" is your means of verifying that the HP 11613B is functioning properly. The "Operator's Check" tests the calibrator to the limits of the test equipment. Passing the "Operator's Check" provides the user a high confidence level that the HP 11613B is within its specifications if it has not been opened or subjected to adverse environmental conditions.

This check consists of three major parts. Each part uses one routine of the supplied software. Together these parts measure the calibrator's output waveform and its internal attenuators. Perform the procedures in the order presented for incoming inspection or any time you want to check the operation of the calibrator.

Refer to *Table 3-1, Software Menu Map*, as required.

### OPERATOR'S CHECK OF OUTPUT SIGNAL

#### Description

This procedure uses an oscilloscope to check three parameters of the maximum output signal: amplitude, rise time and overshoot. It also checks the frequency and symmetry of the signal with a universal counter. The signal is checked at the calibrator's MONITOR connector. Successful completion of this check proves that the calibrator is receiving power from the HP 8757A and that the calibrator's maximum output waveform is within specifications.

## Equipment Required

Controller .....	HP 200 or 300 series computer with 3.5 or 5.25 inch disc drive
Operating language .....	BASIC 2.0 or above
Software .....	supplied with the HP 11613B
Scalar network analyzer .....	HP 8757A
Oscilloscope .....	HP 1740A/41A
Universal counter .....	HP 5316A
Adapter, BNC tee (m)(f)(f) .....	HP p/n 1250-0781
BNC cable(s) (m)-(m) .....	HP 11086A

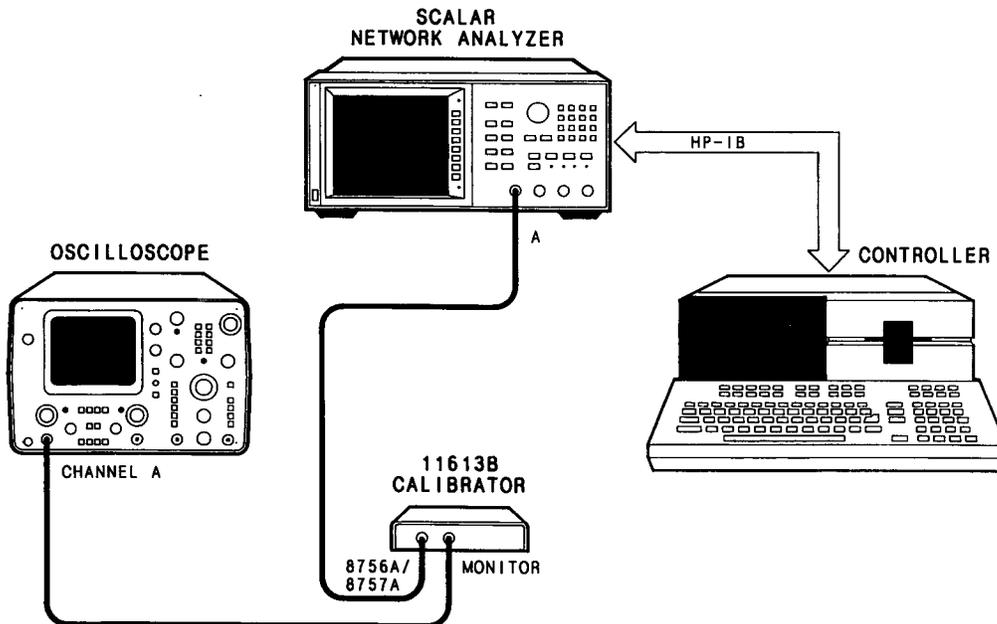
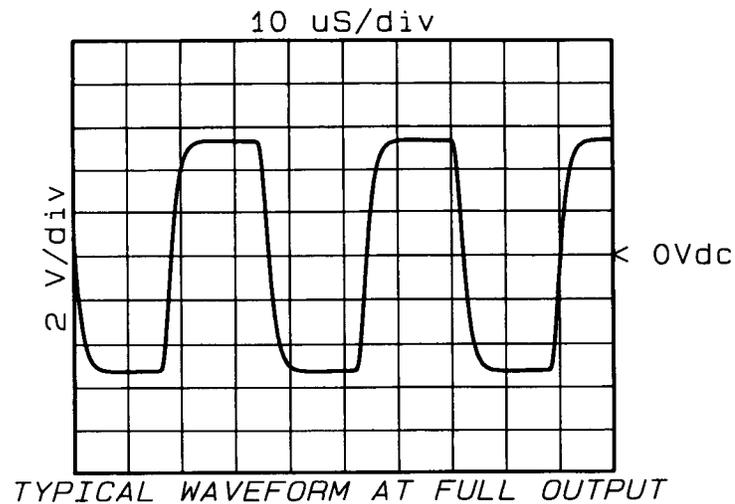


Figure 6-1. Test Setup #1 for Output Signal Check

## Procedure

1. Load BASIC and the HP 11613B software into the controller and RUN the HP 8757A program. Refer to "Loading the Program" (Section 2) as required. When "HP 11613 CALIBRATOR MAIN MENU" appears on the controller CRT, select the [OP CHECK] softkey.
2. Select the [SIG TST] softkey. The CRT should display "HP 11613 OPERATOR'S CHECK OF OUTPUT SIGNAL".
3. Connect the equipment as shown in Figure 6-1.
4. Adjust the oscilloscope to display the 10.6V, 27.8 kHz signal and note the peak-to-peak voltage on the *Operator's Check Record, Table 6-1*. If the oscilloscope does not display the signal, perform this procedure with the HP 11613B connected to another HP 8757A input.
5. Record the 10% to 90% rise time of the signal on the *Operator's Check Record*.

6. Inspect the waveform for overshoot. It should look similar to Figure 6-2. Record your observation on the *Operator's Check Record*.



**Figure 6-2. Typical Monitor Output Waveform**

7. This concludes the output signal checks with the oscilloscope; disconnect it from the calibrator.
8. Turn on the universal counter. Set all other keys out.
9. With the inputs disconnected, set the counter's trigger levels to 0.0V by rotating the channel A LEVEL/SENS knob CCW until the trigger level LED lights. Rotate the knob CW until the LED just extinguishes. Repeat this procedure for channel B. Once set, do not readjust these two knobs.
10. Connect the equipment as shown in Figure 6-3.

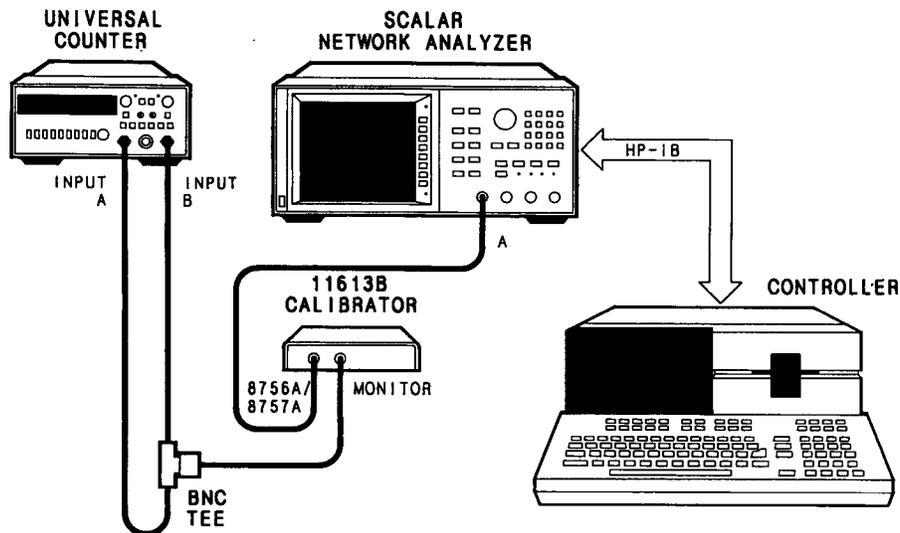


Figure 6-3. Test Setup #2 for Output Signal Check

11. The CRT should again display "HP 11613 OPERATOR'S CHECK OF OUTPUT SIGNAL". If not, refer to the *Software Menu Map, Table 3-1* and press the softkeys as required to enter that menu.
12. On the counter, set channel A to trigger on the rising edge, B on the falling edge by selecting A @ RISING EDGE, B @ FALLING EDGE.
13. Measure the frequency by pressing **FREQ A**. Record this frequency on the *Operator's Check Record*.
14. Measure the positive half cycle by setting the **FREQ/PERIOD** key (blue) to **PERIOD** and selecting **TI AVG A to B**. Record this value on the *Operator's Check Record*.
15. Measure the negative half cycle by resetting A @ FALLING EDGE, B @ RISING EDGE. Record this value on the *Operator's Check Record*.
16. Divide the larger value in step 14 or 15 by the smaller value to determine the ratio. Enter the result on the *Operator's Check Record*.
17. This concludes the "Operator's Check of Output Signal". If the HP 11613B met its specifications, press the softkey **[DONE]** and proceed with "Operator's Check with HP 3456A DVM", which follows.

If the HP 11613B failed its specifications, check all cables and connections. If the failure was caused by a faulty cable or connection, correct the fault and repeat this test. If the HP 11613B still fails its specifications, refer to "Troubleshooting the HP 11613B", Section 7.

## OPERATOR'S CHECK WITH HP 3456A DVM

### Description

This procedure checks, with a digital voltmeter, the absolute level of the calibrator's MONITOR output with no attenuation and with each single stage of attenuation. It also compares the output of various stages in combination with the output of different stages in combination (for example, 3+18 dB compared to 1+20 dB). Finally, it plots the attenuation errors over 40 dB on a graph which also displays the error limits.

Successful completion of this test indicates that the HP 11613B maximum output meets specifications and that all internal stages are operational and mutually consistent. Successful completion of this test also indicates that the calibrator can vary its output by increasing the attenuation in 0.5 dB steps from 0 dB to 40 dB and the calibrator can receive serial data over its 8757A cable.

### Equipment

Controller .....	HP 200 or 300 series computer with 3.5 or 5.25 inch disc drive
Operating language .....	BASIC 2.0 or above
Software .....	supplied with the HP 11613B
Digital Voltmeter .....	HP 3456A
Scalar network analyzer .....	HP 8757A
BNC/dual banana plug cable .....	HP 11001A

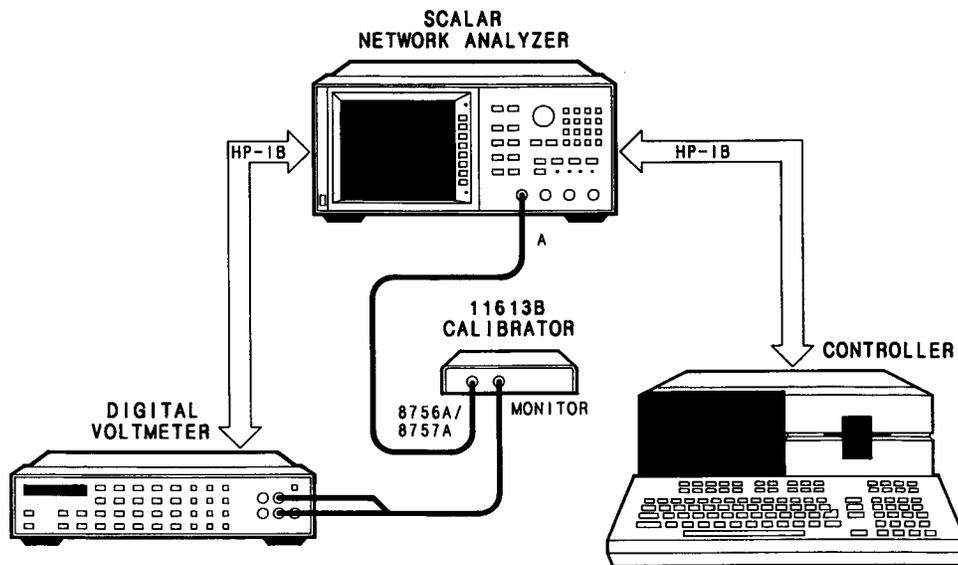


Figure 6-4. Test Setup for Operator's Check with HP 3456A DVM

## Procedure

1. The HP 11613B software program should be in the "HP 11613B OPERATOR'S CHECK MENU". If not, refer to the *Software Menu Map, Table 3-1* to enter that menu.
2. Configure the instruments as shown in Figure 6-4 and as indicated by the CRT prompts.
3. Press the [3456 TST] softkey and then press the [CONTINUE] softkey each time the controller finishes a test.
4. This concludes the "Operator's Check with HP 3456A DVM". If the controller CRT indicates PASSED and returns to the "HP 11613 OPERATOR'S CHECK MENU", note the result on the *Operator's Check Record* and continue with the following procedure.

If the computer CRT indicates "FAILED", check all the cables and connections. If you find a fault, repeat the "Operator's Check" from the beginning. Otherwise perform the entire "Operator's Check" with another HP 8757A input.

If all of the network analyzer inputs have failed the "Operator's Check", refer to "Troubleshooting Procedures" in Section 7, Service.

## OPERATOR'S CHECK WITH HP 8757A NETWORK ANALYZER

### Description

In this procedure the HP 8757A is used to determine whether the calibrator's attenuators are functioning properly. This procedure assumes that the HP 8757A input log amplifier and its associated signal path are reasonably operational, though the input need not be calibrated.

Measurements made by the HP 8757A, expressed as direct readings from the analog-to-digital converter (ADC) board, range from 0 to 32,767 bits. First the calibrator is checked at minimum output and maximum output. Next intermediate stages of attenuation are compared in various combinations (for example, 3+3 dB versus 6 dB). Then the calibrator output is attenuated in 13 dB steps to check the overall slope. Finally, the calibrator is attenuated from 0 dB to 137 dB in 0.5 dB steps and the incremental slope is plotted. At the same time, slope variations from one attenuation level to the next are checked.

### Equipment

Controller	HP 200 or 300 series computer with 3.5 or 5.25 inch disc drive
Operating language	BASIC 2.0 or above
Software	supplied with the HP 11613B
Scalar network analyzer	HP 8757A

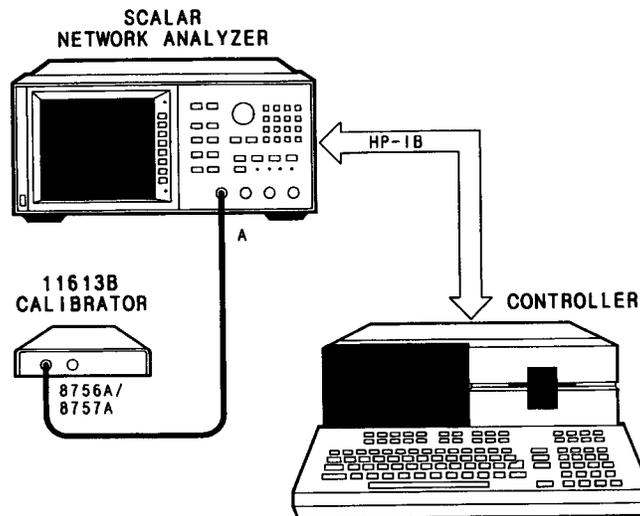


Figure 6-5. Test Setup for Operator's Check with HP 8757A Network Analyzer

## Procedure

1. Set up the equipment as shown in Figure 6-5.
2. In the "OP CHECK" menu (refer to Table 3-1 as required), press the softkey [8757 TST] and then press the softkey corresponding to the HP 8757A input the calibrator is connected to. Then follow the CRT prompts to check the proper operation of the calibrator. At the end of the routine, the CRT should again display the "HP 11613 OPERATOR CHECK MENU".
3. This concludes the procedure, "Operator's Check with HP 8757A Network Analyzer". Assuming the calibrator has also passed the two previous procedures, passing this procedure completes the "Operator's Check". You may now use the calibrator with confidence to perform any of the other procedures described in this manual.
4. If the computer CRT indicates that the HP 11613B has not passed any portion of this check, read the following. Note that the following comments assume that the calibrator has passed the two previous parts of the "Operator's Check".
5. The "Operator's Check with HP 8757A Network Analyzer" begins with a measurement of the maximum and minimum output levels of the calibrator.

If the maximum signal is out of range, the HP 8757A is faulty since the maximum signal measured good in the preceding procedure, "Operator's Check with HP 3456A DVM". Select another network analyzer input and repeat the "Operator's Check" from the beginning.

If the minimum signal is out of range, the HP 8757A or the HP 11613B is faulty. Either perform the "Operator's Check" on another network analyzer input, continue testing the current input in the hope that one of the following tests may identify the problem, or refer to step 9.

6. The "HP 11613B Attenuator Stage Matching Check" compares different combinations of attenuators with equal total attenuation (for example 3+18 dB versus 1+20 dB). This test was performed in the procedure, "Operator's Check with the HP 3456A DVM". A failure now probably indicates that the HP 8757A input in use is faulty. Repeat the "Operator's Check" with another HP 8757A input.
7. The "Slope Check Over 13 dB Steps", attenuates the calibrator in 13 dB steps from 0 dB to 143 dB. The steps are measured in ADC bits and divided by 13 dB to obtain the bits/dB result. The first 39 dB of attenuation was checked in the "Operator's Check with the HP 3456A DVM" test. Thus a failure at the 13, 26 or 39 dB level probably indicates a faulty HP 8757A. Repeat the "Operator's Check" with another HP 8757A input.

A failure only at attenuation levels greater than 39 dB is inconclusive. Either perform the "Operator's Check" on another network analyzer input, continue testing the current input in the hope that one of the following tests may identify the problem, or refer to step 9.

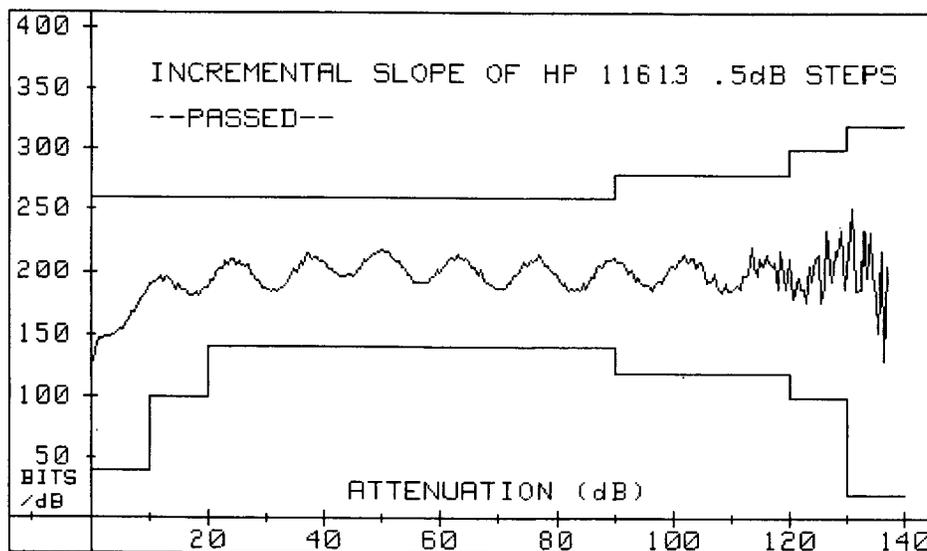


Figure 6-6. Operator's Check with HP 8757A Graph

8. The "Incremental Slope of HP 11613 .5dB Steps", test plots the slope of each 0.5 dB step in the HP 11613B. Figure 6-6 is a typical plot. Variations in slope are also computed but are not displayed unless they are out of limit.

An "Incremental Slope Failure" at attenuation levels less than 40 dB indicates that probably the HP 8757A is faulty since the first 40 dB of attenuation was tested in the "Operator's Check with the HP 3456A DVM". Repeat the "Operator's Check" with another HP 8757A input.

An "Incremental Slope Failure" at attenuation levels greater than 40 dB should be evaluated. In general an incremental slope failure which appears abrupt on the plot is usually caused by the HP 11613B. A failure which appears smooth is usually caused by the HP 8757A.

A change in slope failure not accompanied by an incremental slope failure is usually caused by the HP 11613B. Repeat the "Operator's Check" with another HP 8757A input or continue with step 9.

9. The HP 11613B and the HP 8757A are very interdependent instruments. It is difficult to distinguish between "Operator's Check" failures caused by the calibrator and those caused by the network analyzer. If another HP 8757A input (even on another analyzer) is available for performing the "Operator's Check", use it. Remember to press **[NEW 8757]** in the main menu to re-initialize the HP 8757A and the computer system variables whenever you change network analyzers. Note also that you should pass all three parts of the "Operator's Check" on a given HP 8757A input to establish that the calibrator is functioning properly.

Passing the "Operator's Check" on at least one HP 8757A input establishes with a high level of confidence that the calibrator is functioning properly. However, even if no input passes the "Operator's Check", certain conclusions may be drawn.

If the failures of different HP 8757A inputs are not similar, the log amplifiers and the associated ADC input circuitry of the network analyzer may be faulty. Refer to the *HP 8757A Service Manual* to troubleshoot the problem.

If the failures of different HP 8757A inputs are similar, probably either the network analyzer ADC board or the calibrator has failed. Performing the *Dynamic Power Accuracy* performance test on an HP 8757A input will determine whether that input is operating properly. Refer to the *HP 8757A Operating Manual* to perform that test. If an HP 8757A input passes the *Dynamic Power Accuracy* test and fails the "Operator's Check", the HP 11613B must have failed. Return it for repair. Include a list of the failure messages and failed data displayed on the controller CRT.

10. This completes the "Operator's Check" for the HP 11613B/8757A system.

## OPERATOR'S CHECK FAILURE MESSAGES

This failure message listing is arranged alphabetically. Messages which begin with punctuation or numbers are listed last.

Table 6-2. Operator's Check Failure Message Listing (1 of 2)

### ABSOLUTE LEVEL OUTPUT ERROR IN THE HP 11613 OR HP 8757 :

The HP 11613B is set to its maximum and minimum output and measured at the HP 8757A in ADC bits. Either the HP 11613B or the HP 8757A has caused a measurement error.

### ATTENUATOR OUT OF SPEC AS NOTED ABOVE :

The HP 11613B was attenuated from 0 dB to 40 dB in 0.5 dB steps and measured on the DVM. Each attenuator noted is out of spec.

### CHANGE IN SLOPE OVER .5dB STEPS :

The slope of the HP 11613B in 0.5 dB steps is approximately 200 bits/dB as measured by the HP 8757A. The variation of this slope from step to step should be small. If the variation is out of range, either the HP 8757A or the HP 11613B is in error.

### HP-IB TIME-OUT ERROR; CHECK INSTRUMENTS! :

When the controller sent a command over the HP-IB, it did not receive a response. Make sure each instrument is properly connected and set to the proper HP-IB address. Press [PRESET] on the HP 8757A to check the network analyzer address.

### HP 11613 NOT CONNECTED TO INPUT A :

The HP 11613B has been set to maximum output level at input A and the HP 8757A has failed to measure that signal. The program has concluded that the calibrator is not connected to input A. If the calibrator is properly connected, either the HP 8757A or the HP 11613B may have failed.

### HP 11613 SLOPE ERROR :

The HP 11613B was attenuated over 137 dB in 0.5 dB steps. The slope measured by the HP 8757A was not the typical 200 bits/dB expected. The error may have been caused by either instrument.

### HP 3456 NOT FOUND AT ADDRESS 722 :

Confirm the DVM's HP-IB port is connected to the network analyzer's HP Interface Bus port. Check the DVM's address by pressing its [RESET] key. The DVM display should flash "Add022". If it does not, refer to its manual to reset the address. Repeat the check.

### HP 3456 ``TERMINAL`` BUTTON ISN'T SET TO FRONT :

Press the button to set it to the front position as required.

Table 6-2. Operator's Check Failure Message Listing (2 of 2)

**HP 8757 NOT FOUND AT ADDRESS 716 :**

Confirm the network analyzer's HP Interface Bus port is connected to the computer's HP-IB port. On the front panel of the network analyzer, press **[LOCAL]** and then **[8757]**. The HP 8757A's CRT should display "HP-IB ADDRESS 16". If it does not, press **[1] [6] [ENT]** to reset the address.

**MAKE SURE HP 11613 IS CONNECTED TO HP 3456 :**

The measured output level of the calibrator was too low. Confirm the connection from the calibrator MONITOR output to the VOLTS input of the DVM. Repeat the check.

**MAXIMUM HP 11613 OUTPUT LEVEL IS OUT OF RANGE :**

The HP 11613B was set to maximum level. The level measured too high or too low. Check the connection as above.

**STAGES DENOTED BY ``\*\*\*\*\*'' ARE INCONSISTENT :**

Different attenuator stages or combinations of stages with equal total attenuation (for example 3+3 and 6) have been measured and compared. The difference is excessive. The HP 11613B is probably faulty.

**STAGES DENOTED BY ``\*\*\*\*\*'' ARE OUT OF RANGE :**

Every attenuator stage has been measured by the DVM and compared to the expected reading. Each denoted stage is out of range. The HP 11613B is probably faulty.

## OPERATORS CHECK OF THE GPIO INTERFACE (OPTIONAL)

### Description

If the HP 11613B is to be used with the HP 8756A or 8755A/B/C then the GPIO interface circuitry should be verified. This is a simple functional test that can be performed using either the HP 8757A or 8756A.

### Equipment

Scalar Network Analyzer .....	HP 8756A, or 8757A
Controller .....	HP 200 or 300 series computer with 3.5 or 5.25 inch disc drive
Operating language .....	BASIC 2.0 or above
Software .....	supplied with the HP 11613B
GPIO interface .....	HP 98622A

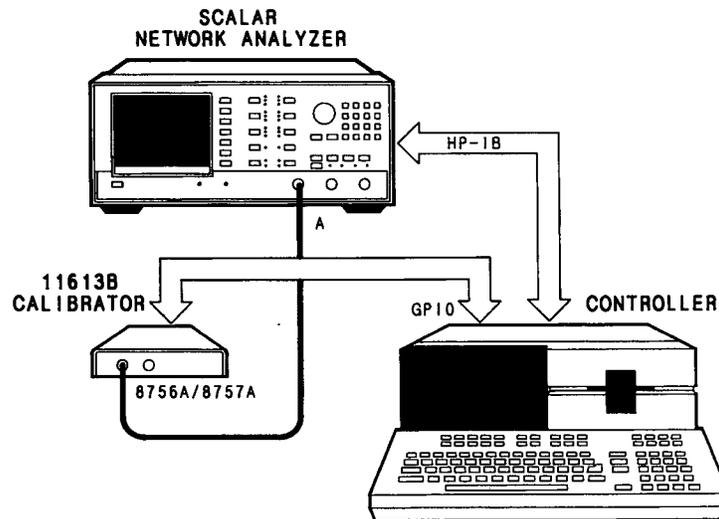


Figure 6-7. Operator's Check of GPIO Interface

### Procedure

Connect the equipment as shown in Figure 6-7. Connect the rear of the HP 11613B to the GPIO interface using the cable supplied. Connect the output of the calibrator to any input (except C) of the HP 8757A.

Load and run the program for the HP 8756A (even though you may be using the HP 8757A). When the main menu of the program is reached, select the softkey [SET LVL], then select the correct input channel. Change the output of the HP 11613B by selecting the appropriate softkeys and verify that the measured signal reasonably tracks the expected reading from the HP 8757A (accuracy is not tested here, only the ability to change levels). This verifies that the internal GPIO interface is working properly.

Table 6-1. Operator's Check Record

<b>HP 11613B Calibrator</b>		Tested by .....		
Serial Number .....		Date .....		
Humidity* .....		Temperature* .....		
*optional				
Procedure	Operating Characteristic	Result	Pass	Fail
<b>Operator's Check of Output Signal</b>				
<b>Peak to peak</b>	10.6 +0.5V	_____	_____	_____
<b>Rise time (10%-90%)</b>	3.4 +0.4 $\mu$ s	_____	_____	_____
<b>Overshoot</b>	Negligible	_____	_____	_____
<b>Frequency</b>	27,778 +12 Hz	_____	_____	_____
<b>Positive Half Value</b>		_____	_____	_____
<b>Negative Half Value</b>		_____	_____	_____
<b>Ratio</b>	<1.08	_____	_____	_____
<b>Operator's Check with HP 3456A</b>	Pass	_____	_____	_____
<b>Operator's Check with HP 8757A</b>	Pass	_____	_____	_____
<b>Operator's check of GPIO (optional)</b>	Pass	_____	_____	_____

**IN CASE OF DIFFICULTY**

- Confirm that each instrument is set for the correct HP-IB address.
- Check all cables and connections.
- Check the integrity of the operating language and software by reloading and re-running it or by using back-up copies.
- Perform the procedure again.
- Return the HP11613B to Hewlett-Packard for calibration.



## Section 7. Service

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### INTRODUCTION

This section concentrates on the theory of operation, troubleshooting techniques, adjustments and replaceable parts of the calibrator.

### THEORY OF OPERATION

The HP 11613B calibrator provides a crystal controlled 27.778 kHz waveform over a 154.5 dB range in 0.5 dB steps. The oscillator provides the maximum signal level required for calibration. The 0.5 dB steps are produced by a series of precision resistive divider networks. Power, amplitude control and the calibration signal are all transmitted between the calibrator and the HP 8757A front panel input through the calibrator's single 8756A/8757A cable. An HP 9000 series 200 or 300 controller connected to the HP 8757A HP-IB port controls the calibration process. When calibrating an HP 8756A or 8755A/B/C, the amplitude control information is sent to the calibrator through the GPIO cable in a serial format. If this cable is left connected to the calibrator, it will only respond to the serial information sent from the GPIO and not from the HP 8757A.

When calibrating the HP 8756A or 8757A, the controller commands the calibrator to output a series of signals at specific power levels. The controller measures the resulting log amplifier response and creates a calibration table for each input being calibrated. When the controller loads the calibration table(s) into the analyzer's memory, that input is calibrated.

### TROUBLESHOOTING THE HP 11613B

#### Software Troubleshooting

If the program fails to load, use another disc. If you are using BASIC 3.0 or above, make sure you have loaded all of the required binary programs (see note following Section 2, "Introduction"). Remember that the software itself requires up to 150 kbytes of memory. If your controller does not have sufficient memory, power down and reload **only** the operating language with **only** the binary programs required; then check to see whether the controller has 150 kbytes of memory remaining. Refer to the controller manual if necessary.

#### Hardware Troubleshooting

The HP 11613B hardware consists of the calibration device, its attached 8756A/8757A output cable, and the GPIO cable. Troubleshooting hardware related problems consists of confirming that all connections have been properly made, that all cables (including HP-IB cables) are good and that all test instruments are functioning properly. The following procedures isolate possible problems to the calibrator or to the network analyzer.

## Troubleshooting Procedure

**NOTE:** Try to pass the entire “Operator’s Check” on at least one analyzer input prior to performing these troubleshooting procedures. Passing the “Operator’s Check” indicates that the calibrator is performing properly and therefore any observed problems relate to the network analyzer. If the “Operator’s Check” fails on all of the HP 8757A inputs you should determine whether the calibrator is faulty or the network analyzer is faulty. Perform the procedures below to do so.

1. To determine whether the HP 11613B is being provided with power by the HP 8756A/57A analyzer, use a DVM to measure the  $-12.6\text{V}$  and  $+15\text{V}$  power supplies at pins 4 and 5 of one of the network analyzer’s front panel input connectors. These pins are identified in Figure 7-1. To insure that the supplies are good under load, connect a  $348\Omega$  resistor from pin 4 to chassis ground and measure the voltage across the resistor with a DVM. Repeat the procedure for pin 5. If pin 4 reads  $-11 \pm 0.5\text{V}$  and pin 5 reads  $+13 \pm 0.5\text{V}$  under load, continue with the next step. The voltage levels on the HP 8755A/B/C will be slightly different.

If you do not obtain the proper readings at pins 4 and 5, refer to the analyzer’s service manual to troubleshoot the power supply problem of the network analyzer input.

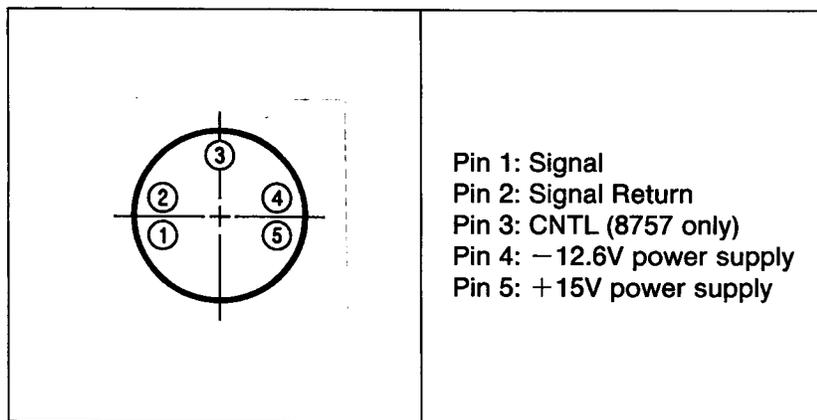


Figure 7-1. Identification of Analyzer Input Pins

**Note:** Steps 2 through 7 apply only when using the HP 8757A analyzer.

2. If the network analyzer input is supplying power through pins 4 and 5, check the HP 8757A serial interface with an oscilloscope.
3. Use the *Basic Operation Setup*, Figure 2-1a and equipment with the addition of an oscilloscope. Do not connect the calibrator.
4. In the “HP 11613B CALIBRATOR MAIN MENU” (see “Loading the Program”, Section 2), press [OP CHECK] and then [SIG TEST].
5. Select a softkey to choose the network analyzer input you want to check.



9. Vary the output of the calibrator either by rotating the computer's keyboard knob or by pressing the softkeys. If the EXPECT= and MEAS= levels on the CRT track monotonically, the serial interface and the calibrator are good.

If they do not track, continue with step 10.

10. Connect the MONITOR output of the calibrator to an oscilloscope. Press [MAX SIG]. The scope should display a 10.6 Vp-p signal. As you vary the output with the knob or softkeys the displayed signal should vary as indicated by Table 7-1. This indicates that the network analyzer (or GPIO interface) is successfully talking to the calibrator and the calibrator is correctly responding to the program. Thus the calibrator and the serial interface are good. Any remaining fault is probably in the analyzer.

*Table 7-1. LVL Setting vs Monitor Output Voltage*

LVL	MONITOR
0 dB	10.6 Vp-p
-10 dB	3.35 Vp-p
-20 dB	1.06 Vp-p
-30 dB	0.335 Vp-p
-40 dB	0.106 Vp-p
-50 dB	33.5 mVp-p
-60 dB	10.6 mVp-p

If rotating the knob or pressing the softkeys in this step does not vary the signal output from the MONITOR jack, the calibrator or GPIO interface cable is faulty. Check the GPIO cable for continuity using Table 7-2. If the cable is good, the problem is most likely in the calibrator. Return the HP 11613B to HP for repair. Include a list of the failure messages and data displayed on the CRT.

*Table 7-2. GPIO Cable Connections (HP P/N 11613-60007)*

Line Name	GPIO Connector Pinout HP 98622A	11613B Connector Pinout
GND	24	1
PCTL	19	2
CTL0	22	3
Data Out 0	17	4
PFLG	44	5
GND	49	6
GND (Inner Shield)	43	—

**Note:** The cable shield is connected to pin 43 of the GPIO connector only. It is not connected on the HP 11613B end of the cable.

## ADJUSTMENTS

There are no user adjustments. If the instrument does not meet its performance standards, return it to Hewlett-Packard for service. Refer to your phone book or the inside rear cover of this manual for the address of an HP Sales and Service office. Section 1 of this manual contains shipment packaging instructions.

## **REPLACEABLE PARTS**

There are no user replaceable parts other than the GPIO interface cable (HP Part No. 11613-60007) and the software disc set (HP Part No. 11613-10002). If the instrument does not meet its performance standards, return it to Hewlett-Packard for service. Refer to your phone book or the inside rear cover of this manual for the address of an HP Sales and Service office. Section 1 of this manual contains shipment packaging instructions.

By internet, phone, or fax, get assistance with all your test and measurement needs.

### Table 1-1 Contacting Agilent

**Online assistance:** [www.agilent.com/find/assist](http://www.agilent.com/find/assist)

**United States**  
(tel) 1 800 452 4844

**Latin America**  
(tel) (305) 269 7500  
(fax) (305) 269 7599

**Canada**  
(tel) 1 877 894 4414  
(fax) (905) 282-6495

**Europe**  
(tel) (+31) 20 547 2323  
(fax) (+31) 20 547 2390

**New Zealand**  
(tel) 0 800 738 378  
(fax) (+64) 4 495 8950

**Japan**  
(tel) (+81) 426 56 7832  
(fax) (+81) 426 56 7840

**Australia**  
(tel) 1 800 629 485  
(fax) (+61) 3 9210 5947

### Asia Call Center Numbers

Country	Phone Number	Fax Number
Singapore	1-800-375-8100	(65) 836-0252
Malaysia	1-800-828-848	1-800-801664
Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
India	1-600-11-2929	000-800-650-1101

