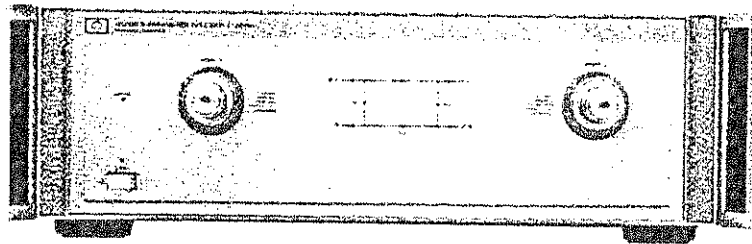


HP 85110A
S-Parameter Test Set
Operating and Service Manual

HP 85110A S-PARAMETER TEST SET



HP Part Number 85110-90001
Print Date: October 1989



HEWLETT
PACKARD

HP 85110A S-PARAMETER TEST SET

SERIAL NUMBERS

This manual applies directly to HP 85110A test sets with serial prefix 2929A.

For additional information about serial numbers, refer to INSTRUMENTS COVERED BY MANUAL in the General Information section.

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MANUAL PART NO. 85110-90001
Microfiche Part Number 85110-90002

Printed: OCTOBER 1989



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Section 1. General Information

INTRODUCTION

The purpose of this manual is to enable you to use your HP 85110A S-parameter test set effectively and confidently. This test set is an integral component of the HP 8510 measurement system.

To begin using your test set, first place this manual in the *Test Sets* section of the *HP 8510B Test Set and Accessories Manual*. The Operating section is distinguished by the tab titled *HP 85110A Test Set* and it consists of:

- General Information
- Installation
- Operation
- Performance Tests
- Adjustments
- Backdating

The Service section is distinguished by the tab titled *HP 85110A Troubleshooting* and it consists of:

- Troubleshooting
- Replaceable Parts
- Service

The major topics of this section, *General Information*, are:

- how to use the test set
- test set description
- operating, safety and warranty considerations

VERIFYING THE TEST SET

The HP 85110A has been designed to operate specifically with the HP 8510 network analyzer.

- To install the instrument, turn to the *Installation* section of this manual.
- To check the proper operation of the test set, perform a system calibration as described in the *HP 8510 Operating and Programming Manual*, for this system. A successful calibration is an indication that the system, and therefore the test set, are operating properly.
- To see the specifications of the test set refer to *Specifications* in the *HP 8510B System Manual*.
- To verify that the instrument meets its published specifications, refer to the *Performance Tests* section in the *HP 8510B System Manual*.
- To troubleshoot the test set, refer to the *Service Overview* section of the *HP 8510B Service Manual* or the section titled troubleshooting behind the tab titled *HP 85110A Troubleshooting*. If you are unsuccessful, refer to your *HP 8510 System Manual* for the address of the Hewlett-Packard office nearest you.

INSTRUMENTS COVERED BY MANUAL

You will find a two-part serial number on the rear panel of 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 test set. The contents of this manual apply directly to test sets with the same serial number prefix as the one(s) on the title page under the heading SERIAL NUMBERS.

If the serial prefix of your test set is not listed on the title page, your instrument differs from those documented in this manual. The differences are documented in the 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 (the part number appears on the title page). With the manual (in 4 x 6 inch microfilm transparency format) you will also receive the latest manual changes supplement.

INSTRUMENT COMPATIBILITY

The HP 85110A is compatible with HP 8510B network analyzers with firmware revision HP 8510B.05.00 and higher and HP 8340A/B or HP 8341A/B synthesizers with firmware revision 31 MAR 88 and later. If your network analyzer and/or HP 834XX source do not have the above revisions it will be necessary to upgrade your system to work with the HP 85110A. The HP 8510B must have Option 008 in order to make pulse profile, pulsed-RF measurements. Please consult your Hewlett-Packard representative for more information.

DESCRIPTION AND OPERATING CHARACTERISTICS OF THE INSTRUMENT

The HP 85110A uses two synthesizers to act as the RF and LO sources for the four mixer based downconverter (Figure 1-1). This approach eliminates the need to dedicate one channel for phase-lock, making full two-port, Pulsed-RF S-parameter measurements possible.

Reflection Measurements

Because of the coupler-based measurement path and attenuators, the test set can handle up to 20 watts (43 dBm). This is accomplished by removing the test set extension link for the appropriate port on the rear panel of the test set and connecting the LOW POWER OUT of the test set to the input of an external amplifier, then connecting the output of that amplifier to the HIGH POWER IN on the rear panel of the test set. This allows high power to be applied to the ports of the test set without damage to the test sets switched splitter, in the case of either S_{11} or S_{22} reflection measurements. If 20 watts (43 dBm) is applied to port 1 via the HIGH POWER IN input on the back of the test set, it will be necessary to add a like amount of attenuation to the measurement path for port 1, to keep from overdriving the a1 mixer and to keep the reflections from the port to the b1 mixer at a low level. The step attenuators for the a1 and b1 mixers operate as a pair, as do the step attenuators for the a2 and b2 mixers.

Transmission Measurements

In the case of either S_{12} or S_{21} measurements, where 20 watts (43 dBm) is applied to one of the HIGH POWER IN inputs on the back of the test set. It will be necessary, for the same reasons previously discussed, to apply 40 dB of attenuation to all four step attenuators (both pairs). In addition if an S_{21} measurement is being made it will be necessary to either add an isolation amplifier or the proper attenuation between either the Port 1 or the Port 2 link on the back of the test set (depending on which Port the power is being input to), to protect the switch splitter from damage from an input of more than +17 dBm (see Figure 1-1).

HP 85110A in a System

The combination of the HP 85110A test set with the HP 8510B network analyzer with Option 008 (Pulsed-RF Measurement Capability), two HP 834XX sources with Option 004 (Rear Output), and an HP 8349B 2 to 20 GHz microwave amplifier with Option 001 (Rear Panel Input/Output) provide a system for making pulsed-RF S-parameter measurements over the frequency range of 2 to 20 GHz (Figure 2-3). This system is suited for making Pulsed-RF measurements on one or two port devices, providing you with the ability to measure and display the relative magnitude and phase shift of the device as a function of time or frequency. It is also suited for making measurements on two port devices when it is inconvenient to physically reverse the DUT (device under test) to measure all four S-parameters. This is especially important for non-reciprocal devices or components like transistors, amplifiers or isolators where S_{12} measurements are important.

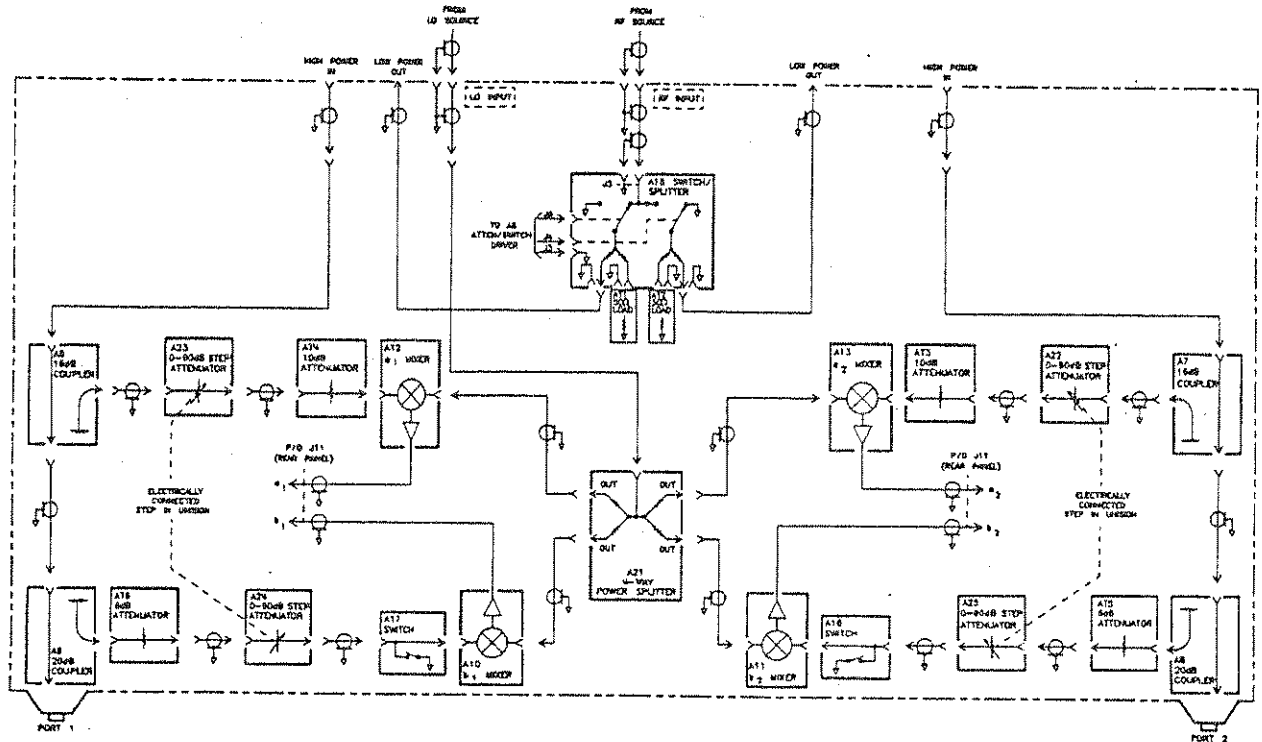


Figure 1-1. HP 85110A RF Block Diagram

OPTIONS

Option 001

This option adds IF switching capability to allow up to four test sets to be connected to the HP 8510B at the same time. The test set in use is selected from the HP 8510B front panel. The 20 MHz IF signal is transmitted from the selected test set through the option 001 test set(s) to the network analyzer. IF switching is performed automatically by the option 001 test set(s), without reconnections. For more information see "Controlling Multiple Test Sets" in the *Operation* section of this manual.

Option 908

This option supplies the test set with the parts required to rack mount it with handles removed. Refer to the *Installation* section of this manual for additional information.

Option 910

This option provides a duplicate test set manual.

Option 913

This option supplies the test set with the parts required to rack mount it with handles. Refer to the *Installation* section of this manual for additional information.

ACCESSORIES

Accessories Supplied

The accessories supplied with the HP 85110A, including part numbers, are listed in the *Installation* and *Replaceable Parts* sections of this manual.

Accessories Available

NOTE: Additional HP 8510 system accessory information is located in the *System and Documentation Overview* section of the HP 8510B System Manual.

Cables, Calibration, Verification and Adapter Kits. Hewlett-Packard offers several calibration kits suitable for calibrating an HP 8510/85110A when making error corrected measurements. Each calibration kit noted below includes a set of precision standards to calibrate an HP 8510 system in the indicated interface. Additional information is located in the *System and Documentation Overview* section of the *HP 8510B System Manual*.

HP 85052B 3.5 mm Calibration Kit. Contains open and short circuits; fixed and sliding loads (2); 3.5 mm to 3.5 mm adapters; 3.5 mm connector tools and gages.

HP 85052D 3.5 mm Economy Calibration Kit. Contains open and short circuits; fixed broadband loads; 3.5 mm to 3.5 mm adapters; 3.5 mm torque wrench.

HP 85053B 3.5 mm Verification Kit. Contains precision airline, mismatched airline, 20 dB and 40 dB attenuators with NBS traceable data and uncertainties.

Cables

HP 85131C 3.5 mm Test Port Return Cable. For measurements where 3.5 mm device-under-test is connected directly to Port 1 of the test set. The test port return cable is connected between the DUT and Port 2.

HP 85131D 3.5 mm Test Port Return Cable Set. For measurements where the 3.5 mm device-under-test is connected between the cable ends.

HP 85131E 3.5 mm Flexible Test Port Return Cable. For measurements where one end of device-under-test is connected directly to Port 1 of the test set.

HP 85131F 3.5 mm Flexible Test Port Return Cable Set. For measurements where 3.5 mm device-under-test is connected between cable ends.

Adapters

HP 85130D NMD-3.5 mm to 3.5 mm Adapter Set. Used to convert special 3.5 mm ports of the HP 85110A test set to standard 3.5 mm connector interface (m or f). Functions as a "test port saver"

HP 85130B NMD-3.5 mm to 7 mm Adapter Set. Used to convert special 3.5 mm test set ports to a 7 mm connector interface.

Transistor Test Fixture Kit. The HP 85041A Transistor Test Fixture Kit (TTF) is a comprehensive measurement system for testing and characterizing stripline packaged microwave transistors. Although it has 7 mm connectors and a frequency range limited to 18 GHz, the TTF may be easily adapted for use with the HP 85110A by using HP 85135C or HP 85135E cables and HP 85130B adapter set. Please consult with your local HP Sales Office for specific recommendations.

OPERATING AND SAFETY PRECAUTIONS

Operating



**ATTENTION
Static Sensitive**

**Handle only at Static Safe
Work Stations**

Beware of damage from electro-static discharge (ESD). The input connectors (test ports or cables or adapters connected to the test ports) are very sensitive to ESD. Use a grounded wrist strap when attaching devices to the input connectors.

Otherwise, you need observe only the following normal precautions in handling and operating the test set:

- Do not exceed the front panel operating level power input as noted:

Maximum Operating Power Level		
Without Attenuation		With Attenuation
Port 1	+17 dBm	+43 dBm
Port 2	+17 dBm	+43 dBm

Note: Any power in excess of +17 dBm into a Port of the HP 85110A **MUST** be offset by an equal or greater amount of attenuation (See the discussion under "DESCRIPTION AND OPERATING CHARACTERISTICS OF THE INSTRUMENT" in this section) to protect the switch splitter. Under no circumstances should the power into the test port exceed +43 dBm.

- Do not torque anything to the test port connector with greater than 90 N-cm. (8 in.-lb.) of torque. The wrench supplied with your accessory kit is calibrated to 8 in.-lb.
- Do not torque anything to the source RF input or any other RF connector, on the back of your test set, with greater than 90 N-cm. (8 in.-lb.) of torque.

Service

The voltages in this test set warrant normal caution for operator safety. Nevertheless, service should be performed only by qualified personnel. Service strategy, troubleshooting procedures, replaceable parts and similar information for the HP 85110A test set is provided in this manual.

ADDITIONAL EQUIPMENT REQUIRED

Additional equipment and accessories required for use with the HP 85110A test set may be found in Table 4-2. The table notes the items required to verify the performance of the test sets and those required to operate them. Other equipment may be substituted if its specifications meet or exceed the specifications listed in the critical specifications column.

SYSTEM SPECIFICATIONS

The specifications of the HP 85110A test set with an HP 8510B network analyzer are defined in the *Specifications* section of the *HP 8510B System Manual*. The Specifications and Performance Verification (SPEC) Software, Program and Data Disks, are provided with the HP 85110A test set. The Program and Data Disks are loaded into your controller. You are then asked a series of questions about how your system is configured. System Specifications are then generated specifically for your system and printed at your request. A more detailed discussion on the use of the SPEC Software is found in your *HP 8510B System Manual*.

CHARACTERISTICS

The performance parameters listed in the Specifications Section in Table 4-1 are typical or nominal characteristics of the HP 8510B/85110A.

Section 2. Installation

INTRODUCTION

This section explains how to install the HP 85110A test set. The topics covered include initial inspection, environmental considerations, positioning and connecting the test set for use, and packaging the instrument. Refer to the *Installation* section of the HP 8510 manual for more complete system connection and turn-on instructions.

INITIAL INSPECTION

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

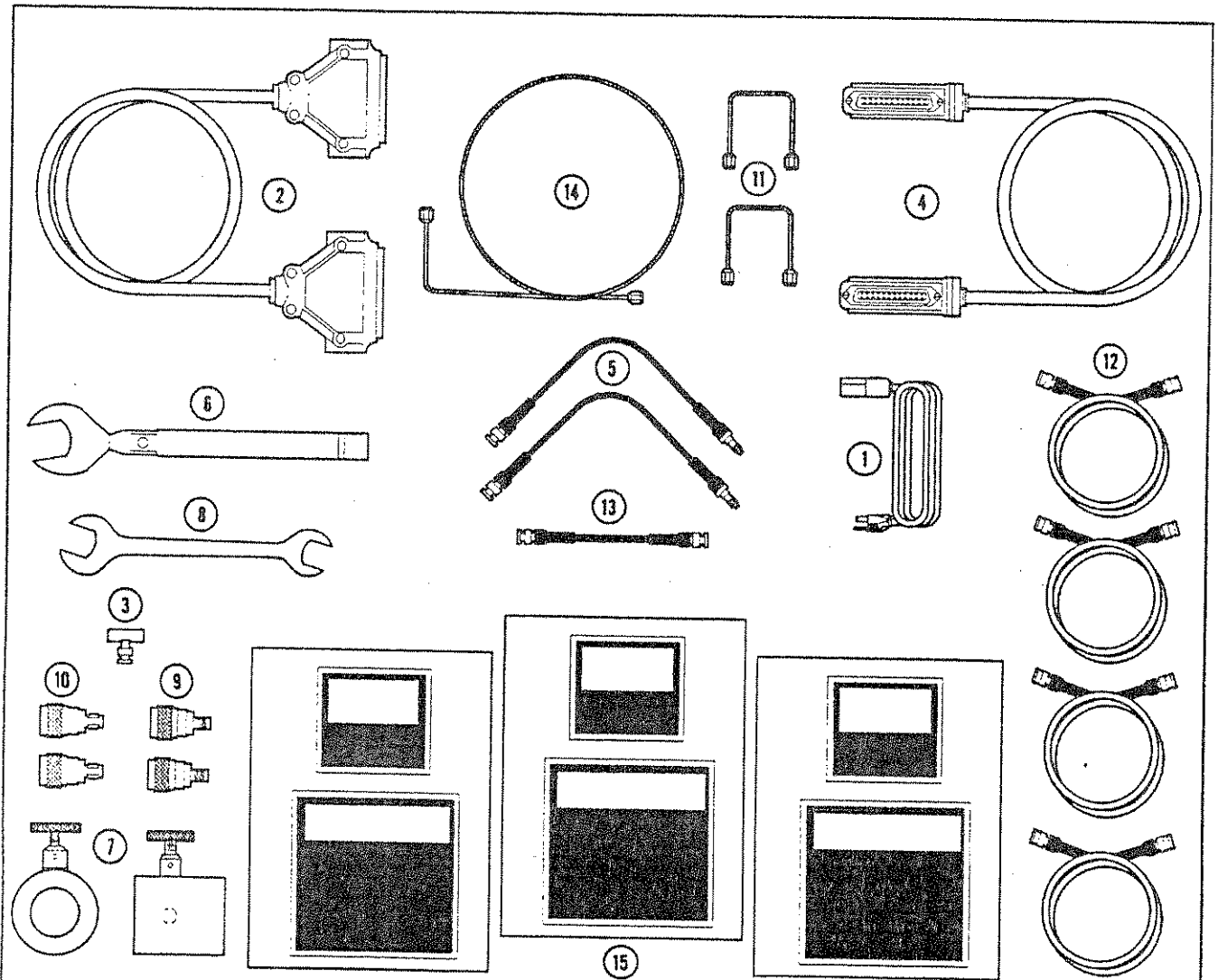
NOTE: If the shipping container is damaged, perform the performance tests outlined in this manual and the HP 8510 manual set. If the test set fails the performance tests, or is damaged or defective, keep the shipping materials and notify both the carrier and the nearest Hewlett-Packard office. The HP office will arrange for repair or replacement of the test set without waiting for settlement of the claim. If any of the following accessories are not received with the test set, notify your nearest HP office and the missing parts will be sent to you.

ENVIRONMENTAL CONSIDERATIONS

Operation and Storage

To perform within specifications, the test sets should be operated in temperatures between 0°C and +55°C with relative humidity less than 95% (at 40°C dry bulb temperature, maximum). They may be operated at altitudes up to 4,500 metres (15,000 feet).

The test sets may be stored in temperatures from -40°C to +75°C, with relative humidity up to 90% at +65°(maximum dry bulb temperature) and at altitudes up to 15,240 metres (50,000 feet).



Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
ACCESSORIES						
1	8120-1348	5	1	POWER CORD U.S.A. ONLY	28480	8120-1348
2	08510-60102	8	1	TEST SET CABLE ASSEMBLY	28480	08510-60102
3	1250-0781	2	1	BNC "T"	28480	1250-0781
4	8120-3445	7	1	HP-IB CABLE ASSEMBLY	28480	8120-3445
5	08513-60009	7	2	RF FLEX SOURCE CABLE	28480	08513-60009
6	8710-1764	2	1	20 MM TORQUE WRENCH 90 N-CM (8 in-lb)	28480	8710-1764
7	08515-60003	3	2	NON-ROTATING CLAMP	28480	08515-60003
8	8710-1770	8	1	1/2 X 9/16 IN OPEN END WRENCH	28480	8710-1770
9	1250-1894	4	2	ADAPTER MALE N TO MALE SMA	28480	1250-1894
10	1250-1250	6	2	ADAPTER MALE N TO FEMALE SMA	28480	1250-1250
11	08512-20019	4	2	PORT EXTENSION CABLE	28480	08512-20019
12	8120-2582	1	4	1 METER BNC CABLE	28480	8120-2582
13	8120-1838	8	1	12 INCH BNC CABLE	28480	8120-1838
14	85110-20003	0	1	LO SOURCE CABLE	28480	85110-20003
SPECIFICATION AND PERFORMANCE VERIFICATION SOFTWARE REV. A.02.00						
15	08510-10031	7	2	PROGRAM DISK	28480	08510-10031
	08510-10032	8	1	DATA DISK	28480	08510-10032

Figure 2-1. Accessories Supplied with the HP 85110A

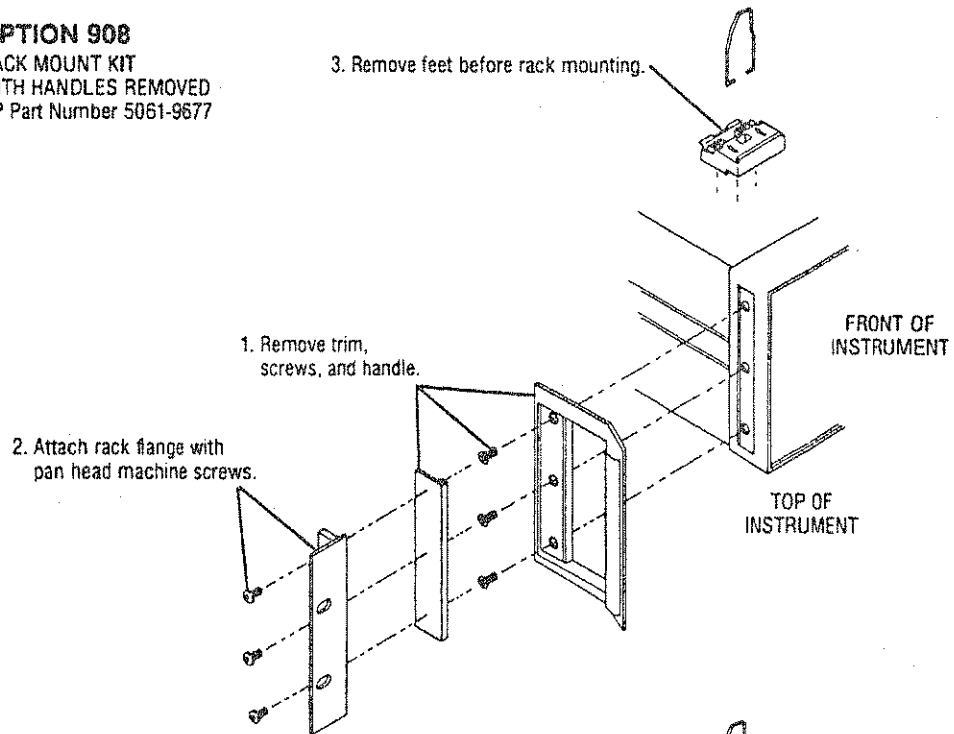
PREPARATION FOR USE

Positioning the Test Set

A work surface should be provided for use with the test set whether it is rack-mounted or used on a bench. To install the flanges to rack mount the instrument (with or without handles) in a standard 19 inch rack, refer to Figure 2-2.

OPTION 908

RACK MOUNT KIT
WITH HANDLES REMOVED
HP Part Number 5061-9677



OPTION 913

RACK MOUNT KIT FOR
INSTRUMENTS WITH PREVIOUSLY
ATTACHED FRONT HANDLES
HP Part Number 5061-9771

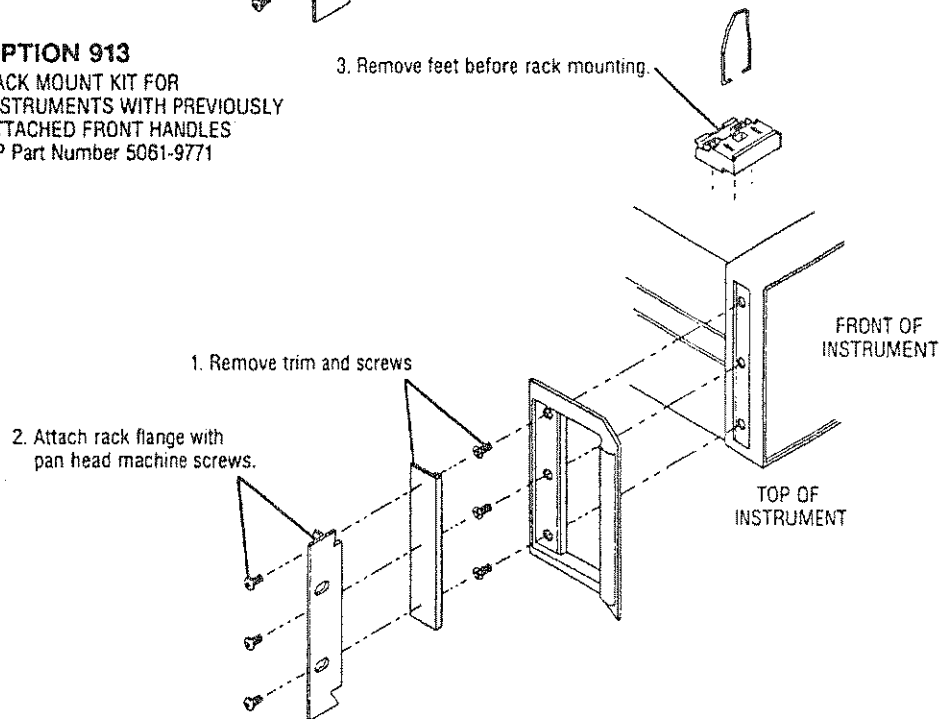


Figure 2-2. Attaching Rack Mounting Hardware

Instructions for rack mounting the test set in a system configuration with the HP 8510 are provided in the *HP 8510 Installation* section.

When installing the test set for use on a bench, place it on a grounded anti-static work surface (Figure 2-3) to lessen the chance of ESD damage. The anti-static surface should extend far enough in front of the test set to provide effective protection at the test ports and cable ends.

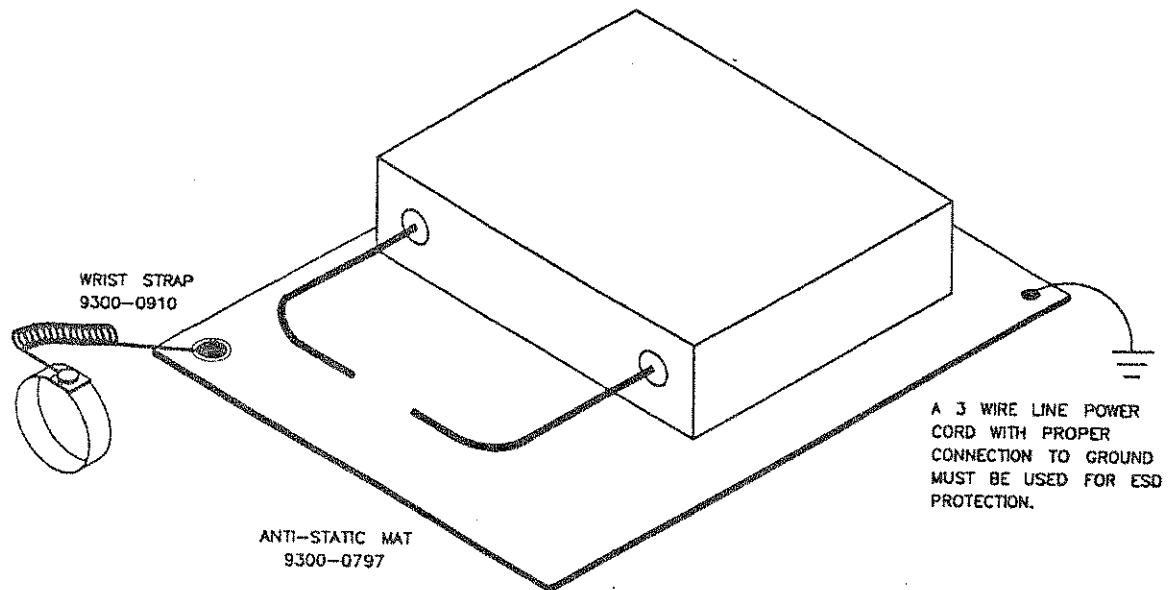


Figure 2-3. Recommended Static Free Workstation

Connecting the Test Set

Mating Connectors. HP 85110A PORTS 1 and 2 are NMD-3.5mm connectors and mate with Precision 3.5 mm female connectors.

The TEST SET INTERCONNECT connector is a series-D subminiature female connector with 7 RF connections. It mates with the corresponding male connector.

The 8510 SYSTEM BUS connector is a female HP-IB type connector and mates with the corresponding male connectors of HP-IB cables.

Power and Control Connections. Figure 2-4 shows the following connections (with the exception of line power) and the required RF source connections.

- Connect the power cords to an electrical outlet and the line modules to supply power to the test set, sources, amplifier and the network analyzer.
- Connect the test set IF interconnect cable from the J11 TEST SET INTERCONNECT connector on the rear panel of the test set to the J1 TEST SET INTERCONNECT connector on the rear panel of the HP 85102 IF Detector.
- Connect the system bus cable from the HP 85110A J12 HP8510 SYSTEM BUS connector to the HP 8510 INTERCONNECT connector of the HP 85101 display/processor and to the HP-IB connectors on the rear panel of both sources. The test set IF interconnect cable and the system bus cable transmit control signals between the test set and the network analyzer.

- Connect a BNC Tee to the 10 MHz REF OUT on the back of the RF Source #1. Connect a BNC cable to each end of the Tee. Connect the short cable to the BNC connector on the back of LO Source #2 labeled FREQUENCY STANDARD EXT. Also, switch the toggle switch on the back of that source to EXT. Connect the other BNC cable to the 10 MHz REF IN on the back of the HP 8510B Network Analyzer. This insures that both sources will use the same reference frequency for internal phase locking, as they step in frequency offset by 20 MHz.
- Connect the 0.5V GHz on the microwave amplifier to the 0.5V GHz on Source #2, using a BNC cable.
- Connect the DET OUT on the microwave amplifier to the EXT LEVELING INPUT on the front panel of Source #2 front panel, using a BNC cable.
- Connect the POS Z from the microwave amplifier to the POS Z on the rear panel of Source #2, using a BNC cable.
- The RF Source PULSE MOD INPUT, on the front panel of Source #1, receives a pulse drive, to pulse the RF Source, from your pulse generator. If you do not have a pulse generator or do not wish to use one you may also pulse your RF Source by connecting the HP 8510 PULSE DRIVE, located on the back of the HP 8510, to the PULSE MOD INPUT on Source #1.
- Connect the STOP SWEEP IN/OUT on the RF Source #1 to the STOP SWEEP input on the rear panel of the HP 8510B.
- Connect the SWEEP OUT on the RF Source #1 to the 0 –10V SWEEP IN on the HP8510B.

Signal Path Connections. The IF signals from the test set are transmitted to the HP 85102 IF Detector by the test set IF interconnect cable (see above and Figure 2-4).

- RF signals are transmitted from Source #1 directly to the RF INPUT on the back of the test set by a 3.5 mm flexible RF cable.
- LO signals are transmitted from Source #2 to the RF INPUT of the microwave amplifier by the use of a short RF cable and then from the RF OUTPUT of the amplifier to the LO INPUT on the rear panel of the test set, utilizing a semi-rigid RF cable. The minimum power into the LO INPUT of the test set must be equal to or greater than +15 dBm.

Anti-Rotation Clamps. Use these clamps to stabilize the test port/RF cable connection. Connect the test port cables to the test ports and tighten them as specified in the cable manual. Loosen the anti-rotation clamp thumb screw sufficiently to slip the clamp over the cable and up to the front panel. The clamp end with the flats should come to rest on the flats of the test port shoulder. Finger tighten the thumb screws to prevent further loosening or tightening of the test port/RF cable connection.

The internal O-ring (HP part number 0900-0007) is field replaceable without disassembling the anti-rotation clamp. Pry it out with fine tweezers or a similar tool when it no longer holds the RF cable securely. Insert the new O-ring by engaging one side of it in the slot of the phenolic clamp donut. Use your fingers to push the O-ring into the rest of the slot.

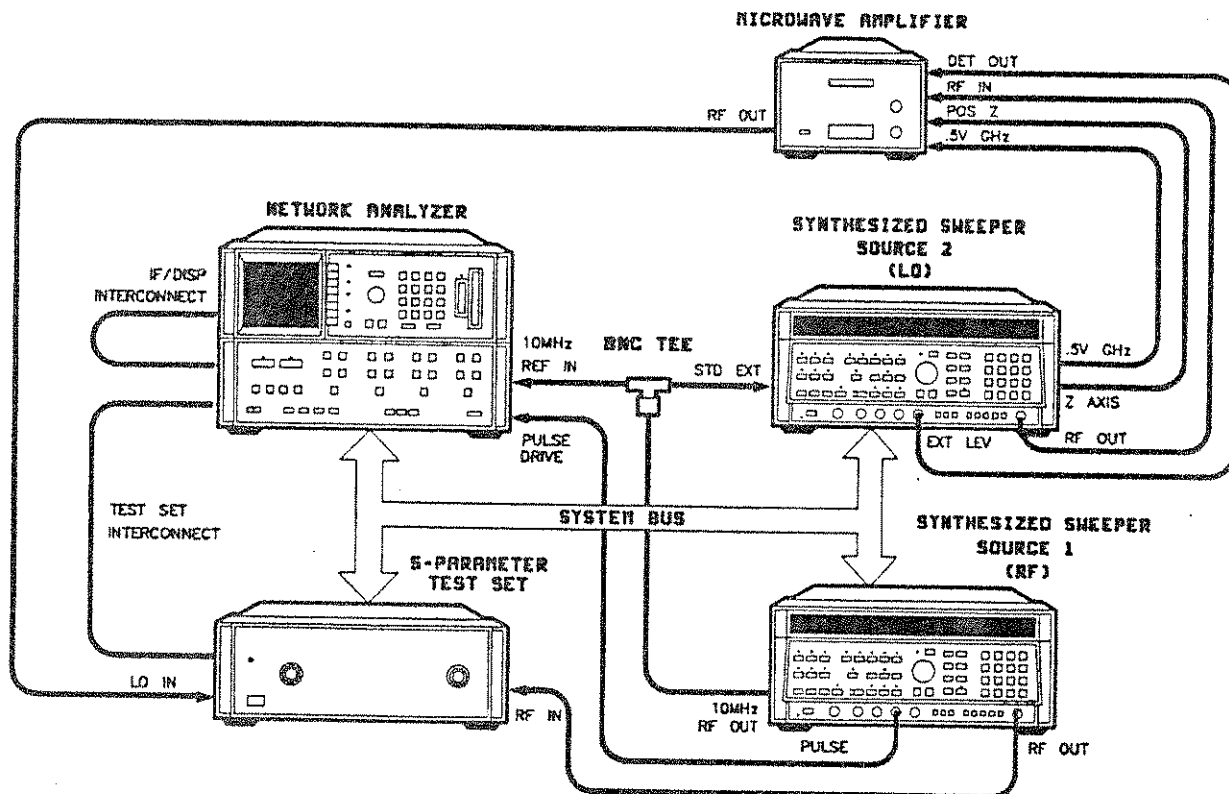


Figure 2-4. HP 85110A Bench Configuration and System Connections

PACKAGING

If reshipping is required, each test set should be repackaged in the original factory package. Containers and materials identical to those used by the factory are available through Hewlett-Packard offices.

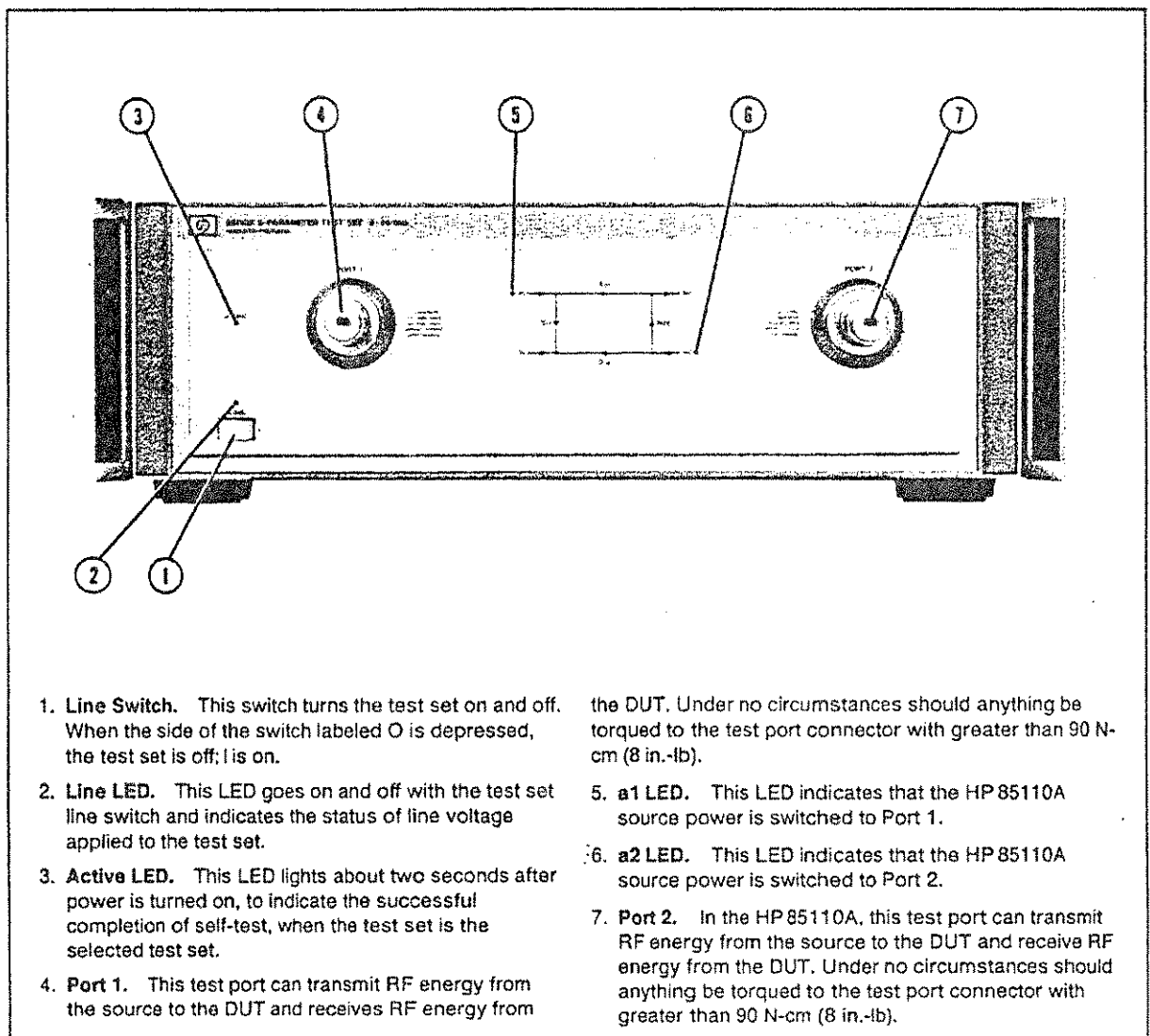
Alternatively, comparable packaging materials may be used. Wrap the test set in heavy paper or anti-static plastic. If shipping to an HP Office or Service Center, complete and attach a service tag (in the HP 8510 manual set). Use sufficient shock absorbing material on all sides of the test set to provide a thick, firm cushion and prevent movement. Seal the shipping container securely and mark it **FRAGILE**.

In any correspondence with HP, refer to the test set by full model and serial number.

INTRODUCTION

This section illustrates the features and functions of the front and rear panels of the HP 85110A test set. It also describes the Multiple Test Set Option (OPT 001) available with these Hewlett-Packard test sets: HP 8511A, HP 8514B, HP 8515A, HP 8516A, HP 85110A. The related automatic control of the HP 8510 Network Analyzer is also included. Additionally, instructions for connecting a cable and anti-rotation clamp to the test set test port are included.

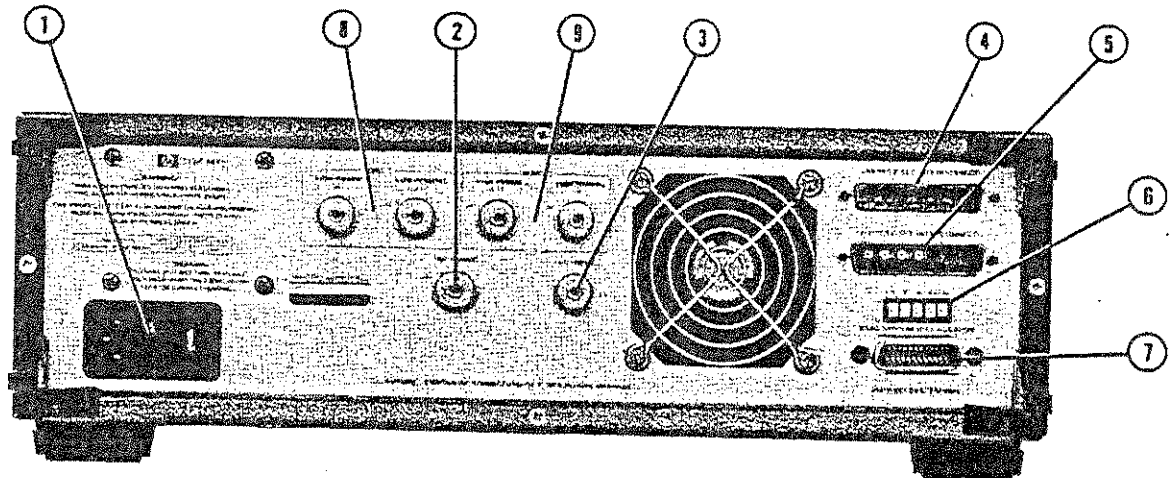
FRONT PANEL FEATURES



1. **Line Switch.** This switch turns the test set on and off. When the side of the switch labeled O is depressed, the test set is off; I is on.
2. **Line LED.** This LED goes on and off with the test set line switch and indicates the status of line voltage applied to the test set.
3. **Active LED.** This LED lights about two seconds after power is turned on, to indicate the successful completion of self-test, when the test set is the selected test set.
4. **Port 1.** This test port can transmit RF energy from the source to the DUT and receives RF energy from the DUT. Under no circumstances should anything be torqued to the test port connector with greater than 90 N-cm (8 in.-lb).
5. **a1 LED.** This LED indicates that the HP 85110A source power is switched to Port 1.
6. **a2 LED.** This LED indicates that the HP 85110A source power is switched to Port 2.
7. **Port 2.** In the HP 85110A, this test port can transmit RF energy from the source to the DUT and receive RF energy from the DUT. Under no circumstances should anything be torqued to the test port connector with greater than 90 N-cm (8 in.-lb).

Figure 3-1. Front Panel Features of HP 85110A

REAR PANEL FEATURES



1. **Line module.** This assembly houses the line cord connector, line fuse and line voltage selector. Pull out the right side of the line module cover to replace or change the fuse or to change the voltage selection. Note that the voltage selector drum must be removed to rotate it to a different voltage setting. Recommended fuse values are printed on the rear panel.
2. **RF Input.** This 3.5 mm connector receives RF energy from the source. Connections made to this input must be torqued no more than 90 N-cm. (8 in.-lb.).
3. **LO Input.** This 3.5 mm connector receives energy from the HP 8349B 2 to 20 GHz microwave amplifier. The power level into this connector must be no less than +15 dBm and no greater than +23 dBm. Connections made to this input must be torqued no more than 90 N-cm. (8 in.-lb.).
4. **J10 Test Set Interconnect.** In test sets without Option 001 the connector has no connections. This connector is used only in test sets with option 001. It allows connecting another test set to the option 001 test set. Up to four test sets can be serially connected to the HP 8510. The HP 8510 system automatically selects the IF output from the chosen test set for processing and display. Refer to CONTROLLING MULTIPLE TEST SETS in this section for more information.
5. **J11 Test Set Interconnect.** This connector transmits the IF signals from the test set to the HP 85102 IF Detector. It also transmits control signals.
6. **HP 8510 System Bus Address Switch.** This five-pole binary-weighted switch sets the system bus address of the test set. The binary weight of each pole is indicated on the rear panel as are the on and off positions. Decimal twenty (off-off-on-off-on, from left to right) is preset at the factory.
7. **J12 8510 System Bus Connector.** This connector is used for GPIB communications with the HP 85101 display/processor.
8. **Port 1 Extension Cable.** This cable may be removed and an amplifier put in its place. The input to the amplifier is supplied by the LOW POWER OUT and the high power output of the amplifier is applied to the HIGH POWER IN. This allows the user to amplify the RF signal after the switch splitter, to supply high power to Port 1 for reflection measurements. If a high power transmission measurement is to be made, either an attenuator or isolation amplifier must be put in place of the Port 2 extension cable.

The extension cable provides access to the RF signal path for other signal conditioning devices and measurement instruments, as well as the example given above.
9. **Port 2 Extension Cable.** Performs the same function as the Port 1 Extension Cable, but for Port 2.

Figure 3-2. Rear Panel Features of HP 85110A

CONTROLLING MULTIPLE TEST SETS

Option 001 for the HP 851X-series test sets allows an HP 8510 to alternately control up to four test sets. While a measurement is proceeding on Test Set number 1, which is equipped with option 001, test device hookup can be accomplished on Test Set number 2, which does not need to be equipped with option 001, unless another test set is to be connected. When the measurement on test set number 1 is complete, then the HP 8510 can control test set number 2. Only one HP 8516A test set may be used in a multiple test set configuration.

In a standard test set, the 20 MHz IF and control signals are applied directly to J11 TEST SET INTERCONNECT, which connects to the HP 8510. Option 001 adds a set of IF switches, control switches, and the J10 TEST SET INTERCONNECT connector. This allows the selection of 20 MHz test set IF signals. As shown in Figure 3-3, test set number 1 can apply its IF to the HP 8510 or it can switch to pass the IF from test set number 2 through the J10 TEST SET INTERCONNECT to the HP 8510.

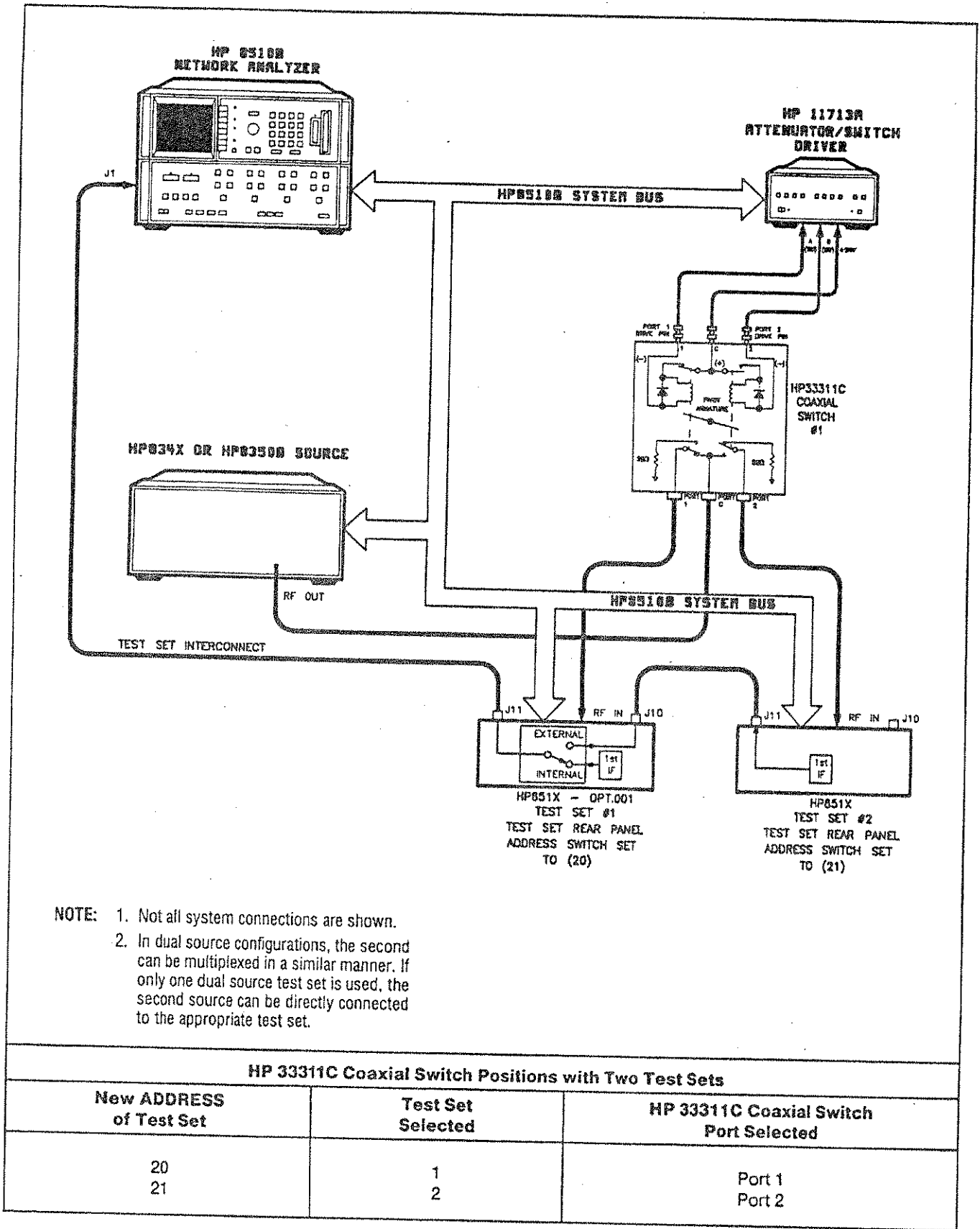


Figure 3-3. RF and IF Switching with Two Test Sets

INSTALLATION

Set each test set rear panel address switch to the address listed in Figure 3-3 if using a two test set configuration, and Figure 3-4 if configuring more than two test sets. Use the supplied Test Set Interconnect cable to connect test set number 1, J11 to the HP 8510. Use the supplied Test Set Interconnect cable to connect test set number 2, J11, to test set number 1, J10. You may continue this test set "daisy chain" to include up to four test sets if the total length of all Test Set Interconnect cables does not exceed 13 meters (about 40 feet). The last test set in the chain does not require option 001.

If the RF coaxial switch(s) is not incorporated into the system, then the RF input to the test set must be manually switched to the Active test set.

OPERATION

Initialization at Power-up

Upon power-up, the IF switches must be configured so that only one system test set is active. The following procedure shows how to make one test set active.

1. Check the active lights of all system test sets.
2. Check the HP 8510's expected test set address by pressing [LOCAL] [TEST SET]. This should match the address of the desired test set. If not, change the address.
3. If unselected test sets are active, (active light ON), deactivate the test set by temporarily addressing it. Then return to the desired address.

Selecting a Test Set

Test Set IF Switching. The active test set is selected by the built-in capability of the HP 8510 to generate an addressed command to the test set. Each time the HP 8510 ADDRESS of TEST SET function is changed (see HP 8510 LOCAL Menu), the HP 8510 switches the previously addressed test set IF to external and the newly addressed test set IF to internal. The test set front panel ACTIVE indicator shows the test set status. When the test set is Active the IF signals from the test set are applied directly to J11 TEST SET INTERCONNECT. When the test set is Inactive the IF signals appearing at J10 are passed through to J11 and on to the next test set or the HP 8510.

The address of the test set can be changed manually from the HP 8510 front panel by selecting the ADDRESS of TEST SET function then entering the address of the test set and pressing [x1], or it can be changed under program control using the HP 8510 HP-IB ADDRESS; command. The HP-IB address of a particular test set is set by address switches on the test set rear panel.

RF Switch Driver Commands. A related feature of the HP 8510 is that when the HP 8510 ADDRESS of TEST SET function is changed, a code sequence is automatically issued over the HP 8510 system bus to the device at the ADDRESS of RF SWITCH. In the recommended configuration, this device is an HP 11713A Attenuator/Switch Driver which in turn controls one or more HP 33311C Coaxial Switches. As shown in Figures 3-3 and 3-4, these switches are used to select which of the test sets receive the RF Output of the network analyzer source. The exact command issued depends upon the new value of the ADDRESS of TEST SET function, also shown in Figures 3-3 and 3-4.

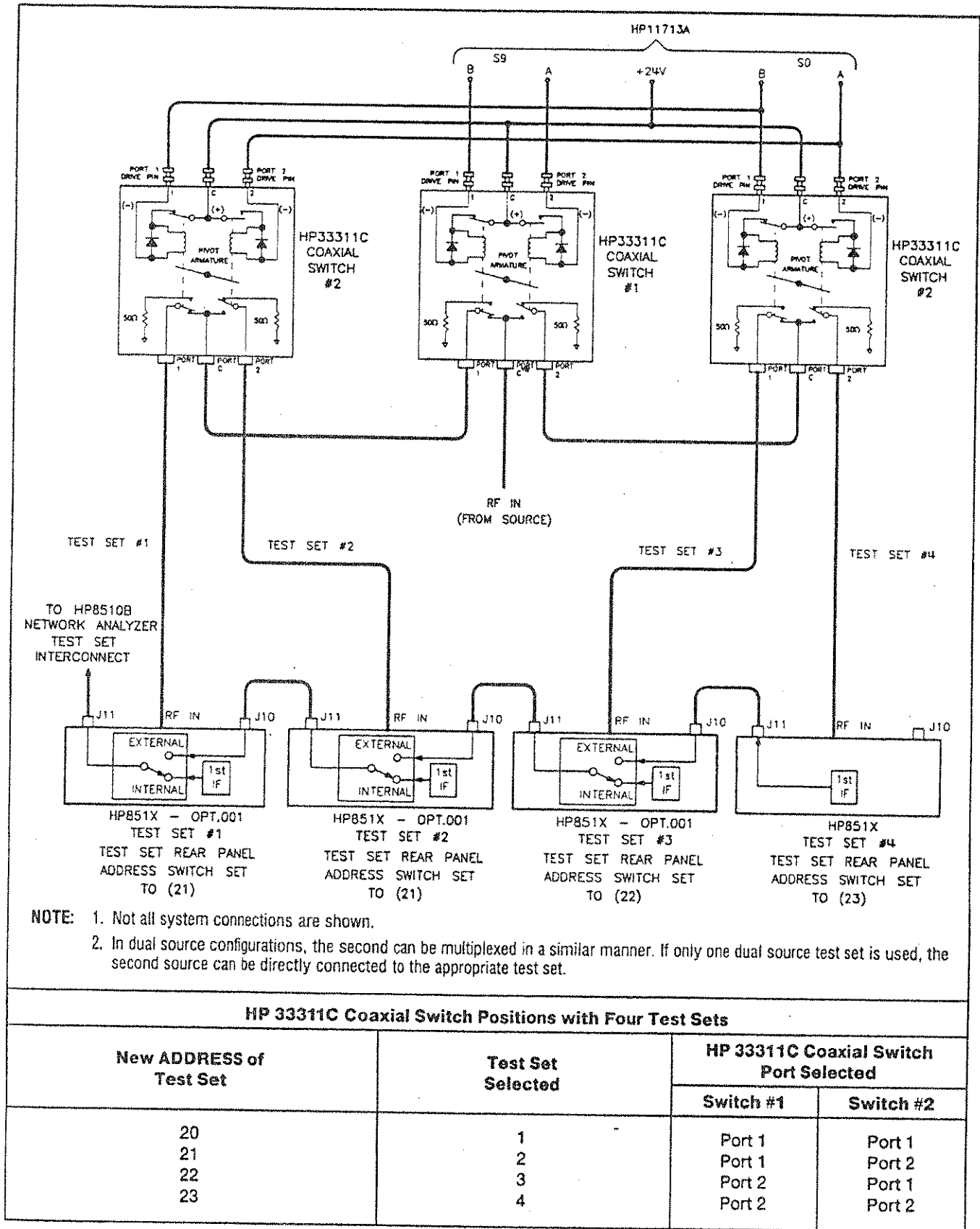


Figure 3-4. RF and IF Switching with Four Test Sets

Measurement Calibration

After selecting the Active test set, perform the system calibration procedure as usual. When you select a different test set, make sure that you recall the Cal Set that applies to that test set.

Since the Cal Set Limited Instrument State does not include the number of the active test set, a Cal Set which does not apply to the current test set can be turned on without any HP 8510 caution messages appearing. This will cause errors in the displayed data because incorrect error coefficients are applied to the measured data.

It may be convenient to store a Hardware State file and an Instrument State file for each combination of test set and cal set. You may also store your Hardware State file on a tape or disc for future use. To change the configuration, simply recall the appropriate Hardware State file, which sets the Address of Test Set and issues the RF switch command, then the appropriate Instrument State file, which recalls the Cal Set.

Operational Checks

To check operation of a multiple test set configuration, first connect a device with a known response at test set number 1, then press HP 8510 [LOCAL] [TEST SET], [ADDRESS of TEST SET], enter the address of test set number 1 (this would be 20), then press [x1]. The test set number 1 measurement should appear. Press [DISPLAY] [DATA→MEMORY] [DISPLAY: DATA and MEMORY] to store the trace for later comparison. Now use ADDRESS of TEST SET to select test set number 2, then switch back to test set number 1. Observe any difference in the response between the stored trace and the result after switching back and forth between the test sets. Repeat for each of the test sets. Any difference in the data believed due to the option 001 IF switch or RF switching must be investigated.

Performance Verification

Standard System Performance Verification procedures are used to verify the operation of the option 001 test set as test set number 1. To verify the performance of another test set in the chain, select it as the Active test set and proceed as usual.

ANTI-ROTATION CLAMP INSTALLATION

The HP 08515-60003 Anti-Rotation Clamps are used to secure the RF connections at the test ports of several Hewlett-Packard test sets. When installed, each clamp holds the large nut that secures the test set RF port connector to the front panel, and the RF cable connector or the front panel adapter mated with the port connector.

Without the clamps, the test port connections may become loose after moving the connected device and could invalidate calibrations and measurements.

PROCEDURE

NOTE: Although the anti-rotation clamps may be used with front panel adapters, these instructions refer to an installation using the HP RF Cables. Adapter installations will be similar.

1. Two anti-rotation clamps are included in the test set accessories box. Remove one from the box and loosen the thumbscrew until it is almost out of the counter-bored hole in the clamp body.

Gently push the clamp (round-hole end first) over and past the RF cable connector you will connect to the test set RF port. The rubber O-ring in the round end of the clamp will fit tightly over the connector. Wiggle the clamp if necessary to get it over the connector.

Connect the cable to the test port and tighten as specified in the cable manual.

2. Important! The test set RF connector is easily loosened so hold the RF cable throughout the rest of this procedure. Do not allow the cable to rotate.
3. See Figure 3-5. Turn the clamp so that the thumbscrew is pointing up. From there, turn the clamp to visually align the clamp flats with the flats on the test port connector nut. This will minimize rotating the connector in the next step.

NOTE: The flats may be in any orientation in respect to the front panel.

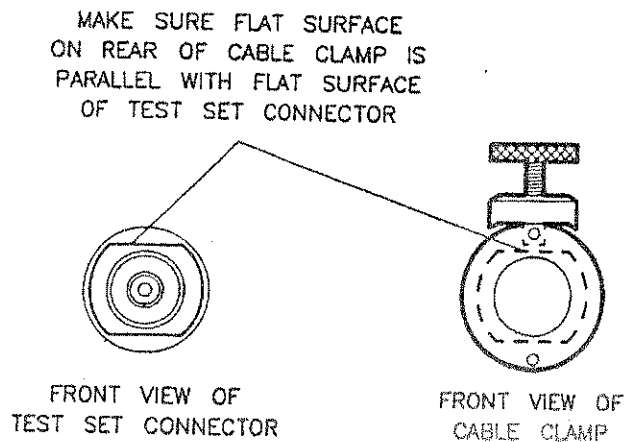


Figure 3-5. Visually Aligning Clamp (Nut Flats)

Make sure that you do not twist the cable as you attach it to the test port. Use the torque wrench supplied with your calibration kit to tighten the cable to no more than 90 ft.-lb. (123 in.-lb).

4. See Figure 3-6. Hold the cable with one hand and gently press the clamp onto the connector nut. The internal flats in the clamp must fit over the flats on the connector nut. Do not rotate the clamp as you do this or the RF connection will be affected.

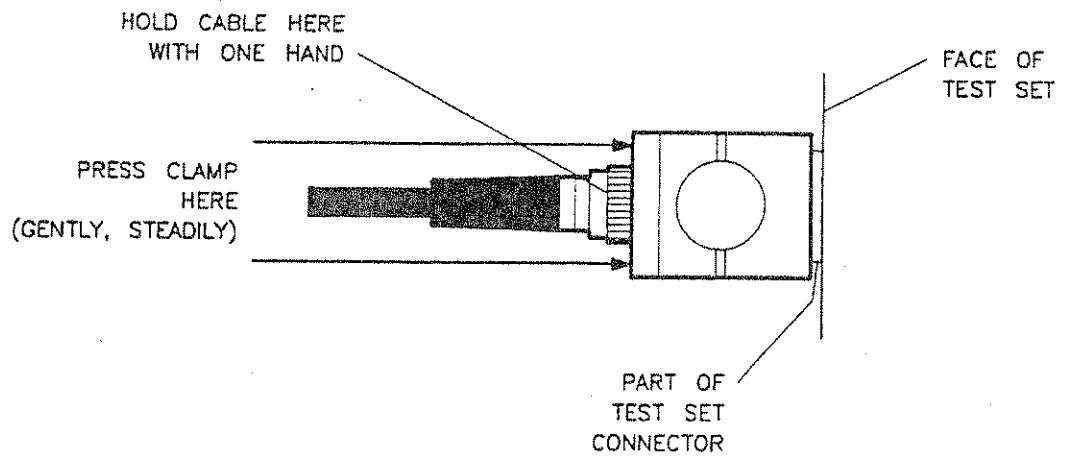


Figure 3-6. Mating the Clamp and Nut Flats

5. See Figure 3-7. Make sure that the thumbscrew is aligned with the counter-sunk hole in the clamp body. Push the clamp toward the test set front panel and then tighten the thumbscrew with your fingers. The cable cannot be damaged by tightening the thumbscrew too tightly.

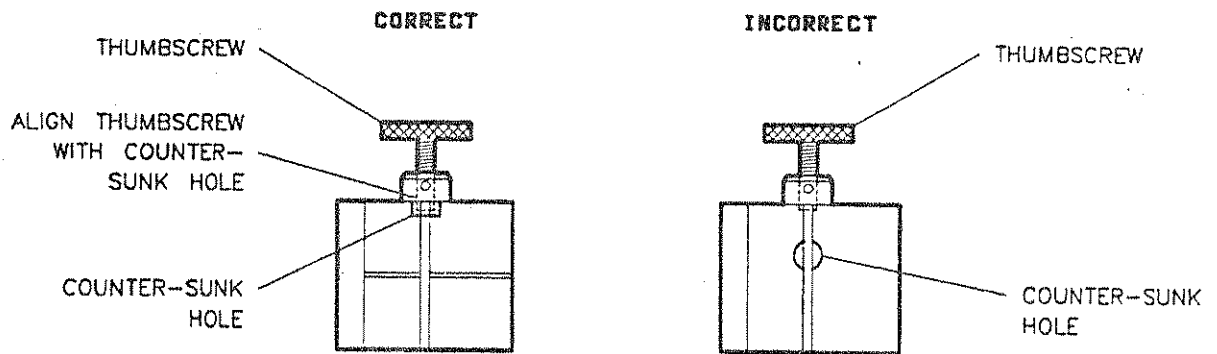


Figure 3-7. Aligning the Thumbscrew with the Counter-bored Hole

6. Repeat steps 1 through 5 for the other clamp.

This completes the anti-rotation clamp installation procedure. Refer to the installation section of the test set operating and service manual for instructions to replace the internal O-ring in the anti-rotation clamp.

Section 4. Specifications

Specifications describe the warranted performance of the instrument.

The electrical specifications of the HP 85110A test set with an HP 8510B network analyzer are defined in the *Specifications* section of the *HP 8510B System Manual*. The mechanical specifications are defined in Table 4-1.

MECHANICAL SPECIFICATIONS

Table 4-1. Mechanical Specifications

<p>Test Ports (Front Panel)</p> <p>NMD-3.5 mm connector center pin recession: 0.005 mm to 0.056 mm (0.0002 in. to 0.0022 in.)</p> <p>NOTE: Refer to your calibration kit manual for information on how to use your gage.</p>
--

SUPPLEMENTAL CHARACTERISTICS

The supplemental characteristics listed in Table 4-2 are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.

Table 4-2. HP 8510B/85110A Characteristics

Test Ports (Front Panel)	RF Connectors (Rear Panel)						
<p>Connector type: NMD-3.5 mm male</p> <p>Impedance: 50 Ohms nominal</p> <p>Incident signal attenuation range: 0 to 90 dB in 10 dB steps</p> <p>Damage input level: > +20 dBm CW RF¹</p> <p>Nominal operating power level:²</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Frequency</td> <td style="padding: 2px;">Operating Level</td> </tr> <tr> <td style="padding: 2px;">2.0 to 8 GHz</td> <td style="padding: 2px;">0 dBm</td> </tr> <tr> <td style="padding: 2px;">8 to 20 GHz</td> <td style="padding: 2px;">-3 dBm</td> </tr> </table> <p>Nominal connector nut size: 20 mm</p> <p>Recommended torque: 90 N-cm (8 in.-lb.)</p>	Frequency	Operating Level	2.0 to 8 GHz	0 dBm	8 to 20 GHz	-3 dBm	<p>Connector type: precision 3.5 mm female</p> <p>RF Source power level:</p> <p>Damage input level: > +23 dBm</p> <p>Minimum: 0 dBm</p> <p>Maximum: +14 dBm</p> <p>Nominal operating level: +6 to +9 dBm⁴</p> <p>Nominal connector nut size: 8 mm</p> <p>Recommended torque:</p> <p>Precision 3.5 mm 90 N-cm (8 in.-lb.)</p> <p>SMA: 56 N-cm (5 in.-lb.)</p> <p>LO Source Power Level:</p> <p>Minimum: +15 dBm</p> <p>Maximum: +27 dBm</p> <p>Nominal: +20 dBm</p> <p>Low Power Out:</p> <p>Damage input level: > +20 dBm CW RF³</p>
Frequency	Operating Level						
2.0 to 8 GHz	0 dBm						
8 to 20 GHz	-3 dBm						
<p>1. See <i>Instrument Description, General Information</i> for more information on higher power operation.</p> <p>2. Available power in PRESET condition.</p> <p>3. This is the damage level of the switch splitter. See <i>Instrument Description, General Information</i> section.</p> <p>4. Adjust power so that the analyzer doesn't lose phaselock.</p>							

Table 4-3. HP 85110A Power Requirements and Physical Characteristics

<p>Operating Temperature: 0°C to 55°C</p> <p>Power: 110, 120, 220 or 240 ± 10% Vac; 47 to 66 Hz line frequency</p> <p>Dimensions: 460 mm × 133 mm × 609 mm (18.1 × 5.25 × 24 inches)</p> <p>Weight: HP 85110A: 17 kg (38 lb) net</p>
--

Table 4-4. Recommended Equipment

Item	Critical Specifications	Recommended Model	Use ¹
Network analyzer Source ² Controller	No substitute No substitute No substitute	HP 8510B HP 8340A/B or HP 8341B HP 9000 series 200 or 300 with 2 Mbyte RAM and BASIC 3.0 or higher OR PC-305 or PC-308 HP BASIC Controller with 2 Mbytes of Basic Language Processor RAM.	O, P, T O, P, T P
Disc drive	compatible with controller		P
Multimeter	range: 0 to 50V	HP 3456A	T
Oscilloscope	50 MHz bandwidth	HP 1740A	T
<p>1. O = operation; P = performance test; T = troubleshooting 2. HP 8340 or 8341. Refer to HP 8510 INSTALLATION manual for additional information.</p>			

Section 5. Test Set Troubleshooting

The information in this section is presented as an aid in troubleshooting the HP 85110A test set. If you are not certain that the problem with your system is due to a faulty test set, read the sections titled SERVICE OVERVIEW and BUILT-IN DIAGNOSTICS in this manual. Continue with this section only if you know the test set is faulty.

HP 85110A TEST SET TROUBLESHOOTING STRATEGY

1. Isolate the problem to the test set using the strategy in the HP 85102A Service Manual.
2. Check the test set power supply, fuses, cables, fan, HP-IB address switch, etc.
3. Use the troubleshooting procedures in this manual to confirm that the problem is in the test set.
4. If the problem is a faulty test set, return it to HP for repair.

The troubleshooting flow diagram in this section gives a visual representation of the troubleshooting method used for the HP 85110A test set.

CHECK ALL CONNECTIONS (loose, broken, crimped, etc.)

Note: Power holes often result from faulty connections. All semi-rigid cables inside the test set are torqued to 56 N-cm (5 in-lb).

- Test set rear panel
- A3 summing amplifier and A5 attenuator/switch driver board cables
- Mixer cables
- RF path connections from the rear panel to the front panel.

CHECK POWER SUPPLY/REGULATOR, FUSES, AND SWITCHES

A15 Regulator Board Assembly

Use a digital voltmeter to check the voltages in Table 5-1. Use an oscilloscope to check ripple if necessary).

Table 5-1. Test Set Power Supply Voltages

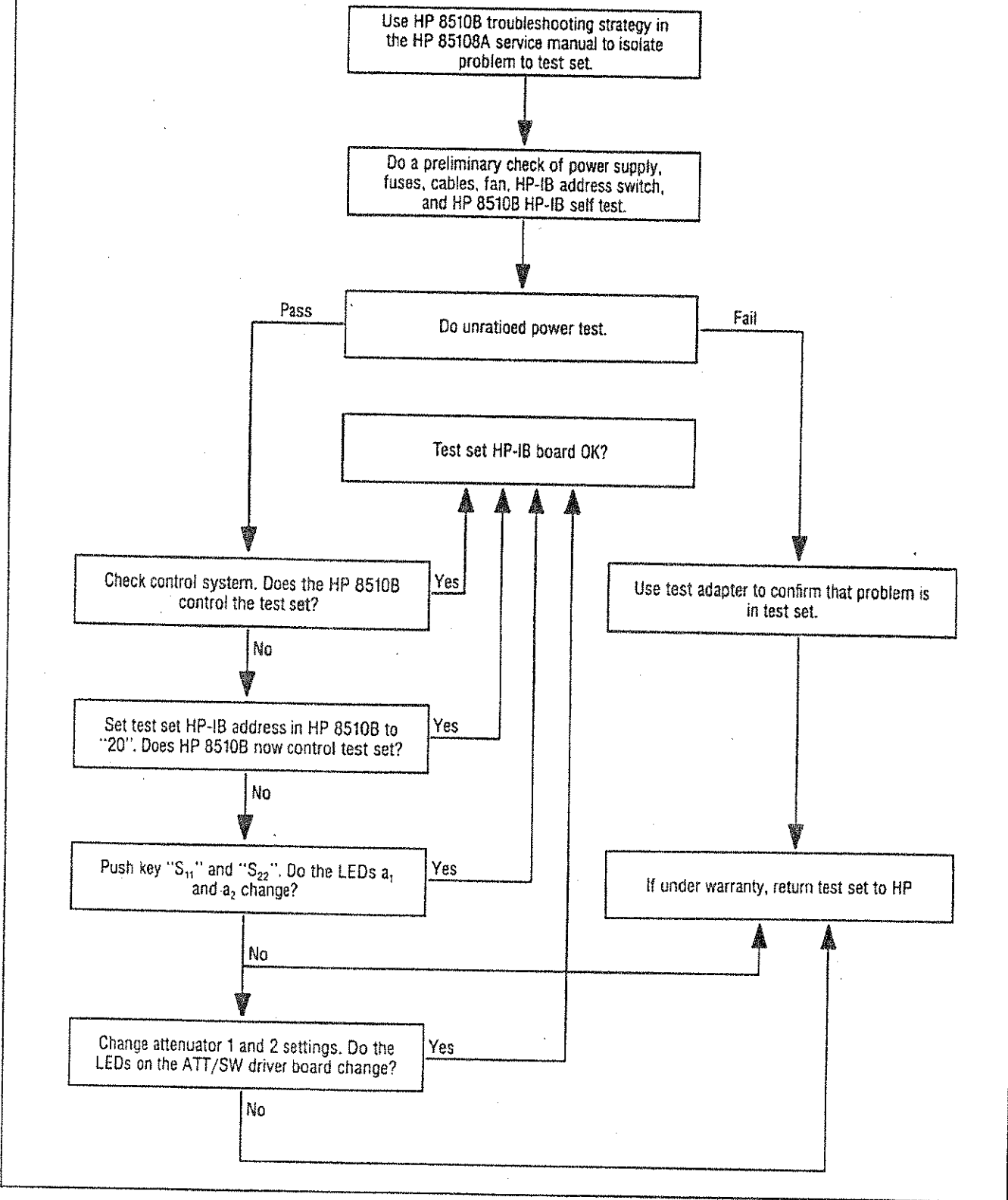
Nominal Voltage	Test Point	Voltage Range	Maximum Ripple Peak to Peak
+15	A22TP1	+13.7 to +15.9	2 mV
-15	A22TP2	-13.8 to -16.2	2 mV
+5	A22TP3	+4.5 to +5.2	2 mV
-5	A22TP6	-4.8 to -5.5	2 mV

Fuses

The HP 85110A uses five fuses.

- Four fuses are used on the A15 regulator board assembly.
- One fuse is used in the line module on the rear panel.

HP 85110A TROUBLESHOOTING FLOW DIAGRAM



HP-IB Address Switches

Set the switches as indicated (dark side of switch is depressed). The HP-IB address switch is on the test set rear pane. It is easy to access but need not be changed unless the HP 8510 bus error message "SYSTEM BUS ADDRESS ERROR" is visible on the CRT. It is shown in Figure 5-1.

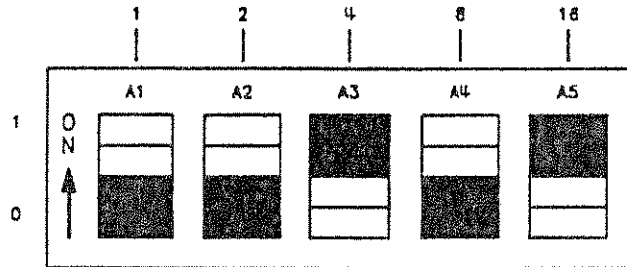


Figure 5-1. HP 85110A Test Set HP-IB Switch Setting (20 binary shown)

TEST SET SELF-TEST INDICATORS

If the ACTIVE LED on the front panel of the test set selected by the HP 8510B does not light within two seconds of turn on or lights immediately, the test set has not passed its self-test. You can determine what part of the self-test failed by noting which HP-IB LEDs on the A4 HP-IB board assembly are lit, as shown in Table 5-2.

Table 5-2. HP-IB LEDs on the A4 HP-IB Board Assembly

Self-Test Indication	A4 HP-IB LEDs				Time (after turn-on)
	LSN	TLK	SRQ	REM	
PWON	ON	ON	ON	ON	0 to 0.5 seconds on briefly
Fail ROM Test	OFF	ON	ON	ON	0.5 to 2.0 seconds
Pass ROM Test	OFF	OFF	ON	ON	
Fail RAM Test	OFF	OFF	OFF	ON	after 2 seconds
Pass RAM Test	OFF	OFF	OFF	OFF	

Two seconds after turn-on, all four HP-IB LEDs on the top of the A4 HP-IB board assembly should go off at the same time the front panel ACTIVE LED lights. Then the LEDs will light according to the state of the test set. If you are using multiple test sets, the first test set in line will be the active test set until another is chosen.

If Self-test Fails to Run

If the portion of memory which contains the self-test programming is faulty, the self-test will not run properly. The following conditions indicate that the self-test ROMs are faulty:

- All LEDs flash briefly and go off
- All LEDs flash briefly and stay on
- ACTIVE LED goes on too soon
- ACTIVE LED does not go on

Given the above self-test failure symptoms, the most probable cause of failure is one or more faulty self-test ROMs, although other causes are possible.

UNRATIOED POWER TEST

This procedure allows you to check the output power level of each test set mixer assembly and its associated IF amplifier alone. The normal power level display, S_{11} for example, is a ratio (in this case, b_1/a_1). The network analyzer automatically powers a predefined port or ports to make a measurement.

Ratioed measurements provide useful data but they can mask certain malfunctions. Assume, for example, the task is to measure an S-parameter at a specific power level. If the test set has a 20 dB power hole due to a faulty RF input connector, that deficiency would be invisible (ratioed out) in a ratioed measurement. But the data would be incorrect; it would not have been taken at the specified power level.

Similarly, troubleshooting system faults in a ratioed measurement mode can be deceptive. The solution is to check each channel singly, to check the power in an unratioed mode. To do so requires specifying which port to drive power to and which channel to achieve phase lock with. The following procedures include steps to redefine parameters as required.

Figures 5-2, 5-4, and 5-5 show which assemblies are included in the signal path of each channel. Realizing that some assemblies are common to two, or all four channels is a powerful troubleshooting tool. Figure 5-3 shows some typical transmission and reflection traces.

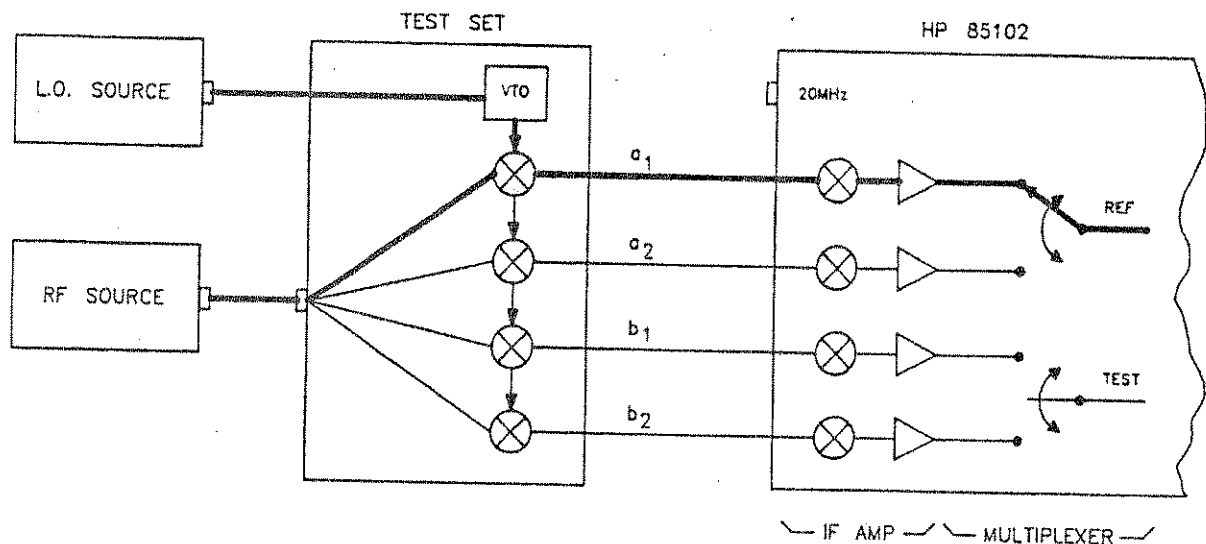


Figure 5-2. Simplified Signal Path of Unratioed Power Test

Reflection Test

1. Activate the pulse configuration by loading the pulse system configuration tape as follows:
 - a. Insert the system configuration software tape into the HP 8510B tape drive.
 - b. Press the following keys/softkeys to load the Instrument State:

[TAPE/DISC] [STORAGE IS TAPE]
 [LOAD] [INST STATE 1-8] (or, [INST STATE ALL]) [INST STATE (POWER UP) 8] [FILE #1].

Load [FILE 8] for pulse configuration.

c. Press the following keys/softkeys to load the Hardware State:

[LOAD] [MORE] [HARDWARE STATE] [FILE #]Load [FILE 8] for pulse configuration.

d. After loading the files, press [PRESET] [RECALL] [INST. STATE 8].

Recalling Instrument State 8 sets the power-on instrument state for the pulse configuration.

2. Press [PRESET] STIMULUS [MENU] on the HP 85102B to preset the HP 8510B and access the STIMULUS menu.

3. To check all mixers in the test set, first redefine the a2 and b2 phase lock and drive paths:

Press PARAMETER [MENU] [User 3 a2] [REDEFINE PARAMETER] [DRIVE] [Port 2] [PHASE LOCK] [a2] [REDEFINE DONE] to redefine a2.

Press [User 2 b2] [REDEFINE PARAMETER] [DRIVE] [Port 2] [PHASE LOCK] [a2] [REDEFINE DONE] to redefine b2.

4. Connect an open (or short) to port 1 and port 2.

5. Refer to Figure 5-3. Press [User 1 a1] and observe the a1 mixer power level. It should be within +5 dB of that shown in the figure. Likewise press [User 2 b2], [User 3 a2], and [User 4 b1]. In each case, the mixer power should be within +5 dB of that shown in Figures 5-4 through 5-6. If it is not, then refer to the procedure titled *If Any User Channels Look Bad* at the end of this section. Figures 5-3a, 5-4a, 5-5a, and 5-6a identify the RF signal paths and components which affect each path for each user definition.

b1 THRU TEST

6. Connect a thru from port 1 to port 2.

7. Press PARAMETER [MENU] [USER 4 b1] [REDEFINE PARAMETER] [DRIVE] [PORT 2] [PHASE LOCK] [a2] [REDEFINE DONE] and observe the b1 power level trace shown by Figure 5-7. If the power level is not within +5 dB of that shown in the figure, refer to the procedure titled *If Any User Channels Look Bad* at the end of this section. Figure 5-7a identifies the RF signal path and components which affect the b1 thru signal path.

b2 THRU TEST

8. Press PARAMETER [MENU] [USER 2 b2] [REDEFINE PARAMETER] [DRIVE] [PORT 1] [PHASE LOCK] [a1] [REDEFINE DONE] and observe the b2 power level trace shown by Figure 5-8. If the power level is not within +5 dB of that shown in the figure, refer to the procedure titled *If Any User Channels Look Bad* at the end of this section. Figure 5-8a identifies the RF signal path and components which affect the b1 thru signal path.

Be sure to redefine the parameters back to the original conditions for a1, b1, a2, and b2 before they were changed in the previous steps.

If one or more channels look abnormal, refer to the procedure titled *If Any User Channels Look Bad* at the end of this section.

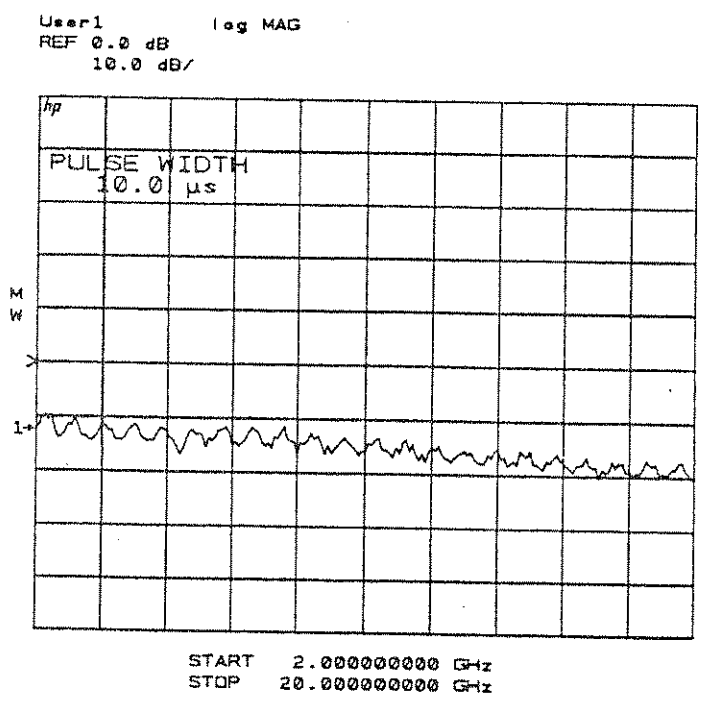


Figure 5-3. Typical a1 Path Signal Trace

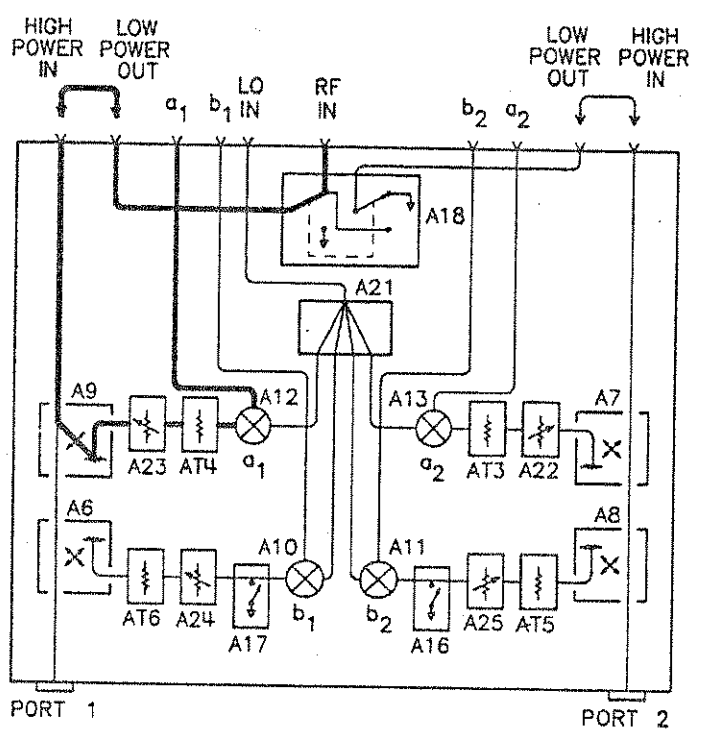


Figure 5-3a. a1 Signal Path

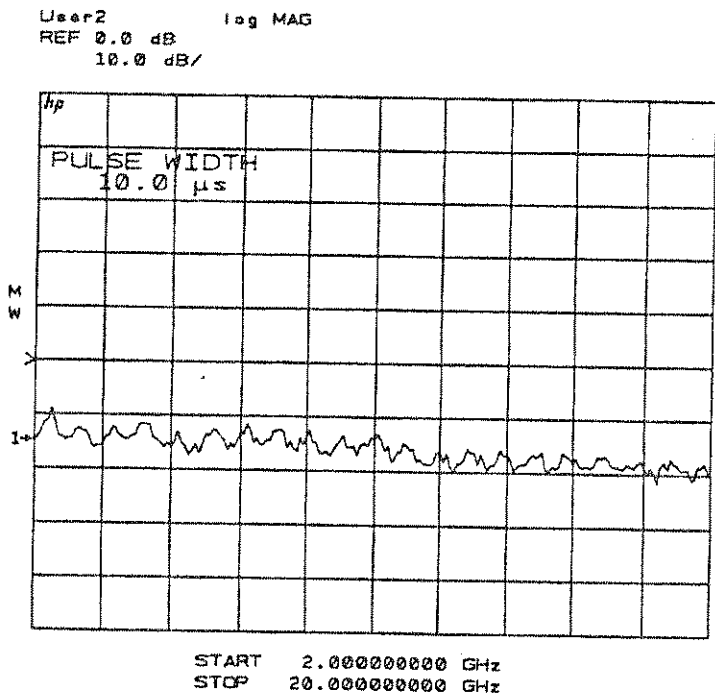


Figure 5-4. Typical b2 Reflection Signal Trace

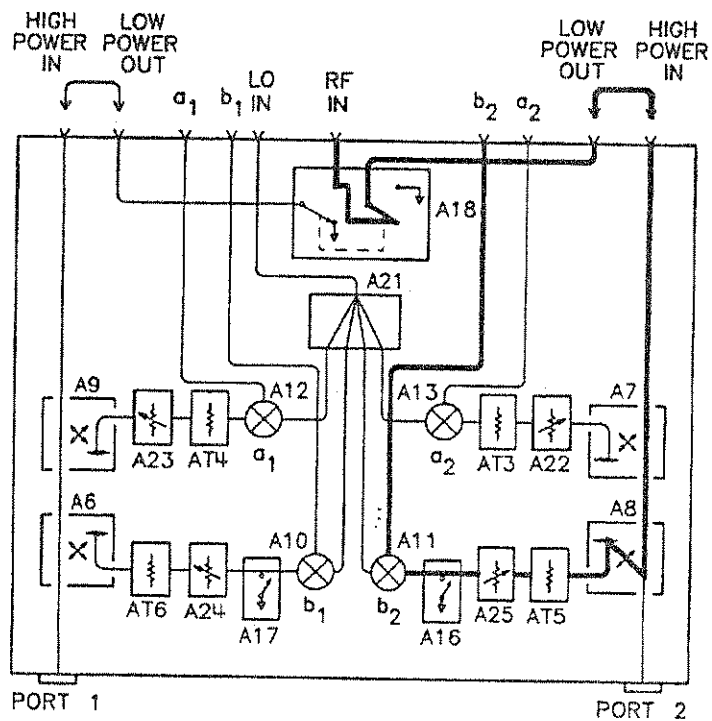


Figure 5-4a. b2 Reflection Signal Path

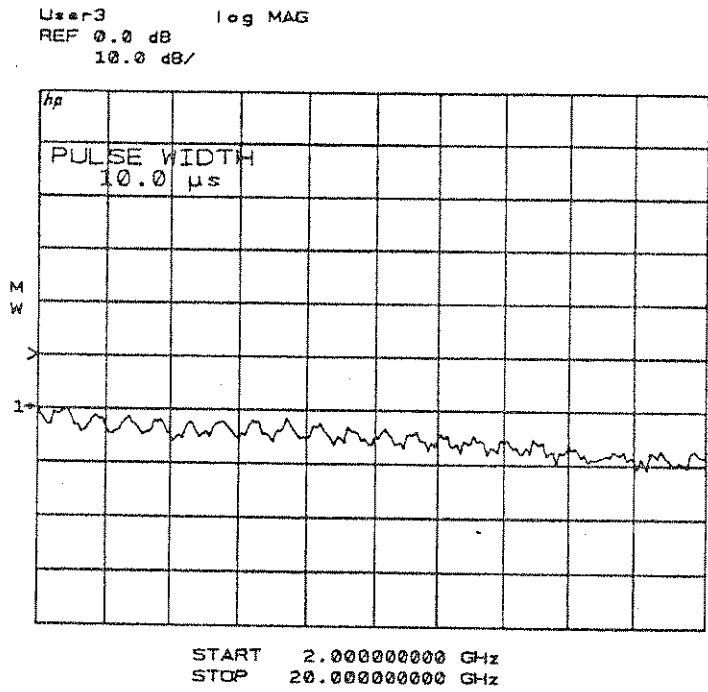


Figure 5-5. Typical a2 Path Signal Trace

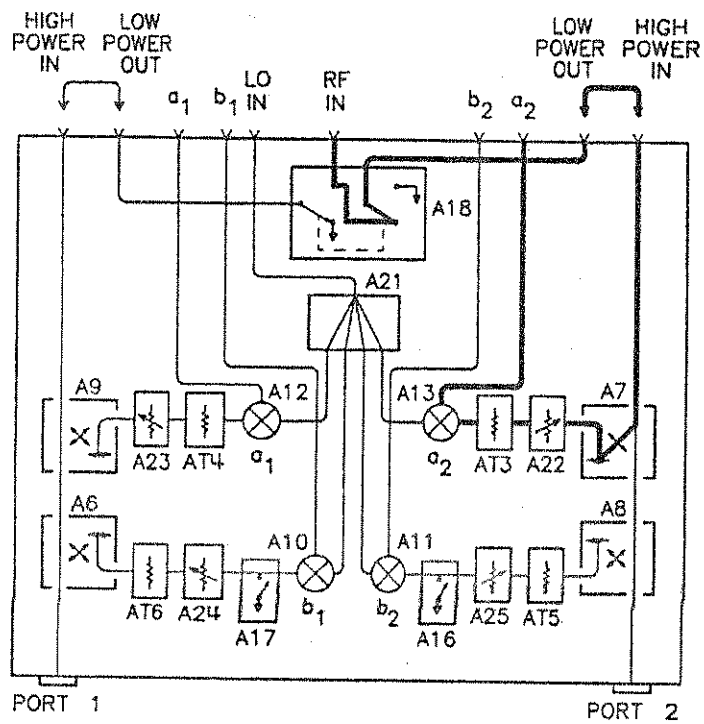


Figure 5-5a. a2 Signal Path

User4 log MAG
 REF 0.0 dB
 10.0 dB/

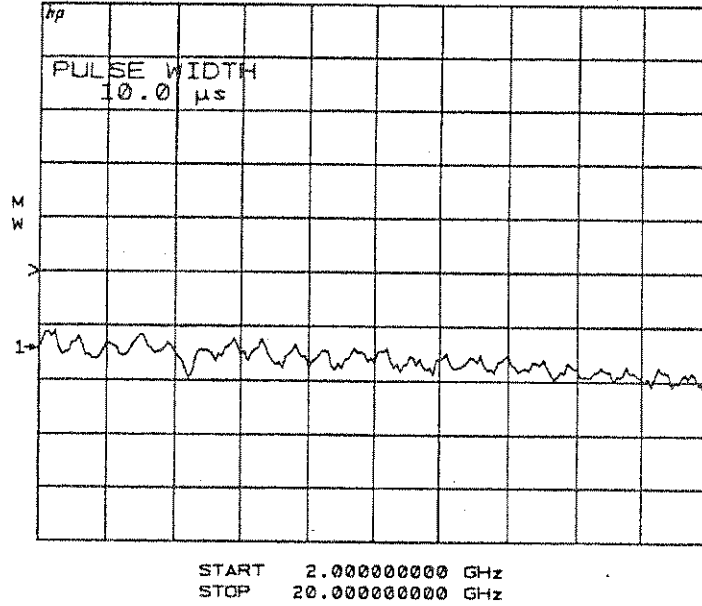


Figure 5-6. Typical b1 Reflection Signal Trace

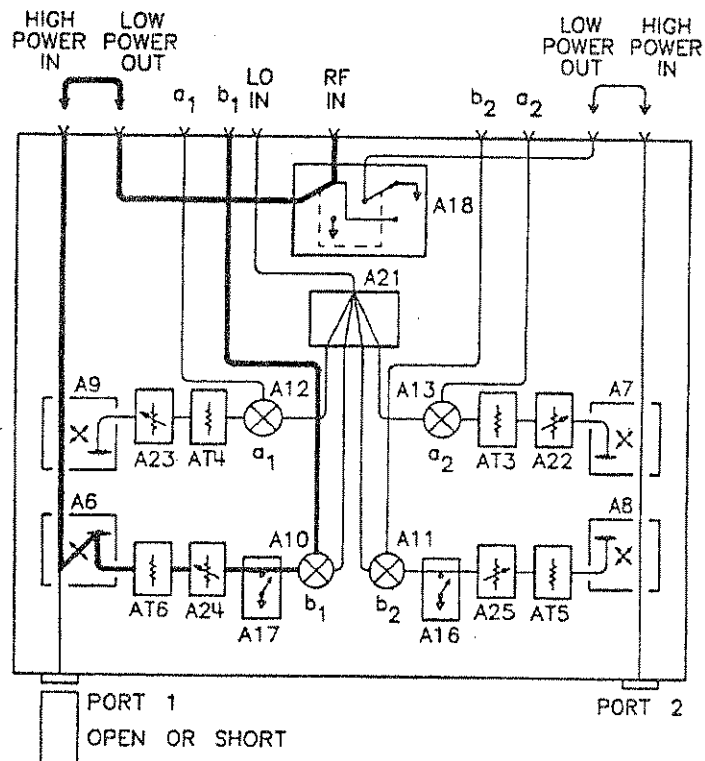


Figure 5-6a. b1 Reflection Signal Path

User4 log MAG
 REF 0.0 dB
 10.0 dB/

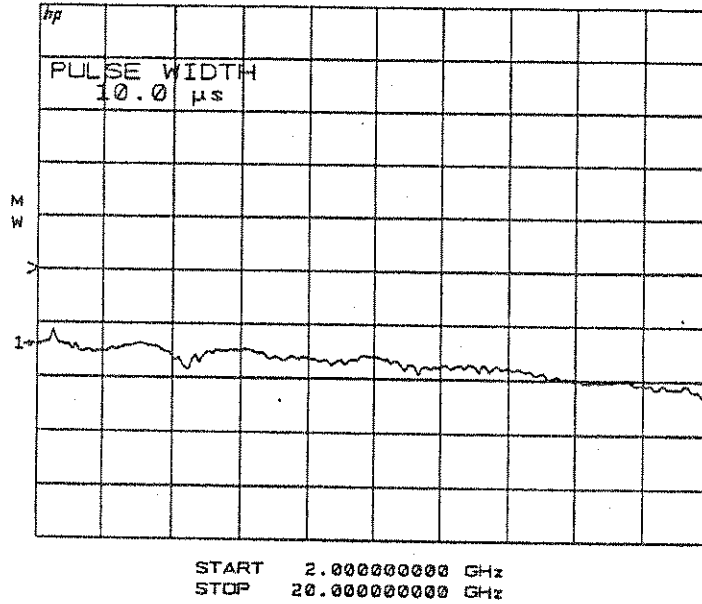


Figure 5-7. Typical b1 Thru Signal Trace

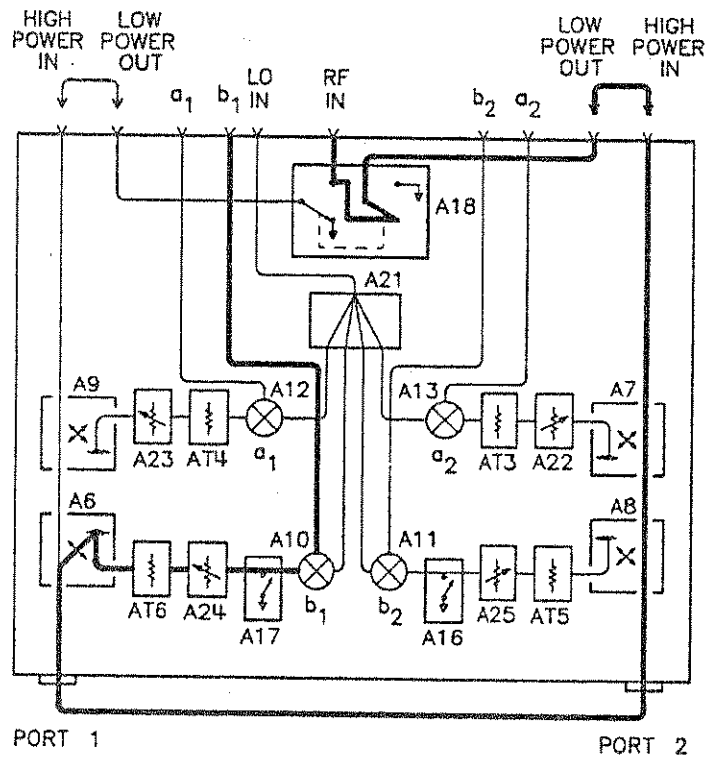


Figure 5-7a. b1 Thru Signal Path

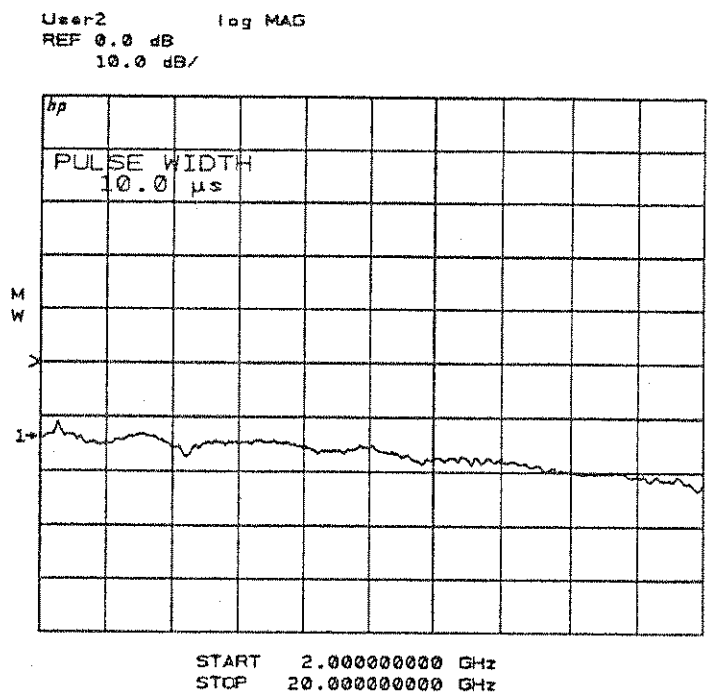


Figure 5-8. Typical b2 Thru Signal Trace

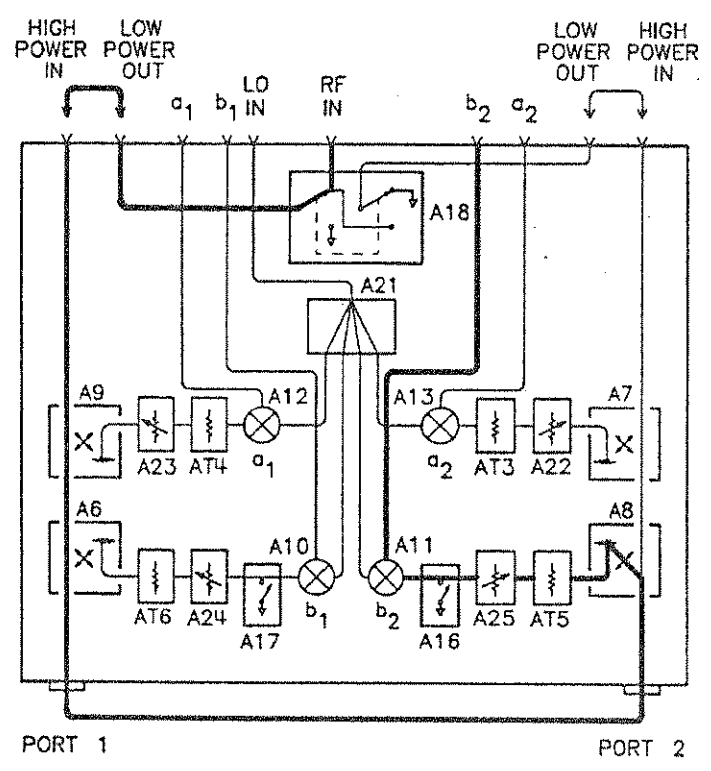


Figure 5-8a. b2 Thru Signal Path

IF ANY USER CHANNEL APPEARS FAULTY

If one or more user channels appear faulty, the problem might be with the source, test set, or the HP 85102B IF/Detector. The service adapter is a source/test set emulator. It provides the same 20 MHz signal to the HP 85102B as the test set and source. Thus, it indicates whether or not the problem is in the HP 85102B IF/Detector. Figure 5-12 shows the RF signal path through the service adapter.

Equipment

- HP 85102B service adapter (provided in the HP 8510B Service Manual. See SERVICE TOOLS).
- BNC cable

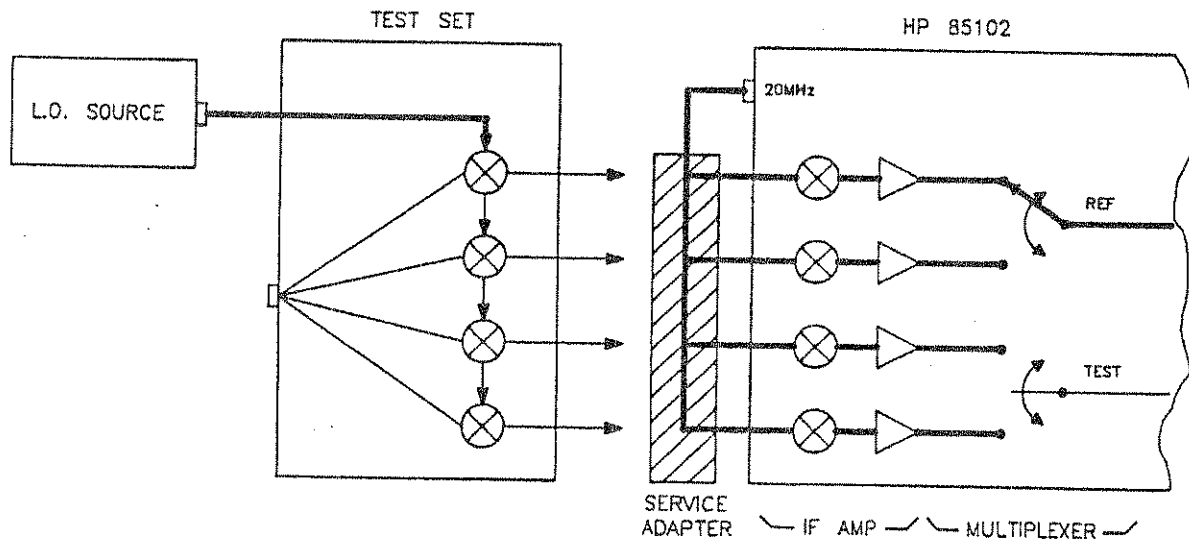


Figure 5-12. HP 85102B Signal Path With Service Adapter

Service Adapter Procedure

1. Connect the HP 85102B service adapter to the HP 85102B rear panel "20 MHz OUT" connector and the "J2 IF-DISPLAY INTERCONNECT" connector.
2. Press [PRESET] [MARKER] STIMULUS [MENU] [STEP] PARAMETER [MENU] and each User softkey to observe the unratiod power level of the User1 through User4 channels. The traces should be flat lines, quite close to each other, as indicated by the marker value (typically about $-28 \text{ dB} \pm 5 \text{ dB}$).

Service Adapter Conclusions

- If all of the channels look good (with the service adapter) and all looked bad in the unratiod power test, the HP 85101B and 85102B are working. The problem is probably source related. Refer to the SOURCE TESTS and SERVICE PROGRAM sections of the Service Manual to continue troubleshooting the problem.
- If all four User channels look bad (with the service adapter), suspect the 20 MHz signal from the A6 clock board assembly. Refer to the paragraph titled *HP 85102 IF/Detector Tests* in the SERVICE PROGRAM section to verify the 20 MHz output.
- If one or more (but not all) channels look bad, troubleshoot the HP 85102B by referring to the SERVICE PROGRAM and BLOCK DIAGRAMS sections of the service manual. Then recheck the unratiod channel power levels.

Single channel problems suggest the IF Mixer board corresponding to the User function (channel a1, b1, a2, or b2) is faulty. Refer to the *Overall System Block Diagram* located in the BLOCK DIAGRAMS section of the Service Manual.

Multiple channel problems indicate the problem is most likely in the HP 85102B circuitry after the IF Mixer boards (for example, the IF amplifiers or synchronous detectors). Refer to the HP 85102A Overall Block Diagram in the BLOCK DIAGRAMS section of the Service Manual.

Determine whether the failure is in the reference path or the test path.

Test the suspect board(s) using the procedures provided in the SERVICE PROGRAM section. Check the HP 85102B IF Amplifiers and Synchronous Detectors by swapping the reference and test board assemblies (since they are identical) and seeing if the problem moves.

TEST SET ASSEMBLY REPLACEMENT PROCEDURES

This section consists of removal procedures for HP 85110A test set major assemblies. The procedures are identified in the text by bold reference numbers in parenthesis; for example, (1). Unless otherwise noted, replace the old assembly by performing the procedure in reverse order of disassembly. This section contains replacement procedures for the following assemblies:

- 1 A6 Directional Coupler (for Port 1)
A8 Directional Coupler (for Port 2)
- 2 A7 Directional Coupler (in a2 Mixer circuit)
A9 Directional Coupler (in a1 Mixer circuit)
- 3 A10 b1 Mixer
A11 b2 Mixer
A12 a1 Mixer
A13 a2 Mixer
- 4 A14 Attenuator/Splitter Board Assembly
- 5 A15 Regulator Board Assembly
- 6 A16 PIN Switch (in b2 Mixer circuit)
A17 PIN Switch (in b1 Mixer circuit)
- 7 A18 Switch/Splitter
- 8 A21 4-Way Power Divider
- 9 A22 90 dB Step Attenuator (in a2 Mixer circuit)
A23 90 dB Step Attenuator (in a1 Mixer circuit)
A24 90 dB Step Attenuator (in b1 Mixer circuit)
A25 90 dB Step Attenuator (in b2 Mixer circuit)
- 10 AT3 3.5 mm 10 dB Attenuator (in a2 Mixer circuit)
AT4 3.5 mm 10 dB Attenuator (in a1 Mixer circuit)
- 11 AT5 3.5 mm 6 dB Attenuator (in b2 Mixer circuit)
AT6 3.5 mm 6 dB Attenuator (in b1 Mixer circuit)
- 12 B1 Fan Assembly
- 13 C1,2,3,4 Filter Capacitors
- 14 J2, J3, J4, J5, J7, and J8 3.5 mm Bulkhead Connectors
- 15 J13 Port 1 3.5 mm Connector
J14 Port 2 3.5 mm Connector
- 16 T1 Power Transformer

Observe the following caution before beginning any of the following procedures:



ATTENTION
Static Sensitive

**Handle only at Static Safe
Work Stations**

The assemblies handled in this procedure are very sensitive to damage by static electricity. They may or may not continue to function if subjected to an electrostatic discharge. In any case, an electrostatic discharge will impair the reliability of these assemblies. Always perform the following steps in order.

- Ground the work area and yourself to prevent electrostatic damage to the microcircuits.
- Turn the test set OFF.
- Disconnect the power cord from the mains.
- Remove the top cover.
- Reverse the following procedures after replacement parts have been installed.

Note: All 3.5 mm and SMA connections inside the test set are torqued to 56 N-cm (5 in-lb). Be careful when handling semi-rigid coaxial cables. They are easy to bend and damage.

EQUIPMENT NEEDED BUT NOT SUPPLIED

Table 5-3 lists all equipment needed for replacing the various assemblies documented in the procedures in this section. Use Figure 5-13 to locate all major assemblies in the test set.

Table 5-3. Equipment Needed to Replace Test Set Major Assemblies

Tools	Used With	HP Part Number
2 point pozidriv screwdriver	all components	8710-0900
1 point pozidriv screwdriver	all components	8710-0899
5/16 inch torque wrench, 90 N-cm (8 in-lb)	all components	8710-1765
3.5 mm gage kit	J13/14 port connectors	in 85052B cal kit
anti-static mat	all components	9300-0797
wrist strap	all components	9300-1257
clip lead	C1-C4 capacitors	any supplier
needle nose pliers	A6/A8 couplers	any supplier
wire cutters	A6/A8 couplers, B1 fan	any supplier
9/16 inch nut driver	connector repair	8720-0008
1/2 inch torque wrench, 280 N-cm (25 in-lb)	connector repair	8710-1581
3.5 mm connector gage	connector repair	1250-1862
100 ohm 20 watt resistor	C1-C4 capacitor removal	0819-0019
1 inch torque wrench, 800 N-cm (72 in-lb)	A6, A8 coupler removal	MTB 100 72binE ¹

¹ Order from Mountz Company, 1080 North 11th Street, San Jose, CA 95112

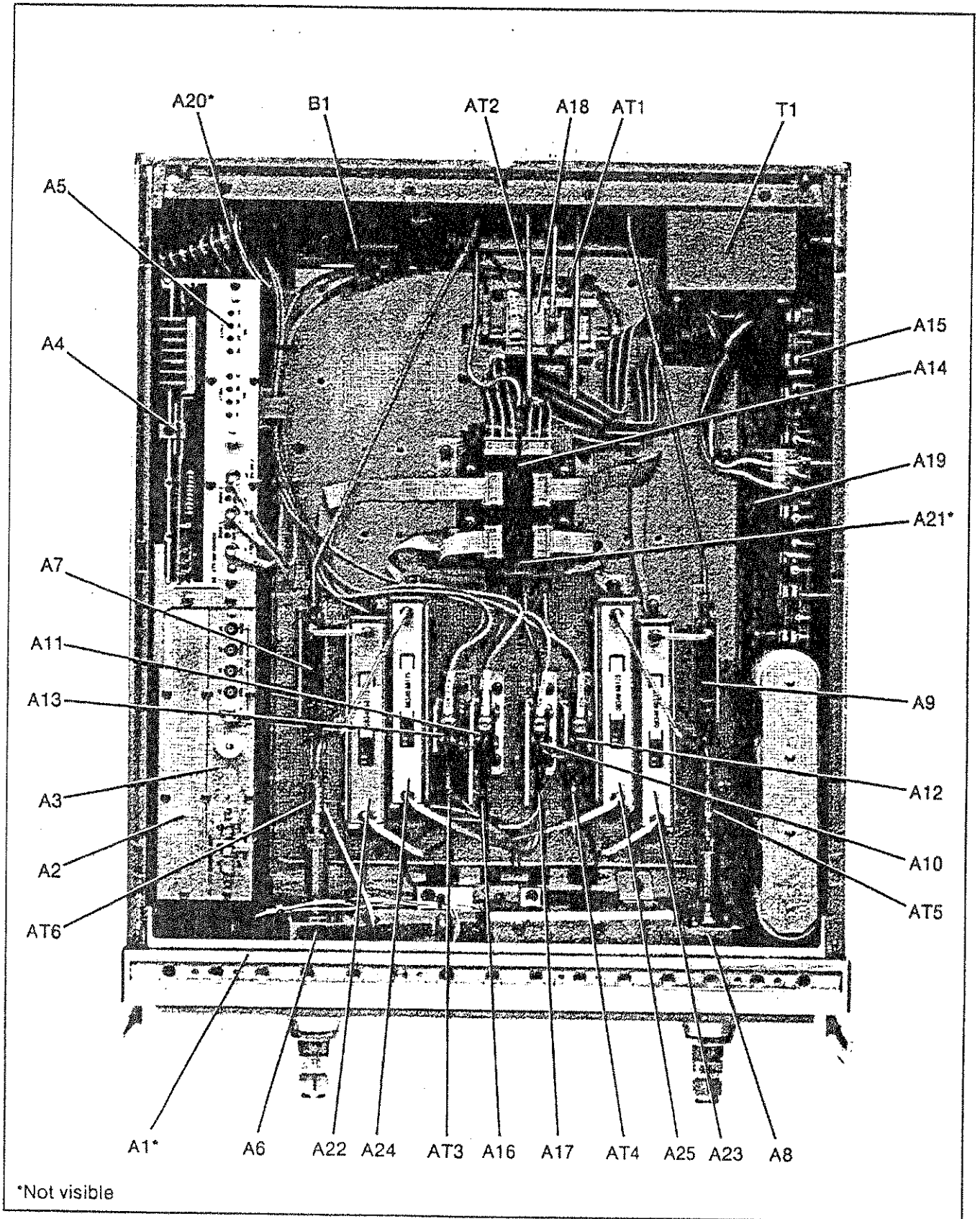


Figure 5-13. General Test Set Component Location Diagram (Top View)

**(1) A6 DIRECTIONAL COUPLER (PORT 1)
A8 DIRECTIONAL COUPLER (PORT 2)**

The easiest way to replace either of these directional couplers is to first remove/loosen the hardline cables connected to the couplers, the port connector nuts, and the hardware connecting the front panel assembly to the main chassis. Secondly, the front panel assembly is pivoted so that the A7/A8 directional couplers are removed together, and lastly, the brackets holding the couplers together is removed. The following procedure explains this process.

1. Remove the top, bottom, and both side covers.
2. Refer to Figure 5-15. Use a 5/16 inch open-end wrench to loosen the connections at the junctions of AT6/A6 (fixed attenuator/port 1 coupler), and AT5/A8 (fixed attenuator/port 2 coupler); shown as callouts 1 and 2 in the figure. Loosen the connections at the other ends of the hardline cables connected to variable attenuators A24 and A25 and remove the cables/fixed attenuators.
3. Remove the hardline cable connected between directional couplers A8 and A9 (callout 3 in the figure).
4. Loosen the hardline cable nut at the connection to directional coupler A7. *Do not remove the hardline cable connection from the coupler.* This nut is callout 4 in the figure.
5. Use wire cutters to cut the cable ties holding together the four wires connecting front panel board assembly A1 and the two S-parameter LEDs (DS1 and DS2) on the front panel. See callout 5.
6. Use needle nose pliers to remove the four wires (colors white/red, white/orange, white/black/red, and white/black/orange) from their individual pin connectors on front panel board assembly A1.

Note: Refer to Figure 5-14 when reconnecting the wires to the A1 front panel board assembly. The color code for each wire is etched onto this board for easier assembly.

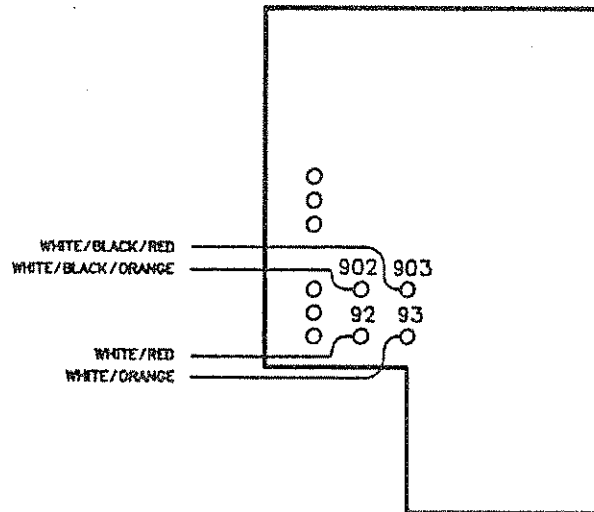


Figure 5-14. Connecting DS1 and DS2 Wires to the A1 Front Panel Board Assembly

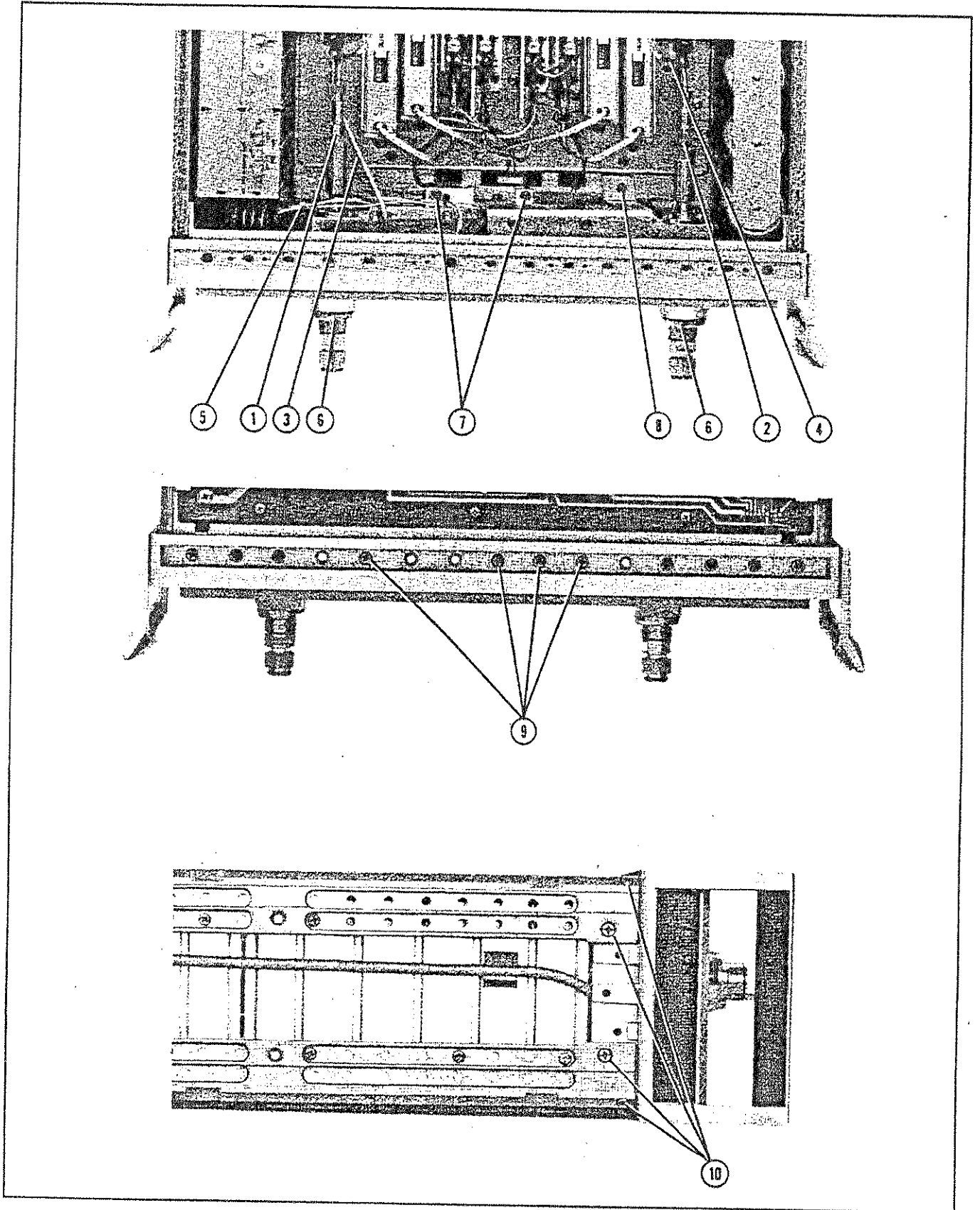


Figure 5-15. Hardware Locations For A6/A8 Directional Coupler Replacement

7. Re-route the four wires mentioned in step 6 so that they are free from the coupler mounting bracket holding together directional couplers A6 and A8.
8. Carefully loosen the large flange nuts holding each port connector/directional coupler onto the front panel. Remove the nuts and washers from the port connectors.

Note: During re-assembly, use a 1 inch torque wrench to tighten these nuts to 800 N-cm (72 in-lb).
9. Use a small pozi-driv screwdriver to remove two .625-inch 6-32 pan head machine screws attaching the coupler mounting block under the A6 directional coupler to the main deck (callout 7 in the figure).
10. Use a small pozi-driv screwdriver to remove one .312-inch 6-32 pan head machine screw attaching the coupler mounting bracket to the main deck (callout 8 in the figure).
11. Turn the test set upside down and use a small pozi-drive screwdriver to remove three .25-inch 4-40 counter-sink head machine screws located toward the center of the front panel assembly (callout 9 in the figure).
12. Turn the test set rightside up and use a small pozi-drive screwdriver to remove eight 4 mm flat head machine screws from the left and right sides of the front frame, illustrated by callout 9 in the figure. The front handles *do not* need to be removed.
13. Gently pull the front panel away from the test set frame, carefully disengaging the hardline cable from the loose connection at the A7 directional coupler. The front panel cannot be removed completely because the on/off switch cable is still attached. Tilt the front panel down so that the A6 and A8 directional couplers are free to be removed. Remove these two couplers and temporarily slide the front panel back into the test set frame.
14. Use a small pozi-driv screwdriver to remove one .312-inch 6-32 pan head machine screw holding the bottom of the coupler mounting bracket to the coupler mounting block attached to the bottom of directional coupler A6. Separate the two directional couplers from each other.
15. If directional coupler A8 is the coupler to be replaced, use a large pozi-driv screwdriver to remove the four .312 inch 8-32 pan head machine screws holding the coupler mounting bracket onto directional coupler A8. This completes the disassembly procedure for A8.

Note: If directional coupler A6 is the coupler to be replaced, continue with this procedure.
16. If directional coupler A6 is the coupler to be replaced, use a 5/16 inch open end wrench to remove the hardline cable attached to A6. Use a large pozi-driv screwdriver to remove four 8-32 pan head screws and lockwashers holding the coupler mounting block to A6. This completes the disassembly procedure for A6.

**(2) A7 DIRECTIONAL COUPLER (IN A2 MIXER CIRCUIT)
A9 DIRECTIONAL COUPLER (IN A1 MIXER CIRCUIT)**

1. Detach the three semi-rigid cables attached to the coupler.
2. Remove the two screws holding the coupler bracket and coupler to the test set, and lift the coupler out of the test set.
3. Remove the two screws holding the coupler to its bracket.
4. Replace the coupler and reverse this procedure to assemble.

- (3) **A10 B1 MIXER**
- A11 B2 MIXER**
- A12 A1 MIXER**
- A13 A2 MIXER**



ATTENTION
Static Sensitive

**Handle only at Static Safe
Work Stations**

The assemblies handled in this procedure are very sensitive to damage by static electricity. They may or may not continue to function if subjected to an electrostatic discharge. In any case, an electrostatic discharge will impair the reliability of these assemblies. Always perform the following steps in order.

- A. Ground the work area and yourself to prevent electrostatic damage to the microcircuits.
- B. Turn the test set OFF.
- C. Disconnect the power cord from the mains.
- D. Remove the top cover.
- E. Reverse the following procedures after replacement parts have been installed.

Note: All 3.5 mm and SMA connections inside the test set are torqued to 90 N-cm (8 in-lb). Be careful when handling semi-rigid coaxial cables. They are easy to bend and damage.

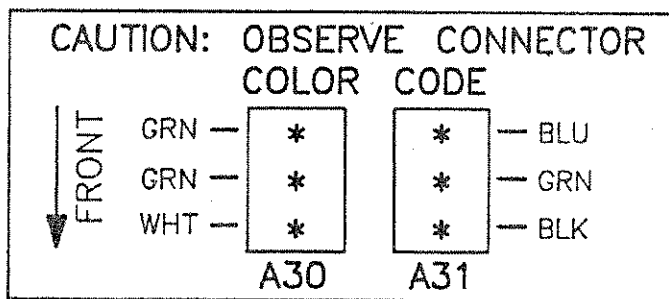
- 1. Remove the flexible cable attached to the top of the mixer.
- 2. Remove the semi-rigid cable attached to the mixer.
- 3. Remove the semi-rigid cable attached to the attenuator or PIN switch that is attached to the mixer.
- 4. Unsolder the two wires on top of the mixer.
- 5. If a PIN switch is connected to the mixer, remove the 3-wire connector on top of the PIN switch.
- 6. Remove the two screws holding the mixer and bracket to the test set and lift the mixer out of the test set.
- 7. Remove the fixed attenuator or switch and bias lines, as appropriate, from the mixer.

CAUTION

A PIN switch will be destroyed if its bias connector is incorrectly joined to its mating connector when power is supplied.

In certain test sets, the PIN switch bias connectors attached to the top of the PIN switch are not "keyed." That is, the bias connectors are not mechanically prevented from being joined incorrectly.

Observe the yellow caution label placed next to the PIN switch bias connectors in test sets having unkeyed mixer bias connectors. The following is a reproduction of the caution label:



8. Remove the four screws holding the mixer to its bracket and remove the attenuator or PIN switch.
9. Remove the mixer and replace.

(4) A14 ATTENUATOR/SPLITTER BOARD ASSEMBLY

1. Remove the six cables plugged into the board.
2. Remove the four screws securing the board to the right divider bracket.
3. Lift out the board and replace.

(5) A15 REGULATOR BOARD ASSEMBLY

1. Unplug the transformer socket from the regulator board.
2. Remove the three mounting screws from the top edge of the regulator board.
3. Remove the regulator board assembly. It may be necessary to partially back out one of the T1 power transformer mounting screws for clearance.

**(6) A16 PIN SWITCH (IN B2 MIXER CIRCUIT)
A17 PIN SWITCH (IN B1 MIXER CIRCUIT)**



**ATTENTION
Static Sensitive**

**Handle only at Static Safe
Work Stations**

The assemblies handled in this procedure are very sensitive to damage by static electricity. They may or may not continue to function if subjected to an electrostatic discharge. In any case, an electrostatic discharge will impair the reliability of these assemblies. Always perform the following steps in order.

- A. Ground the work area and yourself to prevent electrostatic damage to the microcircuits.
- B. Turn the test set OFF.
- C. Disconnect the power cord from the mains.
- D. Remove the top cover.
- E. Reverse the following procedures after replacement parts have been installed.

Note: All 3.5 mm and SMA connections inside the test set are torqued to 56 N-cm (5 in-lb). Be careful when handling semi-rigid coaxial cables. They are easy to bend and damage.

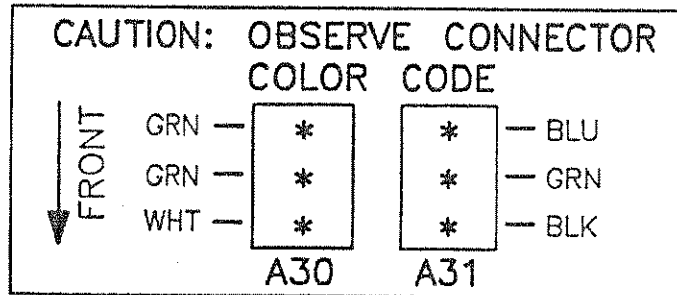
1. Remove the flexible cable attached to the top of the mixer.
2. Remove the semi-rigid cable attached to the mixer.
3. Remove the semi-rigid cable attached to the PIN switch.
4. Remove the 3-wire connector from the top of the PIN switch.
5. Unsolder the two wires on top of the mixer.
6. Remove the two screws holding the mixer and bracket to the test set and lift the mixer out of the test set.
7. Remove the fixed attenuator or switch and bias lines, as appropriate, from the mixer.

CAUTION

A PIN switch will be destroyed if its bias connector is incorrectly joined to its mating connector when power is supplied.

In certain test sets, the PIN switch bias connectors attached to the top of the PIN switch are not "keyed." That is, the bias connectors are not mechanically prevented from being joined incorrectly.

Observe the yellow caution label placed next to the PIN switch bias connectors in test sets having unkeyed mixer bias connectors. The following is a reproduction of the caution label:



8. Remove the two screws holding the PIN switch to the bracket.
9. Remove the switch and replace.

(7) A18 SWITCH/SPLITTER

1. Remove the three semi-rigid RF cables attached to the switch splitter.
2. Remove the three flexible SMB connectors.
3. Remove the four screws securing the bracket and switch splitter to the test set.
4. Remove the switch splitter (with bracket connected) from the test set.
5. Remove the loads and bracket from the old switch splitter and attach them to the new switch splitter to be installed.

(8) A21 4-WAY POWER DIVIDER

1. Remove the A14 attenuator/splitter board assembly using the procedure described in this section.
2. Remove the five semi-rigid cables.
3. Remove the four screws holding the divider to its bracket.
4. Remove the power divider.

**(9) A22 90 DB STEP ATTENUATOR (IN A2 MIXER CIRCUIT)
A23 90 DB STEP ATTENUATOR (IN A1 MIXER CIRCUIT)
A24 90 DB STEP ATTENUATOR (IN B1 MIXER CIRCUIT)
A25 90 DB STEP ATTENUATOR (IN B2 MIXER CIRCUIT)**

1. Unplug the attenuator cable from the A14 Attenuator/splitter board.
2. Remove the two screws holding the attenuator bracket and attenuator to the test set, and lift the attenuator out of the test set.
3. Remove the two screws holding the attenuator to its bracket.
4. Remove the attenuator.

**(10) AT3 3.5 MM 10 DB ATTENUATOR (IN A2 MIXER CIRCUIT)
AT4 3.5 MM 10 DB ATTENUATOR (IN A1 MIXER CIRCUIT)**



**ATTENTION
Static Sensitive**

**Handle only at Static Safe
Work Stations**

The assemblies handled in these procedures are very sensitive to damage by static electricity. They may or may not continue to function if subjected to an electrostatic discharge. In any case, an electrostatic discharge will impair the reliability of these assemblies. Always perform the following steps in order.

- Ground the work area and yourself to prevent electrostatic damage to the microcircuits.
- Turn the test set OFF.
- Disconnect the power cord from the mains.
- Remove the top cover.
- Reverse the following procedures after replacement parts have been installed.

Note: All 3.5 mm and SMA connections inside the test set are torqued to 56 N-cm (5 in-lb). Be careful when handling semi-rigid coaxial cables. They are easy to bend and damage.

Note: Refer to Figure 6-1 in the Replaceable Parts section of this manual for assembly locations and their reference designators.

To replace attenuator AT4, use a 5/16 inch open end wrench to remove the hardline cable connecting AT4 and variable attenuator A23. Remove and replace attenuator AT4.

To replace attenuator AT3, perform the following procedure.

1. Use a 5/16 inch wrench to remove both hardline cables connected to variable attenuator A24.
2. Remove the hardline cable connected between attenuator AT3 and variable attenuator A22.
3. Use a small pozi-driv screwdriver to remove the two pan head screws attaching variable attenuator A24 to the main deck. Carefully move variable attenuator A24 approximately 5 cm (2 inches) toward the rear of the test set until the end of A24 is beyond the front edge of mixer A13.
4. Use a 5/16 inch wrench to remove attenuator AT3.

**(11) AT5 3.5 MM 6 DB ATTENUATOR (IN B2 MIXER CIRCUIT)
AT6 3.5 MM 6 DB ATTENUATOR (IN B1 MIXER CIRCUIT)**

1. Remove the semi-rigid cable attached to the attenuator.
2. Remove the attenuator from the coupler.
3. Replace the attenuator and reverse this procedure to assemble.

(12) B1 FAN

WARNING

Turn the test set OFF and disconnect the power cord from the mains. Electrocutation can result if power is not removed from the test set prior to this procedure.

Note: To replace the fan, transformer T1 must be removed so that the ends of the fan wires may be unsoldered from line module FL1. Refer to Figure 6-6 in the Replaceable Parts section of this manual for a detailed view of the B1 fan and T1 transformer hardware stackup.

1. Turn the test set on its right-hand side.
2. Use a 5/16 inch open end wrench to remove the hardline cables connected between couplers A7, A9 and bulkhead connectors J2 and J5.
3. Unplug the transformer connector mating with connector J2 on the A15 regulator board assembly.
4. Use a large pozi-driv screwdriver to remove the four screws and washers holding transformer T1 onto the rear panel.
5. Use a large pozi-driv screwdriver to remove the one screw holding the transformer angle bracket to the main deck. Carefully remove the transformer from the test set and put it on the bench close to the test set. The transformer wires soldered to the FL1 line module are short, so do not pull on the transformer too much.
6. Strip the heat shrink tubing off of the two fan wires and unsolder them from line module FL1. Use wire cutters to cut any cable ties holding the fan wires to nearby cables.
7. Use a small pozi-driv screwdriver to remove the screw and lockwasher securing the green/yellow fan ground wire to the top of the rear panel frame.
8. Use a small pozi-driv screwdriver to remove the four screws holding fan B1 to the rear panel and remove the fan.

(13) C1,2,3,4 FILTER CAPACITORS

1. Set the test set rightside up and pull the metal and plastic cover off the capacitors.
2. Turn the test set upside down and remove the bottom cover.
3. Discharge each capacitor by attaching one end of an insulated clip lead to the chassis of the instrument and the other end of the clip lead to the 100 ohm 20 watt resistor. Use this resistor to discharge each capacitor terminal (large pozidriv screw on the bottom side of the test set). Each capacitor has two (2) terminals. Discharge every capacitor terminal. Each capacitor takes approximately six seconds to discharge.
4. To remove a capacitor, remove the corresponding pair of screws and pull the capacitor out of the test set.

(14) J2, J3, J4, J5, J7, AND J8 3.5 MM BULKHEAD CONNECTORS

Refer to Figure 5-16 and the following text to replace or repair these 3.5 mm connectors.

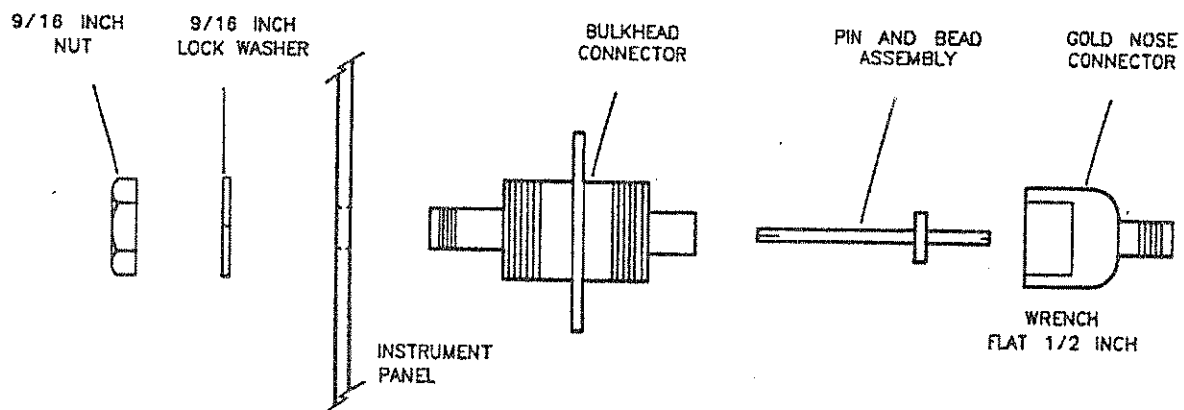


Figure 5-16. Exploded View of 3.5 mm Bulkhead Connector

Disassembly

1. Remove any attached cables from the connector to be replaced.
2. Use a 1/2 inch wrench to loosen the gold nose connector. Remove the pin and bead assembly from the connector. If only the pin and bead assembly needs to be replaced, continue with step 6.
3. From the inside of the test set, use a 9/16 inch nut driver to loosen the 9/16 inch nut and remove the rest of the connector.
4. Use the part numbers given in the replaceable parts section of this manual to order a replacement of the defective part.

Assembly

5. Assemble the bulkhead connector, lock washer and nut. Use the 9/16 inch nut driver to tighten the nut to approximately 500 N-cm (45 in-lb).
6. Clean the pin and bead assembly using the procedures described in the Microwave Connector Care Manual (HP part number 08510-90064) provided with your HP 8510B manual set.
7. Clean the mating surfaces with liquid freon or alcohol and lint-free swabs.
8. Check the pin depth of the gold nose connector. The pin depth specification is 0.0000 to +0.0030 inch.

Note: If the pin depth is not within specification, do not shim. Instead, install another pin and bead assembly.

9. Reconnect the cables disconnected in step 1 using a 5/16 inch torque wrench rated at 56 N-cm (5 in-lb).

(15) J13 PORT 1 3.5 MM CONNECTOR J14 PORT 2 3.5 MM CONNECTOR

Refer to Figure 5-17 and the following text to replace or repair these 3.5 mm test port connectors.

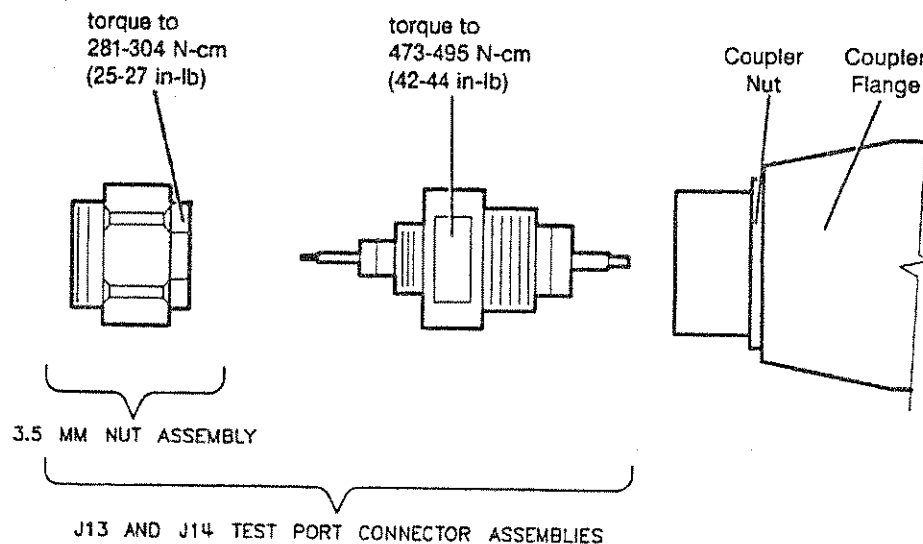


Figure 5-17. Exploded View of the 3.5 mm Port Connector

Center Pin Repair Procedure

Note: Damaged test port center pins must be repaired by replacing the complete test port connector assembly.

1. Remove the test port connector assembly, using a 5/8 inch flat wrench.
2. Replace with a new test port connector assembly using a 5/8 inch torque wrench to the limits called out in Figure 5-17.
3. Check the test port pin depth with a 3.5 mm gage. The center pin recession specification is +0.005 to +0.056 mm (+0.0002 to +0.002 in).

3.5 mm Nut Repair Procedure

1. Remove the damaged nut with a 9/16 inch flat wrench.
2. Replace with a new nut.
3. Torque with a 9/16 inch torque wrench to the limits set in Figure 5-17.

(16) T1 POWER TRANSFORMER

WARNING

Turn the test set OFF and disconnect the power cord from the mains. Electrocutation can result if power is not removed from the test set prior to this procedure.

1. Turn the test set on its right-hand side.
2. Use a 5/16 inch open end wrench to remove the hardline cable connected between coupler A7 and bulkhead connector J2.
3. Unplug the transformer connector mating with connector J2 on the A15 regulator board assembly.
4. Use a large pozi-driv screwdriver to remove the four screws and washers holding transformer T1 onto the rear panel.
5. Use a large pozi-driv screwdriver to remove the one screw holding the transformer angle bracket to the main deck. Carefully remove the transformer from the test set and put it on the bench close to the test set. The transformer wires soldered to line module FL1 are short, so do not pull on the transformer too much.
6. Strip the heat shrink tubing off of the transformer wires soldered to line module FL1 and unsolder them. Unsolder the transformer ground wire connected to the chassis side rail.
7. Remove transformer T1. When replacing the transformer, refer to Figure 5-18, which illustrates the locations of the various wires connected to line module FL1.

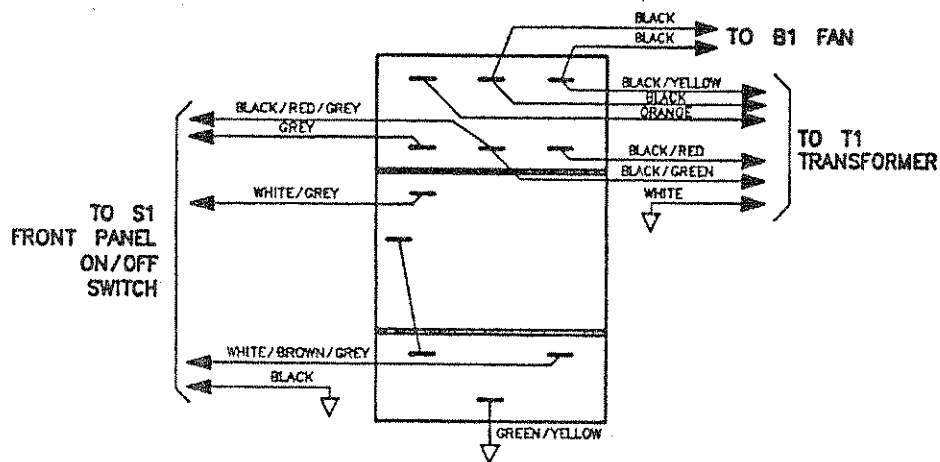


Figure 5-18. Wire Connections to Line Module FL1