HP 85106B MILLIMETER-WAVE NETWORK ANALYZER SYSTEM

Includes Benchtop Configurations

SERIAL NUMBERS

This manual applies directly to HP 85106B Millimeter-Wave System having serial number prefix 3001A and higher.

FIRMWARE REVISION

This manual applies directly to all HP 8510Bs, or HP 8510As that have been upgraded to HP 8510Bs, with operating firmware revision 5.11 or higher.

Part of Manual Set 85106-90026
Microfiche Part Number 85106-90029

Printed: NOVEMBER 1990
Edition 3

HEWLETT PACKARD

The product related to this manual is no longer in production at Hewlett Packard Co. As a service to our customers, we are supplying you with a photocopy of the original document.

MANUFACTURER'S DECLARATION

Each instrument contained in the HP 85106B System and its options has been individually licensed according to the appropriate General License, as follows:

HP 8350B/83540A option 004 Sweep Oscillator	General License FTZ 1046/1984
HP 8510B Network Analyzer	General License FTZ 526/1979
HP 8516A S-Parameter Test Set	General License FTZ 526/1979
HP 83621A Synthesized Sweeper	General License FTZ 1046/1984
HP 85105A Millimeter-wave Controller	General License FTZ 1046/1984
HP 85104A Test Set Module	General License FTZ 1046/1984
HP 9122C Disk Drive	General License FTZ 1046/1984

The German Bundespost has been notified that this equipment was put into circulation and has been granted the right to check the product type for compliance with these requirements.

Note: If the test and measurement equipment is operated with unshielded cables and/or used for measurements on open set-ups, the user must insure that under these operating conditions, the radio frequency interference limits are met at the border of his premises.

Die im System HP 85106B verwendeten Geraete und deren Optionen sind, gemaess nachfolgender Aufstellung, entsprechend der jeweils geltenden Allgemeinen Genehmigung zugelassen:

HP 8350B/83540A option 004Sweep Oscillator	Allgemeine Genehmigung FTZ 1046/1984
HP 8510B Network Analyzer	Allgemeine Genehmigung FTZ 526/1979
HP 8516A S-Parameter Test Set	Allgemeine Genehmigung FTZ 526/1979
HP 83621A Synthesized Sweeper	Allgemeine Genehmigung FTZ 1046/1984
HP 85105A Millimeter-wave Controller	Allgemeine Genehmigung FTZ 1046/1984
HP 85104A Test Set Module	Allgemeine Genehmigung FTZ 1046/1984
HP 9122C Disk Drive	Allgemeine Genehmigung FTZ 1046/1984

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Geraetes/Systems angezeigt und die Berechtigung zur Uberpruefung der Serie auf Einhaltung der Bestimmungen eingeraeumt.

Zusatzinformation fuer Mess-und Testgeraete:

Werden Mess-und Testgeraete mit ungeschirmten Kabeln und/oder in offenen Messaufbauten verwendet, so ist vom Betreiber sicherzustellen, dass die Funk-Entstoerbestimmungen unter Betriebsbedingungen an seiner Grundstuecksgrenze eingehalten werden.

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (refer to Table of Contents).

Indicates hazardous voltages.

Indicates earth (ground) terminal.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an autotransformer make sure the common terminal is connected to the neutral (grounded side of the mains supply).

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from their power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

HP 85106B Millimeter-wave Network Analyzer System

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Section 1. Getting Started

INTRODUCTION

This manual explains the assembly, operation, and repair of the HP 85106B Millimeter-wave S-parameter Network Analyzer System.

The HP 85106B Millimeter-wave (mm-wave) system includes one each of the following components, all of which are factory installed in a system cabinet:

- HP 8510B Network Analyzer
- HP 85105A Millimeter-wave Controller
- HP 83621A Synthesized Source
- HP 8350B/83540A Sweep Oscillator With Option 004 (rear panel output)
- HP 9122C Dual Disk Drive
- System Cabinet - all instruments noted above are mounted in this cabinet

To complete your millimeter-wave system, two test set modules must be ordered for the frequency band of interest. Refer to the paragraph titled "Frequency Bands and Accessories Available" in this section.

An HP 85106B system configuration disk and system configuration tape are included with your system. This disk (or tape) allows you to load the mm-wave instrument and hardware states into your system. Refer to the "Operation" section of this manual for more information about loading your system's configuration.

HOW TO USE THIS MANUAL

Use this manual for setup, calibration, performance verification, and troubleshooting of the HP 85106B system. Consult the manuals of individual instruments and accessories in the system when necessary for reference.

This manual is divided into the following sections and is organized as follows:

1. **Getting Started** contains information on the installation of your system, up to power-on.
2. **Operation** contains a system description, instructions for powering-on the system, performing a system calibration, and several example measurements.
3. **Performance Verification** contains information regarding performance verification of the system using a waveguide verification kit and the HP 8510 Specifications and Performance Verification software.
4. **Service and Troubleshooting** contains information about troubleshooting and repairing a system that is not working properly.

5. **HP 85104A** contains information that is specific to the HP 85104A test set module such as replaceable parts, theory of operation, and troubleshooting information.

6. **HP 85105A** contains information that is specific to the HP 85105A mm-wave controller such as replaceable parts, theory of operation, and troubleshooting information.

7. **Appendix** contains information on HP-IB addresses, hardware states and instrument states for microwave and millimeter-wave HP 8510 systems.

DESCRIPTION OF THE MILLIMETER-WAVE SYSTEM

The HP 85106B is the base for every mm-wave system; the components of the HP 85106B are necessary for all waveguide bands from 40 to 110 GHz (refer to Table 1-1). Two HP 85104A Series Test Set Modules must be added to make the system operational; these components are band-dependent. For fully error-corrected measurements, a calibration kit in the same frequency band as the test set modules being used must also be added. Refer to the paragraph titled "Frequency Bands and Accessories Available" for the specific model numbers required for your system.

Table 1-1. HP 85106B Frequency Bands

45 MHz to 40 GHz **Coaxial**	33 to 50 GHz **Q-band** WR-22	40 to 60 GHz **U-band** WR-19	50 to 75 GHz **V-band** WR-15	75 to 110 GHz **W-band** WR-10

SYSTEMS COVERED BY THIS MANUAL

A serial number label is attached to each HP 85106B system cabinet. This label is located on the front of the cabinet in the lower left corner, and has the serial number of your system printed on it.

A typical serial number label is shown in Figure 1-1. The serial number has two parts. The first four digits followed by a letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument (or system). The contents of this manual apply directly to systems having the same serial number prefix or higher as listed on the Title Page of this manual under the heading SERIAL NUMBERS.

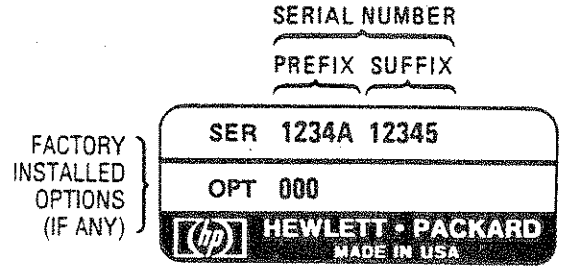


Figure 1-1. Typical Serial Number Label

HP 85106B MILLIMETER-WAVE SYSTEM OPTIONS

The following options are available with the HP 85106B system:

Option 001. This option adds the HP 8516A 45 MHz to 40 GHz coaxial, S-parameter test set, the HP 85133D test port return cable set, the HP 85056A 2.4 mm calibration kit, and cabling for switching between mm-wave operation and microwave operation.

Option 002. This option deletes the HP 8350B/83540A sweep oscillator, and adds an HP 83621A synthesized source.

Option 010. This option adds time domain capability to the HP 8510B network analyzer.

Option 230. This option allows for operation of the system with a 220/240V line voltage.

WARRANTY

The HP 85106B Millimeter-wave Network Analyzer system carries a one year on-site warranty. If instruments are ordered separately, such as the HP 85104A and 85105A, they are included in this warranty as long as they are used in an HP 8510 system.

FREQUENCY BANDS AND ACCESSORIES AVAILABLE

The following items are required (or strongly recommended) to complete your HP 85106B system. Order the model numbers that correspond to the frequency range you are operating in.

33 to 50GHz (WR-22)
- HP Q85104A WR-22 Test Set Module (2 required for S-parameter)
- HP Q11644A WR-22 Calibration Kit (required for error corrected measurements)
- HP Q11645A WR-22 Verification Kit (strongly recommended)

40 to 60GHz (WR-19)
- HP U85104A WR-19 Test Set Module (2 required for S-parameter)
- HP U11644A WR-19 Calibration Kit (required for error corrected measurements)
- HP U11645A WR-19 Verification Kit (strongly recommended)

50 to 75 GHz (WR-15)
- HP V85104A WR-15 Test Set Module (2 required for S-parameter)
- HP V11644A WR-15 Calibration Kit (required for error corrected measurements)
- HP V11645A WR-15 Verification Kit (strongly recommended)

75 to 110 GHz (WR-10)
- HP W85104A WR-10 Test Set Module (2 required for S-parameter)
- HP W11644A WR-10 Calibration Kit (required for error corrected measurements)
- HP W11645A WR-10 Verification Kit (strongly recommended)

UPGRADE PATHS

Upgrade packages from an HP 8510A, HP 8510B, HP 85106A, and other HP systems are available. See Appendix B or contact the nearest Hewlett-Packard office for more information.

SYSTEM INSTALLATION

The major portion of the HP 85106B system is already rack-mounted, assembled, and has most of the cabling attached when it arrives from the factory.

During the installation, the HP Customer Engineer will do the following:

- Uncrate the system cabinet.
- Complete the system checklist.
- Assemble the work surface and connect it to the system cabinet.
- Install the HP 85104A test set modules (shipped separately from the system cabinet).
- Verify that the HP-IB addresses are set properly and power-on the system.
- Run a performance verification of the system, which includes a measurement calibration.

System Arrival

The HP 85106 system will arrive with all rack components and instruments assembled and cabled in the system cabinet. The work surface is included in the system cabinet packaging. The HP 85104A modules and any optional instruments or peripherals will be shipped separately from the system cabinet. The system cabinet will be packaged in one of two different types of crates. For all overseas shipments or shipments by aircraft, the system cabinet is shipped laying down on its back in a special crate. For surface shipments, the cabinet is secured upright on a pallet. Refer to "Unpacking the System Cabinet" for detailed information on unpacking instructions.

Keep the shipping containers in one area to help verify the receipt of all components ordered. Inspect all shipping containers. Keep the carton and packaging material until the entire shipment has been verified for completeness, and the system has been checked mechanically and electrically. Check all equipment received against the receiving checklist on the following page.

If the shipment is damaged or incomplete, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the packaging material shows signs of stress, notify the carrier as well as the HP Customer Engineer. Keep the shipping materials for the carrier's inspection. The Hewlett-Packard office will arrange for repair or replacement of damaged equipment without waiting for a claim settlement from the carrier.

Receiving Checklist

When the entire shipment has arrived, contact your nearest HP office to arrange for installation of your system, if installation is available in your area. The HP customer engineer will perform the installation, beginning with the following receiving checklist.

HP 85106B RECEIVING CHECKLIST

Refer to Figure 1-2 and your system while you complete this checklist.

HP 85106B Standard System

Instrument	Manual Part Number
☐ HP 8510B Network Analyzer	08510-90067
☐ HP 83621A Synthesized Source	83621-90002
☐ HP 8350B/83540A Sweep Oscillator (with Option 004)	08350-90092
☐ HP 85105A Millimeter-wave Controller	85106-90026
☐ HP 9122C Dual Disk Drive	none

HP 85106B Option 001 - Adds Microwave Test Set

☐ HP 85106B Standard System	85106-90026
☐ HP 8516A S-Parameter Test Set	08516-90001
☐ HP 85133D 2.4 mm Cable Set	85133-90001
☐ HP 85056A 2.4 mm Calibration Kit	85056-90012

HP 85106B Option 002 - Substitutes HP 83621A for HP 8350B/83540A

☐ HP 85106B Standard System (without HP 8340B/83540A Source)	85106-90026
☐ HP 83621A Synthesized Source	83621-90002

HP 85106B Option 010 - Adds Time Domain to the HP 8510

☐ HP 85106B Standard System (HP 8510 has time domain)	85106-90026

Miscellaneous Equipment

- ☐ Controller
- ☐ Plotter
- ☐ Millimeter Calibration Kits
- ☐ Millimeter Verification Kits

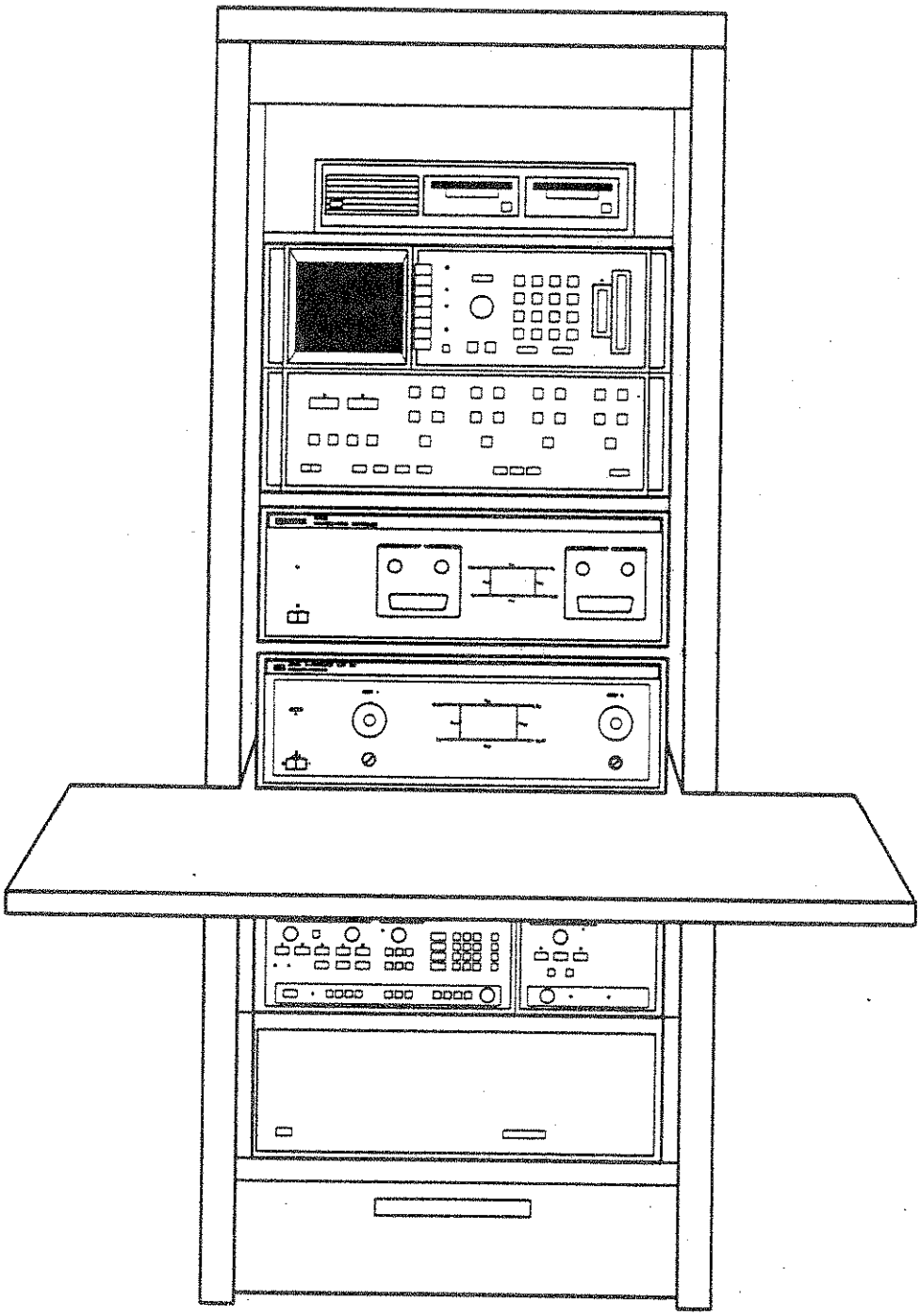


Figure 1-2. HP 85106B Millimeter-wave S-parameter Network Analyzer System

SITE PREPARATION

This section contains the environmental and electrical requirements necessary for your HP 85106B system. Make sure your site meets these requirements before you install your system.

Environmental Requirements

The environmental requirements of the HP 85106B System are listed in Table 1-2. Notice that these characteristics are the same as those for the HP 8510B Network Analyzer.

Note the accuracy-enhanced measurement requirements which follow.

Table 1-2. HP 85106B Environmental Requirements

Temperature	0° to 55°C (+32° to 135°F)
Relative Humidity	5% to 95% at +40°C or less (non-condensing)
Altitude	Up to 4600 metres (approximately 15,000 feet)

In addition to the above requirements, keep the environment as dust-free as possible, and clean the air filters and the rack regularly.

Accuracy-Enhanced Measurement Requirements

Accuracy-enhanced (error corrected) measurements require the ambient temperature of the HP 85106B system to be maintained within ±1°C of the ambient temperature at calibration. The calibration temperature must be in the operating temperature range of the calibration kit (typically 20° to 26°C). See the appropriate calibration kit manual for the actual operating temperature.

Power Requirements

Install the required AC power at all necessary locations. Place air conditioning equiment or other motor-operated equipment on a different AC line than that used for the system.

Three-wire power cables must be used with all instruments. These cables provide the required ground when connected to an appropriate outlet.

Table 1-3 lists the maximum VA power ratings of the HP instruments used in the HP 85106B system.

System Heating and Cooling

Install air conditioning and heating if required. Air conditioning requirements depend on the amount of heat produced by the instruments. Use the BTU/hour ratings from Table 1-3 to determine the total rating of your system. Each VA rating is multiplied by 3.4 to determine the BTU/hour rating of each instrument.

To convert the total BTU/hour figure to "tons," divide the total BTU/hour value by 12,000. A "ton" is the amount of heat required to melt a ton (907 kg) of ice in one hour.

Table 1-3. Maximum VA Ratings and BTU/hour Ratings of HP Instruments

Instrument	Maximum VA Rating[1]	VA Subtotal	Maximum BTU/hour	BTU/hour Subtotal
Standard Equipment				
HP 85101 Display Processor	250		850	
HP 85102 IF Detector	210		714	
HP 85105 Test Set Controller	270		918	
HP 8360 Synthesized Source	400		1,360	
HP 8350 with Plug-in	375		1,275	
HP 8516 Coaxial Test Set (opt.001)	95		323	
HP 9122 Disk Drive	65		221	
Totals:				
Standard System	1,570 VA		5,338	
Option 001/002	1,690 VA		5,746	
Accessory Equipment				
HP 9000 Series 300	250		850	
HP 98751A 19 inch CRT	420		1,430	
HP 98752A 19 inch CRT	420		1,430	
HP 98753A 19 inch CRT	420		1,430	
HP 98754A 19 inch CRT	420		1,430	
HP 98785A 16 inch CRT	200		680	
HP 98789A 16 inch CRT	200		680	
Typical Hard Disk	65		222	
HP LaserJet II	170 to 800		580 to 2,720	
HP PaintJet	20		68	
HP 7550A Plotter	100		340	
Your System's Total				

1. Values are based on 120 Vac supplied to each instrument at 60 Hz.

System Voltages Available

All instruments in the HP 85106B system must be set to the same voltage as the system rack; either 120 Vac or 220 Vac.

All system instruments are set to 120 Vac at the factory, except for Option 230, which are set to 220 Vac.

CAUTION

The cabinet fans may be permanently damaged if a 120V system is plugged into a 230V ac power outlet. The cabinet fans are wired for either 120V or 230V, but not both. Therefore, a system wired for 120V operation cannot be switched to 230V operation simply by changing individual instrument voltage selection switches.

Consult the individual instrument manuals to change voltages from 120V to 100V (120V systems only), or from 220V to 240V (Option 230, or 230V systems only).

Weights and Dimensions

Listed below are the weights of each version of the HP 85106B system cabinets (fully loaded).

Standard	267 Kg (576 lbs)
Option 001	289 Kg (624 lbs)
Option 002	280 Kg (604 lbs)
Option 001/002	302 Kg (652 lbs)

Listed below are the outside dimensions of the system cabinet (including work surface).

Height:	160 cm (63 inches)
Width:	60 cm (23.6 inches)
Depth:	80 cm (31.4 inches)

UNPACKING THE SYSTEM CABINET

There are two types of shipping crates used to ship the system cabinet:

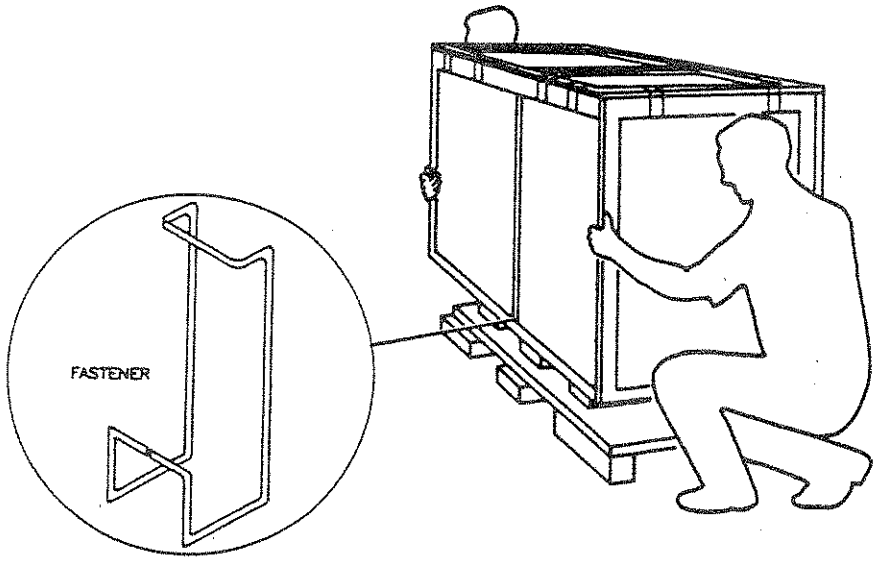
The first style is shipped with the system cabinet lying down. It is used when the shipment is by air carrier; height limitations require the system cabinet to be shipped this way. The crate may be re-used to ship the HP 85106B cabinet one more time after initial system receipt. You may want to keep it for this future use.

The second style cabinet packaging is designed for surface shipments and is shipped with the system cabinet standing upright on a pallet.

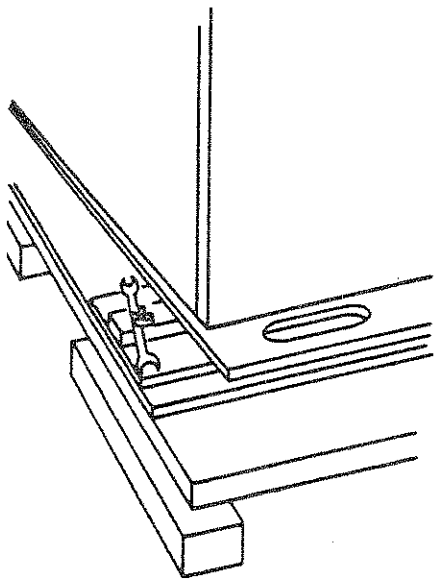
Follow the next procedure to safely unpack the system cabinet. The air carrier style cabinet packaging is illustrated in Figure 1-3, and the surface shipment style packaging is shown in Figure 1-4.

These tools are recommended:

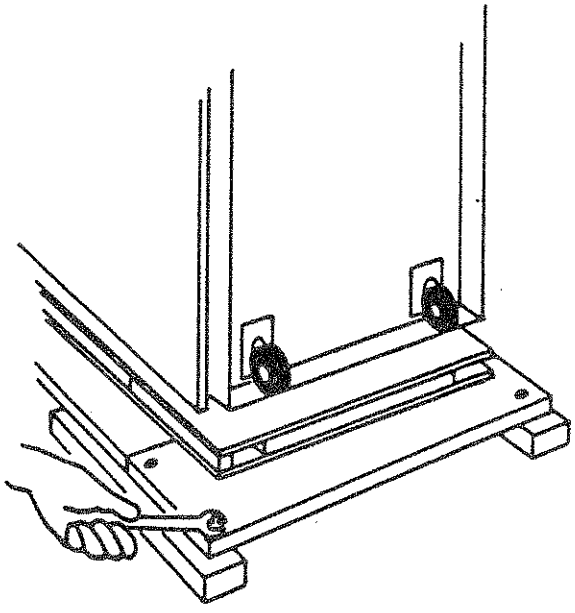
- hammer
- large flat-blade screwdriver
- 12-inch adjustable open-end wrench



Remove 12 fasteners from the bottom edges using a hammer and screwdriver. Two people are required to remove the cover. Lift slowly and use safe lifting techniques. Remove the top cap, polyethylene cover, and work surface box and set them aside.

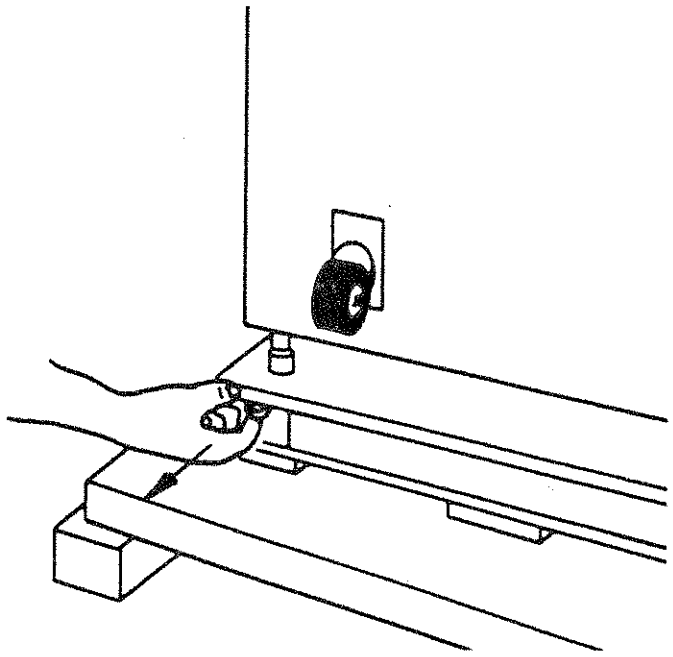


Remove the wrench and wing nut at the top right-hand corner of the crate. Remove the wing nut at the top left-hand corner also.

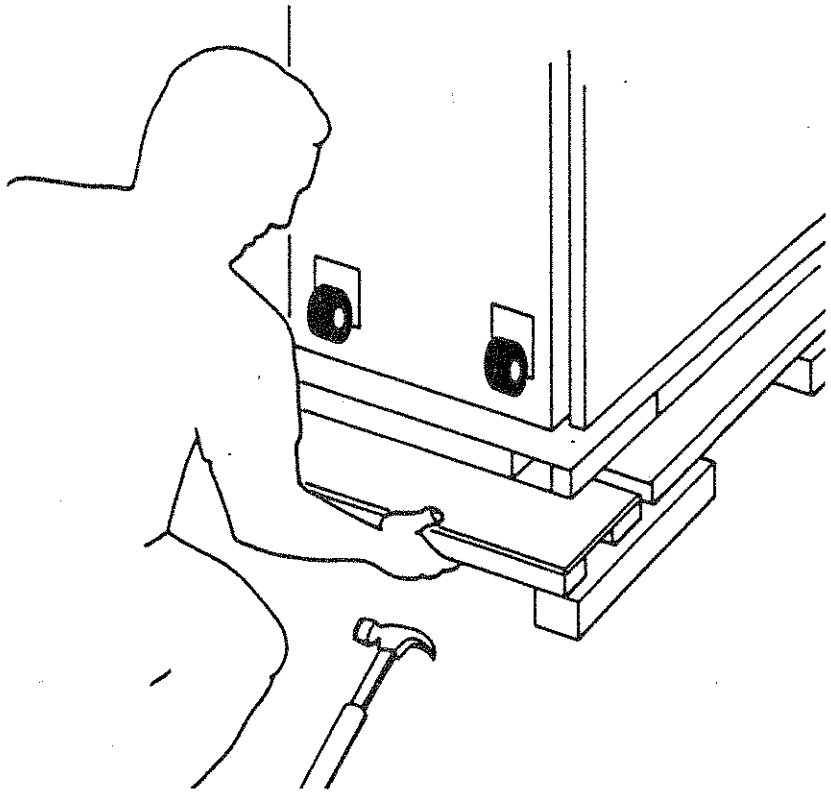


Use the wrench to remove the four bolts at the bottom end of the crate. Set them aside.

Figure 1-3. Unpacking the HP 85106B System Cabinet in Air Carrier Style Packaging (1 of 4)

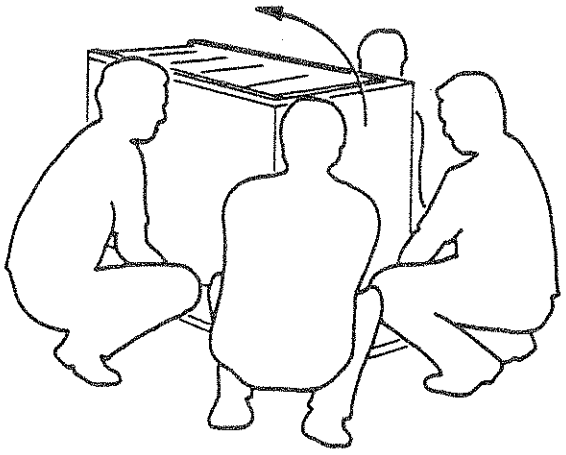


Remove the two metal pins and flat washers at the bottom end of the crate.

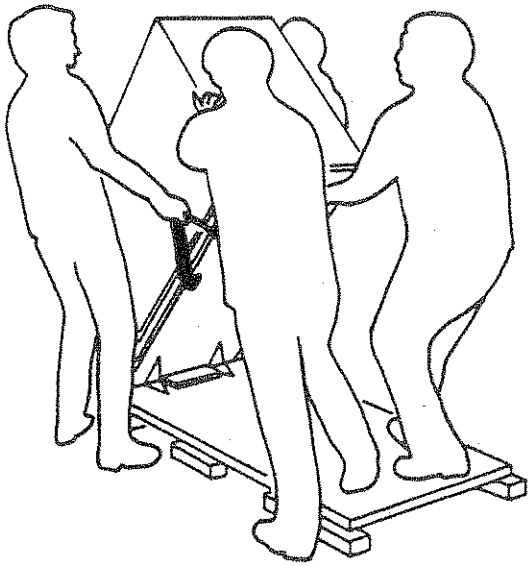


Remove the wooden pallet extender at the crate bottom using a hammer, if necessary. Set the extender aside.

Figure 1-3. Unpacking the HP 85106B System Cabinet in Air Carrier Style Packaging (2 of 4)



Move in close to the cabinet. Keep back straight. Crouch down and lift slowly with your legs.

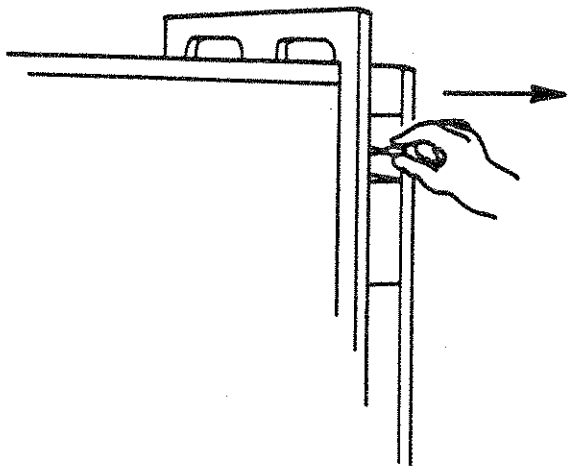


Slowly rock cabinet forward using your legs, not your back.

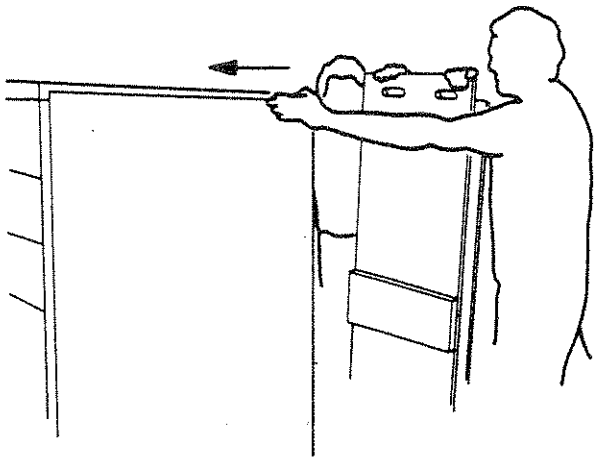
Do not allow anyone in front of the cabinet.

Be careful to avoid twisting your body.

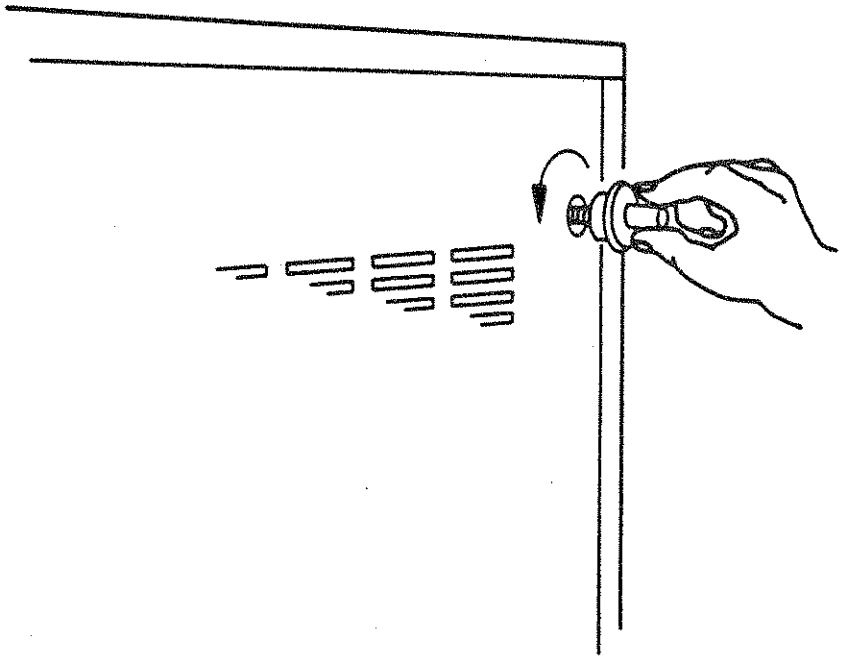
Figure 1-3. Unpacking the HP 85106B System Cabinet in Air Carrier Style Packaging (3 of 4)



Remove the two pins and flat washers on each side of the top of the crate.

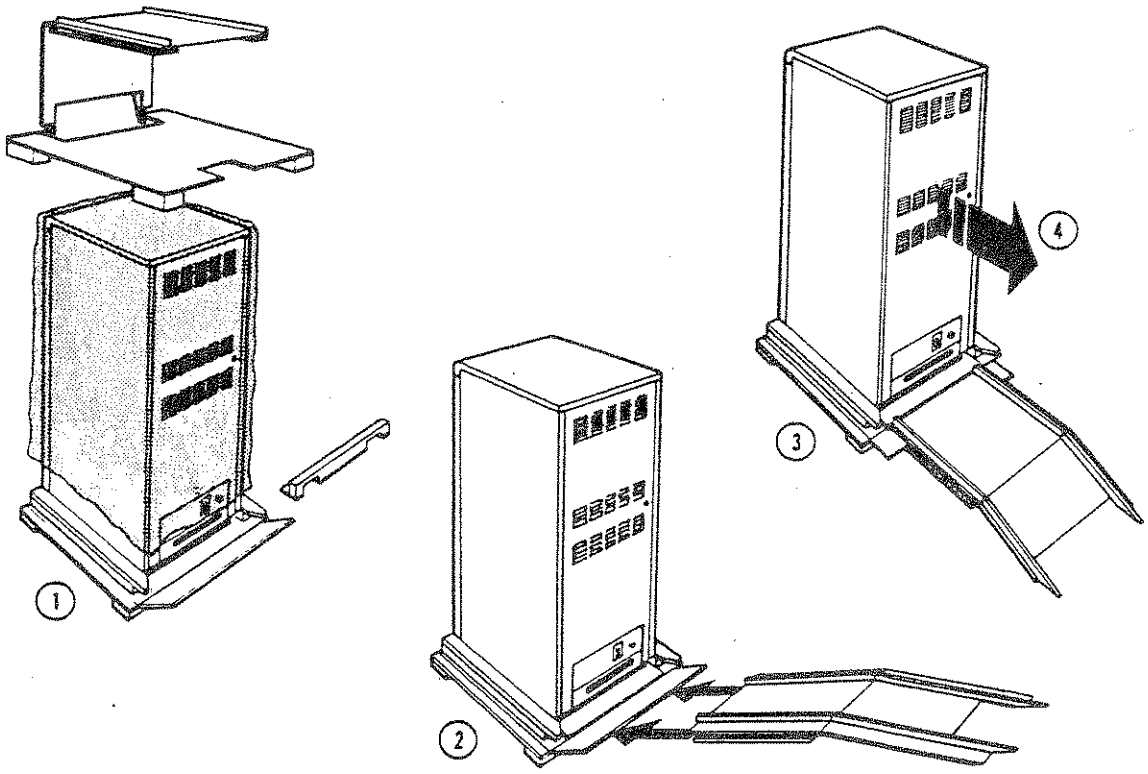


Carefully push the cabinet away from the wooden pivot plate.



Remove the four shipping bolts from the back of the cabinet. Use the 12-inch adjustable open end wrench to loosen these bolts, if needed.

Figure 1-3. Unpacking the HP 85106B System Cabinet in Air Carrier Style Packaging (4 of 4)



1. Cut the wrapping bands on the crate. Snap off the retaining clips on the sides of the crate. Remove the cardboard cover.
2. Take out the ramp. The cardboard spacer below it can be discarded, as can the plastic foam around the cabinet.
3. Remove the wooden spacer at the lower end in back of the cabinet. Slide the ramp over the short rear panel at the bottom.

WARNING

At least two people are recommended to control the system cabinet in the next step.

The loaded cabinet weighs approximately 600 pounds. DO NOT attempt to lift the cabinet.

Do not allow anyone in front of the cabinet when it is being rolled down the ramp.

4. Have at least two people roll the cabinet down the ramp carefully. Hold back on the front edges of the cabinet, with persons standing on either side of it to avoid getting in the way of the heavy, rolling cabinet.

Figure 1-4. Unpacking the HP 85106B System Cabinet in Surface Shipment Style Packaging

Installing the Work Surface

The work surface is included in the system cabinet packaging. The following tools are needed to install the work surface:

- a small flat-blade screwdriver
- a medium-sized Pozidriv screwdriver
- a 1/2 inch open-end or socket wrench

Procedure

Refer to Figure 1-5 for this procedure.

1. Fully extend the four lock feet at the bottom of the rack cabinet. This will prevent the cabinet from rolling as you install the adjustable work surface.

2. Unpack the adjustable work surface and the work surface support rails. Attach the right and left filler panels to the outside of the support rails as follows:

   Lay the rails down so the ends that have a row of holes in them are toward the front; the ends with the keyhole-shaped cutout are toward the rear, and the rails are facing inward toward each other. This is the position they will have when installed in the rack.

   Position each filler panel (right and left) so the small end of the panel is toward the rear of the support rail. Attach each filler panel to the rail using the two 1/2-inch long 10-32 Pozidriv screws and two external-tooth lockwashers.

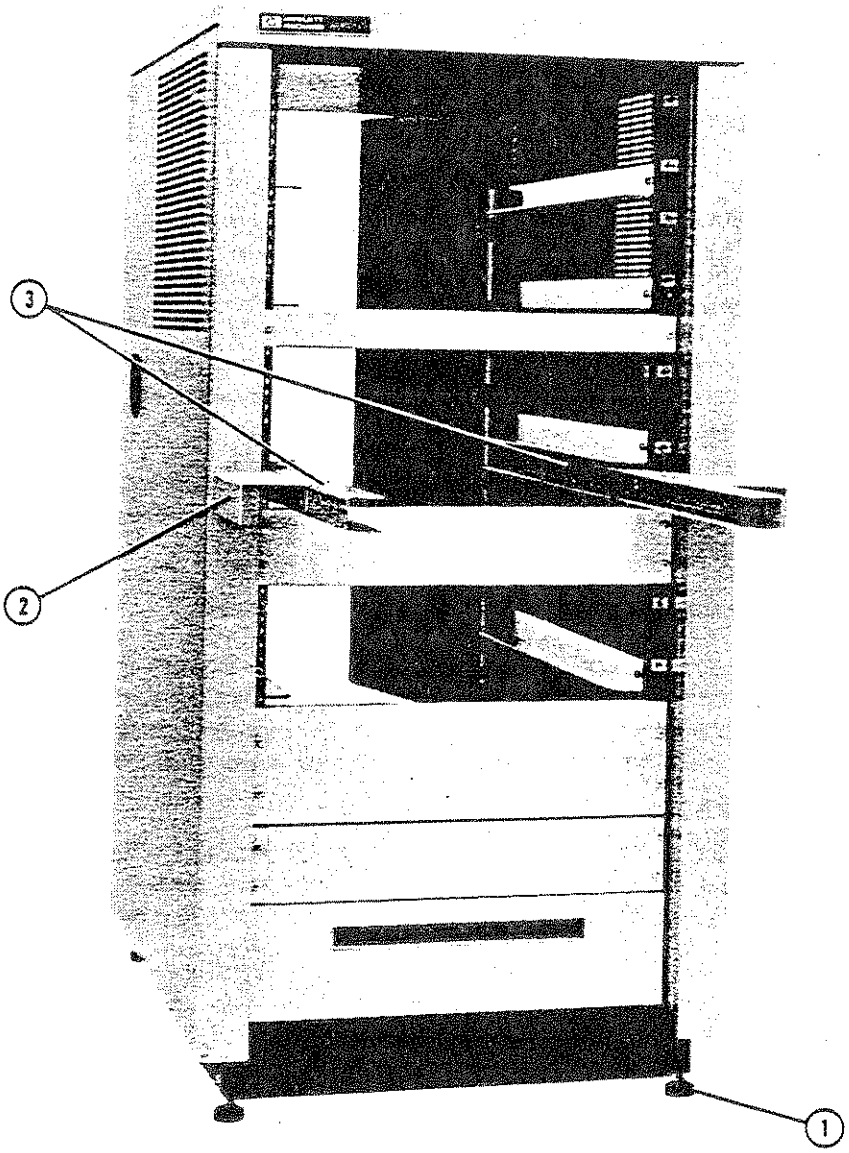
3. Attach the work surface support rails to the inside of the cabinet.

   Pass the large end of the keyhole-shaped cutout in each rail over the shoulder screw already mounted inside the cabinet. Slide the rail to the rear of the cabinet. Then use one 1/2 inch long 10-32 Pozidriv screw, one split lockwasher, and one flat washer to secure each rail. Before tightening the screws completely, make sure the rails are level. You may need to hold the rail in place as you tighten the screws.

4. Slide the work surface onto the support rails. As you do, hold out the two spring-loaded pins underneath the two sides of work surface in order to slide the work surface all the way onto the support rails. Slide the work surface all the way back onto the rails so that it comes to rest against the front of the rack.

   Attach the shoulder screws to the work surface support rails from underneath the work surface. These shoulder screws stop the forward travel of the work surface and prevent accidentally sliding the work surface all the way off of the support rails as it is being adjusted. Make sure that the work surface is steady and level. Adjust and re-tighten the support rail attaching screws if necessary.

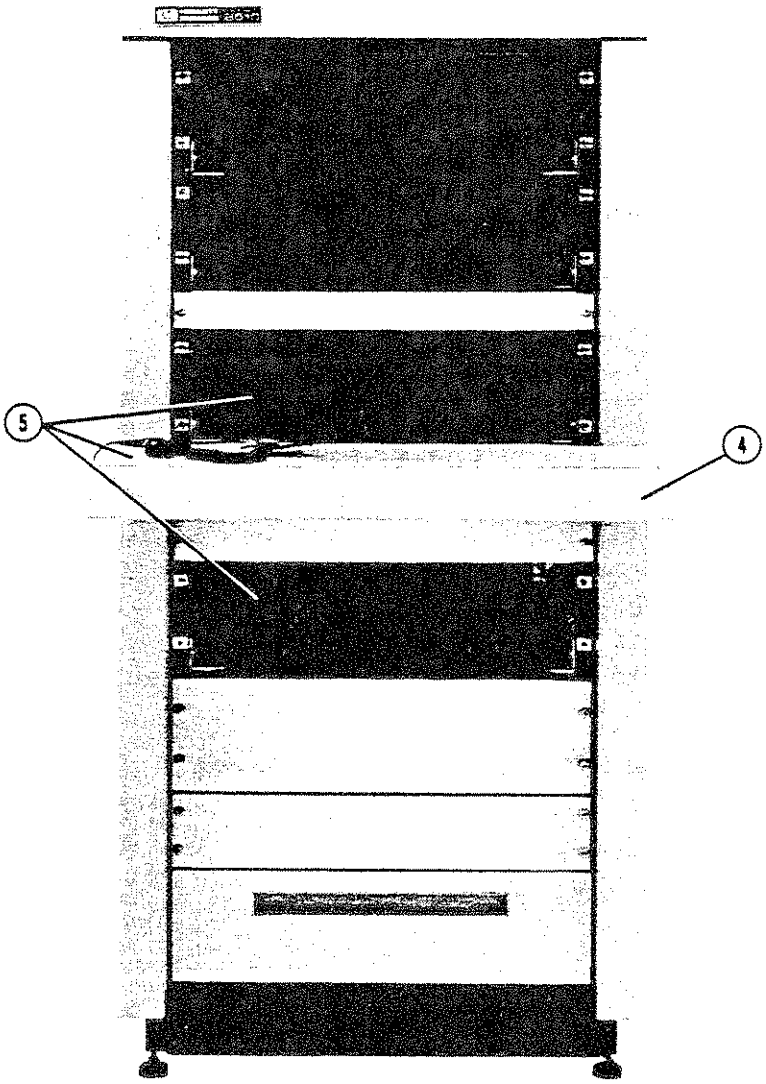
5. Install the anti-static mat and connect the ground wire that comes with the mat to a suitable ground connection such as the ground terminal on the front left of the HP 85105A.



PROCEDURE

1. Extend lock feet, bottom of cabinet.
2. Attach right and left filler panels to work surface support rails.
3. Attach work surface support rails to inside of cabinet.

Figure 1-5. Installing the Work Surface (1 of 2)



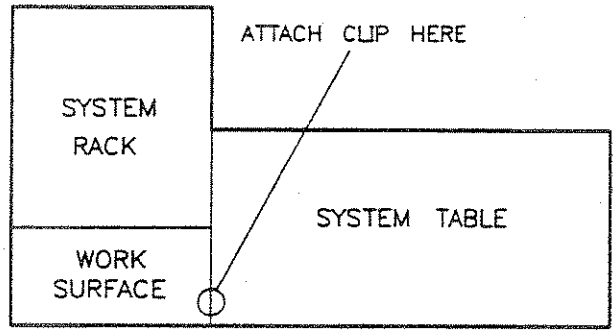
PROCEDURE

4. Slide work surface onto support rails.
5. Install anti-static mat.

Figure 1-5. Installing the Work Surface (2 of 2)

Installing The System Table

Assemble the system table and position it so that the left end is perpendicular to the right side of the system cabinet as shown in Figure 1-6. The system table will now be secured to the work surface by a clip that attaches to the underneath edges of the table and work surface. Engage the uncoated end of the table attaching clip over the indentation toward the **front** of the work surface.



PROCEDURE: Attach the clip to the **front** indentation under the work surface. The vinyl-coated clip handle should be toward the table. Lock the clip handle over the underside edge of the table.

Figure 1-6. Attaching the Work Surface to the System Table

The open part of the clip should now face outward, and the vinyl-coated handle should be on the side of the work surface where the table is attached. The clip should fit into the front indentation and should hang straight down underneath the work surface. Now, grasp the attaching clip handle and push it upward over the underside edge of the table. The clip should snap into place and will hold the table securely to the work surface.

Finally, engage the table caster locks so the table will not move.

INSTALLING THE TEST SET MODULES

ATTENTION
Static Sensitive

Handle only at Static Safe Work Stations

CAUTION

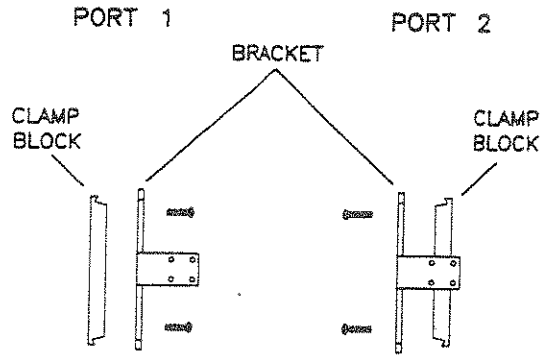
The test set modules are extremely sensitive to electrostatic discharge (ESD). Ground your work station before removing the test set modules from their packaging and installing them into your system. Refer to "Replaceable Parts" in the HP 85104A section of this manual for part numbers of a grounded wrist strap and a conductive bench mat.

INSTALLING THE CABLE SUPPORT ASSEMBLY

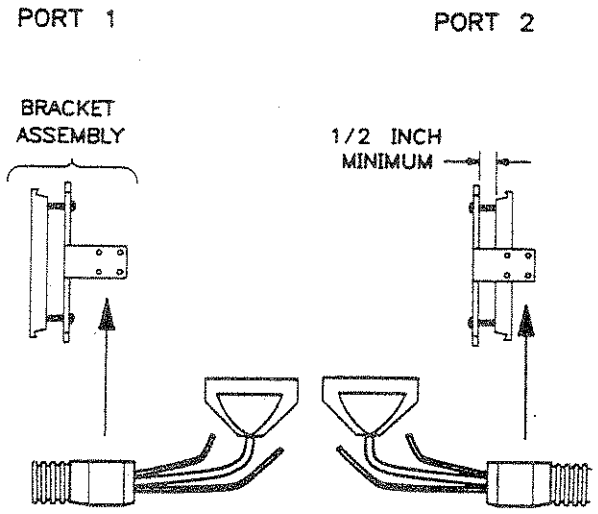
The cable support assembly provides support for the RF, LO, and interconnect cable that connect the test set module to the mm-wave controller.

Figure 1-7 shows the individual pieces of the cable support assembly. The barrel is attached to the test set module cable assembly, the bracket and clamp block must be attached to the barrel and then to the mm-wave controller handle. Follow the procedure below to install the cable support assembly.

NOTE: The cable support assembly orientations for port 1 and port 2 are different. Be sure to follow the instructions for the appropriate port

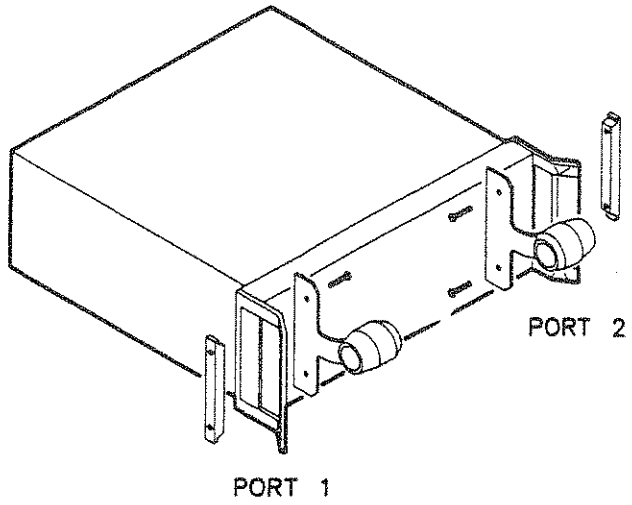


Attach the bracket to the clamp block. Note the different orientation of the bracket and clamp block for port 1 and port 2.



Attach the bracket to the barrel using the 4 Pozidriv screws. Note the separate port 1 and port 2 configurations.

Loosen the 2 Pozidriv screws on the bracket so there is approximately 1/2 inch between the bracket and clamp block.



Slide the bracket/clamp block into the HP 85105A mm-wave controller handle. Notice that port 1 and port 2 have different configurations. Hold the bracket and clamp block together and tighten the 2 screws on the bracket. Push the bracket towards the instrument front panel so the bracket is flush against the front panel.

Repeat this procedure for the other port if necessary.

Figure 1-7. Cable Support Assembly

Installing the Test Port Extensions

Each test set module is shipped with 2 or 3 straight extensions (depending on the waveguide band) and one 90° bend. These extensions should be connected to the test port of your module before you perform a calibration and performance verification (refer to Figure 1-8). The straight extensions have precision flanges and the 90° extension has standard flanges. Use a straight extension for the actual test port.

CAUTION

Do not use the 90° bend as the test port since it does not have precision flanges.

Follow the procedures below to connect the test port extensions to the modules.

Connecting Precision Flanges

To connect the precision flanges (the straight extensions):

1. Install the captive screws in all four tapped holes in one of the flanges.
2. Bring the flanges together using the guide pins for alignment, then gradually tighten all four screws in an X pattern to the final torque.

Connecting Standard Flanges

The standard flanges are designed so the mating surfaces are on a different plane than the edges. It is necessary that the mating surfaces are flat against each other.

To connect the standard flanges (the 90° bend):

1. Install the captive screws in all four tapped holes in one of the flanges.
2. Carefully bring the flanges together using the guide pins for alignment and hold the mating surfaces in contact while engaging the first few threads of all four screws.
3. Gently tighten one top screw until there is light pressure on the mating surface, then lightly tighten the opposite bottom screw to bring the flange mating surfaces into even contact.
4. Gradually tighten all four screws in an X pattern to the same final torque. This will ensure that equal contact pressure is applied to all four waveguide wall surfaces.
5. While tightening the screws, inspect the mating surfaces for proper alignment by placing a lamp or white paper behind the connection. If the flanges cannot be aligned so there is no gap, loosen all of the screws and start again.

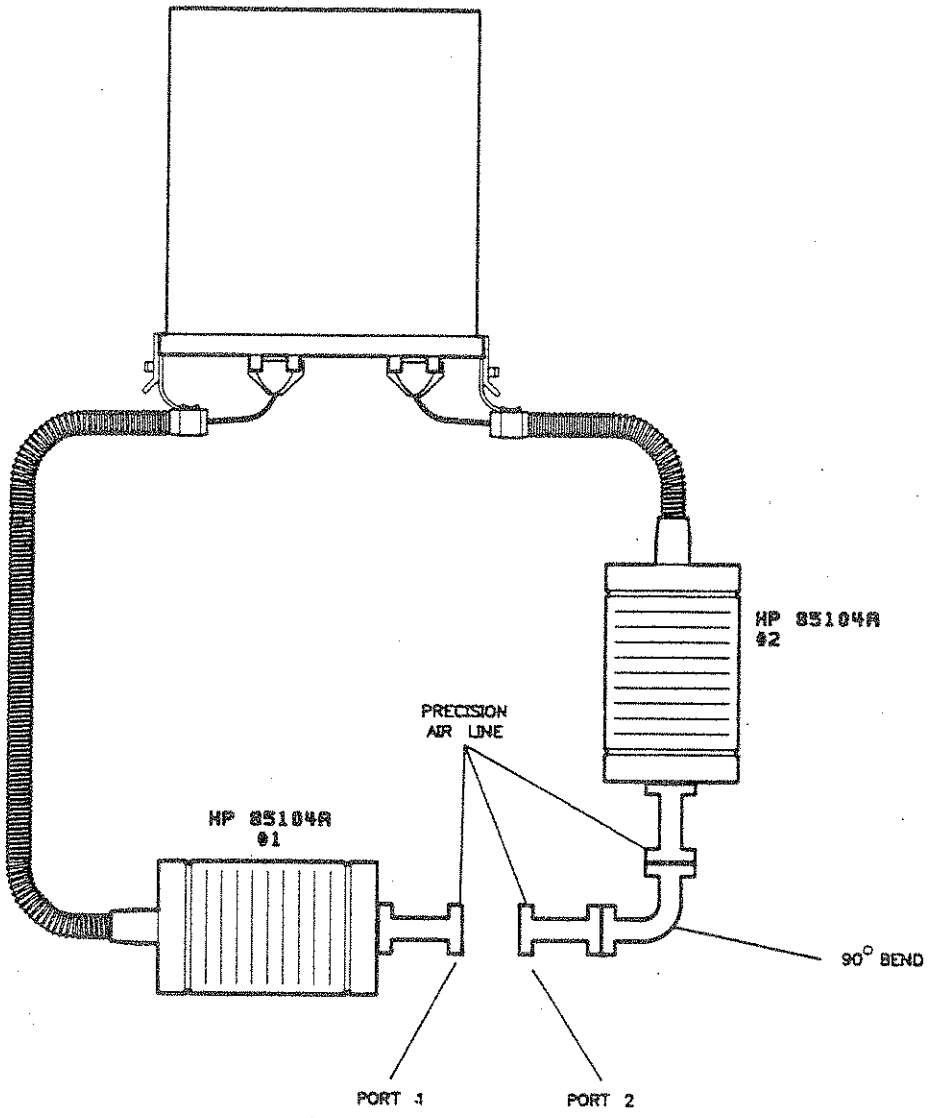


Figure 1-8. Connecting the Test Port Extensions

Connecting the Test Set Modules to the HP 85105A

Be sure the power to the HP 85105A is OFF. Then connect the test set modules to the HP 85105A Millimeter-wave Controller as shown in Figure 1-9. Refer to the "Operation" section of this manual for further information on the operation of the test set modules as part of the HP 85106B system.

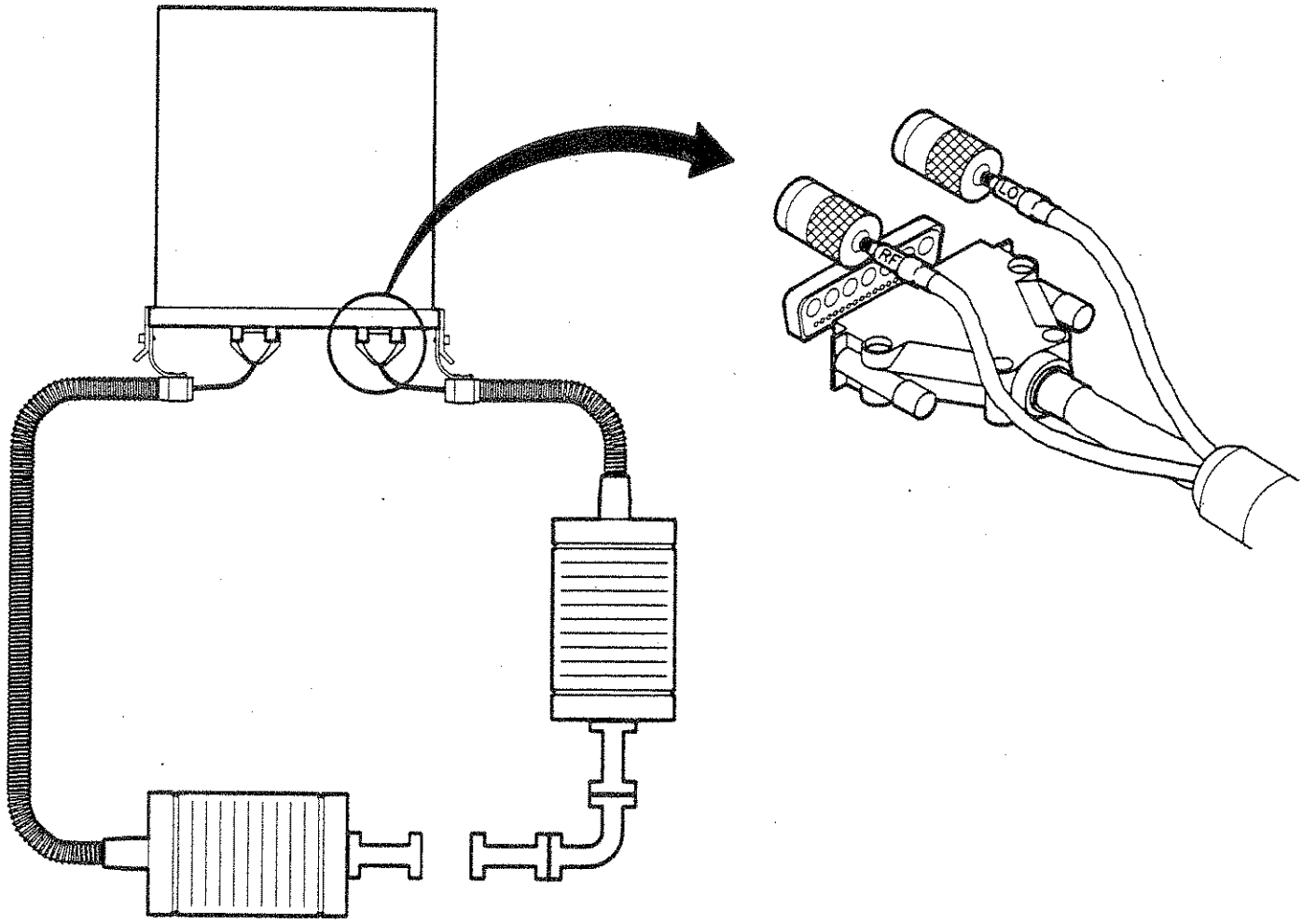


Figure 1-9. Installing the Test Set Modules

SYSTEM CABLING

Figures 1-10a and 1-10b are the cabling diagrams for the HP 85106B system (standard/option 001 and option 002 configurations). The system is shipped from the factory with most of the cables connected (except for any accessories).

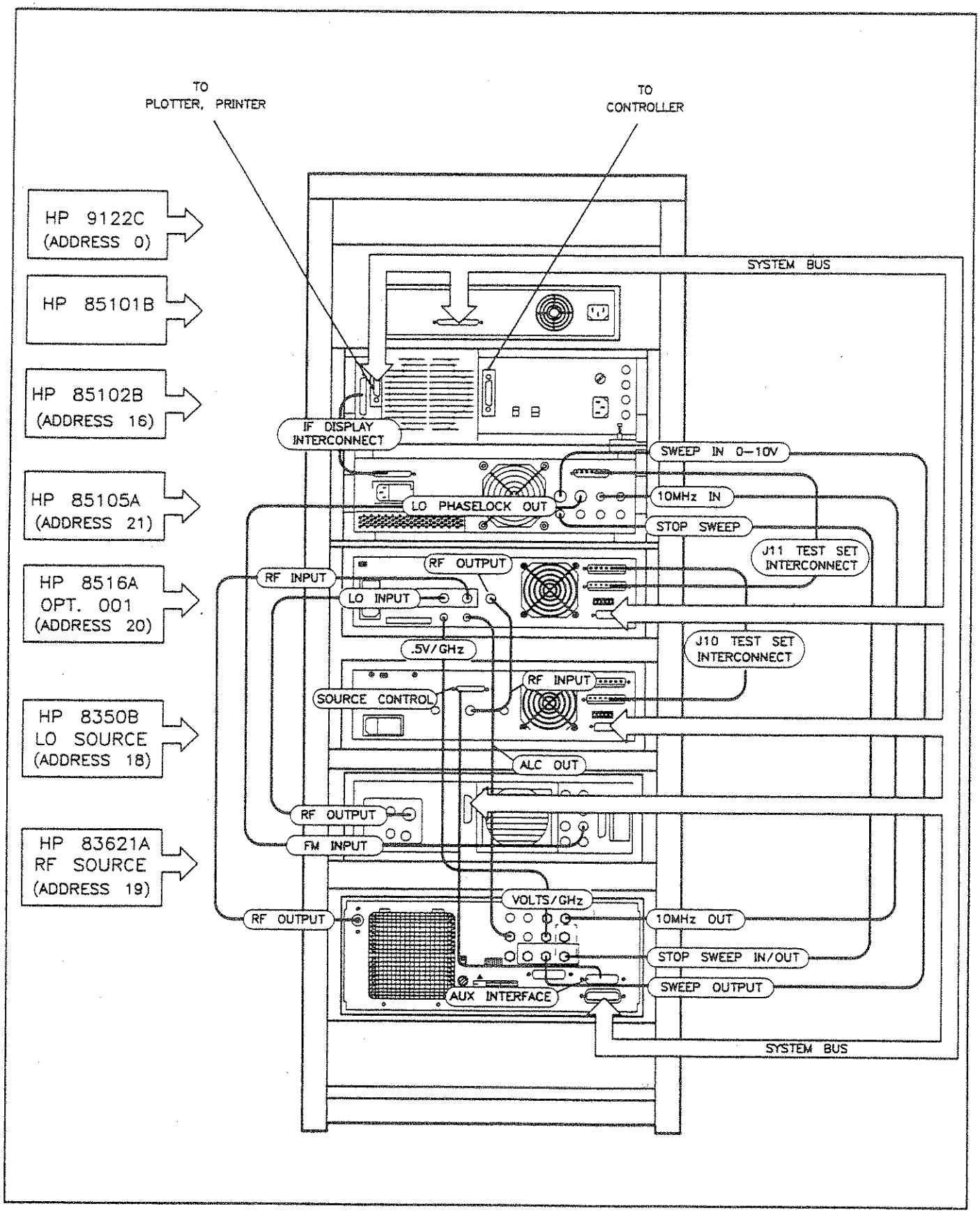


Figure 1-10a. HP 85106B Cabling Diagram (standard/option 001 configuration)

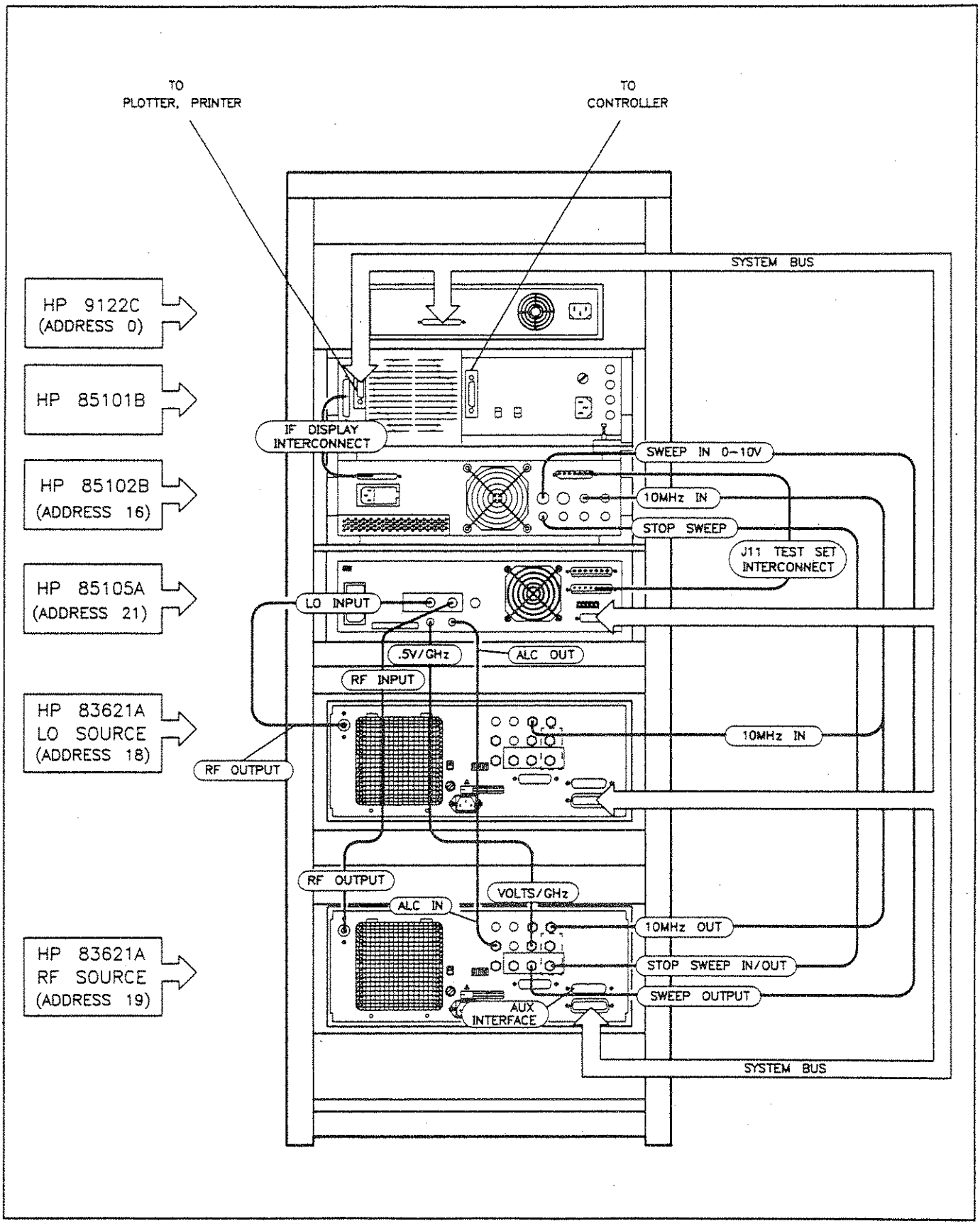


Figure 1-10b. HP 85106B Cabling Diagram (option 002 configuration)

INSTALLING A CONTROLLER

A controller must be connected to your system to run the performance verification software. The controller must be an HP 9000 series 300 computer with BASIC 5.0 or later and there must be 2 megabytes of available RAM after BASIC has been loaded. Refer to the "Performance Verification" section of this manual for more information.

Making Connections

There are two separate busses in this system:

- The HP-IB Bus
- The HP 8510B System Bus

Both busses use the same type of connector and cable, but the busses are not interchangeable.

The HP-IB Bus

The computer retains full control of this bus, no other device can send commands unless the computer relinquishes control. Connect your peripheral equipment to this bus only if you want this equipment to be controlled by the computer.

HP 8510B System Bus

The HP 8510B must be able to send HP-IB commands to the other instruments in the system at any time, without waiting for "permission" from the computer. To facilitate this, a special HP-IB bus was created called the *HP 8510 System Bus*. Connect your peripheral equipment to this bus (via the "8510 Interconnect" connector) only if you want this equipment to be controlled by the HP 8510.

ABOUT THE SYSTEM CABINET

Each HP 85106B System (regardless of option) is shipped in a 1600 mm (63 inch) high cabinet.

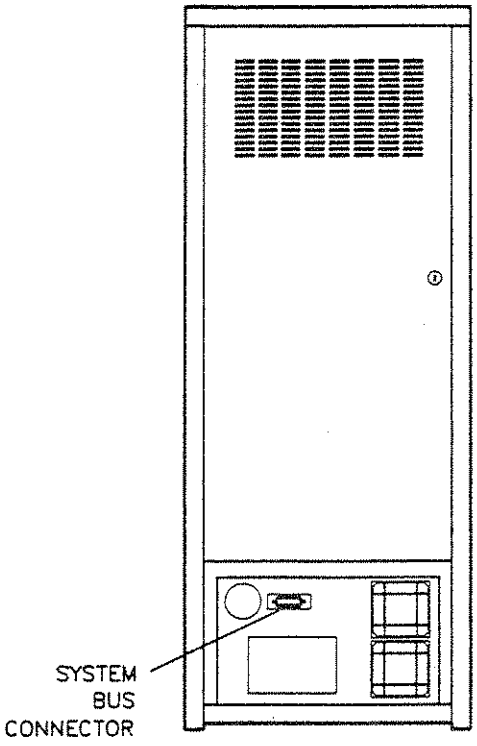


Figure 1-11. HP 85106B System Cabinet (rear view)

System Bus Connector

The mm-wave system cabinet has an "HP-IB System Bus" connector on the rear of the cabinet, below the door (refer to Figure 1-11). An interconnect cable (W33) is connected to this connector on the inside of the cabinet. Connect the "free" end of W33 to either the HP-IB Bus connector (for computer control) or the 8510 Interconnect connector (for system bus control), depending on which bus you want to control your peripheral equipment. Refer to "Installing a Computer" earlier in this section for more information.

Connecting a Plotter

To connect a plotter to the system, connect one end of the HP-IB cable to the plotter (the plotter should have its own HP-IB cable). Connect the "free" end of the plotter cable to either the "8510 Interconnect" connector (for system bus control) or to the "HP-IB connector" (for HP-IB bus control). Refer to "Installing a Computer" for more information regarding the busses. Set the plotter address to 5.

Connect the plotter to an ac power source and turn it on. Refer to "Accessory ac Power Outlet" in this section for information about connecting the plotter to an ac power outlet inside the system cabinet.

Accessory ac Power Outlet

All power connections for instruments in the system are located inside the cabinet via a multiple-outlet power strip. On some systems, an extra power outlet is provided on the power strip for accessories. Power cables for accessories may be routed through the hole provided in the rear of the cabinet. Special "boot" ac power cables are included with your HP 85106B System for this purpose.

CAUTION

Before connecting any equipment to the extra power outlet, refer to the paragraph entitled Environmental Characteristics earlier in this section for the maximum VA ratings for this outlet on your system.

The HP 85106B Installed In a Different Cabinet

Hewlett-Packard strongly recommends that the HP 85106B System Cabinet be used with the HP 85106B mm-wave System. HP is not obligated to support user-configured mm-wave rack systems other than the HP 85106B rack-mounted system. The customer takes full responsibility for instrument damage incurred due to using racks or system cabinets other than the one supplied with the HP 85106B System.

Contact your nearest HP Office for more information about ordering a rack for your system.

HP 8510B BENCHTOP MILLIMETER-WAVE SYSTEMS

Figure 1-12 shows the Hewlett-Packard suggested benchtop configuration of the HP 8510B millimeter-wave system and how this system is cabled. Although other benchtop configurations are available, the required cable lengths for a different configuration may vary from what is shipped with each instrument.

Table 1-4 lists the cables used in this configuration.

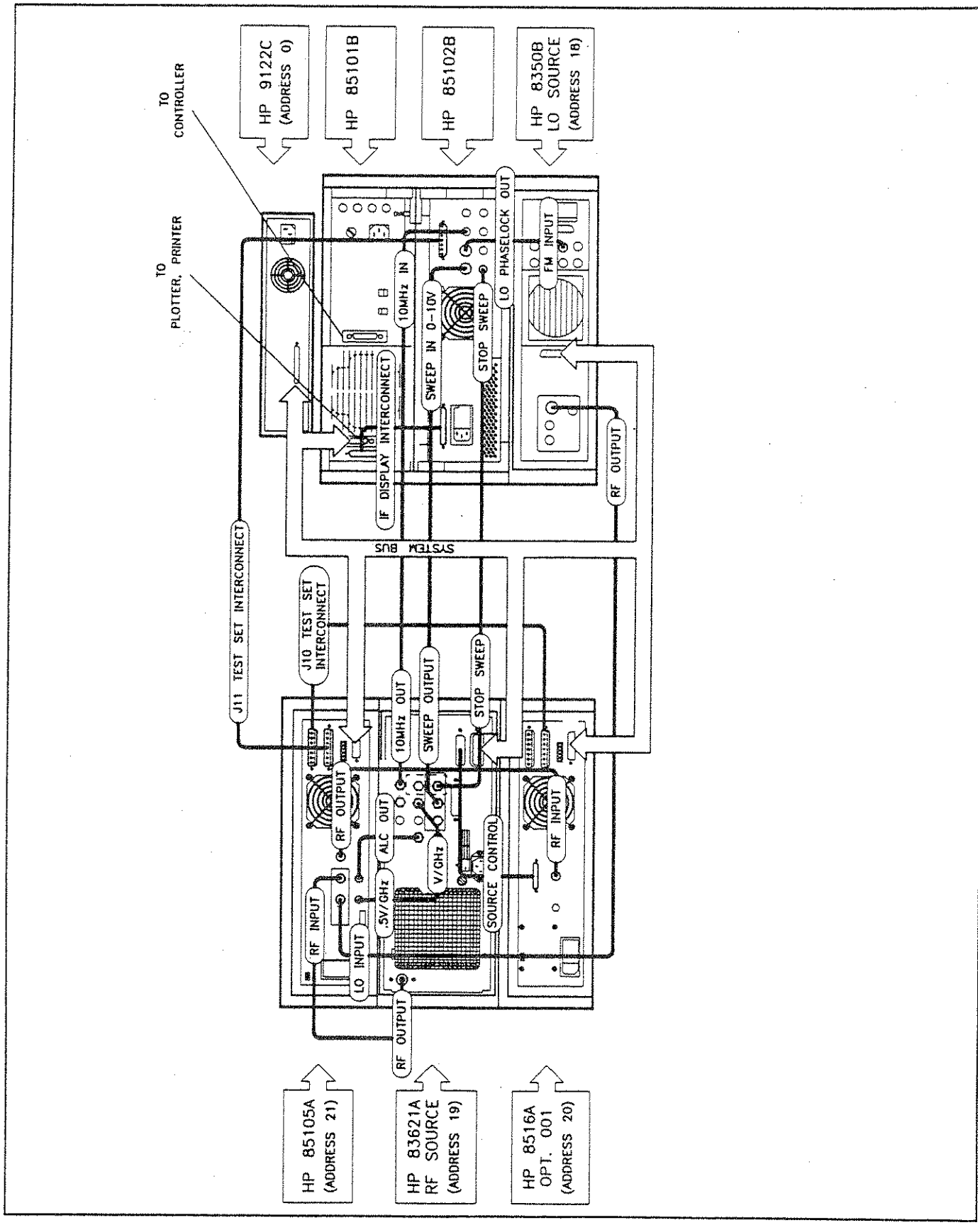


Figure 1-12. Suggested Benchtop Configuration of the HP 8510B Millimeter-wave System

Table 1-4. Electrical Connections Assuming the LO is an HP 8350

Description	From Instrument/Connector	To Instrument/Connector	HP Part No.
line	Display/Processor/line module		8120-1396
line	IF Detector/line module		8120-1396
line	HP 85105/line module		
line	Test Set/line module		8120-1396
line	RF Source/line module		8120-1396
line	LO Source/line module		8120-1396
line	Amplifier/line module		8120-1396
IF Display Interconnect	Display/Processor/IF Display Interconnect	IF Detector/IF Display Interconnect	08510-60101
Test Set Interconnect	IF Detector/Test Set Interconnect	HP 85105/J11 Test Set Interconnect	08510-60106
Test Set Interconnect*	HP 85105/J10 Test Set Interconnect	Test Set/J10 Test Set Interconnect	08510-60102
BNC	RF Source/10 MHz Ref Output	IF Detector/10 MHz IN	8120-1840
BNC	RF Source/Stop Sweep In/Out	IF Detector/Stop Sweep	8120-1840
BNC	RF Source/Sweep Output	IF Detector/Sweep In 0 to 10V	8120-1840
HP-IB	RF Source, LO Source, Disk Drive, HP 85105, Test Set*/HP-IB	Display/Processor/HP 8510 Interconnect	8120-3445
RF	RF Source/RF Output	HP 85105 RF Input/J7 RF Input	85100-60002
RF	LO Source/RF Output	HP 85105/LO Input	85100-60002
RF*	HP 85105/RF Output	Test Set/RF Input	08513-60009
BNC	IF Detector/LO Phaselock Out	LO Source/FM Input	8120-1840
Source Interconnect*	Test Set/J15 Source Interface	RF Source Auxiliary Interface	08516-60009

*Used only with option 001

NOTE: If you are using 2 synthesized sweepers (as in option 002), you will need a BNC-T adapter (HP part number 1250-0781) to tie the 10 MHz time bases together.

Space Requirements

To ensure adequate cooling and reliable operation in a benchtop configuration, follow these guidelines:

- Keep all instrument feet on to maintain 12 mm (1/2 inch) vertical clearance between stacked instruments.
- Keep instrument covers on during operation.
- Maintain 75 mm (3 inches) side separation between instruments.

Connecting A Disk Drive

Connect a disk drive to your benchtop system to save time recalling the millimeter system hardware state, instrument state, and calibration kit state.

To connect a disk drive to the system, connect one end of the HP-IB cable to the disk drive. Connect the "free" end of the disk drive cable to either the "8510 Interconnect" connector (for system bus control) or to the "HP-IB connector" (for HP-IB bus control). Refer to "Installing a Computer" for more information regarding the busses. Set the disk drive address to 0.

Connect the disk drive to an ac power source and turn it on. Refer to the paragraph titled "Accessory ac Power Outlet" in this section for information about connecting the disk drive to an ac power outlet inside the system cabinet.

Setting HP-IB Addresses

When the HP 8510 is powered on, all previously assigned HP-IB addresses are automatically recalled from memory and assigned to the various system instruments, including the HP 8510. Before the system can be operated, individual system instrument HP-IB address switches must be checked and switched to match the addresses assigned by the system. The instruments and the applicable default addresses are shown in Table 1-5.

All instrument addresses in HP 85106B systems are set at the factory prior to shipment. Instrument addresses of benchtop mm-wave systems must be checked and set according to the addresses shown in Table 1-5.

Table 1-5. HP 85106B System Instrument HP-IB Addresses

Address Of	HP-IB Address Standard	HP-IB Address Option 001 or Option 001/002
HP 8510	16	16
System Bus	17	17
RF Source	19	19
Coaxial Test Set (optional)	31	20
Plotter	5	5
Printer	1	1
Disk Drive	0	0
LO Source	18	18
mm-wave Controller	21	21

SHIPPING YOUR HP 85106B SYSTEM

If you want to ship your HP 85106B system, repackage the system in the crate it came in (this crate can be re-used once after initial receipt). Make all surface shipments via padded van; with an air suspension ride.

Regardless of crate style, ALL SURFACE SHIPMENTS MUST BE MADE VIA PADDED VAN (AIR SUSPENSION RIDE). Surface shipments in vehicles without air suspension may result in damage to the system components, cabinet, and shipping crate.

Section 2. Operation

INTRODUCTION

This section describes operation of the millimeter-wave (mm-wave) system, including power-up, configuring the instrument and hardware states for dual source operation, an operator's check, measurement calibration procedures, and some typical measurement examples. This section applies to all HP 8510B systems equipped with the HP 85105A test set controller and HP 85104-series test set modules whether the system instruments are configured as a benchtop system, or a rack-mounted system such as the HP 85106B. In operation, the mm-wave system functions like any other HP 8510 system with an S-parameter test set, as described in the standard *HP 8510 Operating and Programming* manual. The information here supplements the operating information specific to the mm-wave configuration.

SYSTEM DESCRIPTION

The HP 85106B Millimeter-wave Network Analyzer is configured for wide dynamic range S-parameter measurements of waveguide components. This setup allows automatic switching for all four S-parameters, making it unnecessary to manually disconnect and reverse the device during the measurement process. Figure 2-1 shows a simplified block diagram of this system, applicable to all waveguide bands. The HP 85106B mm-wave network analyzer system consists of an HP 8510B, two sources, a band-independent HP 85105A mm-Wave Test Set Controller, and a pair of band-dependent HP 85104-series mm-Wave Test Set Modules covering the 33 to 50 GHz, 40 to 60 GHz, 50 to 75 GHz, or 75 to 110 GHz waveguide band (Q, U, V, and W band, respectively). One source provides the RF (stimulus) signal signal and the second source provides the Local Oscillator (LO) signal.

Integrating the necessary amplifiers, frequency multipliers, and signal separation devices into the test set controller and test set modules, and providing a large work surface to position the modules brings a new level of convenience to mm-wave S-parameter measurements. Precision calibration standards in the HP 11644-series mm-Wave Calibration Kit permit full use of all built-in HP 8510 accuracy enhancement models.

The HP 8510 uses its multiple source control feature over the system bus to tune both the RF source and the LO source over the entire frequency sweep. All system functions, from setting up the measurement frequencies to calibration and measurement are controlled directly from the HP 8510B front panel. The measurement results are displayed on the HP 8510 CRT.

Stimulus for the device under test is generated using the synthesized RF source followed by a power amplifier and switch in the test set controller. This RF is routed to either the Port 1 test set module for forward measurements, or to the Port 2 test set module for reverse measurements. Components in the test set module provide frequency multiplication, signal separation to sample the incident, reflected, and transmitted signals, and the harmonic mixers to accomplish the first IF conversion to 20 MHz.

The second source provides the Local Oscillator (LO) for the four harmonic mixers. This LO source is set such that the millimeter-wave RF test signal frequency and the appropriate LO harmonic are offset by exactly 20 MHz. The system time base obtained from one synthesized source is used in the other synthesized source in the HP 8510. If an HP 8350B is used as the LO source, it is phase-locked through its FM input via the external phase-lock feature of the HP 8510. The resulting 20 MHz IF signals are amplified and then applied to the HP 8510 IF/detector section for routing to either the Normal or optional Wideband IF section for detection, post-processing, and display.

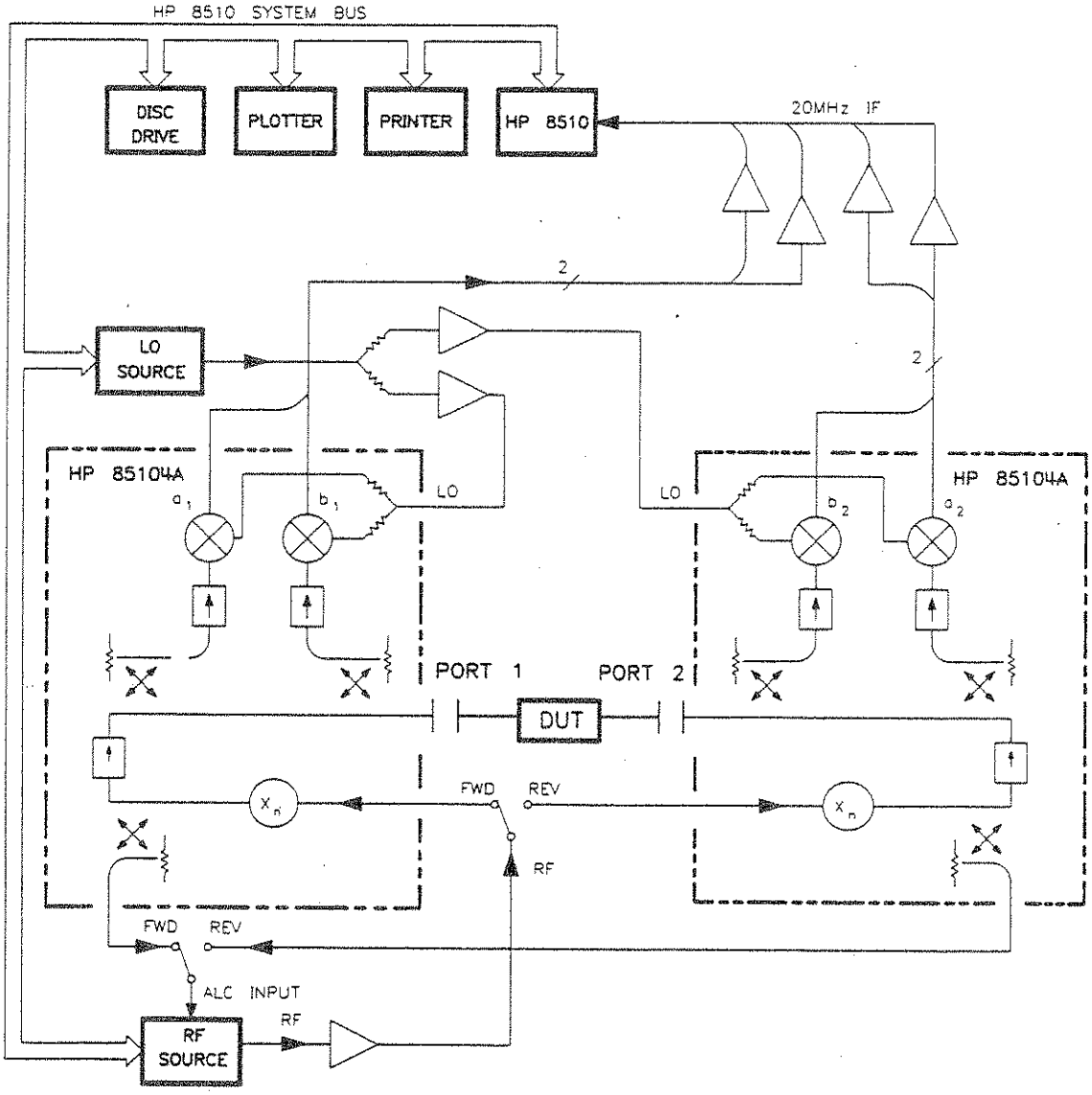


Figure 2-1. Simplified Block Diagram of the HP 85106B Millimeter-wave System

Since the HP 85105 includes RF and IF switching hardware, the system may also be configured for coaxial measurements from 45 MHz to 40 GHz by addition of a coaxial test set with convenient switching between coaxial and waveguide test sets. If the optional microwave test set is installed in the system, the RF signal, the 20 IF MHz signals, and the phaselock control signals first pass through the test set controller before entering the HP 8510B IF/detector section. Up to two other coaxial test sets can be added to the system by adding external RF and IF switching hardware. This is described in Section 6, "HP 85105A."

SYSTEM SETUP

This section describes how to prepare the mm-wave system for operation. System setup includes turning on system power, setting up the system hardware state and instrument state memories, configuring the test set modules, and an operator's check.

Turn On System Power

1. Verify that the hardware is connected as described in Section 1, "Getting Started" and shown in Figure 1-10.

2. Turn power on to all the system instruments except the HP 8510. Wait 10 seconds then turn on the HP 8510.

If the current HP 8510 hardware state and instrument state is correct for the current system configuration, the network analyzer will begin making measurements according to the last HP 8510 Instrument State 8. Proceed to paragraph "Configuring Port 1 and Port 2."

If the current HP 8510 hardware state and instrument state is not correct at this point the HP 8510 may display an error message and a beeper may sound. Do not be alarmed. The HP 8510 will remain in an error condition until the multiple source mode is activated and the HP 8510 receives a signal that it can detect. In the meantime, the beeper may be turned off by pressing (SYSTEM) then ***[BEEPER OFF]***. Load network analyzer memory as described in the following procedure.

Configure Network Analyzer Memory

The system setup procedure is greatly simplified by loading the appropriate Machine Dump file from the mm-wave System Disk supplied with the system. This disk, (HP part no. 85106-10005), contains files which define the specific hardware state and instrument state for the various millimeter-wave frequency ranges. As an alternative to using the disk, refer to the procedure using the tape cartridge at the end of this section.

Each Machine Dump file on this disk describes the complete HP 8510 memory configuration including the appropriate hardware state, the current and all eight instrument states, cal sets, and cal kits for one of the mm-wave bands or for operation with a coaxial test set. The following procedure describes loading network analyzer memory from the system disk.

1. First load the desired Machine Dump file from the system disk by inserting the disk into drive 0 of the external disk drive, then press:

   (TAPE/DISC)
   [STORAGE IS DISC]
   [LOAD] [MORE]
   [MACHINE DUMP]
   Use the knob to select the file for the desired frequency band (see Table 2-1).
   [LOAD FILE]

   The file will be loaded.

Table 2-1. Machine Dump Files Stored on the mm-wave System Disk

Frequency Range (GHz)	33 to 50	40 to 60	50 to 75	75 to 110	0.045 to 40
Band	Q (WR-22)	U (WR-19)	V (WR-15)	W (WR-10)	Coaxial
Machine Dump File					
Sweeper is LO	MD_SWPWR22	MD_SWPWR19	MD_SWPWR15	MD_SWPWR10	MD_COAX
Synthesizer is LO	MD_SYNWR22	MD_SYNWR19	MD_SYNWR15	MD_SYNWR10	MD_COAX

2. When the Machine Dump file is loaded, the system will begin sweeping over the full frequency range of the current band. Press (CAL) and read the *[CAL 1]* label to see that the calibration kit for the desired band has been loaded.

The system is now ready for operation. You may now change the instrument state settings for your specific application.

The initial settings in the Hardware State, the Instrument State, and the Calibration Kit definition are set as listed at the end of this section and Appendix A. These settings remain active until they are changed, a new file is loaded from the system disk, or (PRESET) is pressed to change the current Instrument state.

NOTE: Instrument state 8 is recalled each time HP 8510 line power is turned On. The Machine Dump file loads this register with an appropriate full band sweep. Since the hardware state is not modified at power-up, the system can be configured to power up in a particular frequency range by saving the desired instrument state into register number 8.

Create New Machine Dump File

You may wish to create a new Machine Dump file to store the exact system configuration for a specific application.

1. Configure the system for the application. The hardware state, present instrument state, and all memories will be saved exactly as they are currently defined.

2. Store the Machine Dump to disk. Press:
   (TAPE/DISC)
   [STORAGE IS DISC]
   [STORE] [MORE]
   [MACHINE DUMP]
   Enter the desired disk file label (RBAND or UWAVE, for example)
   [STORE FILE]

   This stores the complete system state.

Configuring Port 1 and Port 2

The test set module test port is manufactured with precise tolerances in order to achieve the stated system specifications. Before each connection inspect the test set flange surfaces and the flanges of the device under test for contamination or damage. In general, imperfections not visible with the unaided eye will not affect performance.

During measurement calibration it is very important that the calibration standards be connected using a precise, consistent method. The precision test port flanges and the calibration standards utilize precision guide pin holes and guide pins. These provide additional stability necessary to obtain the best results from measurement calibration.

The recommended arrangement is shown in Figure 2-2. There are several important questions on what is the best setup, but adding the 90 degree bend generally makes it simpler to connect Port 1 and Port 2 to make the thru and to connect the device under test.

CAUTION

Do not exceed +27 dBm incident at Port 2, or Port 1. System specifications are determined with about 0 dBm incident at Port 2 or Port 1. Greater than +27 dBm will damage the test set making it necessary to replace expensive parts. Observe proper precautions, especially when measuring amplifiers having greater than about 20 dB of gain.

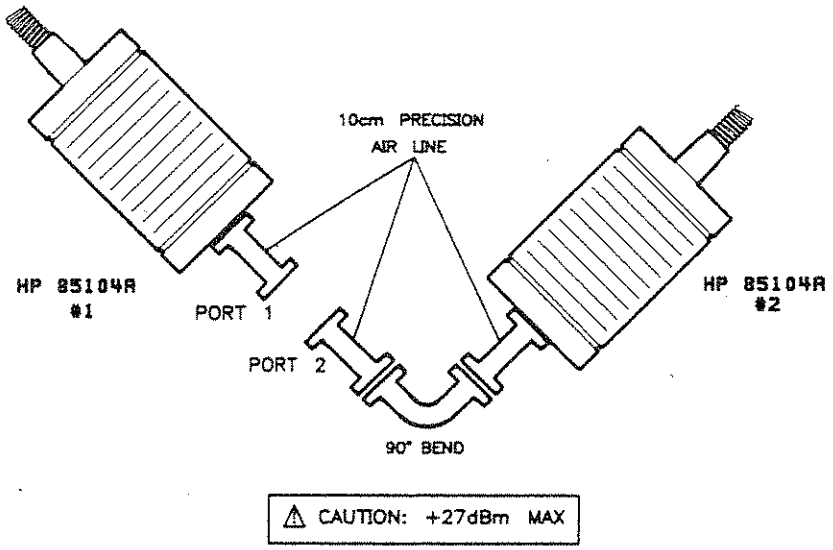


Figure 2-2. Typical Port 1 and Port 2 Configuration

To align the test ports for connection, raise the modules to the same height by fully extending the four feet of each stand. If the surface is level, the test set modules should not rock. If either module is not stable, make the final adjustment by changing the height of the feet using the height adjustment screws.

Release the stand lock by moving the lever, then center the module within the range of motion. Lock the slider. The test port can be moved back and forth (about 4 inches) by turning the small knob at the front of the stand. Typically, Port 1 is fixed in position and Port 2 is moved toward it to make the connection.

WARNING

Never look directly into the open end of a waveguide section when source RF power is ON. Although the signal levels in this setup are relatively low, the mm-wave energy is non-ionizing radiation which can be extremely harmful to the eye, and can result in damage or permanent blindness.

Before inspecting the test ports, reduce the RF power by pressing:

(STIMULUS MENU)
[POWER MENU]
[SOURCE POWER 1] (note RF power level)
Enter (-50) (x1)
Inspect Test Ports
Enter RF power level, (x1) (restore RF power level)

Anti-Static Precautions

The IF and LO ports on the back of the test set modules can be damaged by electrostatic discharge. Before connecting cables to these connectors, short the cable inner conductor to the cable outer conductor. Then short the cable outer conductor to a grounded part of the device outer conductor and then make the connection.

Waveguide Connections

Figure 2-2 shows the arrangement of the waveguide parts of the test set. Familiarize yourself with the specific components which make up the test set before proceeding with assembly. Detailed handling instructions are provided with the calibration kit manuals.

Inspect each flange for damage, then clean the mating surfaces using Isopropyl alcohol and a non-abrasive foam swab. Always support both components being assembled and never allow bending or twisting force to be applied to the flange connections.

For the Q, U, V, and W-band test set modules, special captive screws of two different lengths are used for all connections. These screws have threads only halfway up the screw body. Also, guide pins are an integral part of the flange.

There are two types of flanges used, these are shown in Figure 2-3. All connections except the test ports use the standard flange; the test ports use the precision flange.

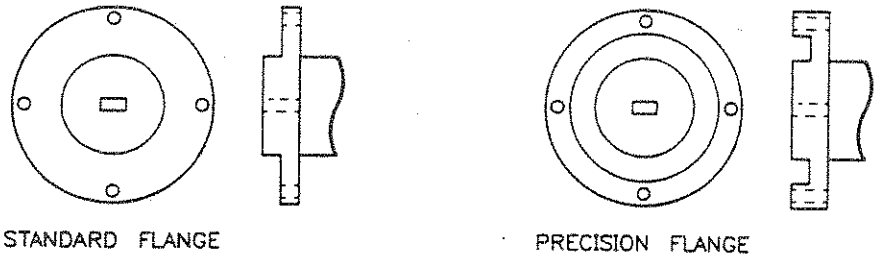


Figure 2-3. Standard and Precision Waveguide Flanges ((Q, U, V, and W bands)

Standard Flanges. The standard flanges are designed so that the mating surfaces are on a different plane than the edges. It is necessary that the mating surfaces are flat against each other. To connect:

1. Install the captive screws in all four tapped holes in one of the flanges.
2. Carefully bring the flanges together using the guide pins for alignment and hold the mating surfaces in contact while engaging the first few threads of all four screws. Now gently tighten the top screw until there is light pressure on the mating surface, then lightly tighten the bottom screw to bring the flange mating surfaces into even, intimate contact.
3. Gradually tighten all four screws in an X pattern to the same final torque. This will ensure that equal contact pressure is applied to all four waveguide wall surfaces.

While making the connection you may inspect the mating surfaces for proper alignment by placing a lamp or white paper behind the connection.

If the flanges cannot be aligned so that there is no gap, loosen all screws and start again.

NOTE: When the top screw is tightened with the bottom screw loose, it tends to bring the upper surface of the mating area together first. The objective is to equalize the pressure across the entire contact surface. As tightening the top screw brings the mating surfaces together, an angle forms. This angle determines the final mating force when the opposite screw is tightened. Tightening the opposite screw then brings the mating surface into complete contact. When the upper screw is holding the mating surfaces together properly (a very shallow angle), gently tighten the opposite screw and recheck flange alignment in all axes using the light or white paper behind the flange. Finally, evenly tighten the screws on the side and recheck alignment.

Precision Flanges. To connect the precision flanges, bring the flange together using the guide pins for alignment, then gradually tighten all four screws in an X pattern to the final torque. The flange outer radius and the inner mating surface share the same plane making these flanges easier to connect.

Make these connections slowly and carefully. With practice, making these connections becomes easier and you will become more confident of making a high quality connection.

OPERATING NOTES

Once the millimeter-wave system has been configured according to the preceding instructions, the system is ready for normal operation. The HP 8510B front panel behaves the same for microwave measurements with the following exceptions.

Use of the (PRESET) Key

Use of the (PRESET) key is not recommended. Use the RECALL Instrument State function. The Machine Dump file contains the correct instrument state 8 for the waveguide band. If (PRESET) is pressed, the system hardware state will not be affected, but the instrument state will change to the standard microwave system instrument state, making it necesssary to Recall Instrument state 8. The important changes to the desired instrument state caused by Preset are:

Sweep Mode. Preset selects Ramp sweep mode. If both the RF source and the LO source are synthesized sweepers (HP 834x or 836x) the mm-wave system only operates in Step, Single Point, or Frequency List sweep modes. For systems using the 8350-series sweeper as the LO, the system can operate in Ramp sweep, but with degraded frequency accuracy characteristics.

SET Z_0. Preset selects 50; the mm-wave system uses 1.

WAVEGUIDE DELAY. Preset selects Coaxial. For mm-wave measurements, Waveguide should be selected.

WAVEGUIDE CUTOFF. This function defines the waveguide cutoff frequency, f_{co}, used in the electrical delay computation. Preset selects 0 Hz.

SOURCE #1 POWER and SOURCE #2 POWER. Power levels defined in the standard instrument state depend on the source and waveguide frequency band; the levels should be close to those listed in the following paragraphs "RF Signal Power Control" and "LO Signal Power Control" and Table 2-2.

After Preset, the operator must Recall an appropriate mm-wave Instrument State saved previously, usually Instrument State 8.

RF Signal Power Control

The RF source power is set to a nominal value by the system configuration software. It may need to be adjusted depending upon the application. For maximum measurement accuracy, the system should be calibrated with the same source power as will be used during measurement. RF source power is adjusted through the Stimilus (MENU), ***[POWER MENU] [POWER SOURCE 1]***.

If the analyzer displays an "I.F. OVERLOAD" warning, the RF power must be decreased.

If maximum dynamic range is required when measuring a device which is not sensitive to its input power, the RF power may be increased to a level just below that which causes an "I.F. OVERLOAD".

If measuring a device where the input power is an important parameter, you should check to verify that the source is leveled. This should be done before calibration or setting up the analyzer for the measurement. (RECALL) Instrument State *[8]* (your current analyzer setup will be lost). Select the Parameter menu, *[User 1 a1]*.[1] Response menu (AUTO), (DISPLAY) *[Data→Memory 1]*. *[DISPLAY: DATA and MEMORY]*. Increase *[POWER SOURCE 1]* slightly and verify that the power increases across the band. If it does not increase at some point, an unleveled condition exists and the power must be reduced. Once you have determined that the source has excess power across the band, return the *[POWER SOURCE 1]* to the original value. If the incident power on Port 2 is also critical, this procedure can be repeated with *[User 3 a2]*, leaving *[POWER SOURCE 1]* at the lower of the two values.

Note: Although the *[POWER SOURCE 1]* is displayed on the analyzer in "dBm", this is actually the value of dBv programmed into the source, which is operating in the EXT DET mode. Changes in this value will result in the output power changing. If the actual output power is critical for the measurement application, first determine that the source is leveled (as described above) then measure the output with a power meter.

LO Signal Power Control

The LO signal power is controlled using the (SOURCE #2 POWER) function. The LO signal power should be as shown in Table 2-2.

Table 2-2. Recommended RF and LO Power Levels for all Bands

Frequency Range (GHz)	33 to 50	40 to 60	50 to 75	75 to 110	0.045 to 40
Band	Q (WR-22)	U (WR-19)	V (WR-15)	W (WR-10)	coaxial
Source #1 Power (RF)	−20	−20	−25	−30	+10
Source #2 Power (LO)	+3	+3	+3	+3	N/A

Frequency Control

Start and stop frequencies are entered using the (START), (STOP), (CENTER) and (SPAN) keys and the numeric keypad. Due to source resolution, frequency entries are sometimes modified by the HP 8510. For example, with the U-band system, an entry of 40 GHz may appear as 39.999999996 GHz.

Operator's Check

A quick operational check may be performed by measuring the power levels of the HP 8510 User parameters a_1, b_1, b_2, and a_2. Observing the appropriate levels (listed in Table 2-3) gives the user a high level of confidence that the system is operating properly. For complete system verification, see Section 3, "Performance Verification" in this manual.

The following measurements show the approximate RF signal levels incident at the first frequency conversion stage and are given in dBm even though the marker value is read out in dB. During this procedure you may adjust the RF source #1 power level, changing the available power at the test port, and thus the IF signal level.

Do not increase source #1 power or connect a device with gain such that greater than −13 dBm is shown in these measurements. Greater than about −10 dBm will result in mixer compression errors, and greater than +10 dBm will probably damage the first frequency conversion stage. System specifications apply when the source #1 power is set as listed in Table 2-3.

1. When looking at user parameters, always turn Averaging off.

1. Press (PARAMETER MENU) then *[USER 1 a_1]*. The forward reference signal path power level is displayed. The power level should be approximately as indicated in Table 2-3.

2. Connect a flush short to test port 1. Select *[USER 4 b_1]*. The forward reflection signal path power level is displayed. The power level should be approximately as indicated in Table 2-3.

3. In order to measure the reverse reference signal path the parameter must be redefined. Press:

   (PARAMETER MENU)
   [USER 3 a_2]
   [REDEFINE PARAMETER]
   [DRIVE] [DRIVE:PORT 2]
   [PHASE LOCK] [LOCK to a_2]
   [NUMERATOR] [NUMERATOR a_2]
   [DENOMINATOR] [NO RATIO]
   [CONVERSION] [CONVERT to S]
   [REDEFINE DONE]

The reverse reference signal path signal level is displayed. The power level should be approximately as indicated in Table 2-3.

4. Connect Port 1 and Port 2 together. Select *[USER 2 b_2]*. The forward transmission signal path power level is displayed. The power level should be approximately xx dB less that what was measured with a short on each test port.

This is an important measurement for setting signal levels in preparation for measuring your components, especially for amplifiers. The maximum signal applied at Port 2 (or Port 1) without damage depends upon the band, but exceeding +20 dBm will probably cause damage. If the IF signal level exceeds about −10 dBm, measurement errors due to compression will result.

If any of the power levels shown below are not observed (approximately ±3 dB), consult the "Service and Troubleshooting" paragraphs in this manual.

Table 2-3. Typical Power Levels for Operational Check of the mm-wave System

Frequency Range (GHz)	33 to 50	40 to 60	50 to 75	75 to 110
Band	Q (WR-22)	U (WR-19)	V (WR-15)	W (WR-10)
a_1	−13	−13	−26	−27
b_1	−15	−15	−27	−28
a_2	−13	−13	−26	−27
b_2	−15	−15	−27	−28

NOTE: 0.1 dB compression, −10 dBm; typical, −13 dBm maximum; damage, +27 dBm.

SYSTEM MEASUREMENT CALIBRATION

A perfect vector network analyzer exhibits flat frequency response, no impedance mismatches, and infinite isolation between channels. In an actual system, all of these characteristics are imperfect, but are generally repeatable and predictable. To correct for these systematic errors, measurement calibration is performed using known impedance standards connected at the measurement ports. All of the required standards are supplied with the HP 11644A-series calibration kits. To be sure the system is meeting measurement specifications, refer to Section 3, "Performance Verification."

The HP 85106B with an 11644-series calibration kit can use any of the accuracy enhancement models available with the HP 8510B. For measurement of 2-port devices, use the Full 2-Port, TRL 2-Port, or a combination of Transmission Response and Reflection 1-Port calibrations. Refer to the standard HP 8510 operating and programming manual and to the calibration kit manual for descriptions of the calibration types. Procedures for the TRL 2-Port, Response, Response & Isolation, and 1-Port calibration types are described in the following paragraphs.

Warm-up Time

Allow at least 30 minutes for the system to reach a stable temperature after power is turned on before expecting highly repeatable measurements. In addition, a stable ambient temperature will help to minimize time base variations as well as physical dimensional changes which appear as short or long term drift in magnitude and phase measurements.

Before Starting Measurement Calibration

Checking the cal kit definition. Be sure the appropriate CAL KIT definition is loaded in the HP 8510B. This definition is part of the Machine Dump file loaded above, and is contained on the tape in each HP 11644A-series calibration kit. Press (CAL) and read the *[CAL 1]* or *[CAL 2]* softkey label to check the calibration kit label.

Setting the Stimulus Values. Set all of the desired Stimulus characteristics for the device measurement. This includes the frequency range or frequency list, the number of points, Source #1 power level, etc. If the DUT must be measured using different stimulus settings, then separate measurement calibrations must be performed for each frequency range (except where the HP 8510 Frequency Subset feature can be used).

Selecting the Averaging Factor. It is also advisable to turn averaging On; an averaging factor of 128 is a reasonable value because it improves the measurement results without substantially increasing measurement time. Press:

(RESPONSE MENU)
[AVERAGING ON/restart] (128) (x1)

Checking the Instrument State. Verify that the System Z_0 is set to 1. This is used to normalize impedance in waveguide. Press:

(CAL) *[MORE]*
[SET Z_0] (1) (x1).

Pressing (PRESET) will set the system impedance defined by the *[SET Z_0]* function to 50 Ohms.

Entering the Exact Offset Delay. For the 1-Port and Full 2-Port calibration types, accuracy can be improved by entering the actual exact length of the waveguide section instead of the nominal length contained in the standard calibration kit definition. For the TRL 2-port calibration, either the actual or nominal length may be used.

The tape file describing the calibration kit definition includes the "nominal" length of the waveguide section used to make the quarter-wave offset short and the quarter-wave offset load. The actual physical length of the waveguide section is engraved on the waveguide section. This value can be converted and entered into the Cal Kit standard definitions thereby improving the accuracy of the offset calibration. Please refer to the HP 11644-series calibration kit manual for instructions to enter the actual offset length. You may want to store this definition onto tape or disk for future use. For further information on modifying the cal kit definition see the standard HP 8510B operating and programming manual and Product Note 8510-5A (HP P/N 5954-1559).

TRL 2-PORT CALIBRATION

The TRL 2-Port calibration procedure is recommended for general measurements of 2-port devices and is required when performing the complete performance verification procedure. The procedure consists of measuring a zero-length thru connection, short circuits at each port, terminations at each port for isolation, and the waveguide shim as the Line standard. This calibration produces 12-term error correction and provides best accuracy for 2-port devices.

1. Set the averaging factor to 128 by pressing:

   (RESPONSE MENU)
   [AVERAGING ON/restart] (128) (x1)

   Leave the AVERAGING FACTOR as the Active Function to allow changing the averaging factor for the different calibration standards during the calibration procedure.

NOTE: If System Performance Verification is being done, the averaging factor is set to 1024 by the performance verification program and should not be changed.

2. Start the calibration procedure by pressing:

   (CAL)
   [CAL KIT 1 WR-xx]
   [CALIBRATE: TRL 2-PORT]

3. Connect Port 1 directly to Port 2. Press *[THRU]*. The HP 8510 makes 6 measurements.

4. Connect the short to Port 1. Press *[S_{11} REFLECT]*. The HP 8510 measures S_{11}.

5. Connect the short to Port 2. Press *[S_{22} REFLECT]*. The HP 8510 measures S_{22}.

6. Press *[ISOLATION]*. The isolation calibration is recommended for wide dynamic range measurements, but it is not required. The isolation measurment is made with both Port 1 and Port 2 terminated with an appropriate one-port device. Since there is only one load in the standard calibration kit, the measurement is performed with a load on one port and a short circuit one other. To omit the isolation part of the calibration, press *[OMIT ISOLATION]* then proceed to step 7.

To perform the isolation cal, first set the averaging factor to at least 512. Connect the load to Port 1 and a short circuit to Port 2, then press *[FWD ISOL'N ISOL'N STD]*. The HP 8510 measures S_{11} and S_{21}.

Next connect the load to Port 2 and the short circuit to Port 2, then press *[REV ISOL'N ISOL'N STD]*. The HP 8510 measures S_{22} and S_{12}. Press *[ISOLATION DONE]*. Set the Averaging Factor back to 128.

7. Connect the waveguide section between Port 1 and Port 2. Press *[LINE]*. The HP 8510 makes 6 measurements.

8. Press *[SAVE TRL 2-PORT]*. The error coefficients are computed and the Cal Set selection menu is displayed. Press a *[CAL SET]* key to store the error coefficients and turn correction on. The HP 8510 will begin to measure all four S-Parameters, automatically switching between Forward and Reverse parameters.

9. To measure a device, connect it between the test ports, and select a parameter to measure by pressing (S11), (S21), (S12), or (S22). Any of the four S-parameters may now be selected for display. To restart the measurement, press (MEASUREMENT RESTART).

RESPONSE AND RESPONSE & ISOLATION CALIBRATIONS

The Response calibration provides for vector normalization of the system magnitude and phase frequency response to that of the selected calibration standard for the current selected parameter. Frequency response is the only error that is removed with this calibration. This calibration type is useful when measuring a well-matched device or when a quick check of device performance is required.

The Response & Isolation calibration accounts for both frequency response and isolation effects. In reflection measurements, both tracking and directivity errors are removed. In transmission measurements, tracking and crosstalk errors are removed. Two standards are required. The response standard is a flush short for reflection measurements or a zero-length thru for transmission measurements. The isolation standard, for either transmission or reflection measurements, is the fixed load. The Response/Isolation calibration is useful when measuring well-matched or high loss devices.

1. Select the parameter to be measured by pressing (S11), (S21), (S12), or (S22) and set the frequency range for the measurement.

2. Begin the calibration process by pressing:
   (CAL)
   [CAL KIT 1 WR-xx]
   [CALIBRATE: RESPONSE] or
   [CALIBRATE: RESPONSE & ISOL'N]

   Proceed to step 3 for a Response calibration or step 4 for a Response & Isolation calibration.

3. For the Response calibration, connect the calibration standard, a thru for transmission or a short at Port 1 or Port 2 for reflection and press the appropriate softkey, *[SHORT]* or *[THRU]*. After the standard is measured, the softkey is underlined. Press *[DONE RESPONSE]*. Proceed to step 5.

4. For the Response part of the Response & Isolation calibration, press *[RESPONSE]*, connect the response calibration standard, a thru for transmission or a short at Port 1 or Port 2 for reflection and press the appropriate softkey, *[SHORT]* or *[THRU]*. After the standard is measured, the softkey is underlined. Press *[DONE RESPONSE]*.

   For the Isolation part of the Response & Isolation calibration, connect a load to Port 1, and a short circuit to Port 2. Press *[ISOL'N STD]*. After the standard is measured, the softkey is underlined. Press *[SAVE RESP&ISOL]*.

5. The error coefficients are computed and the Cal Set selection menu is displayed. Press one of the *[CAL SET]* keys to store the error coefficients and turn correction on. The corrected response is displayed.

6. Check the calibration by observing the corrected response.

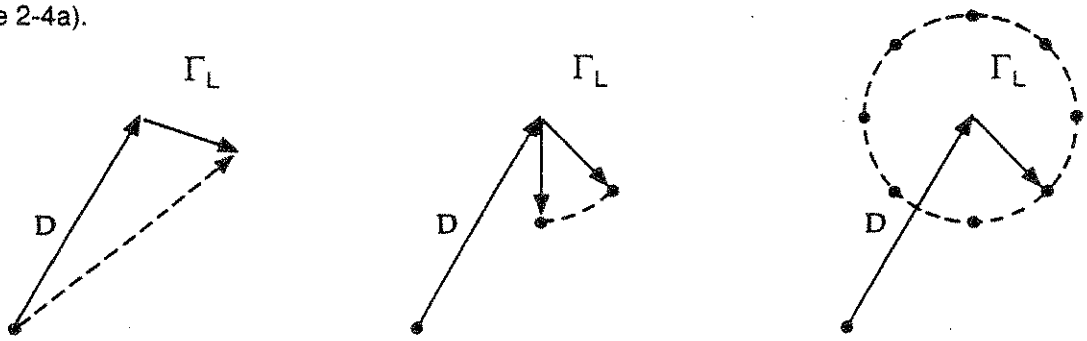
1-PORT CALIBRATION

The S_{11} 1-Port or S_{22} 1-Port calibration requires three standards to quantify and remove the system frequency response, source match, and directivity errors. These calibration types provide best accuracy for reflection measurements of one-port devices. The standards used for this calibration are a flush short, a quarter-wave offset short, and a Z_0 termination. There are three choices for the Z_0 termination, either a fixed load, a sliding load, or a load/offset load combination, but the load/offset load combination is preferred.

Choosing the Right Load Standard

In the 1-Port calibration, a load termination is used to determine the system directivity - the error signal that appears in the reflected signal path that did not reach the test port. This section describes the various load standards that can be used by the HP 8510.

The fixed load is the simplest load standard and provides adequate performance for many applications. During calibration using a fixed load, the load is assumed to be perfect and measured directivity is the combination of the actual system directivity and the actual reflection coefficient of the load. The effective system directivity is therefore dependent on the reflection coefficient of the load element (see Figure 2-4a).



a. Fixed Load *b. Offfset Load* *c. Sliding Load*

Figure 2-4. Phasor Diagram, Measuring Directivity Using Various Standards

Combining a fixed load with an offset load offers significantly better system directivity. This "offset load" technique is a two-step process. First, the fixed load is connected to the test port and measured. Then the same fixed load is offset by the shim and measured again. Since the shim offsets the load by a precisely known distance the angle of the resultant phase shift is known. Using these two measurements and the angle, the HP 8510B can determine the exact directivity (Figure 2-4b). The accuracy of the offset load technique depends on how precisely the offset delay is specified in the cal kit definition (see paragraph "Entering the Exact Offset Delay" in this section).

A sliding load may also be used to determine directivity. The load element is moved to five (or more) positions, determining corresponding points of the circle of Figure 2-4c. The HP 8510B then uses a circle-fitting routine to determine the center of the circle which is the actual directivity. Again, the effective directivity is determined by the dimensions of the line.

An important concern with the sliding load is the mechanical stability of the load element. This restriction has made the sliding load technique impractical in V and W bands, due to the small dimensions.

1-Port Reflection Calibration Procedure

1. Begin the calibration procedure by pressing:

   (CAL)
   [CAL KIT 1 WR-xx]
   [CALIBRATE: S_{11} 1-PORT]

   S_{11} will automatically be displayed on the screen.

2. Connect the flush short and press ***[SHORT]***.

3. Connect the quarter-wave offset shim between the test port and the flush short to make a quarter-wave offset short, and press ***[OFFSET SHORT]*** and wait for this measurement to be completed.

4. Press *[LOADS]* and note that there are several choices for the load. Choose either *[FIXED]*, *[OFFSET]*, or *[SLIDING]*.

   a. **Fixed Load Only.** Connect the load and select *[FIXED]*. When the measurement is complete, press *[DONE LOADS]*.

   b. **Offset Load.** Select *[OFFSET]*, and the two load selections appear, *[LOAD NO OFFSET]*, and *[LOAD OFFSET]*.

      Connect the fixed load directly to the test port and press *[LOAD NO OFFSET]*. After the measurement, insert the quarter-wave waveguide section between the test port and the fixed load. Press *[LOAD OFFSET]*. When the measurement is complete, press *[OFFSET LOAD DONE]* *[DONE LOADS]*.

   c. **Sliding Load** (not available for V and W bands). Select *[SLIDING]*. onnect the sliding load, move the sliding element toward the test port, then press *[SLIDE IS SET]*. After the measurement, change the position of the sliding load and press *[SLIDE IS SET]* again. Repeat this for at least five positions of the load, covering the full range of positions. Press *[SLIDING LOAD DONE]* *[DONE LOADS]*.

5. Press *[SAVE 1-PORT CAL]*. The error coefficients are computed and the Cal Set selection menu is displayed. Press one of the *[CAL SET]* keys to store the error coefficients and turn on correction. The system is now ready for fully error-corrected reflection measurements of one-port devices.

Combining Calibration Error Models

Another technique for measuring 2-port devices is to combine an S_{11} 1-port calibration and an S_{21} thru Response calibration for the forward parameters and an S_{22} 1-Port calibration and an S_{12} thru Response calibration for the reverse parameters. With this technique each parameter has its own cal set and is measured independently of the other parameters. This is usually the fastest way to measure a two-port device but since this technique does not account for source and load match effects, it is only recommended for measurements of well-matched or high loss devices.

EXAMPLE MEASUREMENTS

The HP 8510 equipped with the mm-wave test set, its multiple source operation, waveguide line stretcher, frequency list mode, and other features, is capable of making measurements with unprecedented speed, accuracy, and convenience. Following are useful measurement examples showing waveguide measurements.

Transmission Measurements

The frequency conversion technique used by the HP 85104-series test set modules allow high dynamic range measurements of millimeter-wave components. The transmission signal path noise floor can vary depending upon the frequency range and source RF power available at the test port. A quick check of dynamic range is performed using the Response & Isolation calibration with the test ports in the final measurement configuration. Choose the smallest averaging factor that provides the needed noise floor. Figure 2-5 shows the transmission response of a 44 GHz bandpass filter measured from 33 GHz to 50 GHz.

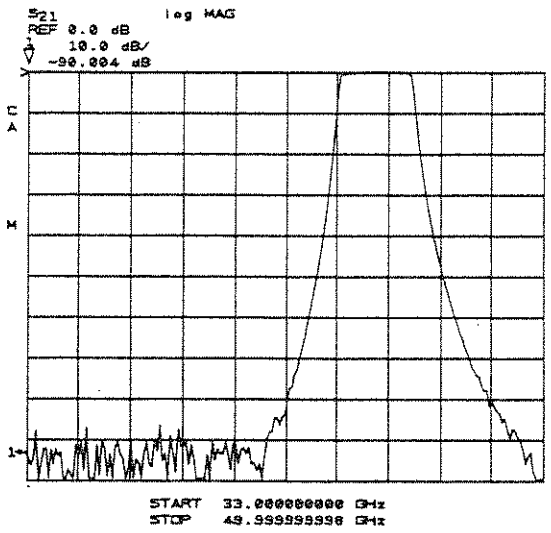


Figure 2-5. S_{21}, Bandpass Filter, 33 to 50 GHz, Showing Typical Dynamic Range

Reflection Measurements

Built-in error-correction provides a powerful measurement capability at millimeter-wave frequencies. Systematic errors are mathematically removed from the measurement system by measuring calibration standards with precisely known characteristics. Figure 2-6 compares the uncorrected and corrected impedance measurements of a W-band fixed load. The slowly varying trace shows the result using an S_{11} 1-port calibration.

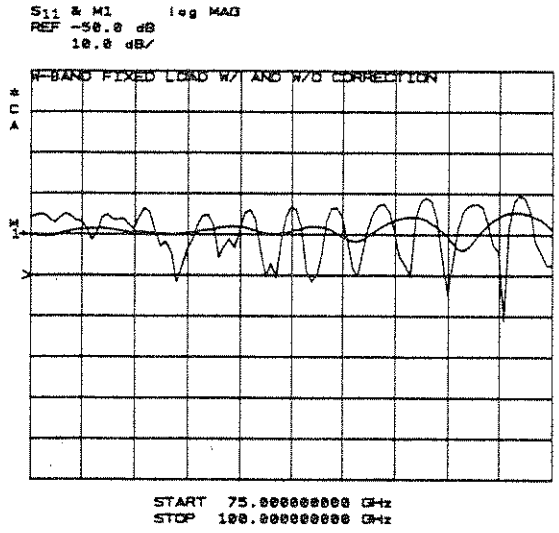


Figure 2-6. Comparing S_{11} Measurements using Response and 1-Port Calibrations

Using Frequency List

The HP 8510 frequency list mode allows the measurement of devices at specific user-defined frequency points. In this measurement of a 94 GHz bandpass filter, a multi-segment frequency list is used to measure the filter transmission response from 80 GHz to 100 GHz in 500 MHz steps, with an increased resolution of 20 MHz from 92 GHz to 96 GHz. Figure 2-7 shows the result the measure all segments selection. Note that either of the segments can be displayed alone.

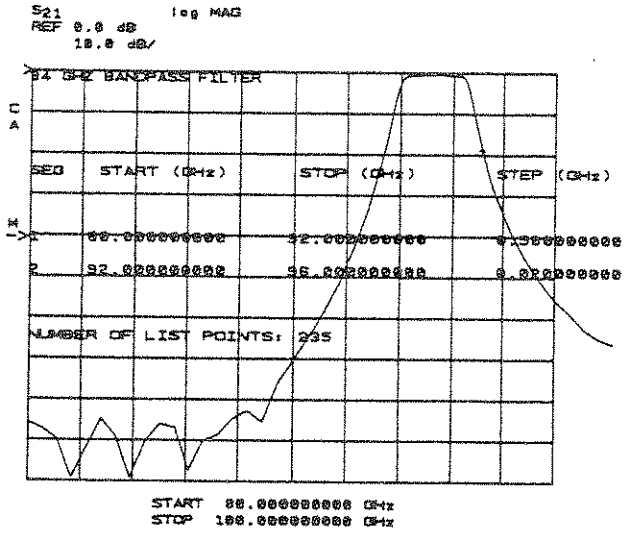


Figure 2-7. S_{21} Response, Using Frequency List to Adjust Frequency Resolution

Waveguide Electrical Delay

For phase and group delay measurements, remember that the propagation constant in waveguide and other non-TEM transmission lines is frequency dependent and that phase and group delay will therefore also exhibit this frequency dependence. Figure 2-8 shows the phase and group delay of a 44 GHz bandpass filter.

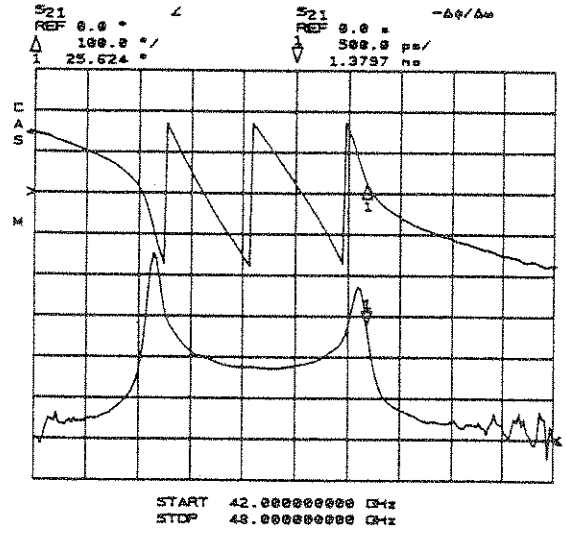


Figure 2-8. Bandpass Filter, S_{21} Phase and Group Delay

The Waveguide Delay function is used to compensate for the frequency dependent propagation constant of rectangular waveguide (dispersion). As shown in Figure 2-9, this provides a display of deviation from characteristic phase.

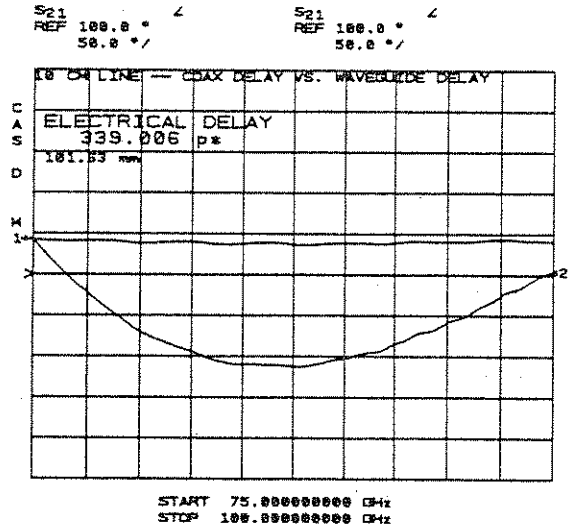


Figure 2-9. Using Waveguide Delay to View the Phase Response

To achieve this measurement, first input the waveguide cutoff frequency (f_{co}) by pressing:

(RESPONSE MENU) ***[MORE]***
[WAVEGUIDE DELAY]

The active function is now WAVEGUIDE CUTOFF, the waveguide cutoff frequency, f_co. This value is a part of the instrument state that was loaded with the machine dump file for the frequency band. If the value is not correct for the band in use, enter the appropriate f_{co} for the waveguide band in use. The electrical delay then applied will vary as a function of frequency to account for dispersion. Now press:

(PRIOR MENU)
[ELECTRICAL DELAY]

Move the measurement marker to the center of the frequency range, then press ***[AUTO DELAY]*** to automatically choose a value for waveguide delay. Now use the knob to enter the appropriate electrical delay value to flatten the trace and view the deviation from characteristic waveguide phase response.

This measurement shows the phase response of the 10 cm line with electrical delay applied. Note that coaxial delay (linear) cannot flatten the phase response. With waveguide delay, the phase response can be flattened, so the actual device length can be measured.

Time Domain Measurements

When the HP 8510 is equipped with Option 010, Time Domain, use *[TIME BAND PASS]* to locate impedance changes within the device under test. Figure 2-10 shows the S_{11} time band pass response of a shorted 10 cm waveguide section is shown, with and without waveguide delay applied.

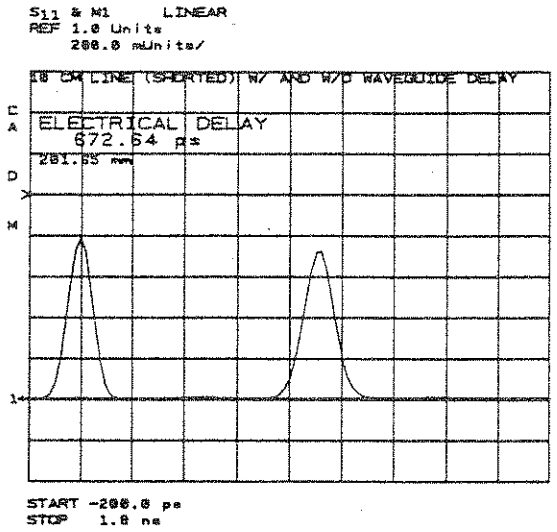


Figure 2-10. S_{11}, Shorted 10 cm Waveguide Section

With no delay applied, the reflection of the short is displayed at about 900 ps. Both the magnitude and location of this time domain response are affected by the dispersive nature of the waveguide. The dispersion tends to "smear" the trace, making the peak magnitude value not accurate. To get a more exact measurement of the shorted line, waveguide delay is added to move the response to time t=0. The delay required is 672 ps, or 201.65 mm, which is the twice the actual electrical length of the waveguide section because the signal propagates from the port to the reflection, then back to the port. Notice also the change in magnitude, due to the dispersion. The corrected response now displays the actual effects of the loss in the line and is unaffected by dispersion.

OPERATION USING A COAXIAL TEST SET

The system may include one of the coaxial test sets in the HP 8510 family. A simplified diagram of interconections is shown in Figure 2-11. The necessary RF signal switch and the 20 MHz IF and control switches are included in the HP 85105. The system is easily switched from millimeter-wave to microwave test set operation by loading the appropriate hardware and instrument states, without changing rear panel connections.

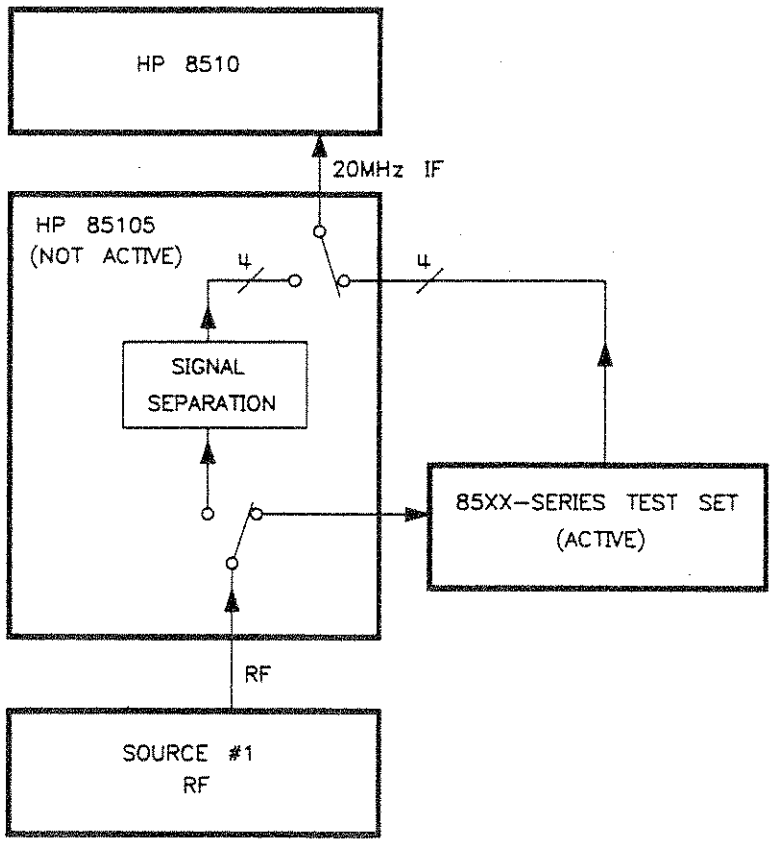


Figure 2-11. Block diagram of System with Coaxial Test Set

This procedure describes how to configure the millimeter-wave system for coaxial measurements.

1. Connect the HP 85105 and the coaxial test set as described in Section 1, "Getting Started." When the coaxial test set is Active, the RF signal is routed from the RF source, through the HP 85105 to the coaxial test set; the IF and control signals from the coaxial test set are selected for application to the HP 8510. The 85106B Option 001 system includes a coaxial test set already connected this way.

   When powering up the system, it is only necessary to power on the instruments that will be used in the coaxial measurements. It is not necessary to power on the LO source or other hardware used only for measurements using the HP 85105.

2. Load the coaxial Machine Dump file from the mm-wave system disk. Press:
   (TAPE/DISC)
   [STORAGE IS DISC]
   [LOAD] [MORE]
   [MACHINE DUMP]
   Use the knob to select file *[MD—COAX]* (see Table 2-1)
   [LOAD FILE]

   Press (PRESET). The key differences between the mm-wave instrument state and the coaxial test set instrument state are listed at the end of this section.

   The coaxial test set **ACTIVE** light should go on and the HP 85105 **ACTIVE** light should extinguish.

3. Check that the calibration kit definition is appropriate for the application. If necessary, load the appropriate calibration kit definition from the tape supplied with the desired coaxial calibration kit. You may wish to store a coaxial calibration kit in CAL KIT 2 and a mm-wave cal kit in CAL KIT 1.

The system is ready for operation using the coaxial test set.

COMMON PROBLEMS AND THEIR SOLUTIONS

While setting up for millimeter-wave measurements, you may encounter some of the following operational problems. Shown below are some recommended things to check for when these problems are encountered.

Problem: **CAUTION: NO IF FOUND** displayed (or very low detected signal levels)

Possible Causes and Solutions: If a microwave test set is also connected, verify that the test set ACTIVE light is off. If it is on, then toggle the test set address. Press (SYSTEM) *[HP-IB ADDRESSES] [TEST SET]*. Enter (20) (x1), then (21) (x1). If an RF Switch is also used, the SWITCH 0 light should be on during mm-wave operation, and off during microwave operation.

Problem: **CAUTION: PHASE LOCK LOST** displayed

Possible Causes and Solutions: (PRESET) was pressed, so the sweep mode was set to ramp. The mm-wave system using two synthesizers does not operate in Ramp sweep mode. Recall the mm-wave instrument state.

Problem: Data is grossly incorrect after calibration.

Possible Causes and Solutions: (PRESET) was pressed and the *[SET Z_0]* function (under the CAL menu) was reset to 50 ohms during a waveguide calibration. RECALL the correct mm-wave instrument state (Z_0=1), then calibrate again.

LOADING HARDWARE STATE AND INSTRUMENT STATE FROM TAPE

If the system does not include a disk drive or if the system disk is not available, the appropriate hardware state and instrument state can be loaded from the tape supplied with the system. This tape, (HP P/N 85106-10004), contains all the appropriate Hardware State files and the Instrument State files for the mm-wave and the coaxial configurations.

The following procedure describes how to setup the system running using the HP 85106 System Configuration Tape.

1. Verify that the hardware is connected as described in Section 1, "Getting Started." If you are unsure of the system configuration, proceed as follows.

   Turn power on to all the system instruments except the HP 8510B. Check that all system instruments are ready, then turn on the HP 8510B. At this point, the HP 8510 may display an error message and a beeper may sound. Do not be alarmed. The HP 8510 will remain in an error condition until the multiple source mode is activated and the HP 8510 receives a signal that it can detect. In the meantime, the beeper may be turned off by pressing (SYSTEM) ***[BEEPER OFF]***.

2. If two or more coaxial test sets are connected in the system, refer to Section 6, "HP 85105A" of this manual. If not, skip this step and proceed to step 3.

3. The correct hardware state file depends upon the type of LO source, sweeper or synthesizer, and the frequency range. Refer to Table 2-4. Load the desired Hardware State from the system tape by inserting the tape into the tape drive, then press:

   (TAPE/DISC)
   [STORAGE IS TAPE]
   [LOAD] [MORE]
   [HARDWARE STATE]
   [FILE n] (select the appropriate file number)

   The file will be loaded.

Table 2-4. Hardware State and Instrument State Files Stored on the mm-wave System Tape

Frequency Range (GHz)	**33 to 50**		**40 to 60**		**50 to 75**		**75 to 110**		**0.045-40**
Band	Q (WR-22)		U (WR-19)		V (WR-15)		W (WR-10)		coaxial
LO Source	SWP	SYN	SWP	SYN	SWP	SYN	SWP	SYN	Either
Hardware State	2	5	2	5	3	6	4	7	1
Instrument State	1		2		3		4		PRESET

SWP=HP 8350-series
SYN=HP 834x-series or HP 836x-series,+

When the Hardware State file is loaded, the system parameters are automatically configured as listed at the end of this section. These settings remain active until they are changed or a new file is loaded from the system disk. Preset and power-up do not change these settings. Note that these definitions are automatically configured for the selected frequency band, so it is not necessary for the user to set or modify these parameters.

4. Load the desired Instrument State file from the system tape. Press:

   (TAPE/DISC)
   [STORAGE IS TAPE]
   [LOAD]
   [INSTRUMENT STATE 1-8]
   [INSTRUMENT STATE 8] (choose an instrument state register)
   [FILE n] (select appropriate file)
   (RECALL)
   [INST. STATE 8]

   The instrument state will be recalled and the system should begin sweeping over the full frequency range of the current band.

   NOTE: Instrument state 8 is recalled each time the system is powered up. Since the hardware state is not modified at power-up, the HP 8510 system can be configured to power up in a particular band by loading the instrument state into register number 8.

5. Load the desired Calibration Kit definition file from the tape in the appropriate HP 11644A-series calibration kit. Insert the tape cartridge and press:

   (TAPE/DISC)
   [STORAGE IS TAPE]
   [LOAD]
   [CAL KIT 1-2]
   [CAL KIT 1]
   [CAL KIT FILE 1]

   Press (CAL) and read the *[CAL 1]* label to see that the cal kit for the desired band has been loaded. The system is now ready for operation.

INSTRUMENT STATE AND HARDWARE STATE SETTINGS

Following is a complete list of Hardware state and Instrument state settings for the system when using the HP 85105 test set controller and the HP 85104 test set modules, and for a system using a coaxial test set.

HP-IB Addresses

Source #1 (RF)	19
Source #2 (LO)	18
Test set	21 (HP 85105)
	20 (Coaxial)
RF switch	31

System Phaselock

LOCK TYPE:	NONE (two synthesizers)
LOCK TYPE:	EXTERNAL (Sweeper LO)
LOCK TYPE:	INTERNAL (single source)

POWER LEVELING

(mm-wave):

SOURCE 1: EXTERNAL
SOURCE 2: INTERNAL

(Coaxial):
SOURCE 1: INTERNAL
SOURCE 2: not used

SWEEP MODE

(85105, two synthesizers)
FREQUENCY LIST or SINGLE POINT or STEP
(85105, RF synthesizer, LO sweeper)
any sweep mode (RAMP sweep not fully specified)
(Coaxial)
any sweep mode

SET Z_0

1 (85105)
50 (Coaxial)

Waveguide Cutoff

Frequency Range (GHz)	33 to 50	40 to 60	50 to 75	75 to 110	0.045 to 40
Band	Q (WR-22)	U (WR-19)	V (WR-15)	W (WR-10)	coaxial
Cutoff Frequency (GHz)	26.338	31.386	39.873	59.024	0

MULTIPLE SOURCE
ON (HP 85105)
OFF (Coaxial)

Multiple Source Definitions are required for each band. These multiple source settings are shown in Figure 2-6 for all the mm-wave bands. These definitions are loaded automatically when the hardware state is loaded. These are examined by pressing (SYSTEM) ***[MORE] [EDIT MLT. SRC]***.

As an example of how the multiple source control works, consider a Q band (33-50 GHz) system set to measure from 42 GHz to 48 GHz at 201 points. For the 101st measurement point along the sweep, the test signal frequency at the DUT is 45 GHz. To generate this 45 GHz signal, the test signal source is set to 15 GHz, amplified, and its frequency is tripled in the test set module (3x15=45). The incident, reflected, and transmitted portions of this 45 GHz signal are separated in the test set module and applied to the first frequency conversion stage. Inside each harmonic mixer the 45 GHz signal is mixed with the tenth harmonic of the LO source to produce an IF signal of 20 MHz. This means that the tenth harmonic of the LO source is at 45.020 GHz, and the LO source fundamental frequency is at 4.502 GHz (10x4.502=45.020). The same approach may be used to show that for the entire 201 point sweep, the test signal source sweeps from 14 to 16 GHz while the LO source sweeps from 4.202 to 4.802 GHz.

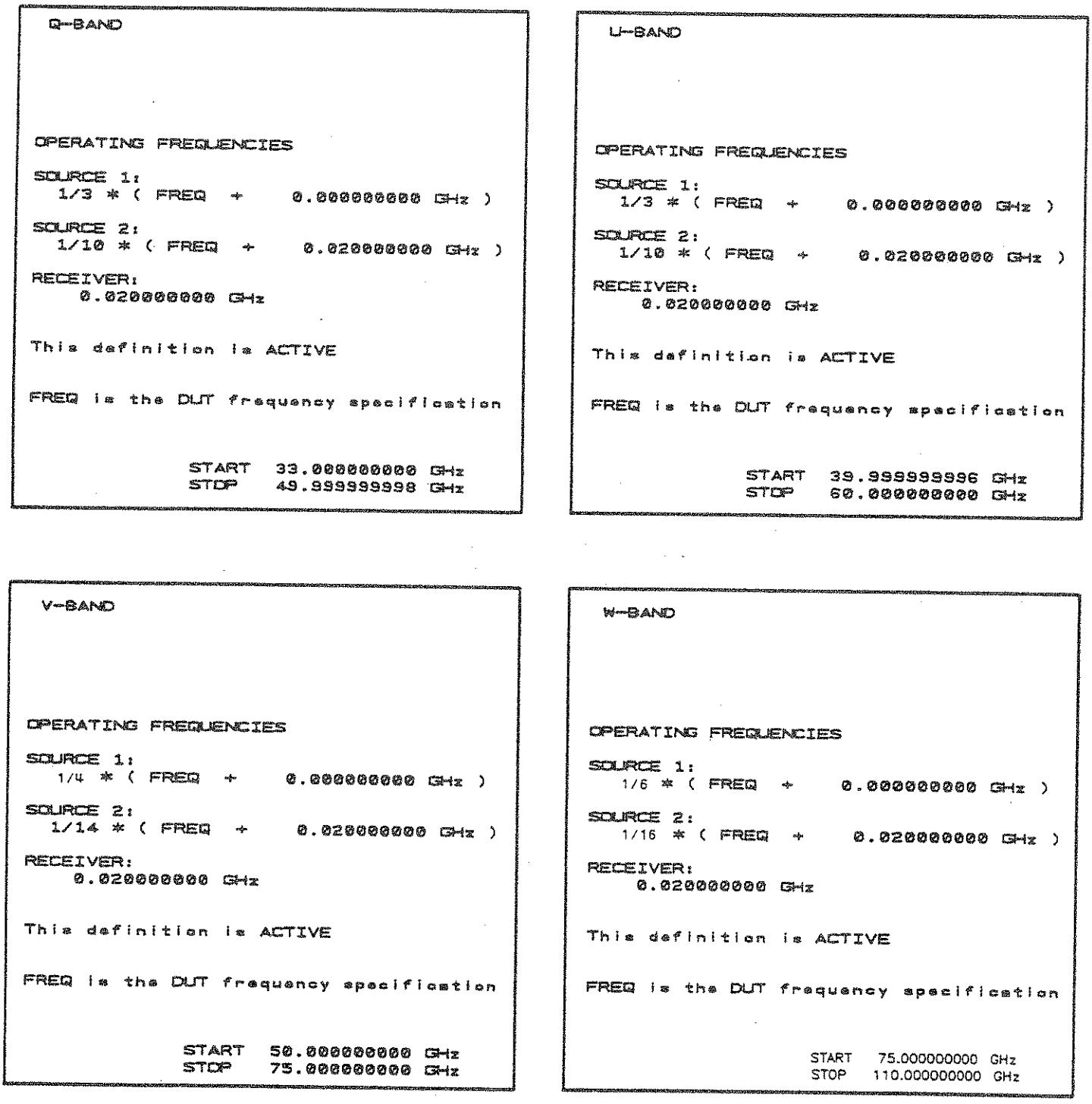


Figure 2-12. Multiple Source Settings for the mm-wave Bands

Section 3. Performance Verification

After installation of the system is complete, a performance verification is necessary to assure proper system operation. A performance verification is included as part of the HP 85106B installation.

Performance verification for the millimeter-wave system is the same as for the standard HP 8510B system, with the exception of one step in the procedure. It is important that you follow this documentation as you calibrate and verify your system.

ABOUT THE SPECIFICATION AND PERFORMANCE VERIFICATION SOFTWARE

The HP 8510 Specifications and Performance Verification software supports two formats: a single disk format that contains the entire verification procedure on one disk (the program and data are combined on one disk), and a multiple disk format that contains separate program and data disks. For HP 85106B system performance verification, load the single disk and leave it in for the entire verification procedure. Ignore the prompts to insert a second disk, instead press ***[RESUME]*** on the controller to continue.

NOTE: Always use the highest revision software for your performance verification.

Load BASIC and BIN Files

The program will run on most 200 and 300 series controllers, except for a 9826 because of its limited CRT display. The controller must have at least 2 megabytes of memory for the program to run.

1. Simplified BASIC loading procedure:

   a. While the controller is OFF, insert the BASIC language system disk in the default drive (typically 0). Then turn the controller ON.

   b. When BASIC is loaded, the drive LED will go off and a prompt will appear on the controller CRT: BASIC Ready. Remove the disk.

   c. Insert the Language Extensions disk in the drive and, one at a time, load the following files. For example, type:

      LOAD BIN "ERR"

      Language Extension files: ERR, CLOCK, GRAPH, MAT, IO

      Then press the (CONTINUE) softkey on the controller keyboard. When the file is loaded the drive LED will go OFF. After loading all the Extensions, remove the disk. Insert the Drivers disk and load the following files in the same manner.

      Driver files: HPIB, (DISC and CS80 for stand alone drives)

After loading all the drivers, remove the disk.

2. After BASIC and the BIN (Binary Language Extensions and Drivers) files are loaded you can perform the following steps to generate specifications. You do not have to connect the HP 8510 to perform these steps. Therefore, you can ignore any CRT prompts that inform you the HP 8510 is NOT connected.

NOTE: If you omitted step 1 above, clear out the common area of your controller's memory by typing: SCRATCH C and pressing (RETURN) or (ENTER).

Insert the HP 8510 Specifications and Performance Verification software disk into the default drive or the drive you specify as the MSI (mass storage is). Type the *load* command and the filename as shown below then press (RETURN) or (EXECUTE). Be sure to type it exactly as shown:

LOAD "SPECS_8510"

The program's title banner information and a ***[RESUME]*** softkey should be displayed at this point.

HP 8510 Specification and Performance Verification Software

Press the ***[RESUME]*** softkey.

3. The program will load the subroutines from this disk; during this time the CRT will be blank.

4. Next, the program will load the following system files:

   - MENUS (ITF or 236) – CRT menu displays
   - DESCRIPT – descriptions of the ERROR terms
   - SOFTWARE – software configuration menu
   - TABLE – the tables that will list specs
   - UNCPLOT – plotting the specs
   - VERIF – the verification menu
   - SERNO – the serial number forms
   - ETERMS – the Eterm menu

5. The next CRT display allows you to set the date and time on the controller CRT.

   At this point, you can press the controller Y key and the program will continue, or you can press the controller N key for NO and set the date and time. When your entries are complete, press the keyboard (ENTER) or (RETURN) key.

6. The program will load the SYSTEM CONFIGURATION menu file HARDWARE. After this file is loaded the HARDWARE CONFIGURATION menu will be displayed. This menu allows you to select the type of system equipment that you want.

   Here is a brief explanation of the main menu choices:

   SYSTEM CONFIG – Select this menu if you want to return to the Hardware Configuration menu or if you want to use the software configuration menu to set the addresses of your HP 8510 or your printer/plotter, or select plot trace pens/colors. This menu will also allow you to reset the program – all menu choices will be returned to the program's default state and the program will begin again from the time and date setting.

   NOTE: Specifications for the HP 8511 systems should be selected with no source, no cal kit, no cables, and no verification kit.

   QUIT PROGRAM – Always use this selection when you are finished using this program.

   VERIFY SYSTEM – This menu is selected when you want to verify system performance. Do not choose this selection until the Hardware and Software Configuration menus have been set.

   SYSTEM UNCERT – This menu is selected when you want to see the calculated uncertainty limits for each type of S-parameter measurement. Do not press this selection now.

   SYSTEM SPECS – When this selection is made, the Specifications menu will appear.

The following example shows the equipment used in a typical millimeter-wave system:

- Network Analyzer: HP8510B – Enhanced Model
- Test Set: U85105A – U-Band S-Parameter (40 GHz-60 GHz)
- Source: U85104A – U-Band Synthesizer (40 GHz-60 GHz
- Calibration Kit: U11644A – (40 GHz-60 GHz)
- Calibration Technique: TL – Thru-Reflect-Line (TRL) Cal
- Test Port Cables: MMCables – R,Q,U,V,W-Band Millimeter L.O. cable
- Verification Kit: U11645A – U-band

7. Select the equipment above or select the equipment for your system. The CRT display will have a highlighted field around the active selection. Use the ***[NEXT]*** and ***[PREVIOUS]*** keys to change the selection in the highlighted area, if required.

   Make all the selections you want until the hardware configuration is correct.

8. Press the softkey labeled ***[Done]*** and the program will load. The program will remember the last system configuration you select and, when you run it again (without turning the controller OFF), the same configuration will appear on the CRT. You can reset the configuration by using the ***[Program Reset]*** softkey, found in the SYSTEM CONFIGURATION menu.

   The MAIN menu will now appear on the controller CRT.

9. At this point, be sure you have the following items ready to use:

   - Calibration kit and its tape. The model number of the calibration kit must match the one you select in the Configuration menu.
   - Verification kit and its tape. The model number of the verification kit must match the one you select in the Configuration menu.

10. Connect the HP 8510

    Be sure the controller is connected to the HP 8510 rear panel HP-IB connector. Also, the HP 8510 must be warmed-up for one hour before verification.

11. Press ***[VERIFY SYSTEM]***. If the program acknowledges the system over the HP-IB, it will display the *System Performance Verification Menu* on the controller CRT.

12. Press ***[SERIAL NUMBERS]***. Enter the serial numbers and the NBS numbers only if you want them to appear on the printout of your performance test results for each verification device. The serial numbers are usually located on the rear panels. NBS test numbers are on the *Certificate of Calibration* that accompanies your verification kit.

    When you are finished with this menu, press ***[DONE]***.

13. You should now be back in the System Performance Verification Menu. Press ***[SYSTEM CAL]***. The configuration information will be displayed; make sure it agrees with the system you are going to verify. If it does, press ***[RESUME]*** to continue. If it does not, return to the Hardware Configuration Menu to correct it.

14. Load the Cal Kit Tape as follows:

    Insert the standards definition tape and press (TAPE/DISC), *[LOAD]*, *[Cal Kit 1-2]*. Then press *[CAL KIT *1]*, *[*File 1]* and if an asterisk (*) appears next to file 2, press it after file 1 is loaded.

    Press (CAL) again to verify that the proper files were loaded. The HP 8510 softkey field should display the type of calibration and the cal kit tape constants revision number. After the tape is loaded, remove it from the drive.

15. Press the *[RESUME]* softkey twice if you are ready to calibrate. The program will set up the HP 8510 and put it into *LOCAL* operation so that you can calibrate the system using its front panel keys.

16. Perform the Calibration

    You need a *Full 2-port calibration* for S-parameter test sets, as in the HP 85106 system.

IMPORTANT INFORMATION FOR MILLIMETER-WAVE SYSTEM USERS

The verification program initializes the system and changes some instrument states. For mm-wave systems, these values must be reset to their initial values. The prompt *Initializing System Prior to Calibration* will be displayed on the HP 8510 CRT.

Reset the following states before continuing with the calibration procedure. Your verification will be invalid if you fail to reset these states.

SYSTEM PHASELOCK

Press (SYSTEM) *[MORE] [SYSTEM PHASELOCK] [EXTERNAL]**

* Set Phaselock to *[NONE]* for all sources except the HP 8350B, which is set to *[EXTERNAL]*.

POWER LEVELING

Press (SYSTEM) *[MORE] [POWER LEVELING] [SOURCE 1:EXT LEVEL] [SOURCE 2:INTERNAL]*.

SOURCE POWER LEVEL

Press STIMULUS (MENU) *[POWER MENU] [POWER SOURCE 1]* (XX)* (X1) *[POWER SOURCE 2]* (XX)* (X1)

* Refer to the table below for the correct power level.

Table 3-1. Recommended RF and LO Source Power Levels

	Band			
	Q (WR-22)	**U** (WR-19)	**V** (WR-15)	**W** (WR-10)
Power Source #1 (RF)[1]	−20	−20	−25	−30
Power Source #2 (LO)	+3	+3	+3	+3

1. Optimum power level may vary from system to system. Adjust the power level to the maximum level without an "IF overload" error message. (Refer to "RF Signal Power Control" in Chapter 2.)

SYSTEM Z_0

Press (CAL) *[MORE] [SET Z_0]* (1) (X1).

These conditions will be recalled automatically during the verification.

17. On the HP 8510 press (CAL). Then select *[TRL 2-PORT]*.

18. Next, a series of softkey selections will appear on the CRT: *[REFLECT'N]* *[TRANSMISSION]*, *[ISOLATION]* and *[LINE]*. When you press one of these keys, another set of softkeys will appear. Connect each device as directed; the HP 8510 will underline each device label when the measurement is complete. After all of the devices are measured (for S_{11} and S_{22}), press the *[DONE]* softkey.

    There is a step-by-step TRL calibration procedure in the 'Operation' section of this manual.

19. After you have made all the calibration measurements, press the appropriate *[DONE]* softkey when the last measurement is complete. Then store the calibration in a Cal Set Register (1 through 8) by pressing the accompanying softkey. If an asterisk (*) appears alongside one of the cal set registers, it means that a calibration is already stored there. If all of the registers are full, go ahead and press a key and respond to the prompts. You will delete the contents of that register and store your calibration there.

    When the calibration is complete, press the program *[RESUME]* key and the program will reset the HP 8510 to *REMOTE* operation and return you to the *System Performance Verification Menu.*

20. Selecting the Verificaton Standard

    Press *[SELECT STANDARD]*. The program will display the *Verification Kit Device Selection Menu. This menu is a form that allows you to select the standard you want to measure, enter its* serial number, change the averaging factor for measurement, select the Cal Set register, and enter any comments.

    A complete verification requires that you measure all devices in the kit. However, you must select the devices, one at a time, from the Verify Standard menu.

21. When this form is complete, press *[DONE]*. Insert the Verification Kit data tape into the HP 8510 tape drive and press *[RESUME]*. The program will read the tape and compare device serial numbers. If the numbers do not match, you can change them by responding to the CRT prompts.

22. Measuring the Standard and Displaying the Data

    When you are ready to measure the device, press *[MEASURE DATA]* and respond to the prompts on the controller CRT. The program will initialize the system and give you instructions for making the proper connections. Measure all of the devices in your kit.

    Press *[PRINT ALL]* and the program will print out a complete results sheet for the measurement of the device. If the device fails at any frequency, the letter *F* will appear in the column and a failure notice will appear at the bottom of the sheet.

23. To quit the program, press *[PRIOR MENU]* until you can select the *[QUIT PROGRAM]* softkey.

Section 4. Service and Troubleshooting

INTRODUCTION

Follow this procedure to troubleshoot the HP 85106B system to the instrument level. This procedure was written for HP 85106B factory-racked systems. When the faulty instrument is found, stop this procedure and follow the respective instrument troubleshooting procedure to locate the faulty assembly.

WARNING

Each instrument in the HP 8510 system contains lethal voltages when the instrument has AC power applied. Refer to the HP 8510 safety information included in the "Service Overview" section of the HP 8510B Network Analyzer Service Manual, included with each HP 85106B system. Servicing must be performed by qualified personnel only.

TROUBLESHOOTING STRATEGY

Troubleshooting the system is done in three stages:

1. The pre-operational check can quickly identify many failures.
2. Using the HP 8510 internal diagnostics determines if the analyzer itself is functional.
3. Specific procedures are used for certain obious symptomatic failures. Hardware service tools are used to emulate source and test set functions, to identify a cause of failure outside the analyzer.

The first part of troubleshooting consists of a pre-operational check of the system that helps to verify that the system is cabled correctly, and that things such as firmware revisions, HP-IB addresses, voltages, and configuration and language switch settings are correct.

The HP 8510 Network Analyzer is the core instrument around which the HP 85106B system is built. The HP 8510 incorporates many internal diagnostics that check operation of the analyzer during initial application of AC line power and continuously while the instrument is running. The faulty system component can be isolated most effectively when these diagnostics are used to confirm or deny operation of the HP 8510.

During the pre-operational check, note any indications of failure that occurred before troubleshooting. These indications may be self-test failure messages, running error messages (caution type), measurement errors, performance test problems, or display hang-ups. Stay with the procedure; these will be discussed at the proper time. Refer to Figures 4-1, 4-2, or 4-3 System Block Diagrams as needed throughout this procedure.

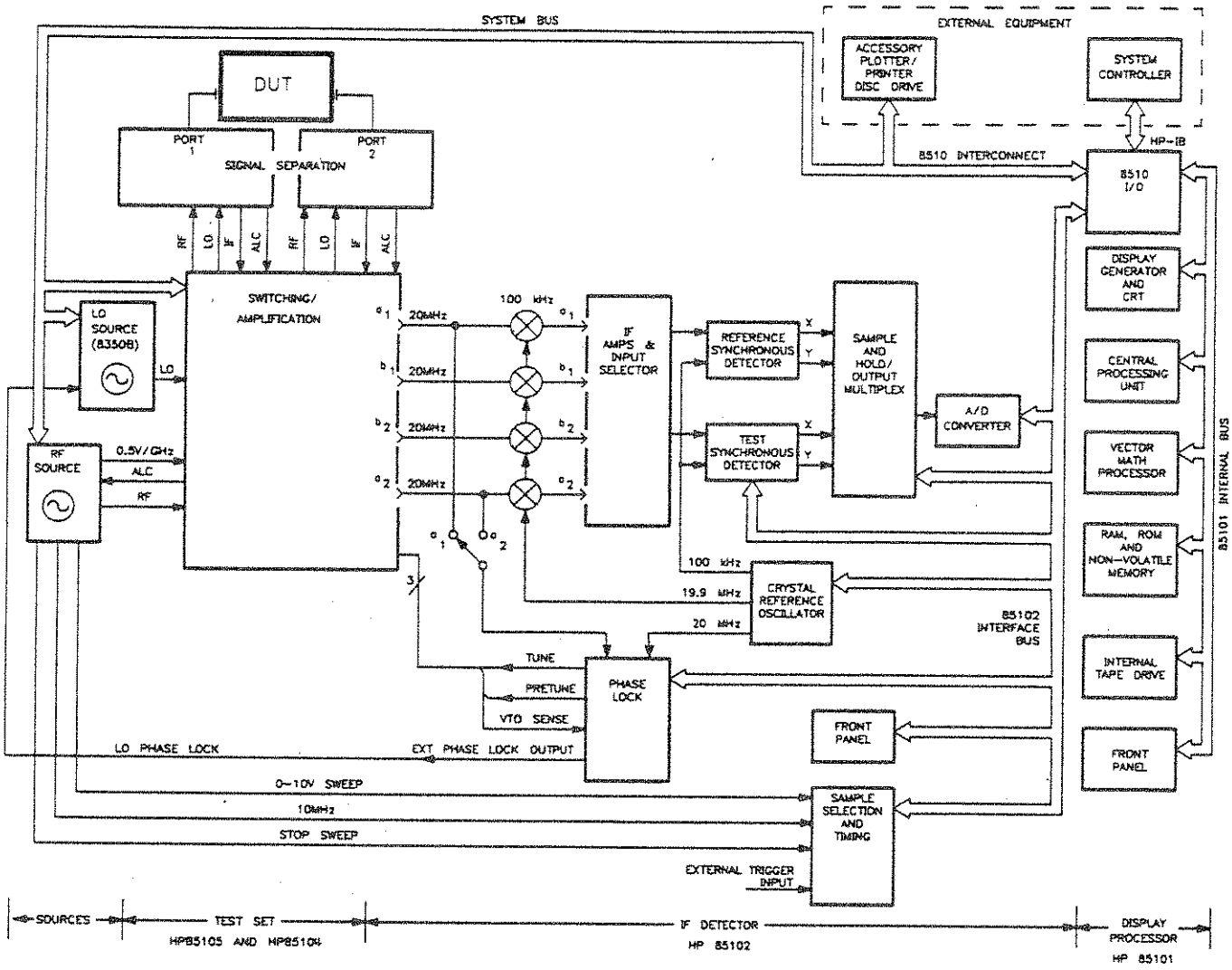


Figure 4-1. HP 85106B Standard System Block Diagram

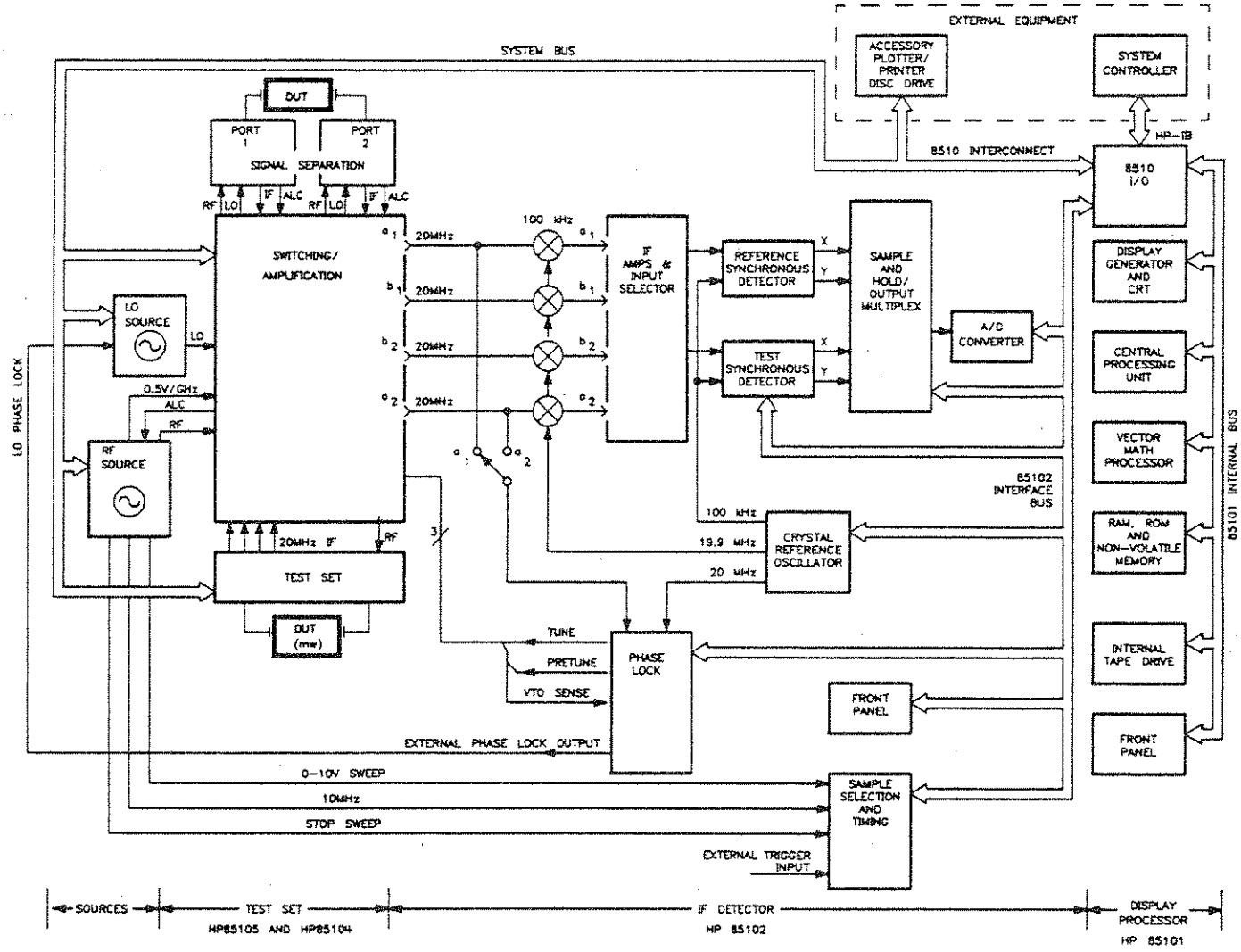


Figure 4-2. HP 85106B Option 001 System Block Diagram

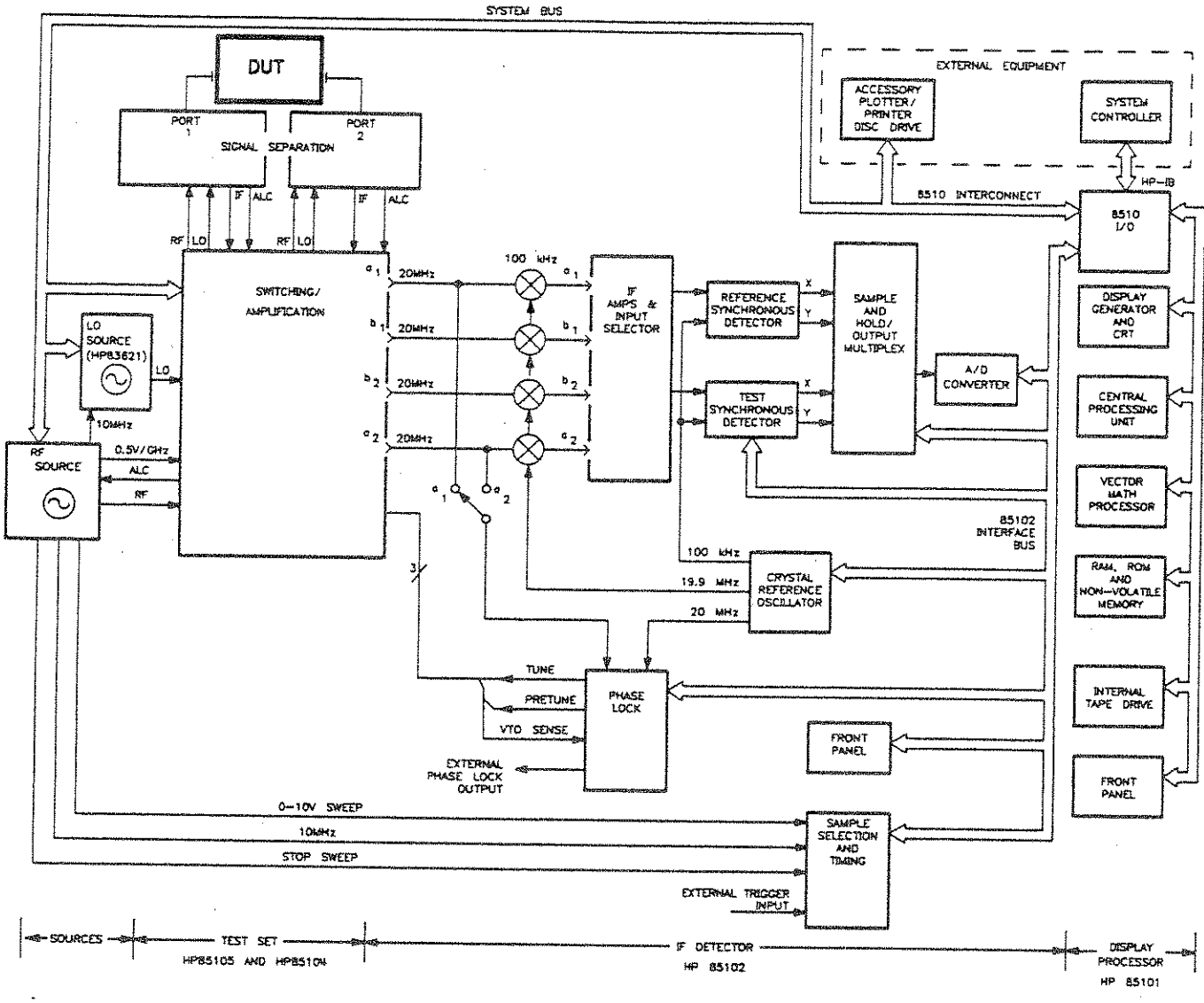


Figure 4-3. HP 85106B Option 002 System Block Diagram

DOCUMENTATION REQUIRED

Throughout this procedure, you are referred to other documentation for information and detailed troubleshooting procedures. The following manuals are referenced, and are therefore required to perform this troubleshooting procedure:

HP 8510B Service Manual (HP part number 08510-90078)
HP 8516A Operating and Service Manual (HP part number 08516-90001)
HP 8360 series Calibration and Installation Manual (HP part number 83621-90024 for the HP 83621A/31A synthesized sweeper)
HP 8350B Operating and Service Manual (HP part number 08350-90092)

1. PRE-OPERATIONAL SYSTEM CHECK

Perform a pre-operational check of the HP 85106B system as indicated in Table 4-1.

Table 4-1. Pre-Operational System Check Table

Check	Additional Information
HP 8510 Front/rear panel control settings	Intensity knob, HP 85101 rear panel service on/ system controlled switch
HP 8510 operating system firmware revision	Must be B.05.11 or later
Cabling and HP-IB addresses of all instruments in the system	See Figures 4-4, 4-5, 4-6, and 4-7 in this procedure
HP 8360 series source language switch setting	See the following paragraph, and Figure 4-7 in this procedure
HP 8350B source configuration switch setting	HP 8350B Operating and Service Manual
HP 8360 series source automated calibration procedure	HP 83621/31 Calibration and Installation Manual

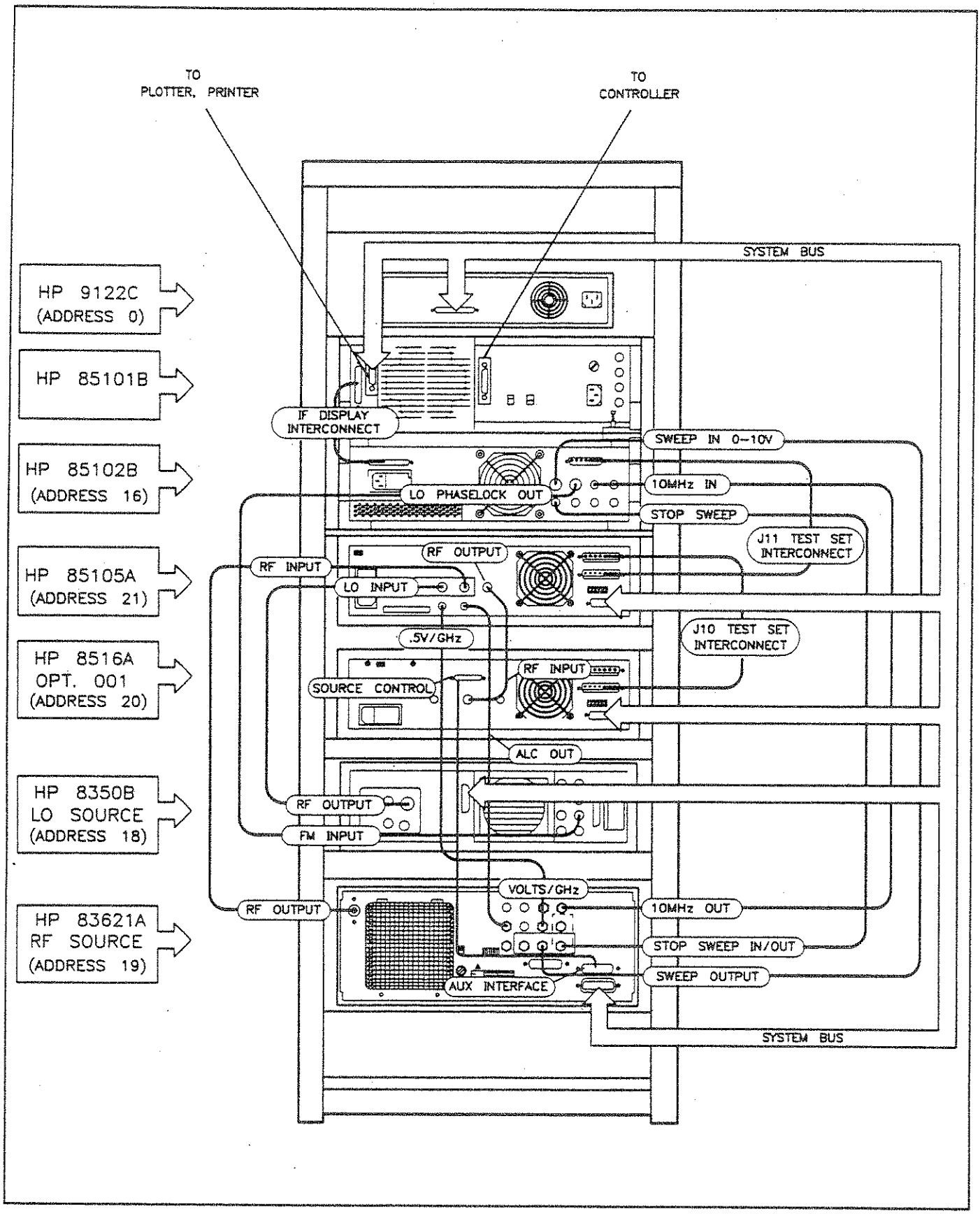


Figure 4-4. Racked HP 85106B Standard/Option 001 Cabling Diagram

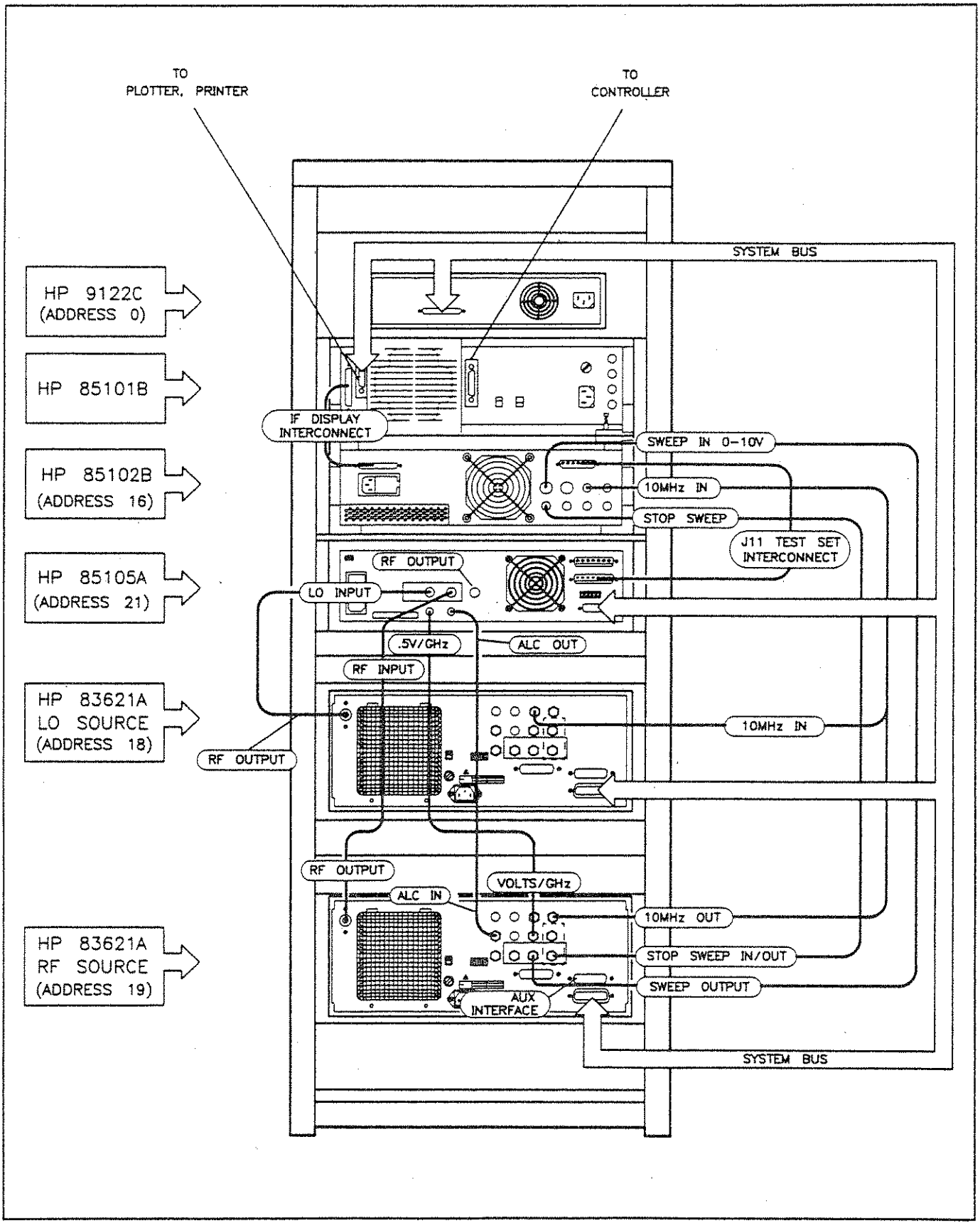


Figure 4-5. Racked HP 85106B Option 002 Cabling Diagram

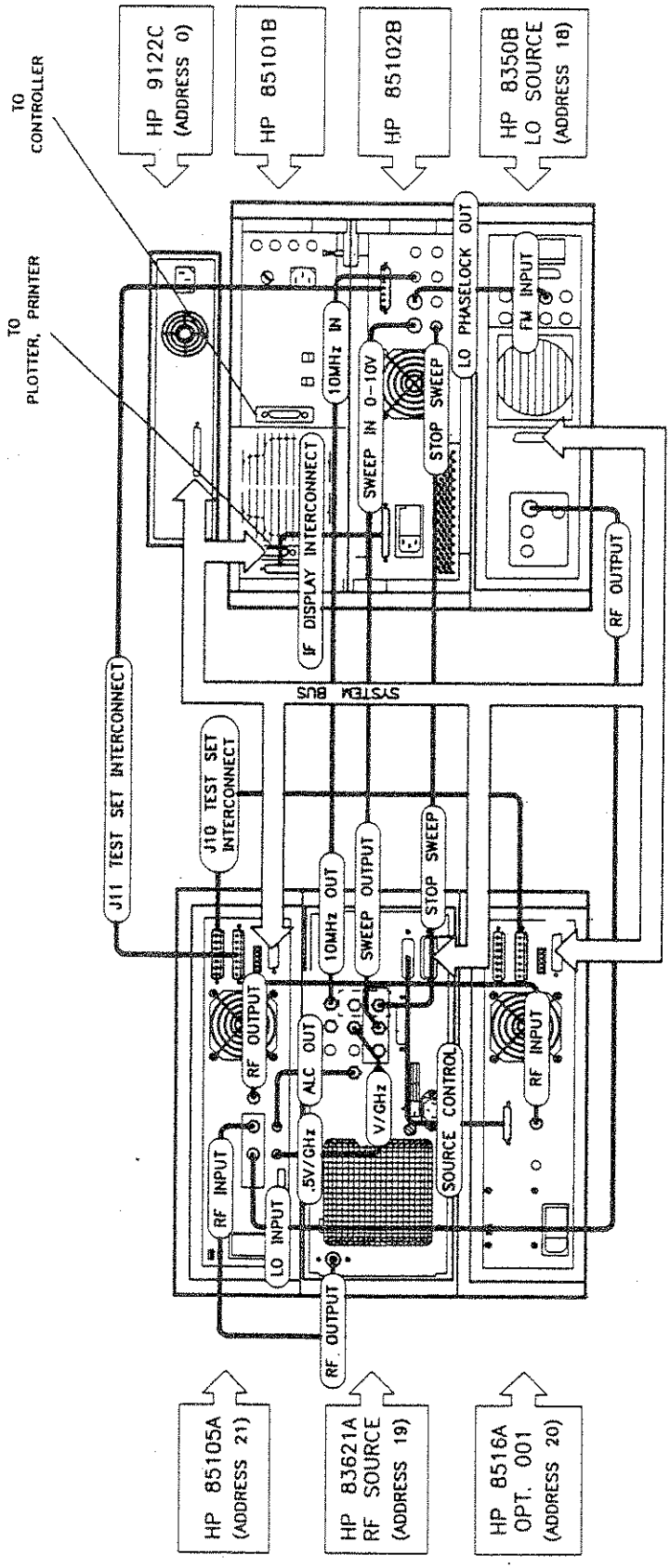


Figure 4-6. Benchtop HP 85106B Standard/Option 001 Cabling Diagram

HP 8360 Series Source Language and HP-IB Address Selection

The HP 8360 series synthesizers use one of the following external interface languages: TMSL (Test and Measurement System Language) or Analyzer Language. Operation in an HP 8510 system requires that the synthesizer be set to Analyzer Language.

The language configuration and the synthesizer HP-IB address are both set with a switch located on the rear panel of the synthesizer. The factory default setting for this switch is Analyzer Language at an HP-IB address of 19. This is the setting normally used for HP 8510 system sources.

Check the rear panel switch (Figure 4-7) to make sure that Analyzer Language and HP-IB address 19 have been set, as shown in the figure.

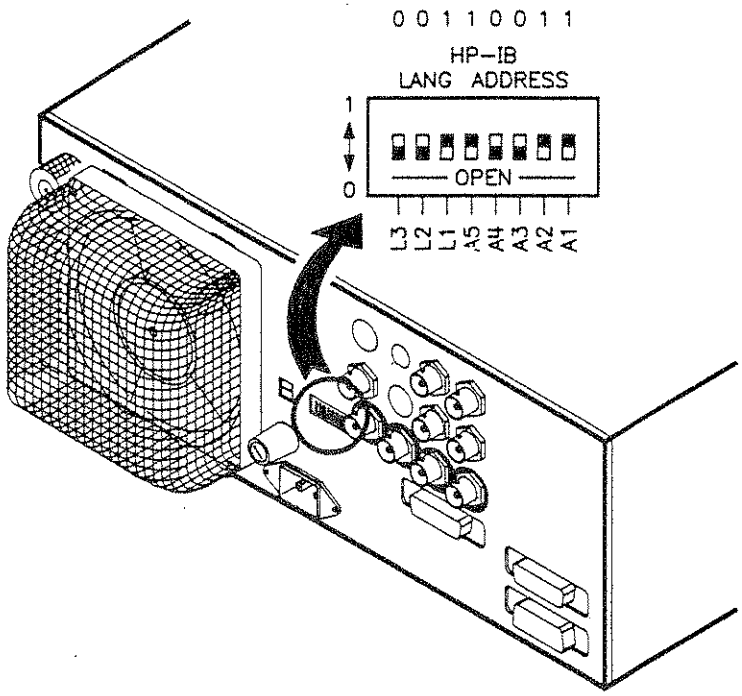


Figure 4-7. HP 8360 Series Source Rear Panel HP-IB Switch

2. TURN ON SYSTEM POWER AND OBSERVE INSTRUMENT FRONT PANELS

NOTE: In the next step, observe the preset routines for each instrument as AC line power is applied. Note any errors.

First, switch off AC line power to all system instruments. Next, apply AC line power to the following system instruments *in the order shown:*

Sources
Millimeter-wave controller/source modules
Test set (if included)
Disk drive

When all system instruments have completed their preset routines and are ready, apply AC line power to the HP 8510.

NOTE: If the HP 8510 hardware state and instrument state are incorrect or not loaded, the HP 8510 may display an error message and a beeper may sound. The beeper may be turned off by pressing the following HP 8510 front panel buttons:

(SYSTEM)
[BEEPER OFF]

If the hardware state and instrument state are incorrect or not loaded, load the desired "machine dump" file from the system disk by inserting the disk into drive 0 of the external disk drive and pressing the following keys on the HP 8510:

(TAPE/DISC)
[STORAGE IS DISK]
[LOAD] [MORE]
[MACHINE DUMP]

Refer to the "Getting Started" section of this HP 85106B Operating and Service Manual for more information about what is included in a "machine dump."

Use the RPG knob on the HP 8510 to select the file for the desired frequency band, then press ***[LOAD FILE]***. The system is ready for operation after the file loads from disk.

NOTE: **Do not** press the green **PRESET** button on the HP 8510! The system instrument state will be reset and the system will no longer be configured properly. The correct instrument state can be restored by pressing **INSTRUMENT STATE** (RECALL) and ***[INST STATE] [8]***.Refer to "Operation" in this HP 85106B Operating and Service Manual for a partial listing of the initial settings in the hardware state, instrument state, and calibration kit definitions loaded from disk.

Instrument state 8 is recalled each time the HP 8510 AC line power is turned on. The machine dump file loads this register with an appropriate full band sweep. Since the hardware state is not modified at power-up, the system can be configured to power up in a particular frequency range by saving the desired instrument state register number 8.

3. CYCLE THE AC LINE POWER

Turn the HP 8510 AC line power off and then on. *Do not* press **PRESET**! Check the RF power and sweep functions of the HP 8510 by observing the display and/or blinking sweep LED on the HP 8350B sweeper front panel. If used, the sweep LED on the HP 8340/41 synthesizer front panel may also be observed.

NOTE: If the HP 8510 locks up, the HP 8510 operating system may have to be re-loaded.

If there are any self-test failure messages or running error messages (caution type), refer to the HP 8510 Service Manual and follow the specific procedure associated with the type of test that failed. If there are unratioed power test failures, refer to "Check Unratioed Power Levels" at the end of this section.

4. CHECK HP 8510 DIAGNOSTICS

When the HP 8510 is energized, it runs an internal self-test check of several internal assemblies. Failure messages appear on the HP 8510 display, along with messages that may indicate the failure. During normal operation, the HP 8510 performs continuous internal diagnostics which indicate failures of the network analyzer during operation. These running error messages (caution type) are also shown on the display.

Self-Test Failure

If one or more self-tests fail as shown on the HP 8510 display, refer to the "self-test" tab in the HP 8510B Service Manual.

Running Error Messages (Beeping)

If a running error message (caution type) appears on the HP 8510 display, refer to the "Running Error Messages" tab in the HP 8510B Service Manual.

5. SYMPTOMATIC FAILURE TYPES

The nature of some types of failures is known. For instance, you may know that the system fails verification. The following paragraphs give suggested courses of action based upon the failure symptom. Based upon your problem (obvious or not), go to one of the following headings in this procedure:

- Millimeter-Wave, Phase Lock, Power Loss, or Frequency Related Problems
- Microwave, Phase Lock, Power Loss, or Frequency Related Problems When Using the Optional HP 8516A Test Set
- Calibration/Verification Problems
- Software Problems
- All Other Problems

Millimeter-Wave, Phase Lock, Power Loss, or Frequency Related Problems

Check Unratioed Power Levels. Refer to the test titled "Check Unratioed Power Levels" later in this troubleshooting procedure. Return to this location if the tests do not help solve the problem.

Microwave, Phase Lock, Power Loss, or Frequency Related Problems When Using the Optional HP 8516A Test Set

To help narrow these problems to the faulty instrument, the service adapter is used to emulate the operation of the source and test set and check unratioed power levels into the HP 85102 IF/Detector.

NOTE: When checking any unratioed power levels, make sure that averaging on the HP 8510 is turned *off*.Refer to "Unratioed Power Test" in the HP 8516A Operating and Service Manual. This procedure allows you to check the output power level of each test set sampler/mixer assembly and its associated IF amplifier individually. Depending upon the test outcome, the procedure directs you to the most probable cause of failure.

Power Supply Problems

WARNING

Each instrument in the HP 8510 system contains lethal voltages when the instrument has AC power applied. Refer to the HP 8510 safety information included in the "Service Overview" section of the HP 8510B Network Analyzer Service Manual, included with each HP 85106B system. Servicing must be performed by qualified personnel only.

Check all AC line (110V/220V) fuses and power switches. Remove the top covers of the following instruments:

HP 85101 network analyzer display/processor
HP 85102 network analyzer IF/detector
HP 85105A millimeter-wave controller
Sources

Check the LED power and service indicator lights. Measure each power supply voltage with a digital voltmeter. The HP 85102B power switch LED is supplied by the +5V supply in the HP 85101B.

Refer to "HP 8510 Power Supply Troubleshooting" behind the "Additional Tests" tab in the HP 8510 Service Manual for more information.

Calibration/Verification Problems

Read the respective manual for the calibration kit used and the connector care manual to review inspection, gauging, cleaning, and use of the calibration and verification devices and test port return cables.

Refer to "Performance Test Failure Troubleshooting" behind the "Additional Tests" tab in the HP 8510 Service Manual, or the information behind the "Performance Verification" tab in this HP 85106B Operating and Service Manual.

Software Problems

First try loading the standard operating system firmware into the HP 8510 from the backup copy. This operating system firmware *must* be revision B.05.11 or later in order for the HP 85106B system to function properly.

There is a chance that you encountered a software "bug" that is already known. Contact HP and explain the details so that the problem can be duplicated and checked.

Continue with "All Other Problems" in this troubleshooting procedure.

ALL OTHER PROBLEMS

The best approach to repair the HP 85106B at this point is to verify that the HP 85101 display/processor is working properly. When its operation is verified, it will act as your diagnostic controller.

Disconnect from the HP 85106B millimeter wave system any external controller, printer, plotter, disk drive, and so forth with all their cables. The instruments attached to the system now should be:

HP 8510 network analyzer
HP 85104A millimeter-wave test sets
HP 85105A millimeter-wave controller
Two Sources

Run the Service Program

This group of internal diagnostics, called the Service Program, will give the fastest and most complete check of the HP 85106 system. Whenever your HP 85106 system appears to have a failure, you can use this program to check the boards in the HP 8510 and HP 85105.

In general, the Service Program is used for the following purposes:

1. When there is a self-test failure, run the Service Program diagnostics for the board that failed, to verify the failure.
2. When there is a running error message (caution type), run the Service Program diagnostics for those board assemblies indicated in the "Running Error Messages" section in the HP 8510B Service Manual. The Service Program will verify if the board has a detectable problem.
3. When there is any reason to suspect a board level problem, run the Service Program diagnostics to check the boards.
4. After a board assembly is replaced, run the appropriate Service Program diagnostics again to verify that the board level failure has been repaired.

Service Hardware Tools

Two service tools are especially designed for use with these diagnostics. They are a source emulator and a test set emulator, both packaged in the back of the HP 8510B Service Manual. In addition, you will also need two BNC-to-BNC cables (not included). The HP 8510 will display a message to alert you when these tools are required in the Service Program.

Test Outcome. If a Service Program test fails and indicates a faulty board, you can be reasonably sure that the board should be replaced. However, refer to the information after the tabs "Front Panel Tests" and "Additional Tests" in the HP 8510B Service Manual. If there is another test for the board in question, you should perform the test to further verify the failure.

If running any of the Service Program tests does not verify or isolate the problem, refer to the information after the tabs "Front Panel Tests" and "Additional Tests" in the HP 8510B Service Manual. The information after these tabs contains separate and different information about testing certain boards and assemblies.

Symptoms Versus Failure Causes. Be sure that you have not overlooked any fundamental problems that can be disguised by a symptom of the real failure. Some of these fundamental problems include incorrect cabling/connections, instruments with incorrect firmware, error messages due to boards improperly seated in their sockets, and so forth.

Overall Service Program Flowchart. Figure 4-8 illustrates the overall Service Program flowchart including HP 8510 key presses to access *all* the tests included in this diagnostic.

NOTE: All tests used to generate signature analysis patterns are for factory repair and are not intended for on-site service. Also, you can always use the front panel recessed (TEST) button to exit the Service Program and reset the HP 8510. Be sure to properly reconnect the system.

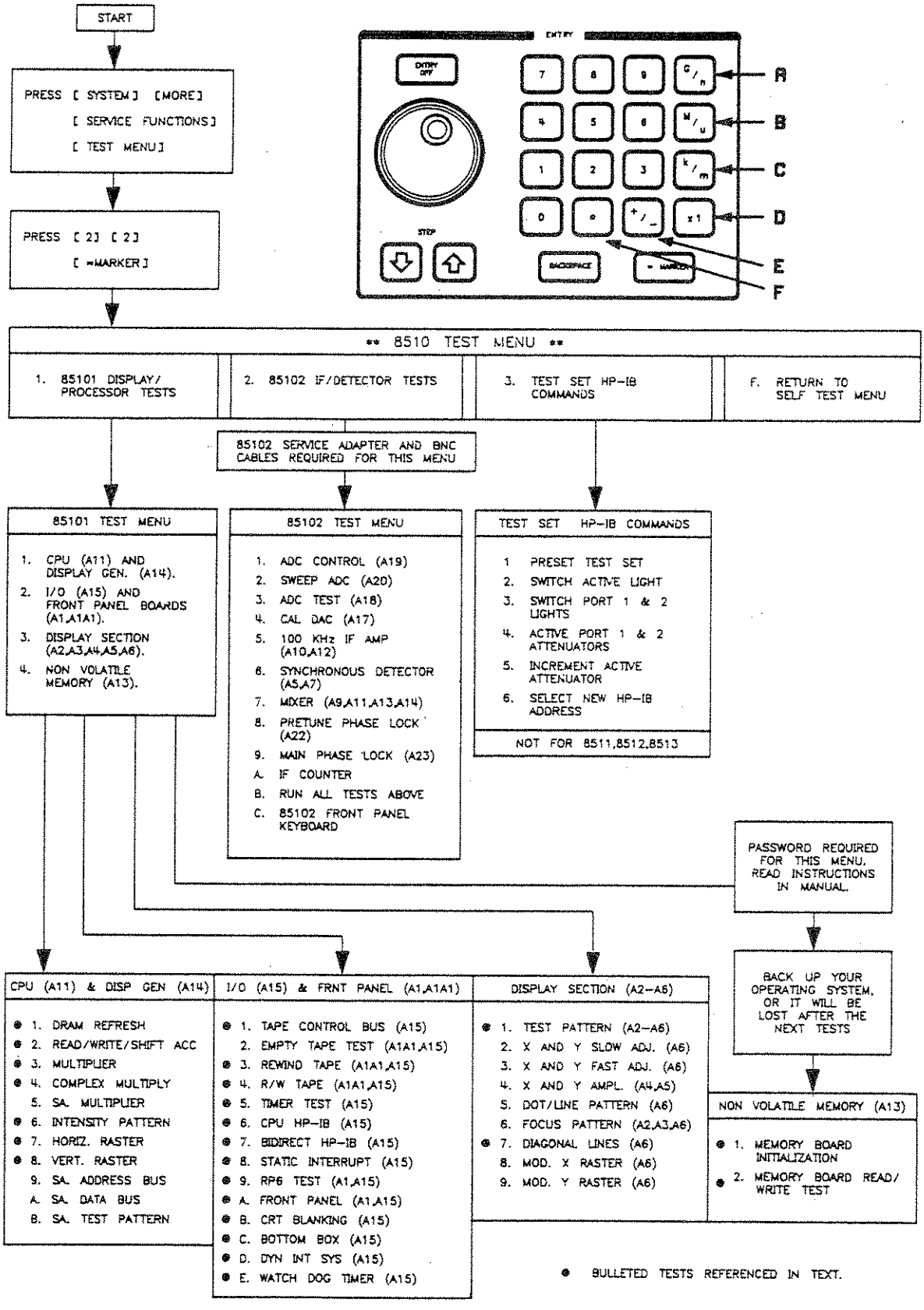


Figure 4-8. Overall Service Program Flowchart

Service Program Procedure Using HP 85101 Tests

Figure 4-9 illustrates the Service Program flowchart for the HP 85101 tests. Run the program *now* using all the bulleted (•) tests in the HP 85101 test menu. These tests can find 95% of all HP 85101 failures, and require approximately ten minutes to complete.

The bulleted steps under the HP 85101 test menu are the most important HP 85101 tests. Those tests not bulleted in the same group are mainly adjustments that increase troubleshooting time and are not needed.

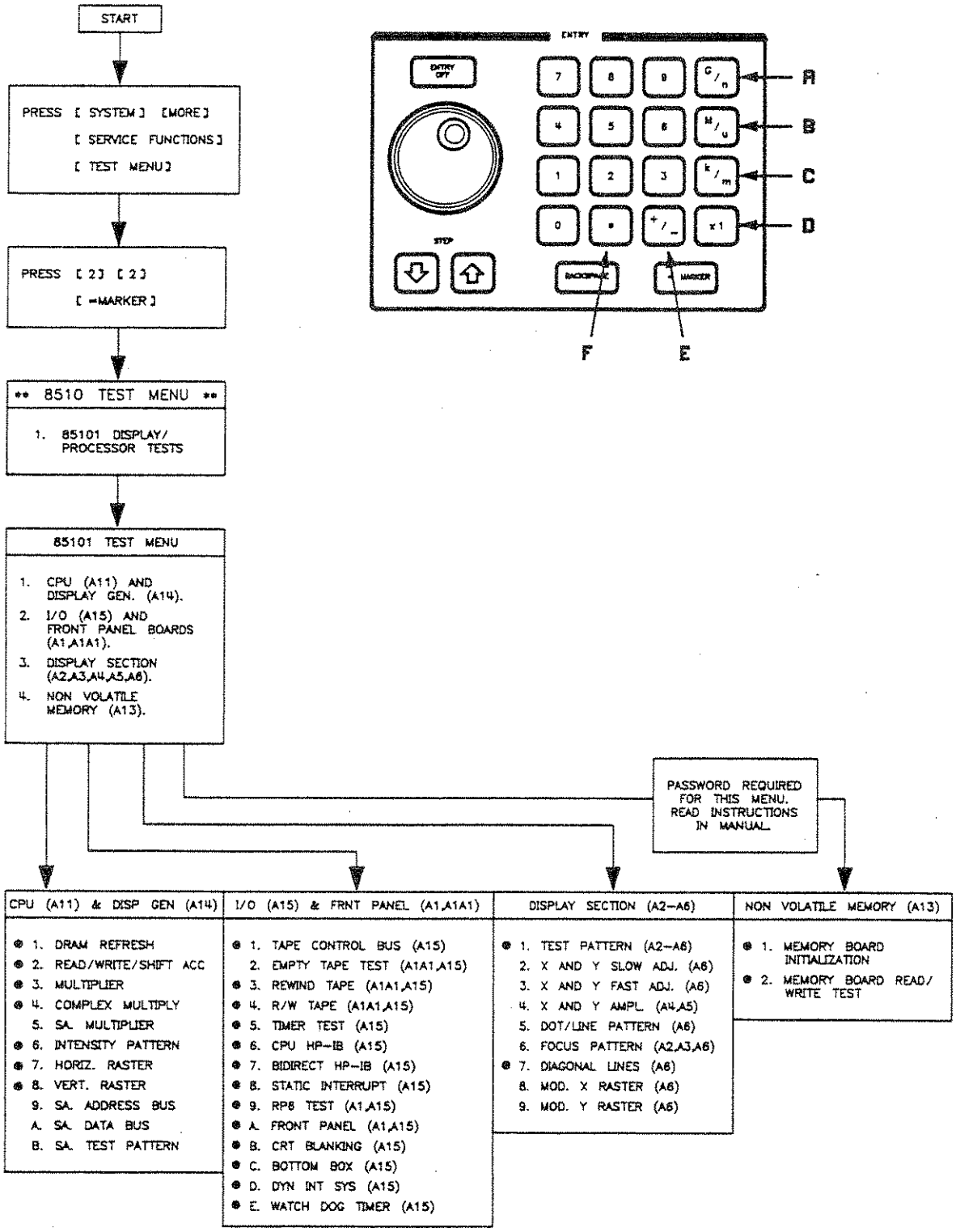


Figure 4-9. HP 85101 Service Program Flowchart

Service Program Procedure Using HP 85102 Tests

If the HP 85101 is working properly, then the problem is probably the HP 85102, the sources, or their interfaces. Verify operation of the HP 85102 by running the following HP 85102 Service Program tests.

Figure 4-10 illustrates the Service Program flowchart for the HP 85102 tests. Run the program *now*. These tests can find 80% of all HP 85102 failures and require approximately one minute to complete.

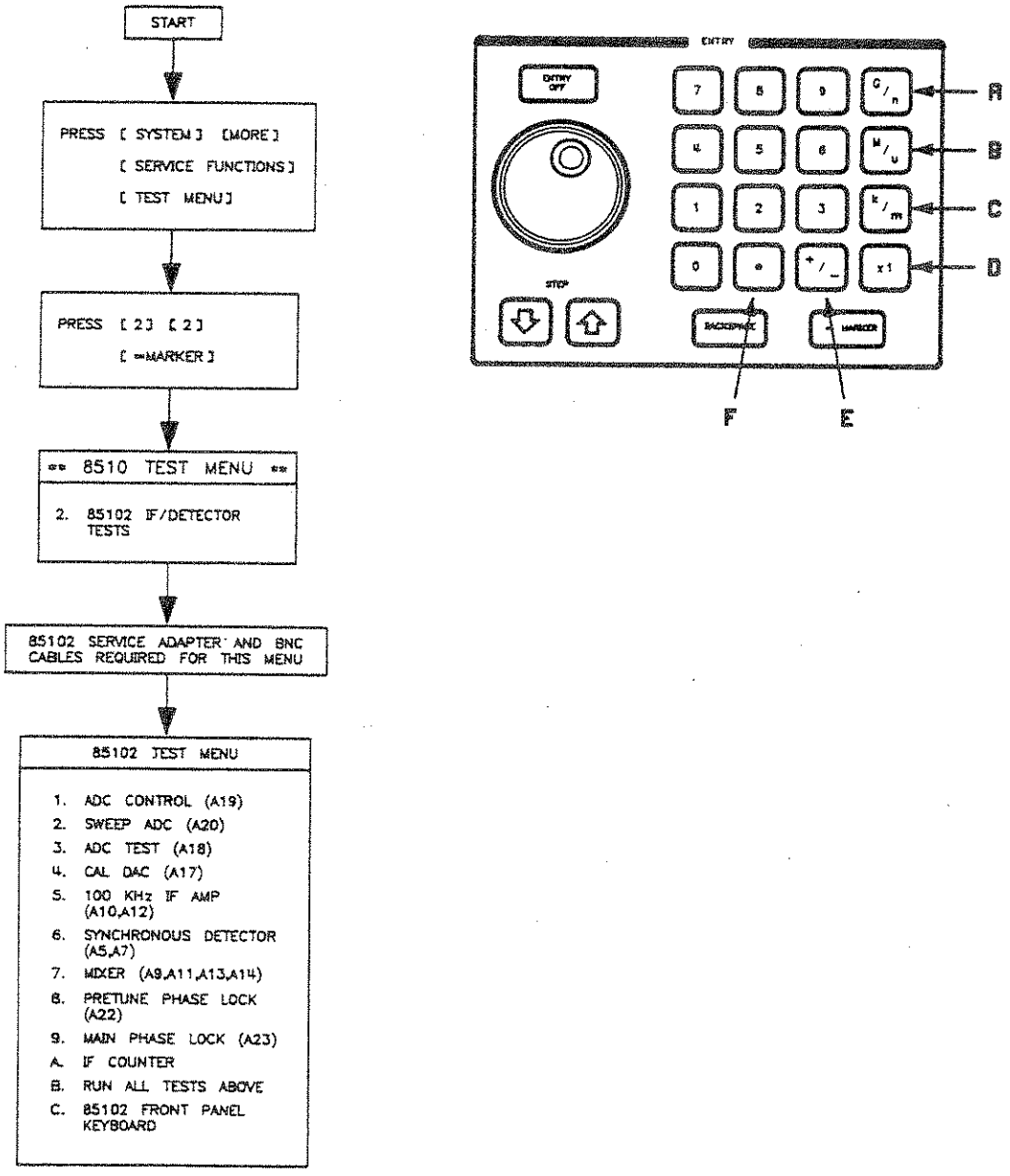


Figure 4-10. HP 85102 Service Program Flowchart

CHECK UNRATIOED POWER LEVELS

This procedure allows you to check the output power level of each sampler/mixer assembly and its associated IF amplifier individually.

The normal power level display, S_{11} for example, is a ratio (in this case, b_1/a_1). The network analyzer automatically applies power to and phase locks a predefined port or ports to make the measurement selected. Ratioed measurements provide useful data but they can mask certain malfunctions. Assume for example that 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 test each channel singly to check the power in an unratioed mode. To do so requires specifying which port receives the driven power, and which channel is phase-locked.

The following procedure includes steps to redefine parameters as required. The power levels given are *approximate*. Figure 4-11 shows which assemblies are parts of the signal path of each channel. Knowing that some assemblies are common to two, or all four channels is a powerful troubleshooting tool.

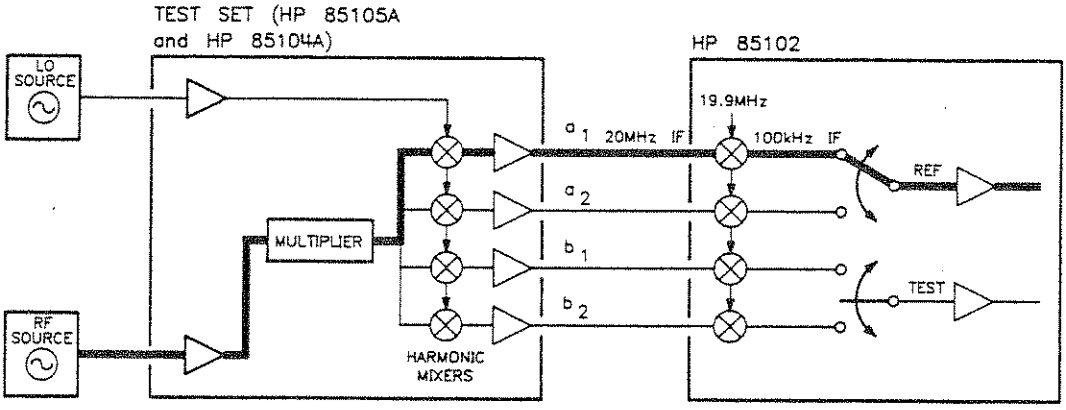


Figure 4-11. Simplified Signal Path of Unratioed Power Test

The mixers shown in the test set block of Figure 4-11 are harmonic mixers. They mix the multiplied signal from the RF source and a harmonic of the signal from the LO source to produce a 20 MHz IF output.

NOTE: All system instruments must be connected and averaging must be turned off during this test.

To check all of the IF signals in the HP 85104A Millimeter-Wave Test Sets, the a_2 and b_2 phase lock and drive paths must be redefined. If the configuration disk or tape has been loaded for the desired millimeter band, the user parameters have already been defined. The following keystrokes are given in case these user parameters ever have to be entered manually.

On the HP 8510, press the following keys to redefine a_2:

PARAMETER (MENU)
[User 3 a2]
[REDEFINE PARAMETER]
[DRIVE] [Port 2]
[PHASE LOCK] [a2]
[REDEFINE DONE]

To redefine b_2, press:

[User 2 b2]
[REDEFINE PARAMETER]
[DRIVE] [Port 2]
[PHASE LOCK] [a2]
[REDEFINE DONE]

Connect shorts to port 1 and port 2 of the test set modules. This is very important!!

On the HP 8510, press the following keys to check the IF signals indicated:

[User 1 a1] checks the a_1 incident IF signal
[User 2 b2] checks the b_2 reflected IF signal
[User 3 a2] checks the a_2 incident IF signal
[User 4 b1] checks the b_1 reflected IF signal

U-Band (40 to 60 GHz) Minimum Unratioed Power Levels:

a_1 or a_2 should be at least −16 dBm across the band
b_1 or b_2 should be at least −18 dBm across the band
with ≤3 dB power variation across the band

The maximum power level must not activate the *IF OVERLOAD* running error message.

W-Band (75 to 110 GHz) Minimum Unratioed Power Levels:

a_1 or a_2 should be at least −23 dBm across the band
b_1 or b_2 should be at least −33 dBm across the band
with ≤3 dB power variation across the band

The maximum power level must not activate the *IF OVERLOAD* running error message.

If All Four Channels Fail the Unratioed Power Test. If the power levels on all four channels fail, the most likely cause of failure is in the RF or LO source paths from the sources.

Remove the HP-IB and RF power cables from the HP 85106B system to isolate the sources. Refer to the appropriate source manual to troubleshoot the HP 8350B, 8340A/B, 8341A/B and 8360 series sources. Be sure to check the power levels out of the source and the RF cables from the sources to the HP 85106B system.

NOTE: Do not try to measure the RF source power in source #1 in the HP 85106B system by disconnecting the RF cable. Measuring the RF from the source breaks the leveling loop and causes the source to supply maximum power output. Instead, try placing a tee in the RF cable path and measure the power that way.

Consider substituting known good sources and cables for the suspected sources, if they are available.

If the sources are all good, then continue this procedure with "If One, Two, or Three Channels Fail the Unratioed Power Test."

If One, Two, or Three Channels Fail the Unratioed Power Test. If the power levels on at least one but not all of the four channels fail, the most likely cause of failure is the HP 85104A Millimeter-Wave Test Set Module or HP 85105A Millimeter-Wave Controller.

To help narrow the problem to the faulty instrument, the service adapter and service tools are used to emulate the operation of the source and test set and check unratioed power levels into the HP 85102 IF/ Detector.

NOTE: When checking any unratioed power levels, make sure that averaging on the HP 8510 is turned *off*.

Run the Service Program procedure (Figure 4-12) using the Test Set HP-IB Commands tests. These tests can find approximately 15% of all HP 85105 Millimeter-Wave Controller failures and requires approximately one minute to complete. The digital functionality of the HP 85105 is checked with this test, not the RF paths.

NOTE: Do not perform Test number 5 "Increment Active Attenuator" in the "Test Set HP-IB Commands" menu. The HP 85105A does not contain any attenuators.

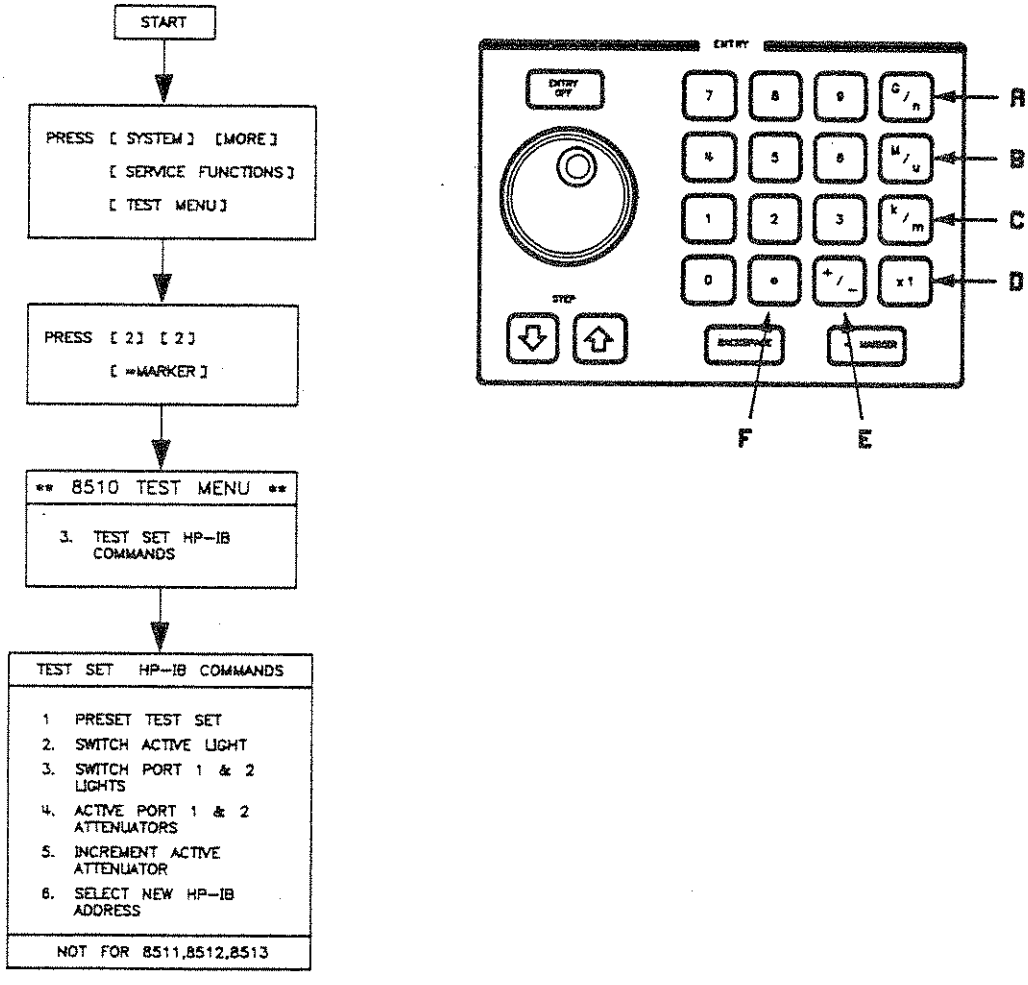


Figure 4-12. Test Set Service Program Flowchart

Troubleshoot the HP 85105A Millimeter-Wave Controller using the procedure in the HP 85105A section of this HP 85106B Operating and Service Manual.

Troubleshoot the HP 85104A Millimeter-Wave Test Set Module using the procedure in the HP 85104A section of this HP 85106B Operating and Service Manual.

Section 5. HP 85104A Test Set Module

INTRODUCTION

This section documents the operation, troubleshooting techniques, and replaceable parts of the HP 85104A Test Set Module.

DESCRIPTION OF THE INSTRUMENT

The HP 85104A Test Set Module (Figure 5-1) is used in conjunction with an HP 85105A Millimeter-wave Controller to make either reflection/transmission or S-parameter measurements at millimeter-wave frequencies. Two test set modules are required for S-parameter measurements.

WARRANTY

Refer to the "Getting Started" section of this manual for warranty information regarding the HP 85104A.

OPERATION

The features and functions of the test set module are described and shown below.

RECEIVING CHECKLIST

Along with your HP 85104A test set module you should have also received:

- 2 Waveguide straight sections (V- and W-band contain 3 straight sections)
- 1 Waveguide bend, 90°

FRONT AND REAR PANEL FEATURES

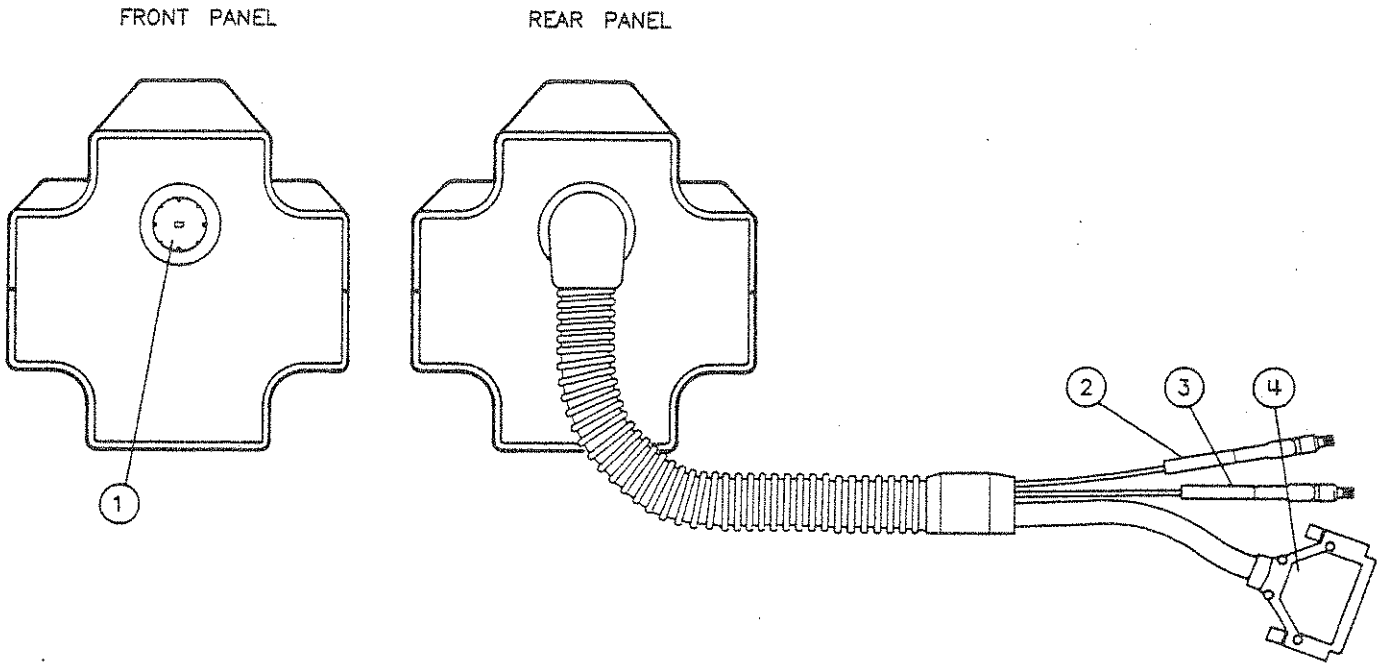


Figure 5-1. Front and Rear Panel Features of the HP 85104A (all waveguide bands)

1. **Test Port Connector.** The RF signal enters the device-under-test through this port.
2. **LO Input Cable.** The LO signal enters the test set module from the HP 85105A through this cable.
3. **RF Input Cable.** The RF signal enters the test set module from the HP 85105A through this cable.
4. **Module Interface Cable.** Voltage and ground lines enter the test set module from the HP 85105A through this cable. Incident and reflected IF signals are returned to the analyzer, and an ALC signal is returned to the RF source through this cable.

INSTALLING THE TEST SET MODULE

The test set modules were configured as part of the system in the "Getting Started" section of this manual. Refer to "Installing The Test Set Modules" in the "Getting Started" section to configure your test set module as shown in Figure 5-2.

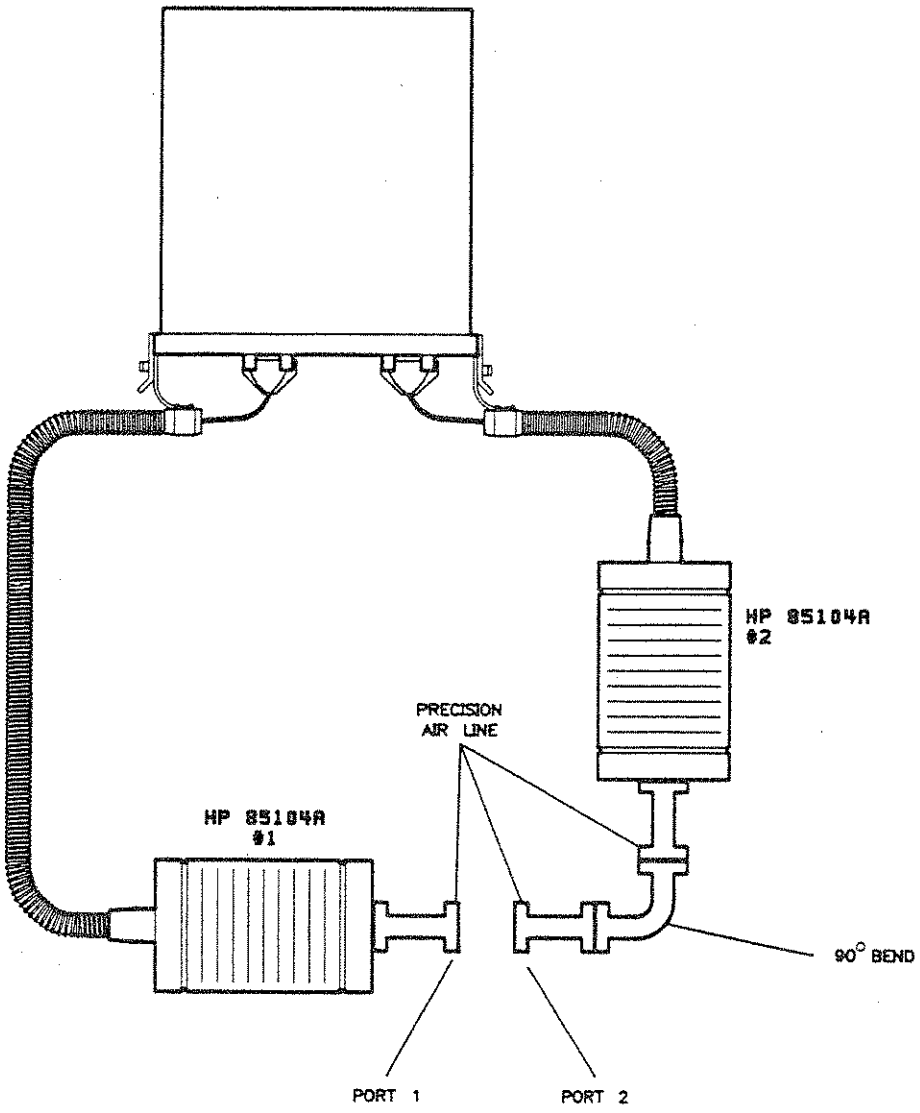


Figure 5-2. HP 85104A Test Set Module Configuration

Installing the Cable Support Assembly

The cable support assembly was installed as part of the system in the "Getting Started" section of this manual. Refer to "Installing the Cable Support Assembly" in the "Getting Started" section for more information.

USING THE TEST SET MODULE STAND

The test set module is attached to a stand that allows for vertical and horizontal adjustment. These adjustments are useful in aligning port 1 and port 2.

Vertical Adjustment

Adjustment Feet. The adjustment feet at each corner of the stand allow limited vertical adjustment of the test set module (Figure 5-3). The range of adjustment is approximately 13 mm (1/2 inch). Move port 1 and port 2 together just enough to judge their relative alignment. Adjust the feet on one of the modules until both modules are even and can be connected together. The waveguide parts must be coplanar.

Thumbwheel. The thumbwheel is on the elevator portion of the stand and allows for vertical adjustment of the module (Figure 5-3). The range of adjustment is approximately 31.75 mm (1.25 inch).

NOTE: Do not raise the module more than 38.1 mm (1 1/2 inches) using the thumbwheel. Otherwise, it is possible for the elevator assembly to disengage from the rest of the stand assembly.

Horizontal Adjustment

Slide Lever. The slide lever locks/unlocks the test set module's horizontal movement (Figure 5-3). The module is locked in place when the slide lever is toward the rear of the module, and unlocked when the slide lever is toward the front of the module. The range of horizontal adjustment is approximately 152 mm (6 inches). This adjustment is especially useful in a production environment in that it allows for quick setup and measurement of a number of devices while keeping the mm-wave modules stable and in place.

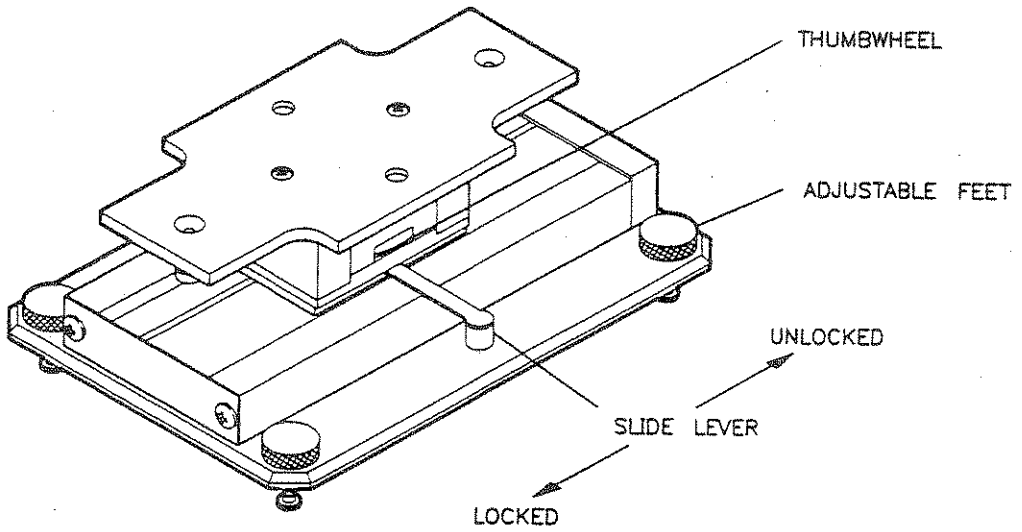


Figure 5-3. Test Set Module Stand

Removing the Test Set Module From the Stand

Follow the procedure below to remove the module from the stand.

1. Turn the power to the HP 85105A mm-wave controller off and disconnect the test set module. Refer to the "Getting Started" section of this manual for information on how to remove the cable support assembly.
2. Turn the module and stand over and loosen the 2 captive screws on the bottom of the stand (one on each end of the stand) until they disengage from the module.
3. Lift the stand off the module.

Reverse the above procedure to attach the module to the stand.

SPECIFICATIONS

Specifications describe the warranted performance of the instrument. The electrical specifications of the HP 85104A, when used in an HP 85106B system (rack or benchtop configuration), are defined in the "Performance Verification" section of this manual.

SUPPLEMENTAL CHARACTERISTICS

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

HP 85104A Supplemental Characteristics

Max RF Input Power (damage level) (into the test port) $>+27$ dBm

HP 85104A Power Requirements and Physical Characteristics

Operating Temperature:	0°C to 55 °C
Power:	All power to the HP 85104A is supplied by the HP 85105A.
Dimensions:	
Module only	292.1 mm x 174.6 mm x 196.9 mm 11 1/2 x 6 7/8 x 7 7/8 inches
Module with stand attached (maximum height)	292.1 mm x 177.8 mm x 349.3 mm 11 1/2 x 7 x 13 3/4 inches
Weight (approximate):	
Module only	5.9 Kg, 13 lb
Module with stand attached	9.1 Kg, 20 lb

TROUBLESHOOTING

The troubleshooting strategy for the test set module is similar to that of the HP 85106B system. Refer to the "Service and Troubleshooting" section, if you have not already done so, to verify that your test set module is faulty.

Follow the troubleshooting flowchart (Figure 5-4) to identify the faulty assembly. The flowchart is keyed to numbered troubleshooting procedures. As you progress through the flowchart perform the numbered procedure associated with each block. A block diagram of the test set module is included in this section to assist you in understanding the operation of the module.

THEORY OF OPERATION

A pair of HP 85104A test set modules are used in conjunction with an HP 85105A millimeter-wave (mm-wave) controller and provides all of the features and functions of a full S-parameter test set. The mm-wave controller routes the LO and RF signals from the sources to the test set modules. Switching from port 1 to port 2 is also performed by the mm-wave controller. The test set modules separate the incident from the reflected RF signal and then down convert those signals to a 20 MHz IF frequency.

Refer to the HP 85104A block diagrams (Figures 5-6 through 5-9) while reading the following description. The RF is received from the mm-wave controller and input to the source module block of the test set module. The RF is then multiplied six times in the case of W-band (2 times for R-band, 3 times for Q-band, 3 times for U-band and 4 times for V-band). This multiplied RF signal then passes through a coupler/detector (only in V and W bands) where the signal is sampled for use in an ALC loop. The RF continues through an isolator and a dual directional coupler. A portion of the incident signal is coupled off and passed through an isolator and into a harmonic mixer, A11. The signal received at the test port (either transmitted from another test set module or reflected from a device under test) is coupled off and passed through an isolator and into a harmonic mixer, A12. The 2-8 GHz LO signal is input from the source through the mm-wave controller. The signal is then divided and input to the harmonic mixers. In the case of W-band, the sixteenth harmonic of the LO mixes with the RF so that a 20 MHz IF frequency is output. The LO harmonic product must be 20 MHz higher in frequency than the RF signal. The IF frequencies (incident and reflected) are then output to the mm-wave controller for further processing. The mixing harmonics for other bands are; R-band: 8, Q-band: 10, U-band: 10, and V-band: 14. The isolators in the test set modules are used to keep reflections from the dual directional coupler, A8, from interfering with the source, and to keep reflections from the mixers, A11 and A12, from interfering with the incident and reflected RF signals.

TROUBLESHOOTING PROCEDURES

The following troubleshooting procedures correspond to the troubleshooting flowchart in Figure 5-4. Use the flowchart and the troubleshooting procedures to troubleshoot your test set module.

The following tools are required to perform these procedures, but are not supplied.

Tools Required

Tool	Size	HP Part Number
Torx-head screwdriver	T-10	8710-1623
Torx-head screwdriver	T-8	8710-1644
Hex-head balldriver	3/32	8710-1539
Pozidriv screwdriver	1 pt	8710-0899
Open-end wrench	5/16 inch	8720-0015
Wrist strap	N/A	9300-1383
Conductive mat	N/A	9300-0797

CAUTION

The test set modules are extremely sensitive to electrostatic discharge (ESD). Ground your work station and yourself before you handle these instruments.

TROUBLESHOOTING SEQUENCE

A flowchart of the troubleshooting sequence is illustrated below. Use this flowchart to determine the faulty assembly.

PROCEDURE 1: CHECK IF POWER LEVELS

1. Check the unratioed power levels (user parameters) for a1, b1, a2, and b2.

   Press PARAMETER (MENU) then press *[USER1]* through *[USER4]*. Refer to the table below for approximate power levels for the band you are using. Attach a short circuit to the module when you are checking b_1 or b_2. Power levels are measured using the configuration tape or disk RF levels.

Table 5-1. IF Power Levels

	Q-band* (WR-22)	U-band* (WR-19)	V-band* (WR-15)	W-band* (WR-10)
a1 USER1	−13 dB	−13 dB	−26 dB	−27 dB
b2 USER2	−15 dB	−15 dB	−27 dB	−28 dB
a2 USER3	−13 dB	−13 dB	−26 dB	−27 dB
b1 USER4	−15 dB	−15 dB	−27 dB	−28 dB

*These values are approximate. The power levels may vary as much as ±3 dB across the band.

PROCEDURE 2: SWITCHING ISOLATORS (A7, A9, or A10)

Before you start this procedure, turn off the power to the HP 85105A mm-wave controller and disconnect the HP 85104A from the HP 85105A.

1. Perform the disassembly procedure, steps 1 through 4, located later in this section.
2. Disconnect the suspect isolator at the coupler interface and at the mixer interface.
3. Loosen the 4 mixer bracket screws and slide the isolator out of the assembly.
4. Replace the suspect isolator with a known good isolator from your other test set module. Be sure to use good waveguide connection techniques (refer to the Operation section of this manual for connection procedures).

NOTE: You must exchange the suspect isolator with an isolator from the same auxiliary arm position.

5. Reconnect the HP 85104A to the HP 85105A. Turn the HP 85105A on and recheck the unratioed power levels (procedure 1).
6. Return to the troubleshooting flowchart.

PROCEDURE 3: SWITCHING MIXERS (A11, A12)

Before you start this procedure, turn off the power to the HP 85105A mm-wave controller and disconnect the HP 85104A from the HP 85105A. This procedure assumes the isolators have been switched back to their original modules.

1. Remove the IF and LO cables from the mixer inputs.
2. Disconnect the isolator at the mixer interface.
3. Remove the mixer bracket.
4. Replace the mixer with the mixer from the opposite auxiliary arm or with a mixer from your other test set module.
5. Attach the new mixer to the isolator and connect the IF and LO input cables. Be sure to use good waveguide connection techniques (refer to the Operation section of this manual for waveguide connection procedures).
6. Connect the mixer clamp to reduce the stress on the waveguide interface.
7. Reconnect the HP 85104A to the HP 85105A. Turn the HP 85105A on and recheck the unratioed power levels (procedure 1).
8. Return to the troubleshooting flowchart.

PROCEDURE 4: SWAPPING THE POWER DIVIDER (A6)

Before you start this procedure, turn off the power to the HP 85105A mm-wave controller and disconnect the HP 85104A from the HP 85105A.

1. Perform the disassembly procedure, steps 1 through 4, located later in this section.
2. Disconnect the LO In and LO Out cables from the power divider.
3. Remove the 2 screws from the power divider using the T-8 torx-head screw driver and slide the divider out of the assembly.
4. Replace the power divider with the power divider from your other test set module.
5. Reattach the LO input and output cables.
6. Reconnect the HP 85104A to the HP 85105A. Turn the HP 85105A on and recheck the unratioed power levels (procedure 1).
7. Return to the troubleshooting flowchart.

PROCEDURE 5: REMOVING THE INCIDENT ISOLATOR/MIXER ASSEMBLY (A9, A11)

Before you start this procedure, turn off the power to the HP 85105A mm-wave controller and disconnect the HP 85104A from the HP 85105A.

1. Perform the disassembly procedure, steps 1 through 4, located later in this section.
2. Disconnect the LO Input and LO Output cables from the power divider.
3. Disconnect the mixer bracket from the A11 mixer (incident signal path).
4. Disconnect the A9 isolator at the coupler interface (incident signal path).
5. Slide the isolator/mixer assembly out of the module and replace it with the incident arm assembly from your other test set module.
6. Reattach the isolator to the coupler. Be sure to use good waveguide connection techniques (refer to the Operation section).
7. Reattach the LO Input and Output cables to the mixer.
8. Reconnect the HP 85104A to the HP 85105A. Turn the HP 85105A on and recheck the unratioed power levels (procedure 1).
9. Return to the troubleshooting flowchart.

NOTE: This procedure also applies to the reflected channel isolator/mixer assembly, A10/A12.

PROCEDURE 6. REPLACING THE REFLECTED ISOLATOR/MIXER ASSEMBLY (A9, A11)

Repeat procedure 5 to return the A9/A11 assembly to the original module.

NOTE: This procedure also applies to the reflected channel isolator/mixer assembly, A10/A12.

PROCEDURE 7: CHECK THE RF POWER INTO THE A13 SOURCE BLOCK

The following equipment is required to perform this procedure:

Power Meter ..... HP 436A
Power Sensor ..... HP 8485A

Before you start this procedure, turn off the power to the HP 85105A mm-wave controller and disconnect the HP 85104A from the HP 85105A.

1. Perform the disassembly procedure, steps 1 through 4, located later in this section.
2. Remove the RF cable from the 90° coaxial bend and connect the RF cable to the power sensor.
3. Reconnect the HP 85104A to the HP 85105A. Turn the HP 85105A on and read the power level on the power meter. Refer to the table below for the correct power levels.

Table 5-2. RF Power Into the A13 Source Block

Band (GHz)	Power Level (dBm)
All Bands	> +13 dBm

4. Return to the troubleshooting flowchart.

PROCEDURE 8: CHECK THE RF POWER OUT OF THE A13 SOURCE BLOCK

The following equipment is required to perform this procedure:

Equipment Required	Q-band	U-band	V-band	W-band
Power Meter Power Sensor	HP 436A HP Q8486A	Anritsu ML83A Anritsu MP715A-004	Anritsu ML83A Anritsu MP716A	Anritsu ML83A Anritsu MP81B

Before you start this procedure, turn off the power to the HP 85105A mm-wave controller and disconnect the HP 85104A from the HP 85105A.

1. Perform the disassembly procedure, steps 1 through 5, located later in this section.
2. Disconnect the LO Input and LO Output cables from the power divider.
3. Remove the 2 screws from the power divider to remove the power divider.
4. Disconnect the main line isolator (A7) from the source and coupler interfaces.
5. Connect the power sensor to the A13 output as shown in Figure 5-5.

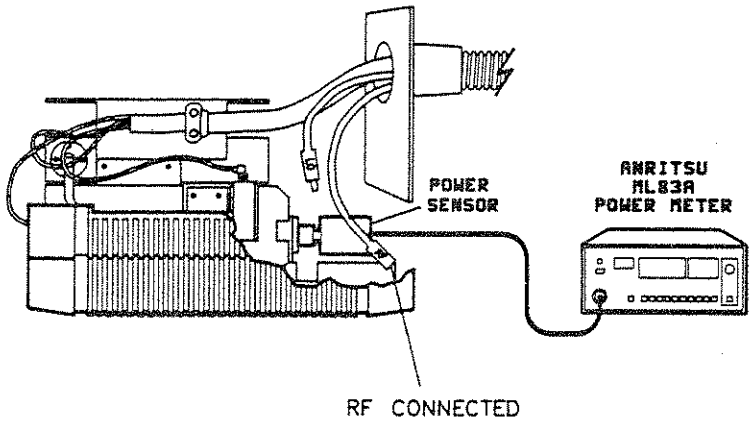


Figure 5-5. Power Level Test Setup

NOTE: It may be necessary to connect a waveguide straight section to the end of the power sensor to reach the A13 output.

6. Reconnect the HP 85104A to the HP 85105A. Turn the HP 85105A on and read the power level on the power meter. Refer to the table below for the correct power level of the band you are using.

Table 5-3. RF Power Out of the A13 Source Block

Band (GHz)	Power Level (dBm)
33 to 50 (Q-band)	>4
40 to 60 (U-band)	>3
50 to 75 (V-band)	>7
75 to 110 (W-band)	>3

7. Reassemble the test set module in the reverse order of what is listed in this procedure.
8. Return to the troubleshooting flowchart.

PROCEDURE 9: SWITCH MAIN LINE ISOLATOR

Before you start this procedure, turn off the power to the HP 85105A mm-wave controller and disconnect the HP 85104A from the HP 85105A.

1. Perform steps 1 through 5 of procedure 6.
2. Replace the suspect isolator with the isolator from your other test set module.
3. Reattach the LO power divider by replacing the 2 screws and reconnecting the LO input and output cables.
4. Reconnect the HP 85104A to the HP 85105A. Turn the HP 85105A on and recheck the unratioed power levels (procedure 1).
5. Return to the troubleshooting flowchart.

PROCEDURE 10: CHECK LO INPUT TO POWER DIVIDER A6

The following equipment is required to perform this procedure:

Power Meter ..... HP 436A
Power Sensor ..... HP 8485A

Before you start this procedure, turn off the power to the HP 85105A mm-wave controller and disconnect the HP 85104A from the HP 85105A.

1. Follow the disassembly procedure (located later in this section) through step 4.
2. Disconnect W7 from the 90° bend of the power divider.
3. Connect the power sensor to W7.
4. Reconnect the HP 85104A to the HP 85105A. Turn the HP 85105A on and read the power level on the power meter. Refer to the table below for the correct power level of the band you are using.

Table 5-4. Power Divider LO Input Level

Band (GHz)	Power Level (dBm)
All Bands	>19 dBm

5. Return to the troubleshooting flowchart.

PROCEDURE 11: CHECK ALL VOLTAGES TO THE SOURCE

1. Refer to the paragraph titled "Module Interface Connector" in the HP 85105A section of this manual and check the voltages on the front panel of the mm-wave test set controller. These voltages are the same voltages entering the A13 source block through the black interface connector on the A5 board (part of the A13 block).
2. Return to the troubleshooting flowchart.

DISASSEMBLY PROCEDURE

This section provides one disassembly procedure that completely disassembles a U-band test set module. Notes are made in the procedure for differences regarding the other waveguide bands. Follow the procedure in order, and stop at the level of disassembly needed for your repair.

Tools Required

Tool	Size	HP Part Number
Torx-head screwdriver	T-10	8710-1623
Torx-head screwdriver	T-8	8710-1644
Hex-head balldriver	3/32	8710-1539
Pozidriv screwdriver	1 pt	8710-0899
Wire cutter	N/A	8710-0012
Open-end wrench	5/16 inch	8720-0015
Wrist strap	N/A	9300-1383
Conductive mat	N/A	9300-0797

CAUTION

The test set modules are extremely sensitive to electrostatic discharge (ESD). Ground your work station and yourself before you handle these instruments.

Procedure

The step numbers correspond to the numbers shown in Figure 5-10. Refer to this figure as you disassemble the test set module.

1. Turn the test set module over so the bottom side is facing up. Remove the stand by loosening the 2 captive screws until the module and stand are disengaged.
2. Remove all extensions from the test port.
3. Remove the 2 bumpers from the housing (one at each end). Remove the 2 torx-head screws from the bottom housing and pull the bottom housing off.
4. Slide the front panel up and out. Cut and remove the cable ties.
5. Disconnect the RF and LO cables from the 90° coaxial bends that are connected to the main top mount (near the power divider).
6. Remove the cable clamp.
7. Disconnect the IF cabling (red/white and blue/white) from the mixers.
8. Disconnect the module interface connector from the A5 board, which is part of the A13 source block.
9. Disconnect the ALC cable (yellow/white) from the A5 board.

NOTE: In some modules this cable may not be accessible at this time. Remove this cable when it becomes accessible.

10. For V and W-bands, disconnect the detector cable from the A5 board, which is part of the A13 assembly. Leave this cable connected to the detector (A14).

NOTE: The coupler/detector (A14) and the source block (A13) must be returned together (attached with 2 screws) if either component is faulty.

11. Remove the rear panel/cable assembly.

12. Remove the hex-head screws from the bottom mount and remove the mount.

13. Remove the semi-rigid coaxial cables from the LO power divider to the mixers.

14. Remove 4 mixer bracket screws and remove the mixer bracket from both sides of the source block.

15. Disconnect the isolator-mixer assembly arms by removing the screws from the flange at the coupler interface.

16. Remove the mixer clamp.

17. Remove the 2 torx-head screws (size T-8) from the LO power divider and remove the power divider.

18. Disconnect the main line isolator arm at the source interface by removing the 4 hex-head screws from the flange.

19. Remove the hex-head screws from the coupler bracket.

20. Slide the coupler/isolator assembly to the rear of the instrument and remove it.

21. For V and W-bands, remove the coupler/detector (A14) from the dual directional coupler (A8).

22. Remove the torx-head screws from the coupler bracket and remove the bracket.

23. Remove the 90° coaxial bend from the RF cable near the RF clamp on the source block.

24. Turn the source block over and remove the 4 torx-head screws from the top housing.

25. Remove the source module assembly, which includes the aluminum bar mount.

NOTE: The coupler/detector (A14) and the source block (A13) must be returned together (attached with 2 screws) if either component is faulty.

This completes the disassembly procedure for the HP 85104A test set module. Refer to the assembly procedure to reassemble the test set module.

NOTE: The assembly procedure must be followed in sequence; it is not the reverse of the disassembly procedure.

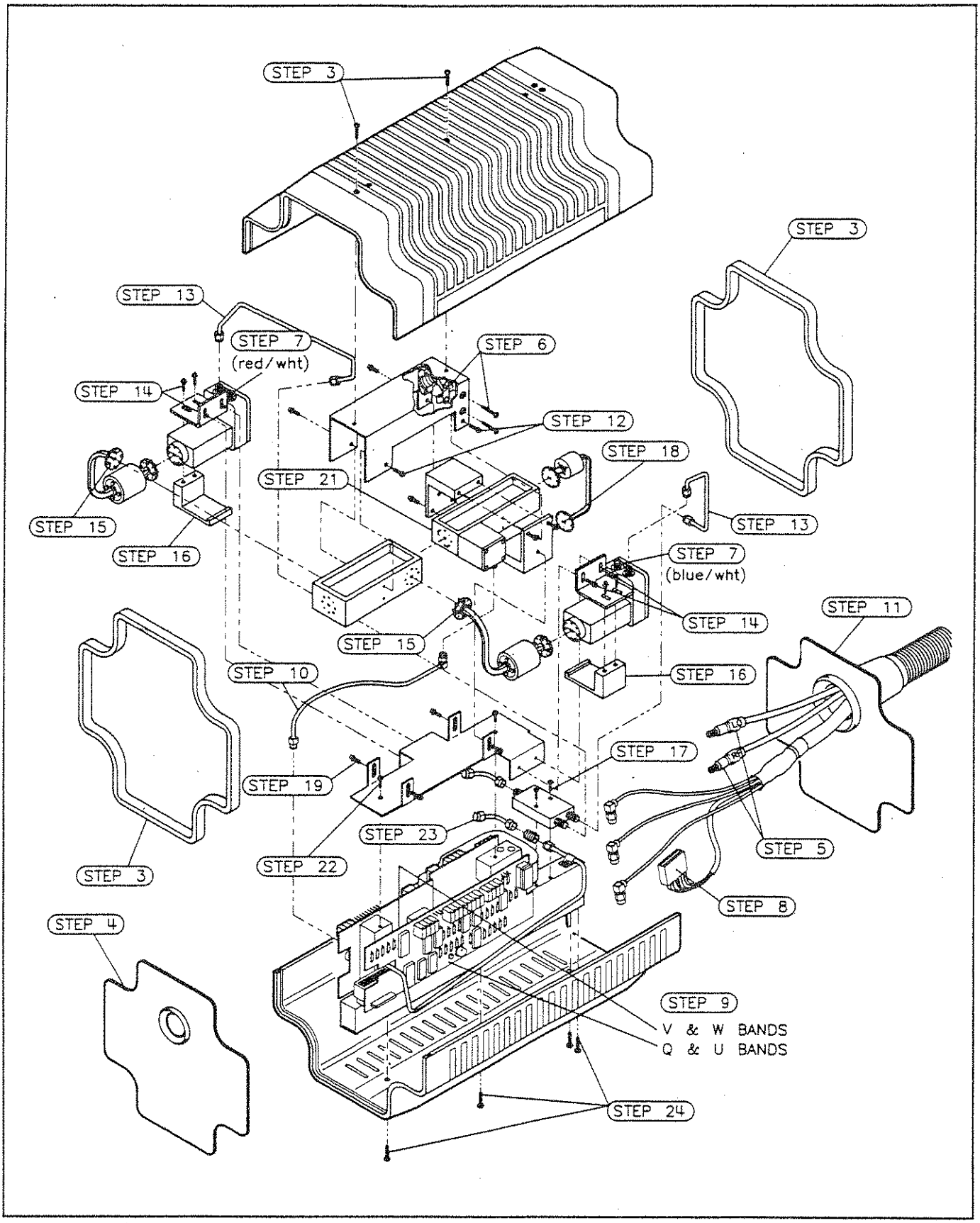


Figure 5-10. HP 85104A Disassembly Procedure

ASSEMBLY PROCEDURE

This section provides one assembly procedure that completely assembles a U-band test set module. Notes are made in the procedure for differences regarding the other waveguide bands. Follow the procedure in order, starting at the step number needed for your repair.

NOTE: The assembly procedure must be followed in sequence; it is not the reverse of the disassembly procedure.

Tools Required

Tool	Size	HP Part Number
Torx-head screwdriver	T-10	8710-1623
Torx-head screwdriver	T-8	8710-1644
Hex-head balldriver	3/32	85104-20035
Pozidriv screwdriver	1pt	8710-0899
Cable ties	N/A	1400-0249

Procedure

The step numbers correspond to the numbers in Figure 5-11. Refer to this figure as you assemble the test set module.

1. Put the source block inside the top housing and insert 4 torx-head screws on the outside of the top housing.
2. Connect the 90° coaxial bend to the semi-rigid cable on the top mount of the source block.
3. Place the coupler bracket on the A13 assembly and attach it with torx-head screws.
4. Connect the coupler/detector (A14) to the dual directional coupler (A8).
5. Using the guide pins, align the flange of the coupler/isolator assembly with the flange of the source block. Hold the mating surfaces in contact while engaging the first few threads of each screw (use 4 long hex-head screws). Follow the standard flange connection technique as outlined in the "Getting Started" and "Operation" sections of this manual.

NOTE: You may have to hold the opposite end of the coupler higher in order to mate the surfaces of the isolator and source module block.

6. Once a good connection has been made at the source/coupler interface, insert the hex-head coupler bracket screws.
7. Position the LO power divider on the source block with the input port towards the right side of the instrument, referenced from the front of the instrument. Use the screw holes toward the right side of the instrument on the source block to attach the LO power divider.
8. Attach the bottom mount to the coupler using hex-head screws.
9. Slide the rear panel/cable assembly into the grooves of the top housing.
10. Connect the cable clamp around the main interface cable and screw the clamp to the right side of the coupler bracket.
11. Attach the module interface connector to A5.
12. Attach the ALC cable (yellow/white) to A5.

13. For V- and W-bands, attach the coupler/detector cable (W13).

14. Place a mixer clamp on each side of the housing across from the coupler bracket side mount.

15. Attach a mixer/isolator assembly to each mixer clamp by aligning the isolator flange with the coupler interface (use the guide pins). Follow the waveguide connection procedure in step 4 of this procedure to connect the flanges.

16. Attach a mixer bracket to each mixer using 2 screws on the mixer clamp and 2 screws on the coupler bracket.

17. Attach the semi-rigid coaxial cables from the LO power divider to the mixers; W10 to the left mixer, and W11 to the right mixer.

18. Attach the IF cables to the mixers (red/white to the incident mixer, blue/white to the reflected mixer).

19. Attach the RF and LO cables (part of the rear panel/cable assembly) to the coaxial elbows on the top mount.

20. Slide the front panel into the groove of the top housing.

NOTE: The grommet in the front panel should move freely after the bottom housing is tightened down.

21. Attach the long flexible cables to a bracket or piece of waveguide with a cable tie.

22. Attach the bottom housing using 2 torx-head screws.

23. Attach the stand to the module by aligning the 2 captive screws with the module and tightening them. Refer to the "Getting Started" section for the procedure to attach the stand. Attach new bumpers to the test set module; the original bumpers cannot be used again. Refer to "Replaceable Parts" for part numbers of the bumper.

24. Reattach the test port extensions (straight sections and bends) to the test port.

The assembly procedure of the test set module is complete. Perform the operator's check for the HP 85106B system located in the "Operation" section of this manual. If the unit is working, a performance verification should be done to assure that the system is operating within its specifications. Refer to the chapter "Performance Verification" in this manual for information.

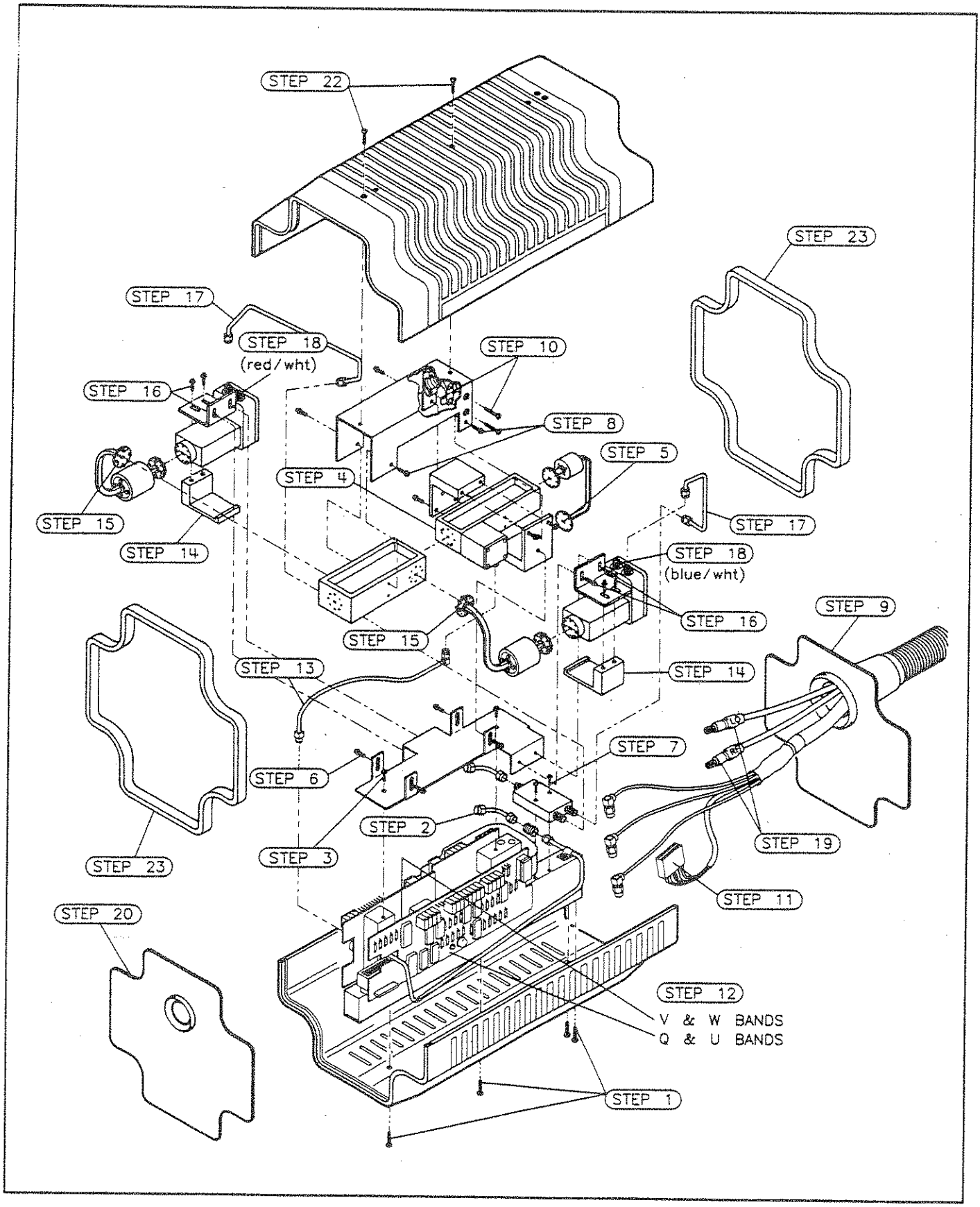


Figure 5-11. HP 85104A Assembly Procedure

REPLACEABLE PARTS

This section contains information about ordering replaceable parts for the HP 85104A test set module. Figures 5-12 through 5-16 list the replaceable parts in reference designator order.

Ordering Information

To order a part listed in this section, quote the Hewlett-Packard part number, indicate the quanity required, and address your order to the nearest Hewlett-packard office.

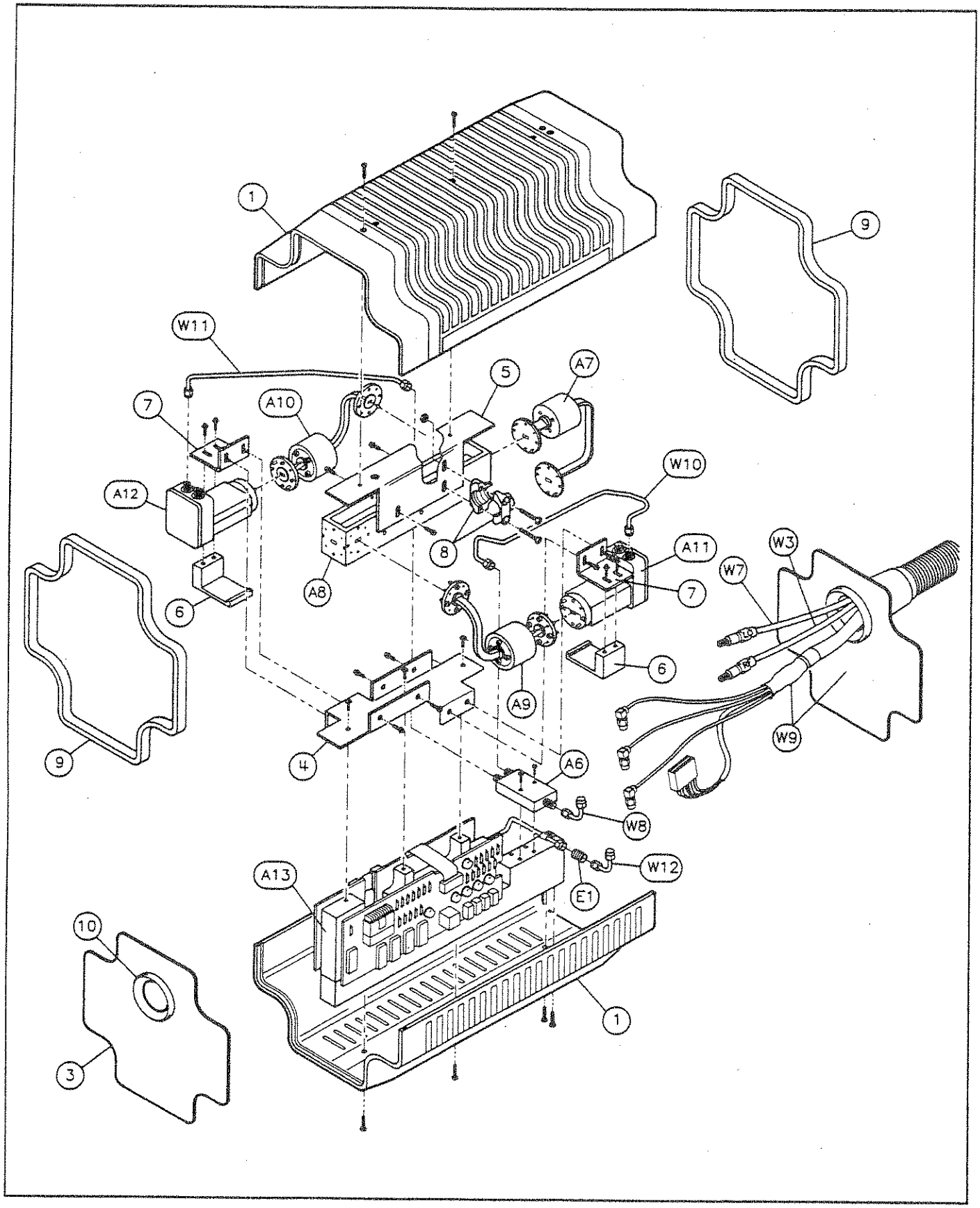


Figure 5-12. HP Q85104A Replaceable Parts (1 of 2)

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	85104-20001	2	Housing	28480	85104-20001
3	85104-00001	1	Front Panel	28480	85104-00001
4	85104-00009	1	Coupler Bracket	28480	85104-00009
5	85104-00007	1	Bottom Mount	28480	85104-00007
6	85104-20020	2	Mixer Clamp	28480	85104-20020
7	85104-00008	2	Mixer Bracket	28480	85104-00008
8	85104-20019	1	Cable Clamp	28480	85104-20019
9	85104-40001	2	Bumper	28480	85104-40001
10	85104-40002	1	Front Panel Grommet	28480	85104-40002
A6	0955-0264	1	Power Divider	28480	0955-0264
A7	85104-60022	1	Isolator	28480	85104-60022
A8	85104-60021	1	Dual Directional Coupler	28480	85104-60021
A9	85104-60023	1	Incident Isolator	28480	85104-60023
A10	85104-60023	1	Reflected Isolator	28480	85104-60023
A11	11643-60028	1	Incident Mixer	28480	11643-60028
A12	11643-60028	1	Reflected Mixer	28480	11643-60028
A13	85104-60011	1	Q-band Module Assy	28480	85104-60011
E1	1250-1158	1	ADPT F SMA F SMA	28480	1250-1158
W3	85104-60016	1	RF Cable Assembly	28480	85104-60016
W7	85104-60017	1	LO Cable Assembly	28480	85104-60017
W8	85104-20021	1	RF Cable - 90° Bend	28480	85104-20021
W9	85104-60015	1	Interconnect Cable Assy Rear Panel	28480	85104-60015
W10	85104-20004	1	Incident LO Input Cable	28480	85104-20004
W11	85104-20005	1	Reflected LO Input Cable	28480	85104-20005
W12	85104-20021	1	RF Cable - 90° Bend	28480	85104-20021
			CABLE SUPPORT ASSY		
	85104-00018	1	Bracket	28480	85104-00018
	85104-20037	1	Clamp	28480	85104-20037
	85104-20038	1	Barrel	28480	85104-20038
			HARDWARE		
	0515-0373	10	SMM 3.0 10 PN TX	28480	0515-0373
	0515-2007	2	SMM 2.5 16 PN TX	28480	0515-2007
	2200-0155	2	SM 440 1.000 PNPD	28480	2200-0155
	2360-0115	8	SM 632 .312 PNPD	28480	2360-0115
	3030-0221	23	SS 440 .375	28480	3030-0221
	2190-0030	27	WSHR LK .115ID 4	28480	2190-0030
	2260-0009	1	Nut-hex 4-40	28480	2260-0009
	3050-0105	27	WSHR FL .125ID 4	28480	3050-0105
			MISCELLANEOUS		
	11644-60033	2	Waveqd Straight, 10 cm	28480	11644-60033
	85104-60034	1	90° Waveguide Bend	28480	85104-60034
	8710-1539	1	Ball Driver	28480	8710-1539
			PARTS NEEDED BUT NOT SUPPLIED		
	8710-0899	1	Pozi Screwdriver, 1	28480	8710-0899
	8710-1623	1	Torx Screwdriver, 10	28480	8710-1623
	8710-1644	1	Torx Screwdriver, 8	28480	8710-1644
	8720-0015	1	Open-end Wrench 5/16	28480	8710-0015
	9300-1383	1	Wrist Strap	28480	9300-1383
	9300-0797	1	Conductive Mat	28480	9300-0797

Figure 5-12. HP Q85104A Replaceable Parts (2 of 2)

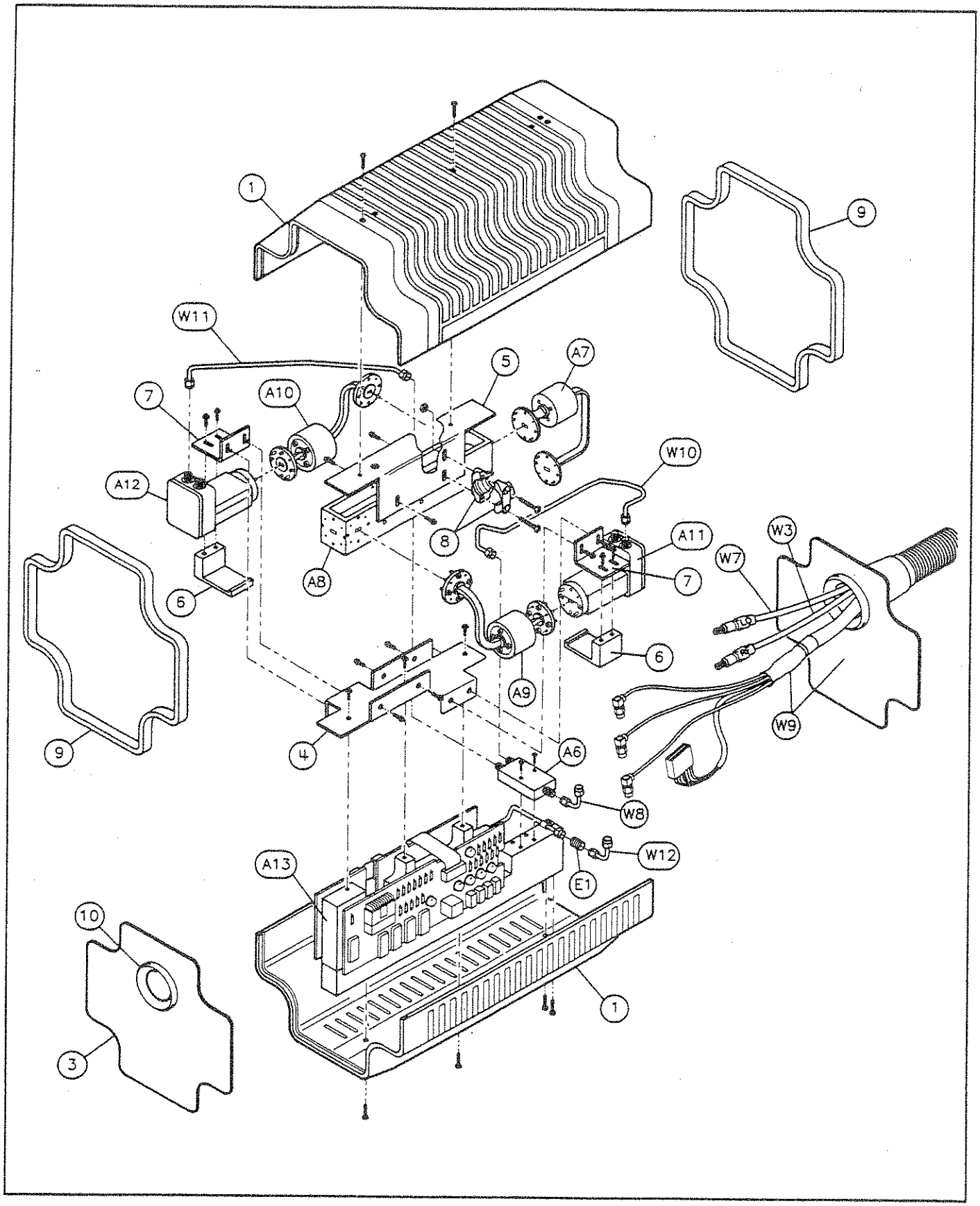


Figure 5-13. HP U85104A Replaceable Parts (1 of 2)

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	85104-20001	2	Housing	28480	85104-20001
3	85104-00002	1	Front Panel	28480	85104-00002
4	85104-00009	1	Coupler Bracket	28480	85104-00009
5	85104-00007	1	Bottom Mount	28480	85104-00007
6	85104-20020	2	Mixer Clamp	28480	85104-20020
7	85104-00008	2	Mixer Bracket	28480	85104-00008
8	85104-20019	1	Cable Clamp	28480	85104-20019
9	85104-40001	2	Bumper	28480	85104-40001
10	85104-40002	1	Front Panel Grommet	28480	85104-40002
A6	0955-0264	1	Power Divider	28480	0955-0264
A7	85104-60019	1	Isolator	28480	85104-60019
A8	85104-60018	1	Dual Directional Coupler	28480	85104-60018
A9	85104-60020	1	Incident Isolator	28480	85104-60020
A10	85104-60020	1	Reflected Isolator	28480	85104-60020
A11	11643-60029	1	Incident Mixer	28480	11643-60029
A12	11643-60029	1	Reflected Mixer	28480	11643-60029
A13	85104-60012	1	U-band Source Module Assy	28480	85104-60012
E1	1250-1158	1	ADPT F SMA F SMA	28480	1250-1158
W3	85104-60016	1	RF Cable Assembly	28480	85104-60016
W7	85104-60017	1	LO Cable Assembly	28480	85104-60017
W8	85104-20021	1	RF Cable - 90° Bend	28480	85104-20021
W9	85104-60015	1	Interconnect Cable Assy Rear Panel	28480	85104-60015
W10	85104-20008	1	Incident LO Input Cable	28480	85104-20008
W11	85104-20009	1	Reflected LO Input Cable	28480	85104-20009
W12	85104-20021	1	RF Cable - 90° Bend	28480	85104-20021
			CABLE SUPPORT ASSY		
	85104-00018	1	Bracket	28480	85104-00018
	85104-20037	1	Clamp	28480	85104-20037
	85104-20038	1	Barrel	28480	85104-20038
			HARDWARE		
	0515-0373	10	SMM 3.0 10 PN TX	28480	0515-0373
	0515-2007	2	SMM 2.5 16 PN TX	28480	0515-2007
	2200-0155	2	SM 440 1.000 PNPD	28480	2200-0155
	2360-0115	8	SM 632 .312 PNPD	28480	2360-0115
	3030-0221	23	SS 440 .375	28480	3030-0221
	2190-0030	27	WSHR LK .115ID 4	28480	2190-0030
	2260-0009	1	Nut-hex 4-40	28480	2260-0009
	3050-0105	27	WSHR FL .125ID 4	28480	3050-0105
			MISCELLANEOUS		
	11644-60033	2	Wavegd Straight, 10 cm	28480	11644-60033
	85104-60034	1	90° Waveguide Bend	28480	85104-60034
	8710-1539	1	Ball Driver	28480	8710-1539
			PARTS NEEDED BUT NOT SUPPLIED		
	8710-0899	1	Pozi Screwdriver, 1	28480	8710-0899
	8710-1623	1	Torx Screwdriver, 10	28480	8710-1623
	8710-1644	1	Torx Screwdriver, 8	28480	8710-1644
	8720-0015	1	Open-end Wrench 5/16	28480	8710-0015
	9300-1383	1	Wrist Strap	28480	9300-1383
	9300-0797	1	Conductive Mat	28480	9300-0797

Figure 5-13. HP U85104A Replaceable Parts (2 of 2)

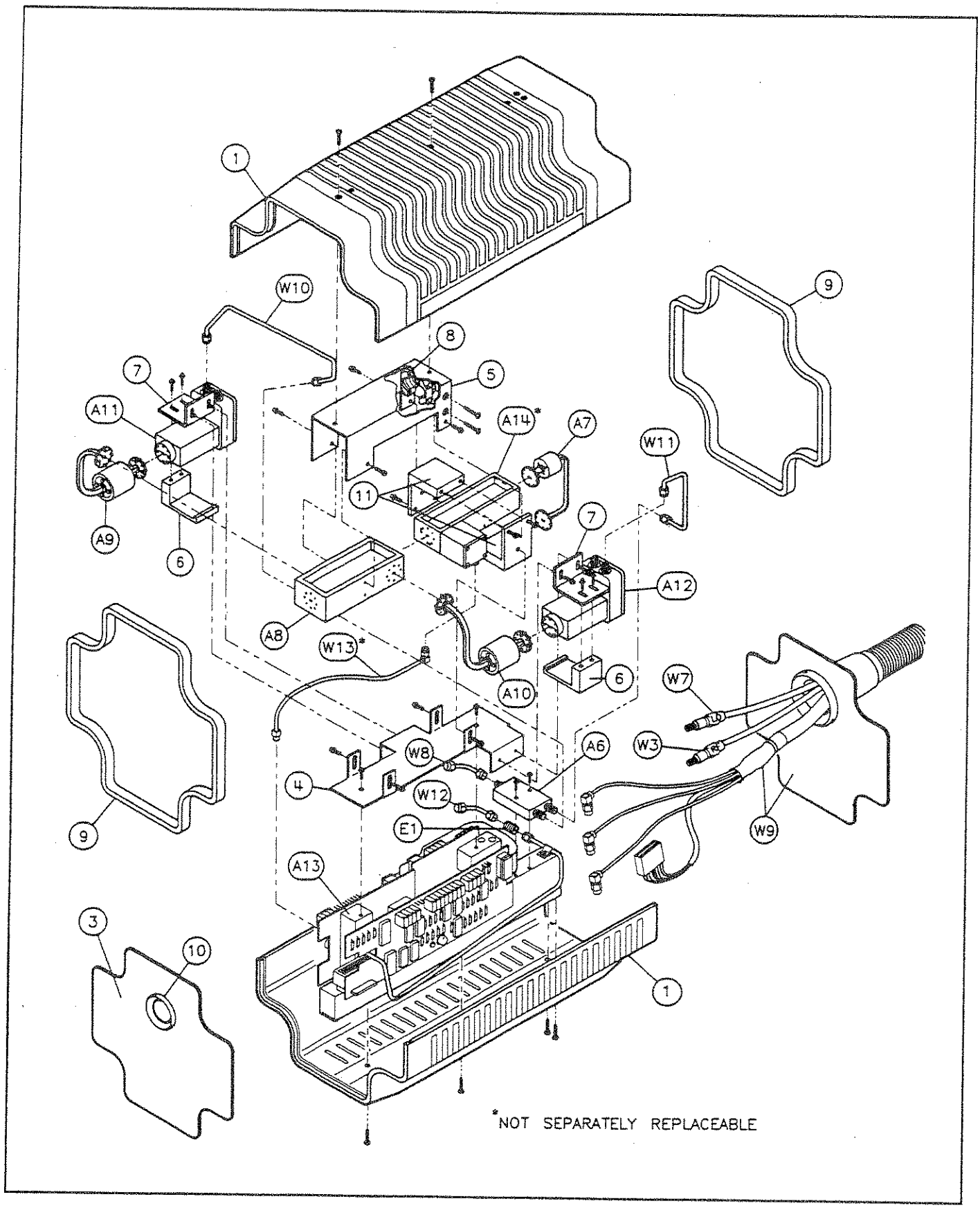


Figure 5-14. HP V85104A Replaceable Parts (1 of 2)

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	85104-20001	2	Housing	28480	85104-20001
3	85104-00003	1	Front Panel	28480	85104-00003
4		1	Coupler Bracket	28480	
5	85104-00006	1	Bottom Mount	28480	85104-00006
6	85104-20020	2	Mixer Clamp	28480	85104-20020
7	85104-00008	2	Mixer Bracket	28480	85104-00008
8	85104-20019	1	Cable Clamp	28480	85104-20019
9	85104-40001	2	Bumper	28480	85104-40001
10	85104-40002	1	Front Panel Grommet	28480	85104-40002
11	85104-20033	1	Detector Clamp	28480	85104-20033
A6	0955-0264	1	Power Divider	28480	0955-0264
A7	85104-60025	1	Isolator	28480	85104-60025
A8	85104-60024	1	Dual Directional Coupler	28480	85104-60024
A9	85104-60027	1	Incident Isolator	28480	85104-60027
A10	85104-60026	1	Reflected Isolator	28480	85104-60026
A11	11643-60030	1	Incident Mixer	28480	11643-60030
A12	11643-60030	1	Reflected Mixer	28480	11643-60030
A13	85104-60009	1	V-band Module Assy	28480	85104-60009
14		1	Not separately replaceable; part of A13 assembly		
E1	1250-1158	1	ADPT F SMA F SMA	28480	1250-1158
W3	85104-60016	1	RF Cable Assembly	28480	85104-60016
W7	85104-60017	1	LO Cable Assembly	28480	85104-60017
W8	85104-20021	1	RF Cable - 90° Bend	28480	85104-20021
W9	85104-60015	1	Interconnect Cable Assy Rear Panel	28480	85104-60015
W10	85104-20012	1	Incident LO Input Cable	28480	85104-20012
W11	85104-20013	1	Reflected LO Input Cable	28480	85104-20013
W12	85104-20021	1	RF Cable - 90° Bend	28480	85104-20021
W13	85104-60037	1	Coupler/detector Cable	28480	85104-60037
			CABLE SUPPORT ASSY		
	85104-00018	1	Bracket	28480	85104-00018
	85104-20037	1	Clamp	28480	85104-20037
	85104-20038	1	Barrel	28480	85104-20038
			HARDWARE		
	0515-0373	10	SMM 3.0 10 PN TX	28480	0515-0373
	0515-2007	2	SMM 2.5 16 PN TX	28480	0515-2007
	2200-0155	2	SM 440 1.000 PNPD	28480	2200-0155
	2360-0115	8	SM 832 .312 PNPD	28480	2360-0115
	3030-0221	23	SS 440 .375	28480	3030-0221
	2190-0030	27	WSHR LK .115ID 4	28480	2190-0030
	2260-0009	1	Nut-hex 4-40	28480	2260-0009
	3050-0105	27	WSHR FL .125ID 4	28480	3050-0105
			MISCELLANEOUS		
	11644-60012	2	Wavegd Straight, 10 cm	28480	11644-60012
	85104-60035	1	90° Waveguide Bend	28480	85104-60035
	8710-1539	1	Ball Driver	28480	8710-1539
			PARTS NEEDED BUT NOT SUPPLIED		
	8710-0899	1	Pozi Screwdriver, 1	28480	8710-0899
	8710-1623	1	Torx Screwdriver, 10	28480	8710-1623
	8710-1644	1	Torx Screwdriver, 8	28480	8710-1644
	8720-0015	1	Open-end Wrench 5/16	28480	8710-0015
	9300-1383	1	Wrist Strap	28480	9300-1383
	9300-0797	1	Conductive Mat	28480	9300-0797

Figure 5-14. HP V85104A Replaceable Parts (2 of 2)

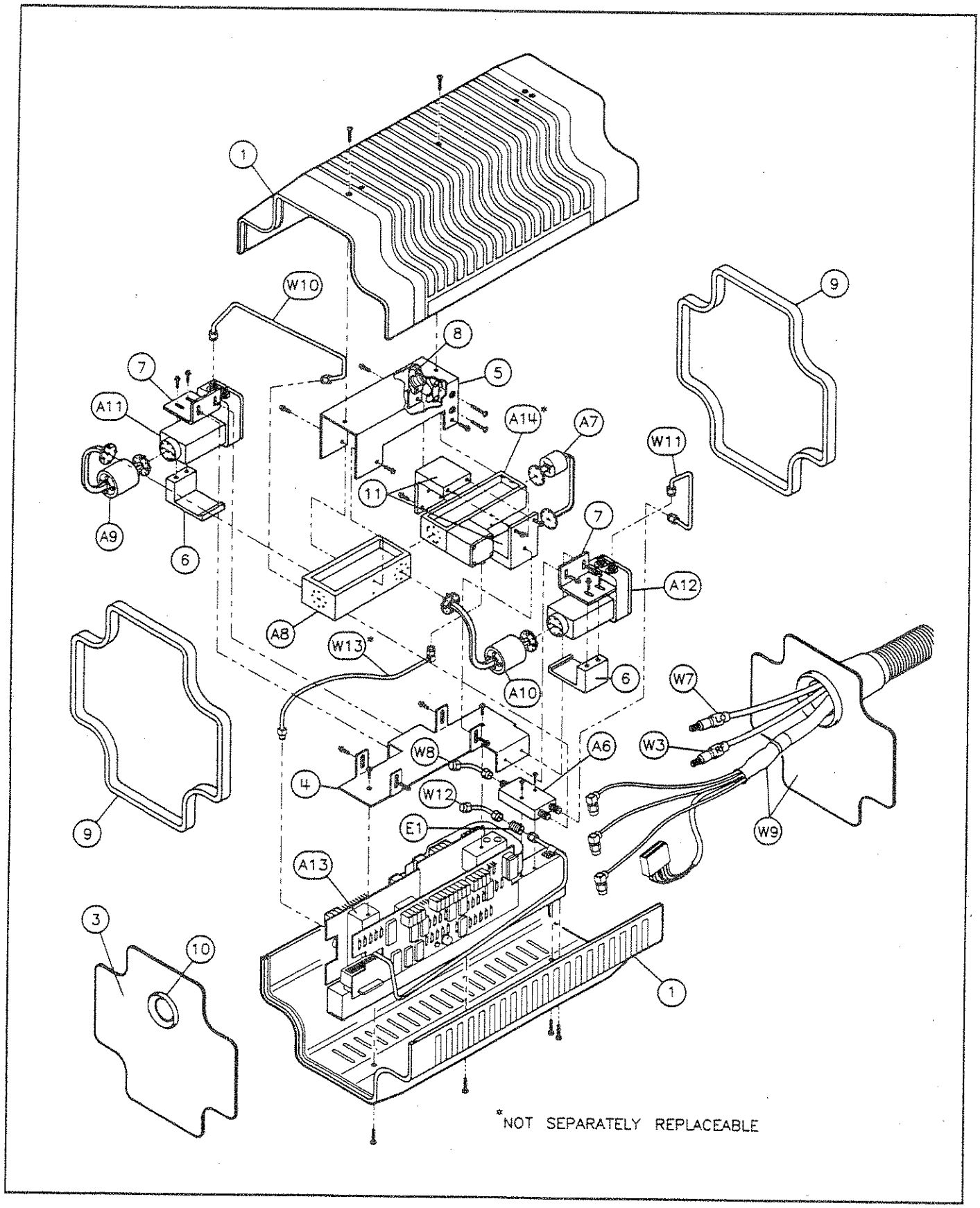
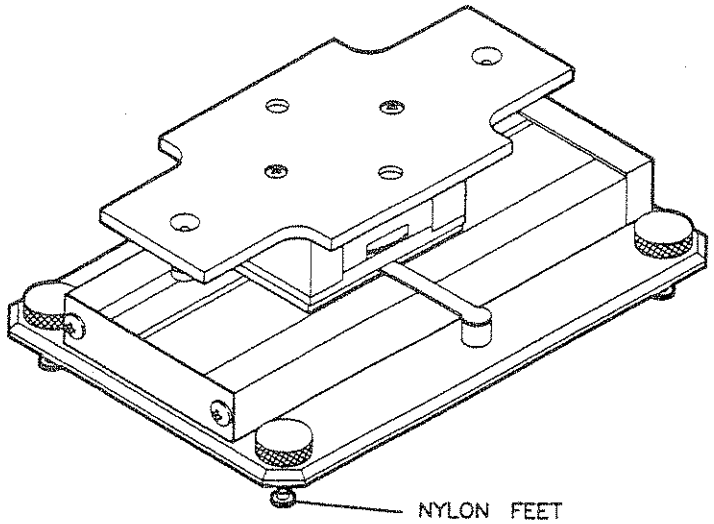


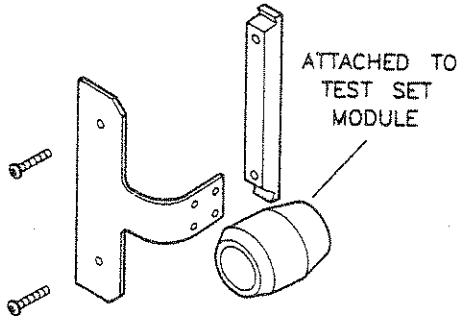
Figure 5-15. HP W85104A Replaceable Parts (1 of 2)

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	85104-20001	2	Housing	28480	85104-20001
3	85104-00004	1	Front Panel	28480	85104-00004
4		1	Coupler Bracket	28480	
5	85104-00006	1	Bottom Mount	28480	85104-00006
6	85104-20020	2	Mixer Clamp	28480	85104-20020
7	85104-00008	2	Mixer Bracket	28480	85104-00008
8	85104-20019	1	Cable Clamp	28480	85104-20019
9	85104-40001	2	Bumper	28480	85104-40001
10	85104-40002	1	Front Panel Grommet	28480	85104-40002
11	85104-20023	1	Detector Clamp	28480	85104-20023
A6	0955-0264	1	Power Divider	28480	0955-0264
A7	85104-60029	1	Isolator	28480	85104-60029
A8	85104-60028	1	Dual Directional Coupler	28480	85104-60028
A9	85104-60031	1	Incident Isolator	28480	85104-60031
A10	85104-60030	1	Reflected Isolator	28480	85104-60030
A11	11643-60031	1	Incident Mixer	28480	11643-60031
A12	11643-60031	1	Reflected Mixer	28480	11643-60031
A13	85104-60014	1	W-band Modulator Assy	28480	85104-60014
A14		1	Not separately replaceable; part of A13 assembly		
E1	1250-1158	1	ADPT F SMA F SMA	28480	1250-1158
W3	85104-60016	1	RF Cable Assembly	28480	85104-60016
W7	85104-60017	1	LO Cable Assembly	28480	85104-60017
W8	85104-20021	1	RF Cable - 90° Bend	28480	85104-20021
W9	85104-60015	1	Interconnect Cable Assy Rear Panel	28480	85104-60015
W10	85104-20016	1	Incident LO Input Cable	28480	85104-20016
W11	85104-20017	1	Reflected LO Input Cable	28480	85104-20017
W12	85104-20021	1	RF Cable - 90° Bend	28480	85104-20021
W13	85104-60037	1	Coupler/detector Cable	28480	85104-60037
			CABLE SUPPORT ASSY		
	85104-00018	1	Bracket	28480	85104-00018
	85104-20037	1	Clamp	28480	85104-20037
	85104-20038	1	Barrel	28480	85104-20038
			HARDWARE		
	0515-0373	10	SMM 3.0 10 PN TX	28480	0515-0373
	0515-2007	2	SMM 2.5 16 PN TX	28480	0515-2007
	2200-0155	2	SM 440 1.000 PNPD	28480	2200-0155
	2360-0115	8	SM 632 .312 PNPD	28480	2360-0115
	3030-0221	23	SS 440 .375	28480	3030-0221
	2190-0030	27	WSHR LK .115ID 4	28480	2190-0030
	2260-0009	1	Nut-hex 4-40	28480	2260-0009
	3050-0105	27	WSHR FL .125ID 4	28480	3050-0105
			MISCELLANEOUS		
	11644-60013	3	Wavegd Straight, 5 cm	28480	11644-60013
	85104-60036	1	90° Waveguide Bend	28480	85104-60036
	85104-20035	1	Ball Driver	28480	85104-20035
			PARTS NEEDED BUT NOT SUPPLIED		
	8710-0899	1	Pozi Screwdriver, 1	28480	8710-0899
	8710-1623	1	Torx Screwdriver, 10	28480	8710-1623
	8710-1644	1	Torx Screwdriver, 8	28480	8710-1644
	8720-0015	1	Open-end Wrench 5/16	28480	8710-0015
	9300-1383	1	Wrist Strap	28480	9300-1383
	9300-0797	1	Conductive Mat	28480	9300-0797

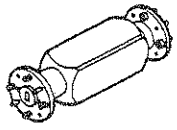
Figure 5-15. HP W85104A Replaceable Parts (2 of 2)



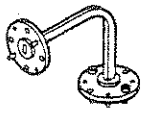
TEST SET MODULE STAND



CABLE SUPPORT
ASSEMBLY *



WAVEGUIDE
STRAIGHT SECTION*



WAVEGUIDE
BEND *

*Refer to the replaceable parts list of the specific band for part numbers.

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	85104-60006 85104-20036	1 4	Stand Assembly Nylon Feet	28480 28480	85104-60006 85104-20036

Figure 5-16. HP 85104A Replaceable Parts - Supplied With All Bands

Section 6. HP 85105A Millimeter-wave Controller

INTRODUCTION

The information in this section documents the operation, troubleshooting techniques and replaceable parts for the HP 85105A Millimeter-wave Controller.

DESCRIPTION OF THE INSTRUMENT

The HP 85105A Millimeter-wave (mm-wave) Controller (Figure 6-1) is designed to be used in conjunction with an HP 8510, two HP 85104A mm-wave test set modules and a coaxial test set (optional). The HP 85105A provides an amplified LO signal to each of the mm-wave modules to drive the harmonic mixers. An amplified RF signal is applied to the active mm-wave test set module, either port 1 or port 2 for S-parameter measurements. The incident and reflected IF signals from the mm-wave test set modules are returned to the HP 85105A, amplified and then output to the analyzer to be processed and displayed. A leveling signal is passed from the mm-wave test set modules thru the controller to the RF source to provide leveled power. When the coaxial test set is selected by the HP 8510B software, the HP 85105A switches the RF to the test set and routes the IF from the test set to the analyzer. No reconnections are required when switching between millimeter-wave and microwave operation. The HP 85105A is equipped with the IF and RF switching capability for routing these signals to either the millimeter-wave or microwave test set.

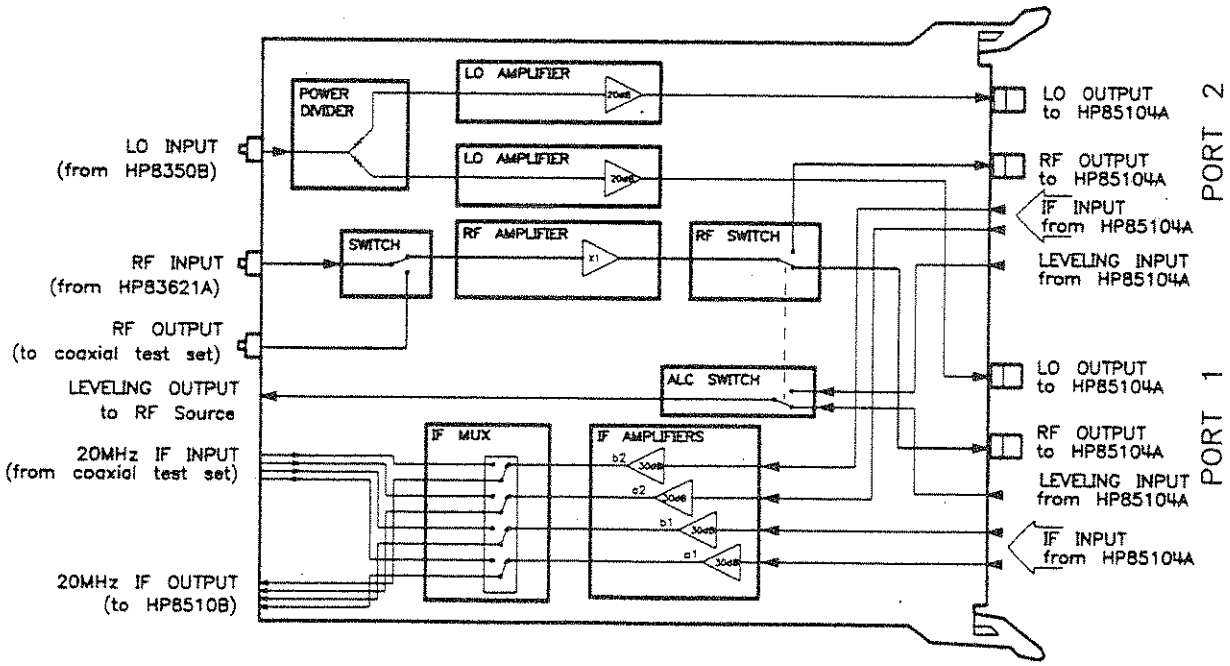


Figure 6-1. HP 85105A Simplified Block Diagram

OPTIONS AND ACCESSORIES

Option 004. Provides for rear panel output of the port 1 and 2 RF, LO, and Module Interface connectors. These connectors are deleted on the front panel. The parts unique to option 004 are detailed in the Replaceable Parts lists.

Accessories. Supplied with the HP 85105A, including part numbers, are listed in the Replaceable Parts lists.

WARRANTY INFORMATION

Warranty information for the HP 85105A may be found immediately following the title page for this manual.

SAFETY

The voltages in this instrument warrant normal caution for operator safety. Service should be performed only by qualified personnel. Before removing the instrument covers to troubleshoot problems or replace assemblies, refer to the *HP 8510 Service Manual* "Service Overview" section for information on hazardous voltage locations and general safety cautions.

INSTRUMENT OPERATION

The following information illustrates the features and functions of the HP 85105A Millimeter-wave Controller. The use of the module interface adapter and multiple coaxial test sets is also described.

Information on cabling the HP 85105A Millimeter-wave controller in either a rack or benchtop configuration may be found in the "Getting Started" section of this manual. The switching functions of the controller are performed by the HP 8510 operating system and may be accessed thru the front panel pushbuttons on the HP 8510 analyzer. For additional information on operation refer to the section of this manual titled "Operation."

FRONT PANEL FEATURES

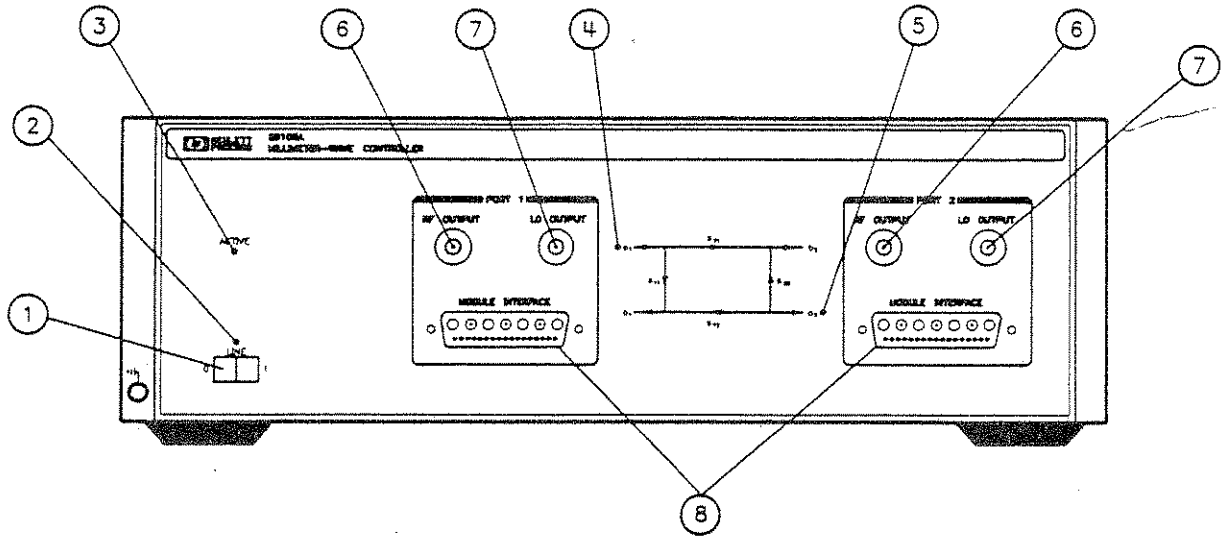


Figure 6-2. Front Panel Features of the HP 85105A

1. **Line Switch.** This switch turns the instrument on and off. When the side of the switch labeled O is depressed, the instrument is off; when the other side is depressed the line power is on.

2. **Line LED.** This LED goes on and off with the instrument line switch to indicate the status of line voltage applied to the instrument.

3. **Active LED.** This LED lights about two seconds after the power is turned on, to indicate the successful completion of self-test, and is lit when the mm-wave test set is selected by the analyzer.

The features for port 1 and port 2 are identical. The following descriptions apply equally to both ports.

4. **a1 LED.** This LED indicates that port 1 is selected and the RF source is switched to port 1.

5. **a2 LED.** This LED indicates that port 2 is selected and the RF source is switched to port 2.

6. **RF Output.** When the port is selected by the analyzer, an amplified RF source signal is available to an HP 85104A test set module or to a multiplier, for customer configured systems.

7. **LO Output.** An amplified LO signal is always available to an HP 85104A test set module or to a harmonic mixer, for customer configured systems.

8. **Module Interface.** The HP 85104A test set module plugs into this interface. This interface supplies dc voltages and ground lines to the module and returns incident and reflected IF signals and an ALC signal to the analyzer and RF source respectively.

REAR PANEL FEATURES

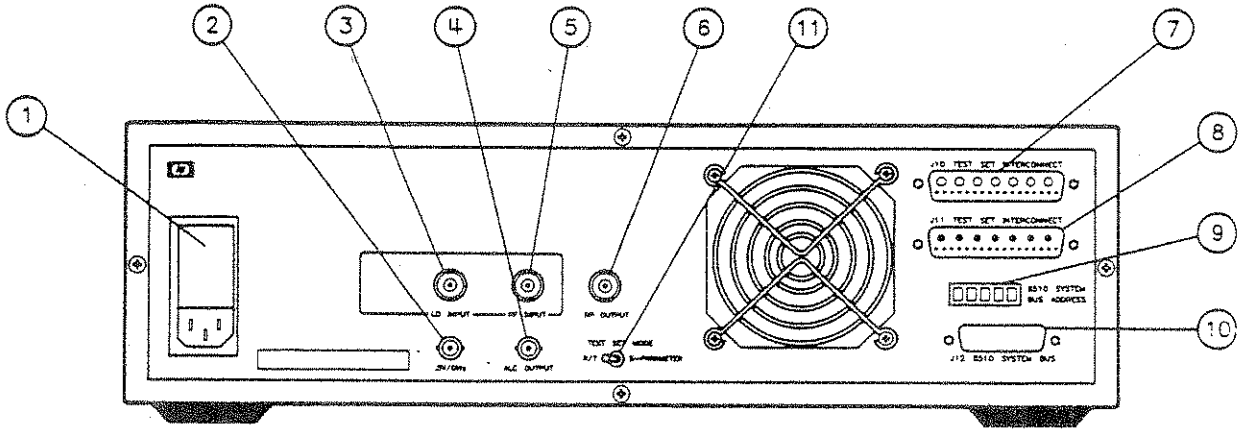


Figure 6-3. Rear Panel Features of the HP 85105A

1. **Line Module.** This assembly houses the line cord connector, line fuse and line voltage selector. Pull out the top 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. **.5 V/GHz.** This input to the instrument comes from the RF source. A voltage level of one half volt is input to this connector for every GHz of RF source frequency. Pin number 14 of the module interface on the front panel of the HP 85105A carries this voltage to the test set modules.

3. **LO Input.** This input to the instrument comes from the LO source. The signal is split and amplified then output to the front panel of the HP 85105A.

4. **ALC Output.** This dc level is input to the RF source. The ALC signal is either generated by the test set module or the HP 85105A. If a test set module is used, the ALC signal generated by the module is input to the HP 85105A via the front panel module interface. If no test set module is sensed by the HP 85105A, the internal ALC signal generated on the RF Leveling Amplifier Assembly is routed to this connector.

5. **RF Input.** This input to the instrument comes from the RF source. The signal is input to a switch. When the test set modules are selected by the HP 8510 the RF is amplified and then input to another switch that directs the RF to either port 1 or port 2. When the coaxial test set is selected by the HP 8510 the RF is switched to the connector labeled "RF Output" on the rear panel of the HP 85105A.

6. **RF Output.** The RF exiting this connector was routed from the RF source to the coaxial test set by the HP 85105A. See the description for RF input.

7. **J10 Test Set Interconnect.** Should be connected to J11 of the coaxial test set. This connector transmits the IF signals from the test set to the HP 85105A.

8. **J11 Test Set Interconnect.** Should be connected to the J1 Test Set Interconnect on the HP 85102 IF detector. This connector transmits the IF signals from the HP 85105A to the HP 85102 IF Detector. It also transmits control signals.

9. **HP 8510 System Bus Address Switch.** This five-pole binary-weighted switch sets the system bus address of the instrument. The binary weight of each pole is indicated on the rear panel as are the on and off positions. Decimal twenty one binary 10101 (on, off, on, off, on) is the default setting.

10. **J12 HP 8510 System Bus Connector.** This connector is used for system HP-IB communications with the HP 85101 display/processor.

11. **Test Set Mode Toggle Switch.** Set to R/T for Reflection/Transmission test set mode, or to S-P for full S-Parameter test set mode. Usually this switch is in the S-P position. The R/T position is used primarily with HP 11643A series test set kits in a reflection/transmission test set up.

MODULE INTERFACE

The module interface connectors for port 1 and port 2 of the HP 85105A are identical. The following information may be used for troubleshooting purposes or for constructing a system without using the HP 85104A test set modules.

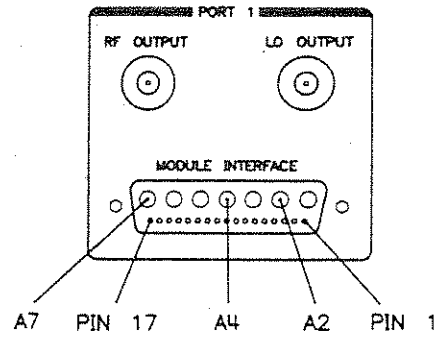


Figure 6-4. Module Interface Connections

COAXIAL WIRES

Jack A2 IF Input. This is the incident IF signal input connection. a1 for port 1 and a2 for port 2.

Jack A4 ALC Input. The ALC signal input connection from the HP 85104A test set modules.

Jack A7 IF Input. This is the reflected IF signal input connection. b1 for port 1 and b2 for port 2.

PIN CONNECTIONS

Pin Number 1 and 2. These two pins are used for analog and dc supply ground lines.

Pin Number 4. This pin is a +15.0 Vdc supply.

Pin Number 6 and 7. These two pins are both +8.0 Vdc supplies.

Pin Number 9. This pin is a +5.0 Vdc supply.

Pin Number 11. This pin is a −15.0 Vdc supply.

Pin Number 13. This is the Module Sense line. When a test set module is connected to the module interface of the HP 85105A a +5.0 Vdc level is input to this pin. The result is that the ALC from the test set module is routed thru the HP 85105A to the RF source. If the +5.0 Vdc is missing from this pin, the internal ALC of the HP 85105A is routed to the RF source.

Pin Number 14. This is the +0.5 Vdc/GHz line. See the description of the .5 V/GHz feature described in "Rear Panel Features."

Pin Number 16 and 17. These two lines are digital ground.

The remaining pins and jacks on this connector are not used.

MODULE INTERFACE ADAPTER

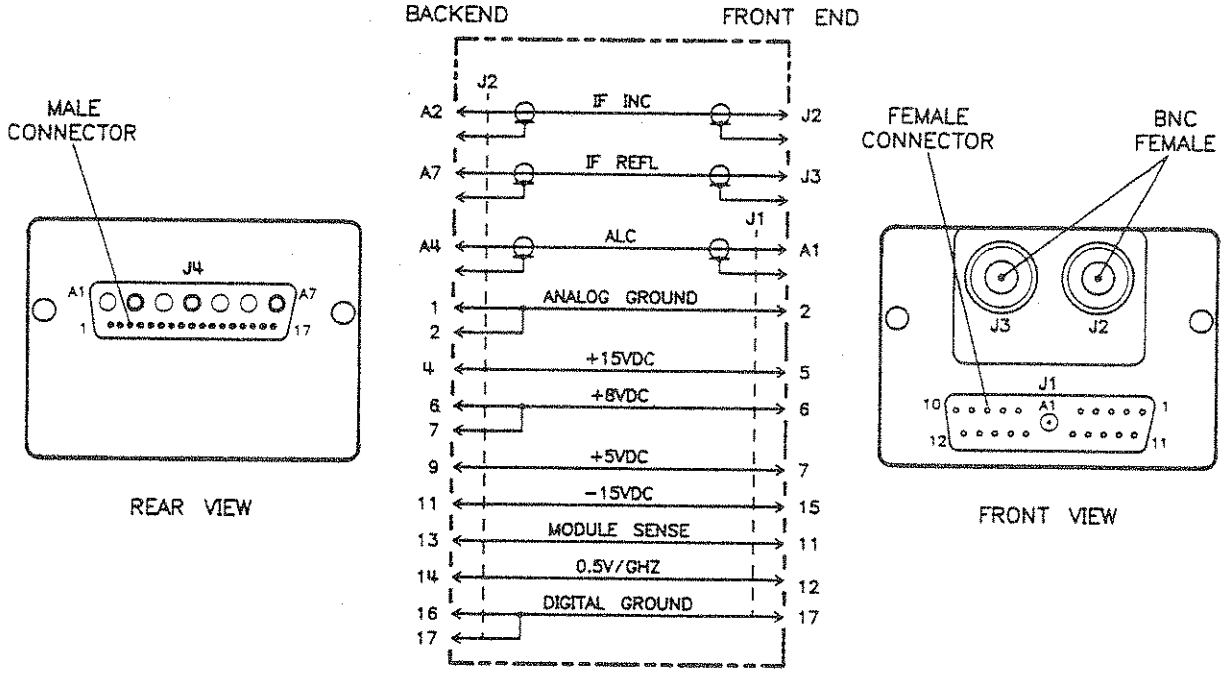


Figure 6-4A. Module Interface Adapter Wiring Diagram

The module interface adapter, supplied with the HP 85105A, is used to adapt the HP 85105A front panel module interface to a plug compatible with HP 8355XX source modules and two BNC connectors used to receive incident and reflected IF signals. Figure 6-4a illustrates how this adapter is wired.

HP 11643A TEST SET KITS and REFLECTION/TRANSMISSION (R/T) MEASUREMENTS

HP 11643 series test set kits and HP 835XX mm-wave source modules may be used with the HP 85105A. Figure 6-4b illustrates an example R/T measurement setup using an HP 8355XX source module and an HP 11643A test set kit with an HP 85105A and the Module Interface Adapter.

NOTE: The *Test Set Mode Toggle Switch* on the rear panel of the HP 85105A must be in the R/T position for this measurement setup to work.

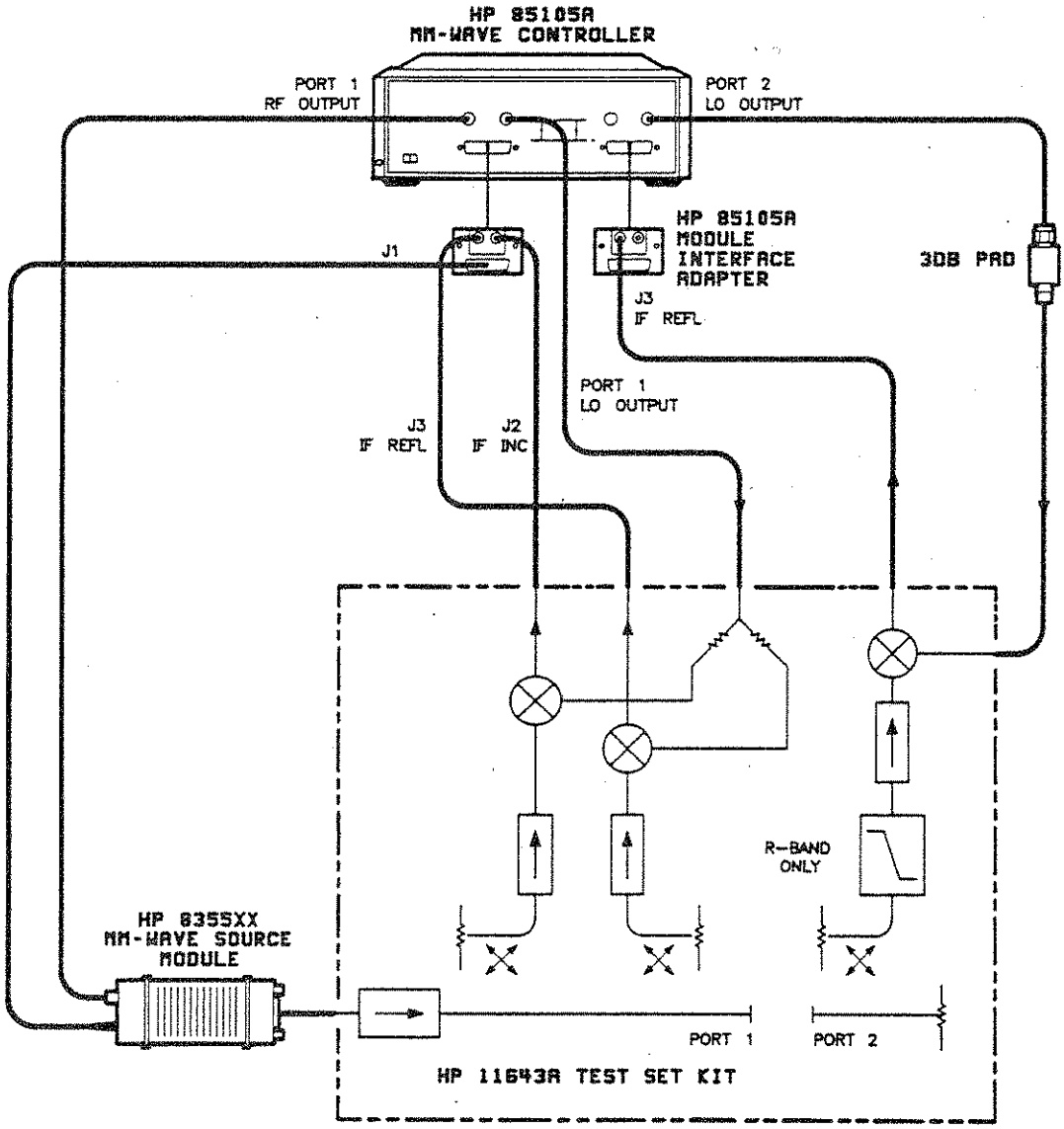


Figure 6-4b. R/T Measurement using an HP 11643A Test Set Kit

CONTROLLING MULTIPLE TEST SETS

Because the HP 85105A has multiple test set switching (option 001) as standard, it can control one set of HP 85104A millimeter-wave test set modules and one coaxial test set without the need for external switches or instruments. Should it be necessary to control more than one coaxial test set option 001 must be installed in each test set and the following procedures may be used.

Option 001 for the HP 851X series test sets allows an HP 8510 to alternately control up to four coaxial test sets (Figure 6-5). The HP 85105A must be the first test set. 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.

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 6-5, 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.

INSTALLATION

Set each test set rear panel address switch to the address listed in Figure 6-5, if configuring three or four 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.

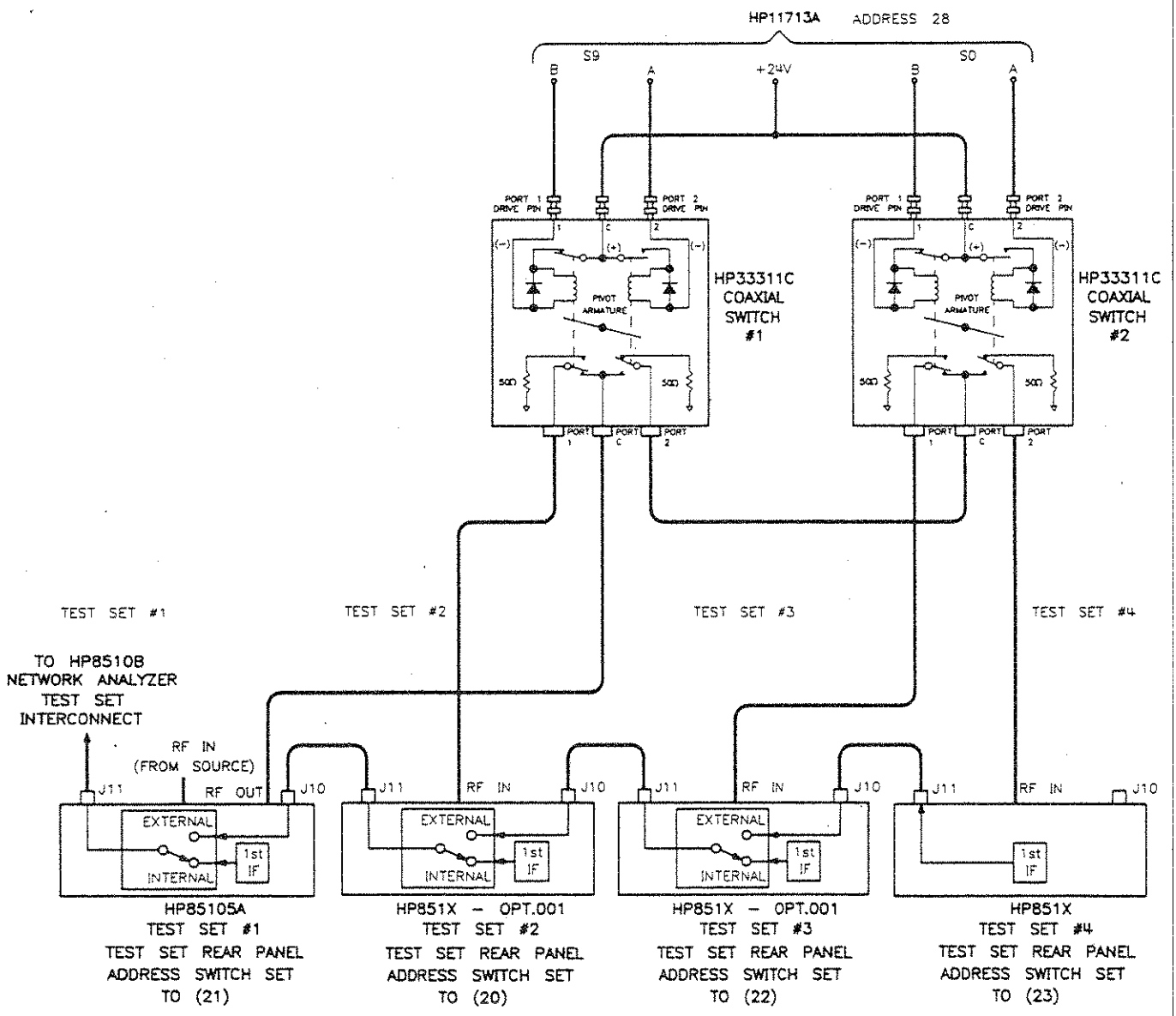
If the RF coaxial switches are not incorporated into the system, then the RF input to the test set must be manually switched to the active test set.

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. See Figure 6-5 for recommended test set addresses.
3. If unselected test sets are active, (active light ON), deactivate the test set by temporarily addressing it. Then return to the desired address.



NOTE:

1. Not all system connections are shown.
2. In dual source configurations, the second can be multiplexed in a similar manner. If only one dual source test set is used, the second source can be directly connected to the appropriate test set.
3. The HP 85105A must be the first test set in line. If an HP 8516A test set is used, it must be second.

HP 33311C Coaxial Switch Positions with four test sets.

New ADDRESS of TEST SET	Test Set Selected	HP 33311C Coaxial Switch Port Selected	
		Switch #1	Switch #2
21	1	Port 1	Port 1
20	2	Port 1	Port 2
22	3	Port 2	Port 1
23	4	Port 2	Port 2

Figure 6-5. RF and IF Switching with Four Test Sets

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 the 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 ADDRTESS; 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 Figure 6-4, 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 Figure 6-5.

Measurement Calibration

After selecting the active test set, perform the system calibration procedure as usual. When selecting 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.

Operational Checks

To check the operation of a multiple test set configuration, first connect a device with a known response at test set number 2, then press HP 8510 (LOCAL) *[TEST SET] [ADDRESS of TEST SET]*, enter the address of test set number 2 (this would be 20), then press (x1). The test set number 2 measurement should appear. Press (DISPLAY) *[DATA → MEMORY] [DISPLAY:DATA and MEMORY]* to store the trace for comparison later. Use ADDRESS of TEST SET to select test set number 3, then switch back to test set number 2. Observe any difference in the response between the stored trace and the result after switching back and forth between 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.

SPECIFICATIONS

Specifications describe the warranted performance of the instrument. The electrical specifications of the HP 85105A Millimeter-wave Controller when used in a HP 85106 or 85109 system are defined in the "Performance Verification" section of this manual.

SUPPLEMENTAL CHARACTERISTICS

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

HP 85105A Supplemental Characteristics

Test Ports (Front Panel)

RF and LO Connector Type: precision 3.5 mm male
Connector torque: 90 N-cm (8 in.-lb)
Nominal operating power level:

OPERATING LEVEL	PORT1	PORT2
RF 8 to 20 GHz	>+17 dBm	>+17 dBm
LO 2 to 8 GHz	>+20 dBm	>+20 dBm

NOTE: The RF level can be adjusted more than 10 dB down from nominal by use of the Source 1 power level menu on the HP 8510.

Connectors (Rear Panel)
RF and LO Connector type: precision 3.5 mm femal
Connector torque:
Precision 3.5 mm, 90 N-cm (8 in.-lb)
SMA, 56 N-cm (5 in.-lb)

RF Source power level:
Damage input level: >+13 dBm
Maximum input level: +5 dBm
Minimum input level: −2 dBm

LO Source power level:
Damage input level: >+13 dBm
Maximum input level: +8 dBm
Minimum input level: 0 dBm

HP 85105A Power Requirements and Physical Characteristics

Operating Temperature: 0°C to 55°C

Power: 110,120,220 or 240 ±10% Vac
48 to 66 Hz line frequency
270 VA maximum

Dimensions: 460 mm X 133 mm X 609 mm (18.1 X 5.25 X 24.0 inches)

Weight: 15 Kg, 35 lbs

TROUBLESHOOTING

The troubleshooting strategy for the HP 85105A is systematic. This information is used after system level troubleshooting has pinpointed the HP 85105A as the problem instrument. Use the following flowchart (Figure 6-6) to identify the faulty assembly. The flowchart is keyed to numbered, individual troubleshooting procedures. As you progress thru the flowchart, perform the numbered procedure associated with each block. A block diagram is provided at the end of this section to assist in understanding the operation of the mm-wave controller.

THEORY OF OPERATION

The millimeter-wave controller, when used in conjunction with two HP 85104 test set modules provides all of the features and functions of a full S-parameter test set. Refer to the block diagram while reading the following description.

An LO signal is input to the rear panel of the mm-wave controller, divided and input to two identical 2-8 GHz leveling amplifier assemblies. The leveled LO signal is then output to ports 1 and 2 on the front panel of the mm-wave controller. An RF signal is input to the rear panel of the mm-wave controller and then fed to a coax switch. If the mm-wave controller is the test set selected by the HP 8510, the RF will be routed thru the coax switch to the RF leveling amplifier assembly and to a PIN switch where the RF will be routed to either port 1 or 2, whichever is active. If a coaxial test set is selected by the HP 8510, the RF is routed from the coax switch and back out to the rear panel of the mm-wave controller. Incident and reflected IF signals are input to the mm-wave controller from the test set modules via the module interface on the front panel of the mm-wave controller. These signals are amplified and output to the analyzer to be processed and displayed. If the coaxial test set is selected by the HP 8510, the IF from the test set is routed thru connectors J10 and J11 on the rear panel of the mm-wave controller and then to the HP 8510. When a test set module is connected to the module interface of the mm-wave controller, a +5 Vdc level is input to pin 13 of the module interface. The result is that the ALC from the test set module is routed thru the mm-wave controller to the RF source. If the +5 Vdc is missing from this pin, the internal ALC of the mm-wave controller is routed from the RF leveling amplifier assembly to the RF source.

STATIC PRECAUTIONS

The assemblies in these procedures are very sensitive to damage by static electricity. They may not continue to function if subjected to an electro-static discharge. Their reliability will be impaired.

EQUIPMENT NEEDED BUT NOT SUPPLIED

The following equipment is needed to troubleshoot your instrument. It is not supplied.

1 point pozidriv (HP Part No. 8710-0899)
2 point pozidriv (HP Part No. 8710-0900)
Service Adapter (HP Part No. 85105-60210
3.5 mm precision f to f adapter (HP Part No. 1250-1749
5/16 in. Torque Wrench (HP Part No. 8710-1655)
HP 436A Power Meter
HP 8485A Power Sensor
HP 8473C Negative Detector
HP 1740A Oscilloscope
HP 8493C 10 dB fixed attenuator

TROUBLESHOOTING SEQUENCE

The following is a flowchart of the troubleshooting sequence. Use it to determine the faulty assembly.

PROCEDURE 1. A15 PRIMARY REGULATOR
A6 SECONDARY REGULATOR
HP-IB ADDRESS SWITCHES
FUSE LOCATIONS

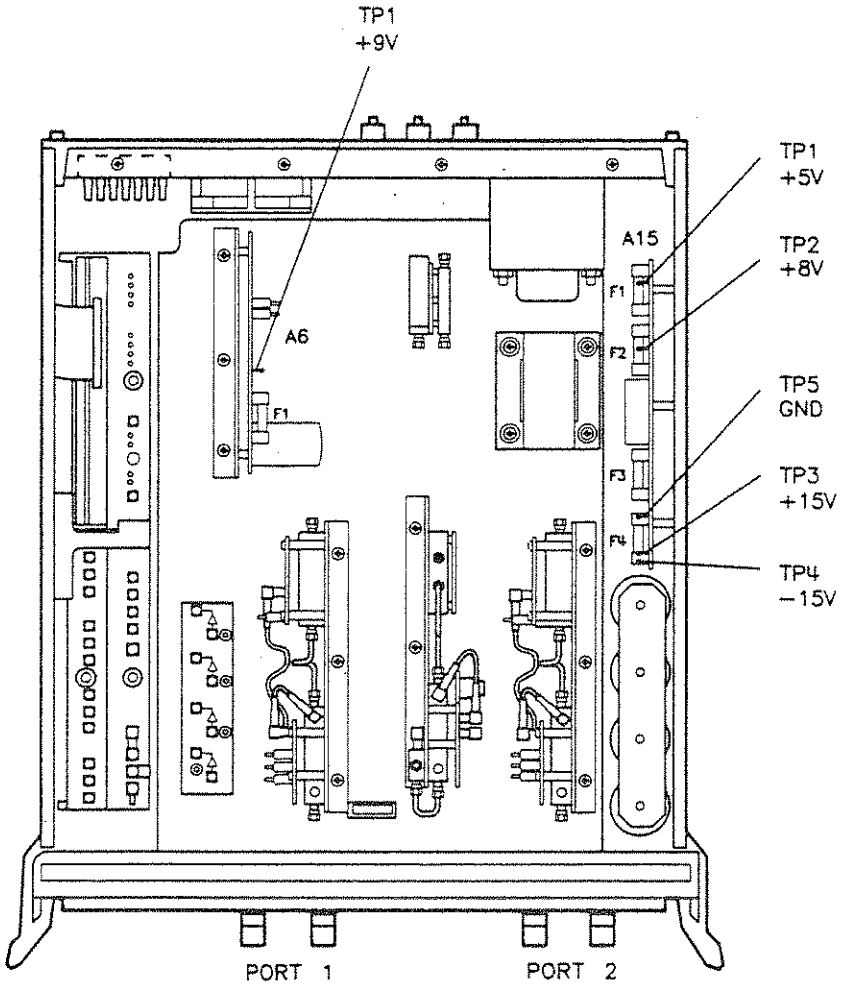


Figure 6-7. Power Supply Fuses and Test Points

A15 Primary Regulator Board Assembly
A6 Secondary Regulator Board Assembly

Use a digital voltmeter to check the voltages and an oscilloscope to check the ripple in Table 6-1.

Table 6-1. Power Supply Voltages

Nominal Voltage	Test Point	Voltage Range	Maximum Ripple Peak to Peak
+14.85 Vdc	A15TP3	+14.10 TO +15.60	2 mv
−14.85 Vdc	A15TP4	−14.10 TO −15.60	2 mv
+9.00 Vdc	A6TP1	+8.55 TO +9.45	2 mv
+8.00 Vdc	A15TP2	+7.60 TO +8.40	2 mv
+5.05 Vdc	A15TP1	+4.75 TO +5.25	2 mv

HP-IB Address Switch

Set the switch as indicated in Figure 6-8 (the dark side of the switch is depressed). The HP-IB address switch is on the instrument rear panel. It is easy to access but need not be changed unless the error message "SYSTEM BUS ADDRESS ERROR" is displayed on the HP 8510 screen. Decimal twenty one, binary 10101 (on, off, on, off, on) is the default setting.

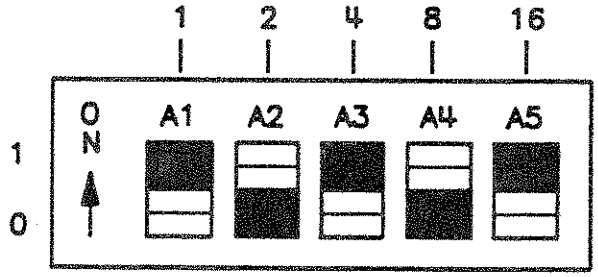
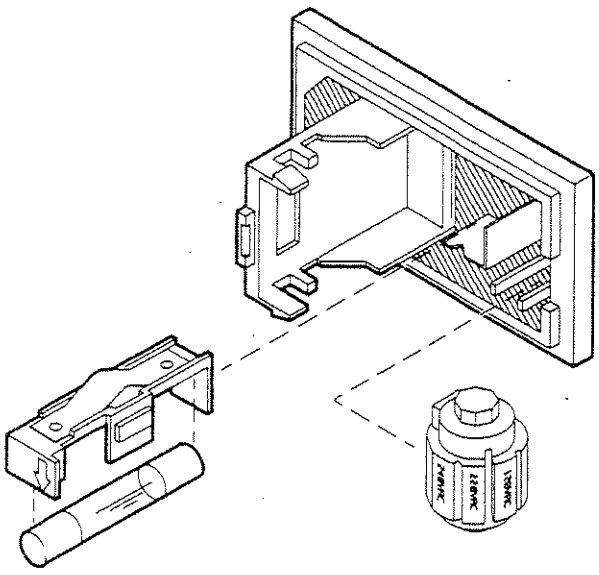


Figure 6-8. Instrument HP-IB Switch Setting

FUSES

The locations of the six fuses used in the HP 85105A are illustrated in Figure 6-7. The values of these fuses and their part numbers may be found in replaceable parts.

Refer to Figure 6-9 for information on how to set the voltage selector cam and replace the line fuse.



CAUTION:

Do not attempt to rotate the voltage selector cam while it is installed in the line module or non-repairable damage will result. The cam must be completely removed from the line module, rotated to the proper position, and reinstalled. Refer to the instructions below.

Replacement of fuse

1. Pry open line module cover door.
2. Pull out fuse carrier.
3. Insert fuse of proper rating.
4. Place carrier back into line module

Selection of Operating Voltage

1. Pry open line module cover door.
2. **REMOVE CAM FROM THE LINE MODULE.**
3. Rotate the cam to the desired voltage. (When the line module cover is closed, the selected voltage will be visible through a small window.)
4. Insert the cam back into the line module.
5. Close the line module cover door.

Figure 6-9. Power Line Module

PROCEDURE 2. SELF-TEST INDICATORS

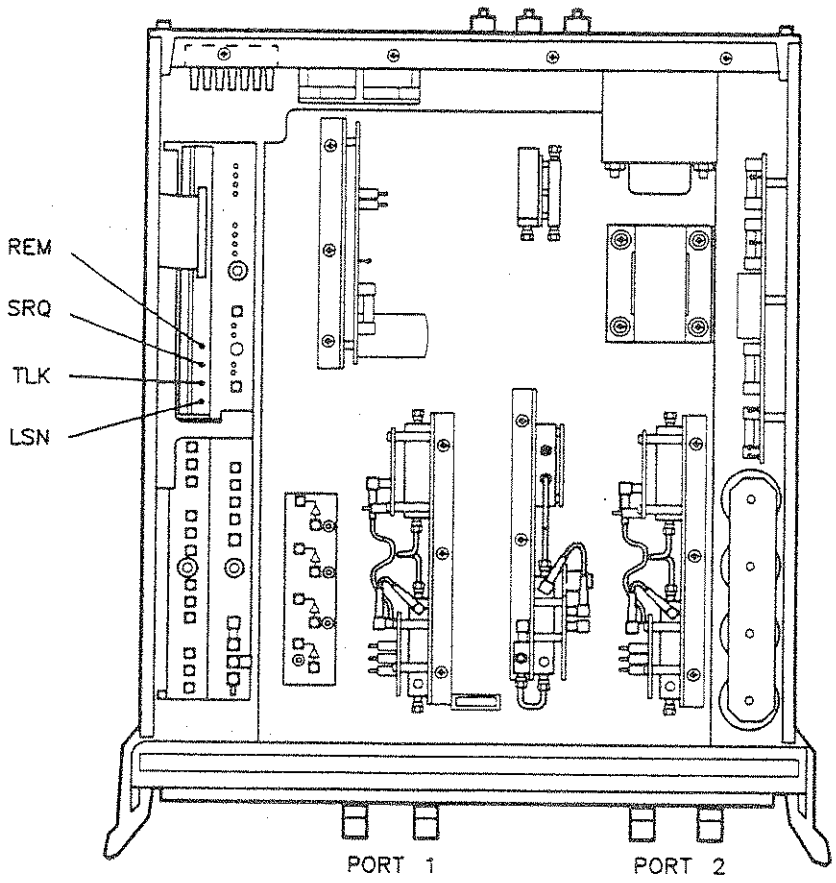


Figure 6-10. Location of Self-Test Indicators

If the ACTIVE LED on the front panel of the instrument fails to light within five seconds of power on or lights immediately, the instrument has not passed its self-test. To determine what part of the self-test has failed, note which LEDs on the A4 board are lit (Figure 6-10), as shown below:

Table 6-2. Self-Test Failure Indications

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

If the 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 most probably 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

PROCEDURE 3. RF AND LO OUTPUT POWER at FRONT PANEL PORTS

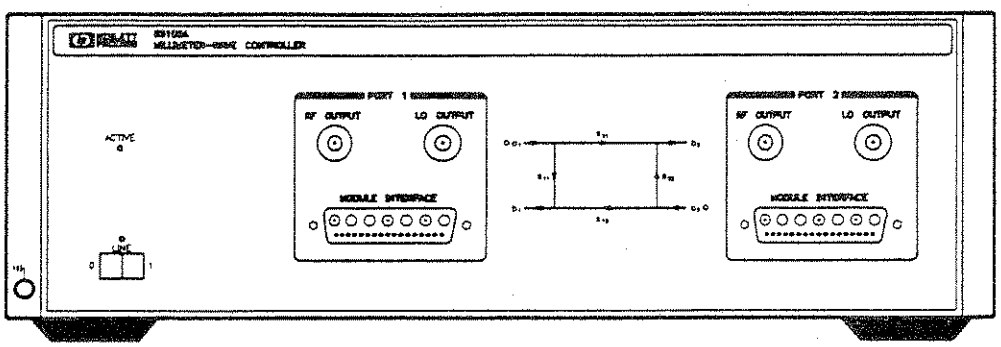


Figure 6-11. Front Panel RF and LO Ports

1. Recall the instrument state stored in register 8 of the HP 8510. This should be the factory supplied configuration for your particular system. If you have modified the contents of register 8, you must reload the instrument states from the system configuration disk or tape supplied with your system. For information on loading the instrument state refer to the section titled "Operation" in this manual.

2. Choose a power meter that covers the frequency band of interest (HP 436A Meter and HP 8485A sensor). Calibrate the power meter and attach a 3.5 mm 10 dB fixed attenuator (8493C) and a female-to-female adapter to the sensor.

3. Attach the power sensor to the LO output on both ports 1 and 2. Select ***[SINGLE-POINT MODE]*** from the (STIMULUS) menu, then using the RPG knob, slowly scan over the frequency band. The power out should be **+22 ±2 dBm**.

4. Attach the power sensor to the RF output of the active port, measure the power out then select the other port and measure its RF output power. Select ***[SINGLE-POINT MODE]*** from the (STIMULUS) menu, then using the RPG knob, slowly scan over the frequency band. The RF power out should be **>+17** dBm for both ports.

PROCEDURE 4. LO INPUT at REAR PANEL

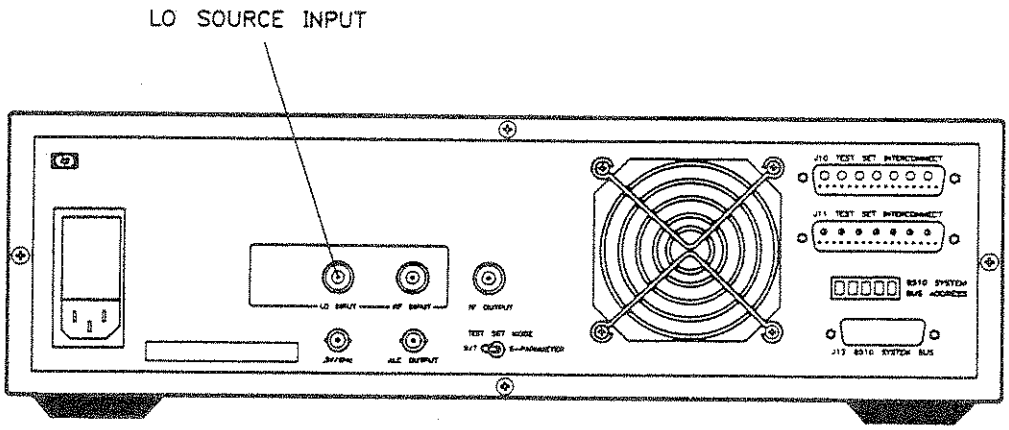


Figure 6-12. Rear Panel LO Input

1. Recall the instrument state stored in register 8 of the HP 8510. This should be the factory supplied configuration for your particular system. If you have modified the contents of register 8, you must reload the instrument states from the system configuration disk or tape supplied with your system. For information on loading the instrument state refer to the section titled "Operation" in this manual.

2. Choose a power meter that covers the frequency band of interest (HP 436A Meter and HP 8485A Sensor). Calibrate the power meter and attach a 3.5 mm (f to f) adapter to the sensor.

3. Disconnect the LO source cable from the back of the instrument and attach the power sensor to the LO cable. Select ***[SINGLE-POINT MODE]*** from the (STIMULUS) menu, then using the RPG knob, slowly scan over the frequency band. The power level should be **0 to +2 dBm**.

PROCEDURE 5. LO INPUT to LEVELING AMPLIFIERS

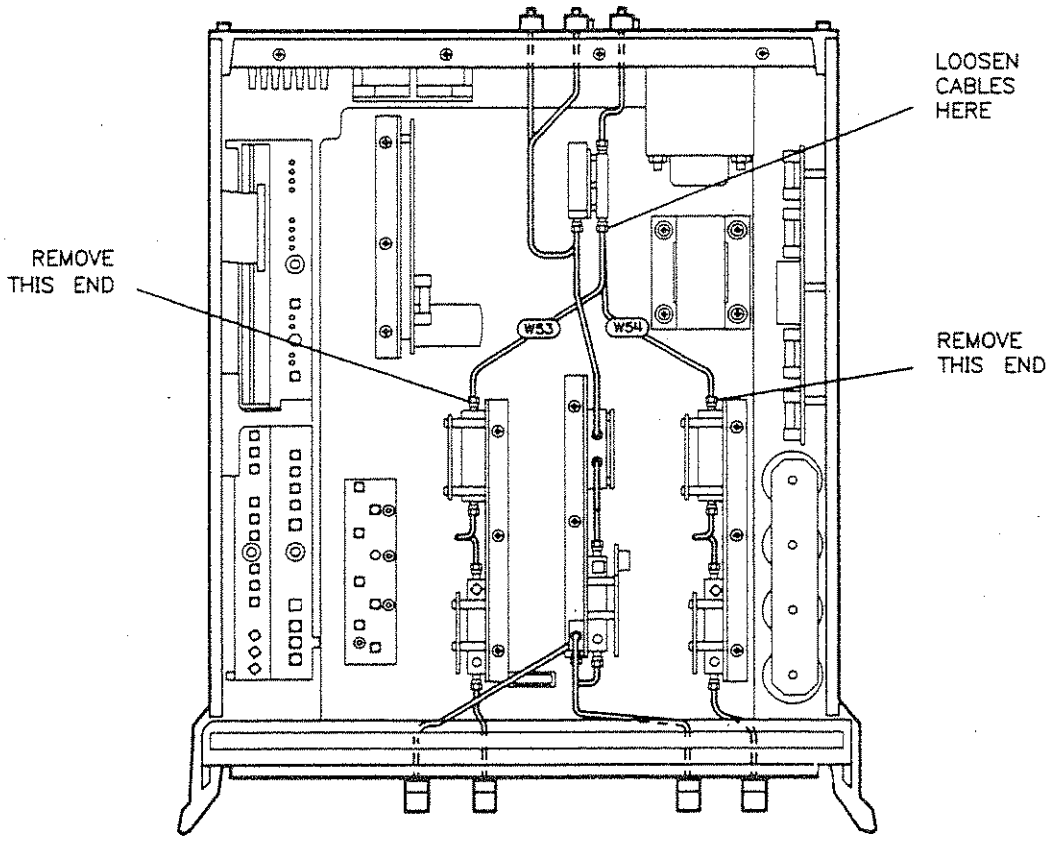


Figure 6-13. LO Input to Leveling Amplifiers

1. Recall the instrument state stored in register 8 of the HP 8510. This should be the factory supplied configuration for your particular system. If you have modified the contents of register 8, you must reload the instrument states from the system configuration disk or tape supplied with your system. For information on loading the instrument state refer to the section tab titled "Operation" in this manual.

2. Choose a power meter that covers the frequency band of interest (HP 436A Meter and HP 8485A Sensor). Calibrate the power meter and attach a 3.5 mm (f to f) adapter to the sensor.

3. Loosen the end of the coaxial cable attached to the power divider and detach the coaxial cable from the leveling amplifier. Rotate the amplifier end of the coaxial cable so that it is easily accessible and then retighten the power divider end. When checking the input to the port 1 leveling amplifier it will be necessary to remove the coaxial cable connecting the RF leveling amplifier to the coax switch, rotate the cable for better access and then reconnect at the coax switch. Attach the power sensor to the cable. Select ***[SINGLE-POINT MODE]*** from the (STIMULUS) menu, then using the RPG knob, slowly scan over the frequency band. The power level should be **−3 to +2 dBm.**

PROCEDURE 6. LO ALC ADJUSTMENT

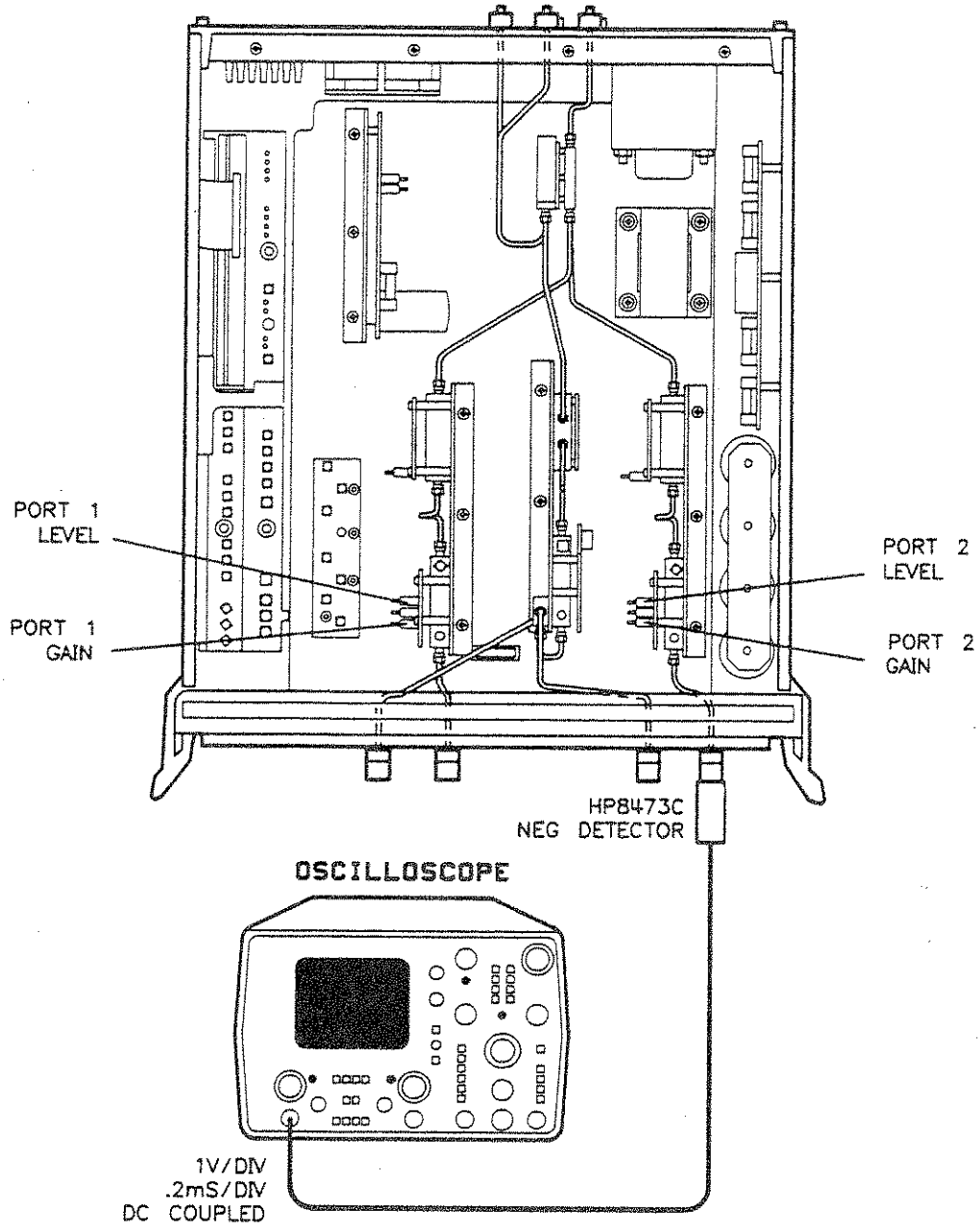


Figure 6-14. LO ALC Adjustment Points

1. Recall the instrument state stored in register 8 of the HP 8510. This should be the factory supplied configuration for your particular system. If you have modified the contents of register 8, you must reload the instrument states from the system configuration disk or tape supplied with your system. For information on loading the instrument state refer to the section tab titled "Operation" in this manual.

2. Check the user parameter (a1 or a2) for the LO port in question. The trace should be **−15 ± 2 dBm** across the band as displayed on the HP 8510 CRT. If this is the case the LO ALC is adjusted properly. If the message "NO IF FOUND" is displayed and/or a trace is not observed at the level mentioned, the LO ALC adjustment needs to be made, continue with step 3.

3. Connect the oscilloscope and negative detector as shown in Figure 6-14. Turn the gain adjustment fully clockwise. Oscillations should be visible on the oscilloscope. Turn the gain adjustment counter clockwise until the oscillations just disappear, then turn three more complete revolutions. Recheck the user parameters in step 2 and then continue with step 4.

4. Choose a power meter that covers the frequency band of interest (HP 436A Meter and HP 8485A Sensor). Calibrate the power meter and attach a 3.5 mm 10 dB fixed attenuator (8493C) and an adapter (f to f) to the sensor. Connect the sensor/attenuator to the LO output of the port in question. Turn the LO level adjustment so that +12 dBm is displayed on the power meter. The LO output is now set at +22 dBm. Select ***[SINGLE-POINT MODE]*** from the (STIMULUS) menu, then using the RPG knob, slowly scan over the frequency band.

PROCEDURE 7. RF AMPLIFIER OUTPUT

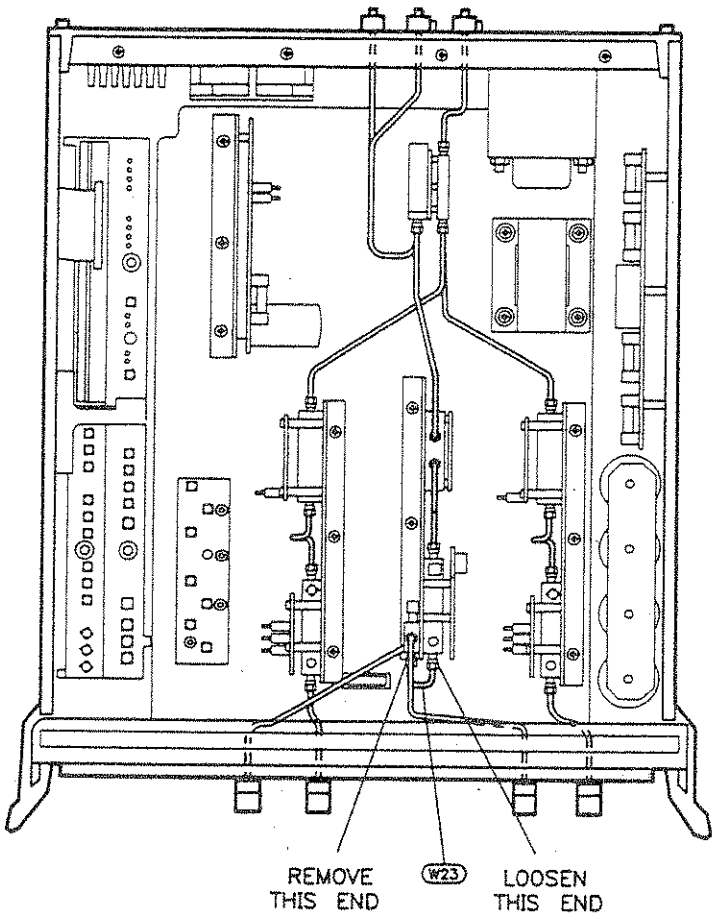


Figure 6-15. RF Amplifier Output

1. Recall the instrument state stored in register 8 of the HP 8510. This should be the factory supplied configuration for your particular system. If you have modified the contents of register 8, you must reload the instrument states from the system configuration disk or tape supplied with your system. For information on loading the instrument state refer to the section tab titled "Operation" in this manual.

   Make sure the test set modules are not connected to the module interface connector.

2. Choose a power meter that covers the frequency band of interest (HP 436A Meter and HP 8485A sensor). Calibrate the power meter and attach a 3.5 mm 10 dB fixed attenuator (8493C) and a female to female adapter to the sensor.

3. Loosen the end of the coax cable attached to the output of the RF leveling amplifier coupler and detach the other end of the coax cable from the pin switch. Rotate the cable and attach the power meter sensor. Tighten the cable end attached to the RF leveling amplifier. Select ***[SINGLE-POINT MODE]*** from the (STIMULUS) menu, then using the RPG knob, slowly scan over the frequency band. The power level should be **+25 ± 2 dBm**.

PROCEDURE 8. RF INPUT at REAR PANEL

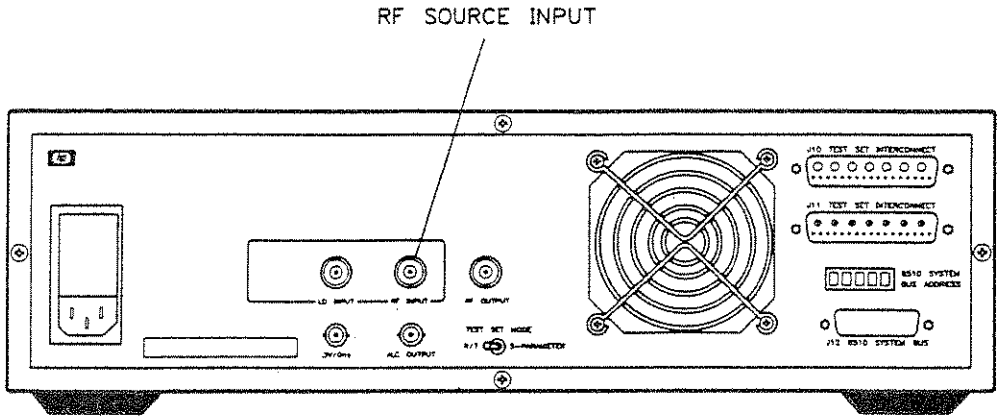


Figure 6-16. Rear Panel RF Input

1. Recall the instrument state stored in register 8 of the HP 8510. This should be the factory supplied configuration for your particular system. If you have modified the contents of register 8, you must reload the instrument states from the system configuration disk or tape supplied with your system. For information on loading the instrument state refer to the section tab titled "Operation" in this manual.

2. Choose a power meter that covers the frequency band of interest (HP 436A Meter and HP 8485A Sensor). Calibrate the power meter and attach a 3.5 mm (f to f) adapter to the sensor.

3. Disconnect the RF source cable from the back of the instrument and attach the power sensor to the cable. Select ***[SINGLE-POINT MODE]*** from the (STIMULUS) menu, then using the RPG knob, slowly scan over the frequency band. The power level should be greater than **+13 dBm**

Because the RF source is externally leveled, when the RF path is broken to measure the signal level the source will output its maximum power of greater than 13 dBm.

PROCEDURE 9. COAX SWITCH VOLTAGES

Microwave Operation. The coax switch routes the source RF thru the HP 85105A and to the optional coax test set when HP-IB test set address 20 is selected on the HP 8510. At that time the bias voltages on the coax switch are as shown in Figure 6-17.

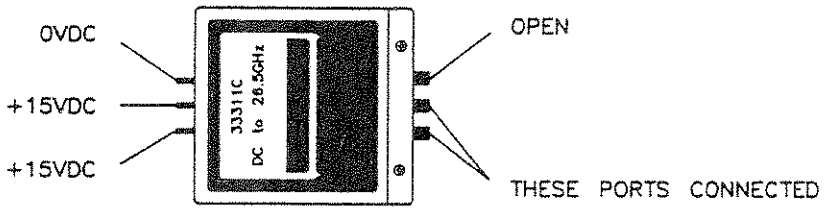


Figure 6-17. Switch Bias Voltages, Microwave Operation

Millimeter-wave Operation. The coax switch routes the source RF to the RF leveling amplifier when HP-IB test set address 21 is selected on the HP 8510. At that time the bias voltages on the coax switch are as shown in Figure 6-18.

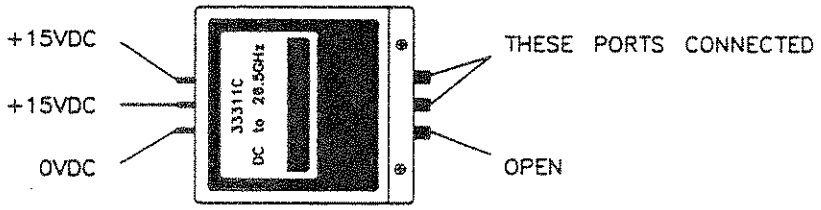


Figure 6-18. Switch Bias Voltages, Millimeter-wave Operation

PROCEDURE 10. A5 ATTENUATOR SWITCH DRIVER BOARD

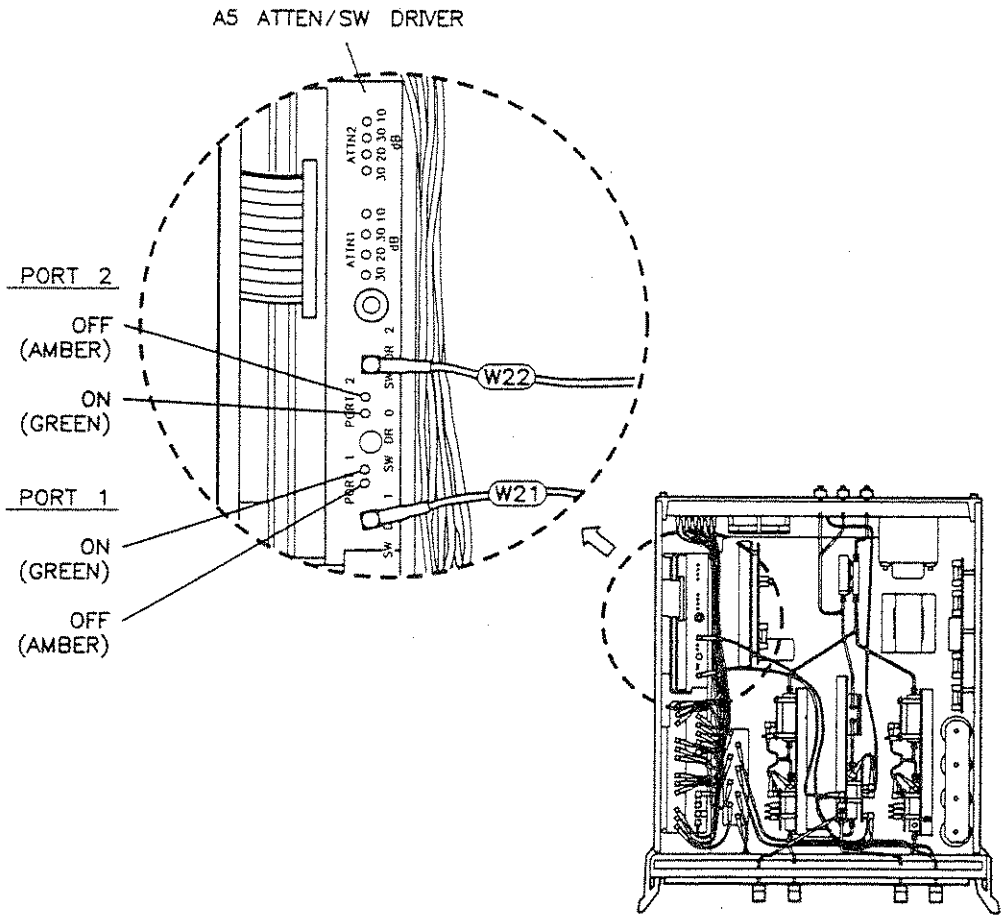


Figure 6-19. Attenuator Switch Driver Board

1. Remove cables W21 and W22 from the A5 attenuator switch driver board.
2. Switch the instrument to port 1. When port 1 is active, the port 1 indicator light on the A5 board will be green and the port 2 indicator light will be amber. The voltage measured at A5J1 is **+15 ±1.5 Vdc** and the voltage measured at A5J2 is **−15 ±1.5 Vdc**.
3. Switch the instrument to port 2. When port 2 is active, the port 2 indicator light on the A5 board will be green and the port 1 indicator light will be amber. The voltage measured at A5J1 is **−15 ±1.5 Vdc** and the voltage measured at A5J2 is **+15 ±1.5 Vdc**.

PROCEDURE 11. IF PATH, a1,a2,b1,b2

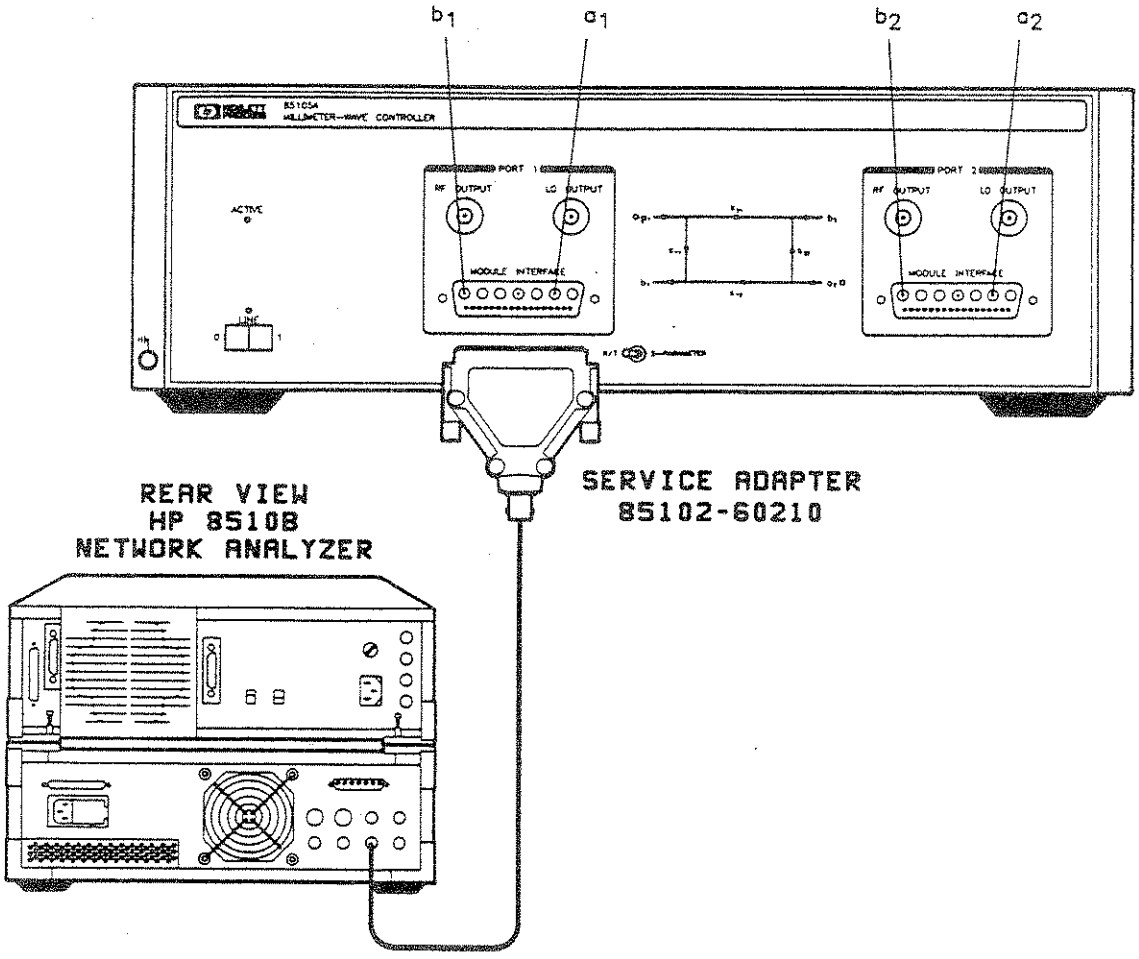


Figure 6-20. IF Inputs

1. Connect a BNC cable to the 20 MHz Out on the rear panel of the HP 85102 and to the service adapter (85102-60210). Connect the service adapter to the port 1 module interface.
2. A 20 MHz signal is routed from the 85102 thru the service adapter and injected into the a1 and b1 inputs of the module interface, Figure 6-20. Check the a1 and b1 user parameters for port 1. The traces should be a flat lines approximately −5 dB across the band as displayed on th HP 8510 CRT.
3. Repeat steps 1 and 2 for the user parameters a2 and b2 at the module interface at port 2.

PROCEDURE 12. A2 IF MULTIPLEXER

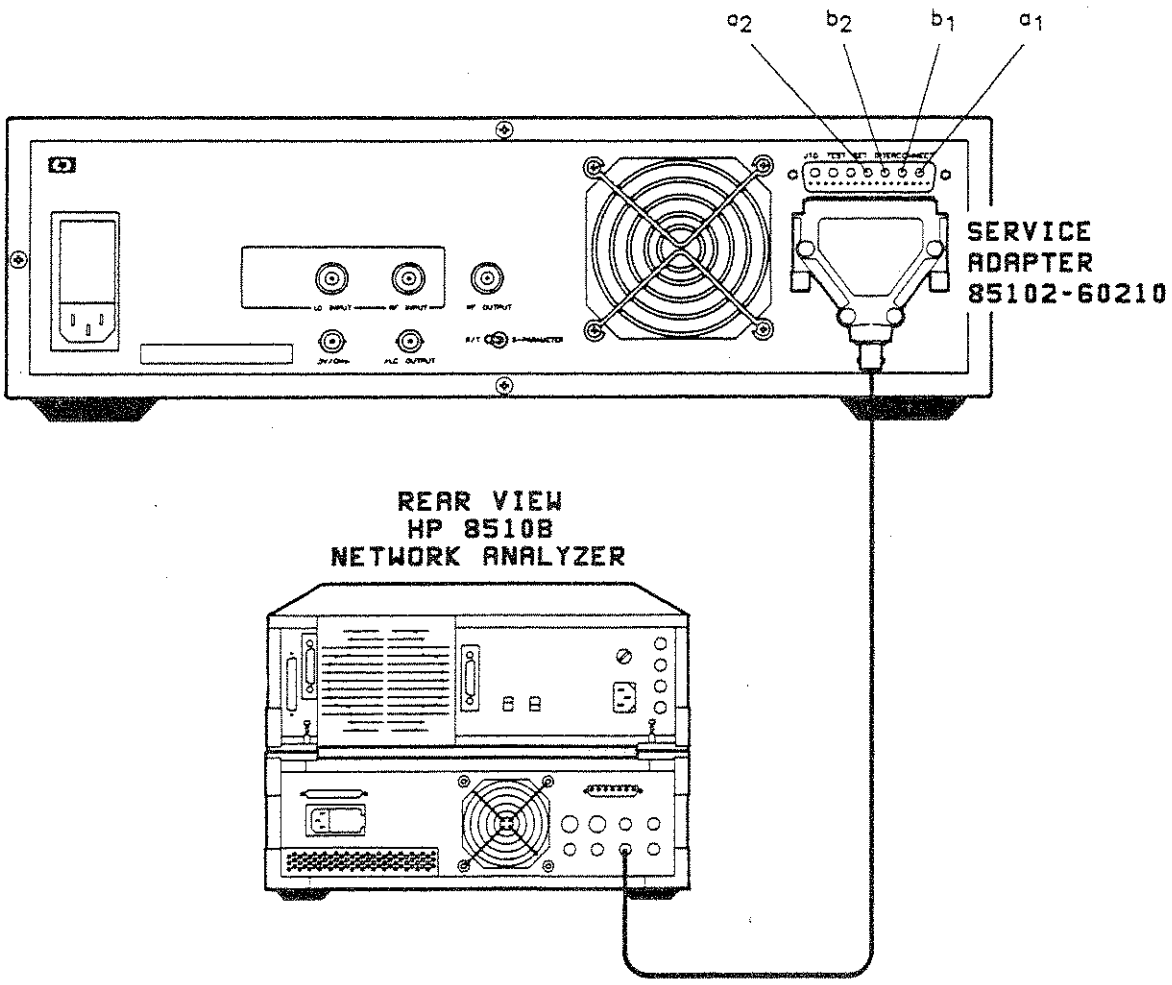


Figure 6-21. Multiplexer Inputs

1. Switch the system to microwave operation by choosing test set address 20 for the coaxial test set.
2. Connect a BNC cable to the 20 MHz Out on the rear panel of the HP 85102 and to the service adapter (85102-60210). Connect the service adapter to the J10 TEST SET INTERCONNECT on the rear panel of the HP 85105A. A 20 MHz signal is routed from the 85102 thru the service adapter and injected into the a1, a2, b1 and b2 inputs of the J10 TEST SET INTERCONNECT.
3. Check the a1, a2, b1, and b2 user parameters. The traces should be a flat lines approximately **−28 dB** across the band as displayed on the HP 8510 CRT.

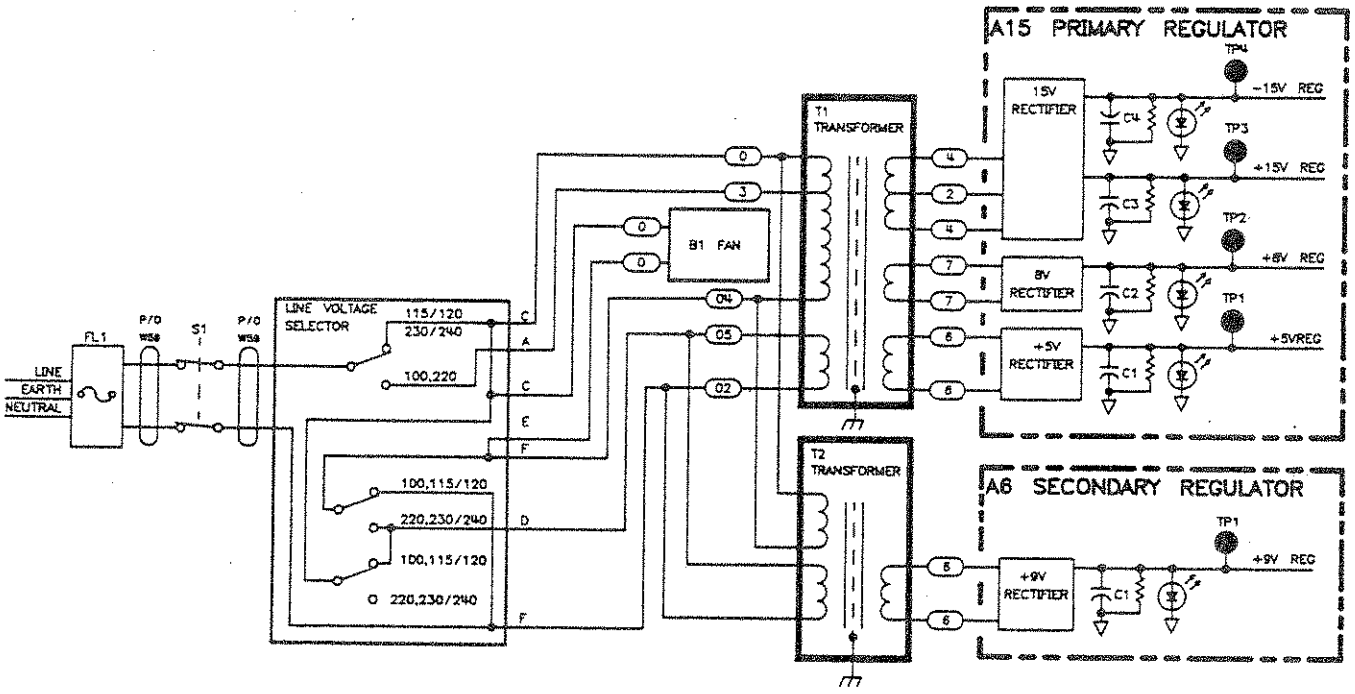


Figure 6-21a. HP 85105A Power Supply Block Diagram

REPLACEABLE PARTS

This section contains information for ordering replaceable parts. The replaceable parts include major assemblies and chassis hardware, but not parts of major assemblies. Table 6-3 lists major reference designations and abbreviations used in the parts lists.

R-E (REBUILT-EXCHANGE) ASSEMBLIES COST LESS

Lower cost assemblies are available through the rebuilt-exchange program. These factory rebuilt (repaired and tested) assemblies meet all factory specifications required of a new assembly. They are offered on an exchange (trade-in) basis only. The defective assembly must be returned for credit. Figure 6-22 illustrates the procedure. The rest of the figures provide parts information. If you have any questions, contact your HP customer engineer.

REPLACEABLE PARTS LIST

The following figures assist in locating and identifying all replaceable parts, including corresponding lists that provide the following information:

1. Hewlett-Packard part number.
2. Part quantity as shown in the corresponding figure. There may or may not be more of the same part located elsewhere in the instrument.
3. Part description, using abbreviations in Table 6-3.
4. A typical manufacturer of the part in a five-digit code (refer to the Manufacturers Code list in Table 6-3).
5. The manufacturer's part number.

ORDERING INFORMATION

To order a part listed in the replaceable parts lists, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

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

To Order Parts....fast!

(800) 227-8164
Monday through Friday, 6 am to 5 pm (Pacific Standard Time)

The parts specialists have direct online access to replacement parts inventory corresponding to the replaceable parts list in this manual. There is a charge for hotline one day delivery, but four day delivery time is standard. After hours and holidays, call (415) 968-2347

This service applies to the United States only. Outside of the United States, contact your nearest HP office.

Table 6-3. Reference Designations, Abbreviations, and Manufacturers Code List

REFERENCE DESIGNATIONS

A ..... Assembly
CR ..... Diode, Diode Thyristor, Step Recovery Diode (SCR), Varactor
DS ..... Annunciator, Lamp, Light Emitting Diode (LED), Signaling Device
F ..... Fuse
FL ..... Filter
J ..... Electrical Connector (Stationary Portion), Jack
MP ..... Miscellaneous Mechanical Part
P ..... Electrical Connector (Movable Portion), Plug
Q ..... Silicon Controlled Rectifier (SCR), Transistor, Triode Thyristor
R ..... Resistor
S ..... Switch
TP ..... Test Point
U ..... Integrated Circuit
W ..... Cable, Transmission Path, Wire

ABBREVIATIONS

A

ADJ ..... Adjust, Adjustment
AMP ..... Amplifier
ASSY ..... Assembly
ATTN ..... Attenuator

B

BD ..... Board
BNC ..... Type of Connector

C

C ..... Capacitance, Capacitor
CBL ..... Cable
CHAM ..... Chamfer
CPU ..... Central Processing Unit

D

D .... Deep, Depletion, Depth, Diameter, Direct Current
DB ..... Decibel, Double Break
DBL ..... Double

E

EXT ..... Extended, Extension, External, Extinguish

F

F ..... Fahrenheit, Farad, Female, Film (Resistor), Fixed, Flange, Flint, Fluorine, Frequency
FL ..... Flash, Flat, Fluid
FLTR ..... Filter, Floater

G

GHZ ..... Gigahertz

H

HD ..... Hand, Hard, Head, Heavy Duty
HEX . Hexadecimal, Hexagon, Hexagonal

I

ID ..... Identification, Inside Diameter
IN ..... Inch, Indium
INTL ..... Internal

K

KB ..... Knob

L

LED ..... Light Emitting Diode
LG ..... Length, Long
LKWR ..... Lockwasher

M

MACH ..... Machine
MM ..... Millimeter
MTLC ..... Metallic

N

NEG ..... Negative

O

OD ..... Olive Drab, Outside Diameter

P

PAN-HD ..... Pan Head
PC .. Picocoulomb, Piece, Printed Circuit
PNL ..... Panel
P/O ..... Part of
PN ..... Part Number

R

R ..... Rear
RFI ..... Radio Frequency Interference

S

SAMP ..... Sampler
SCR ... Screw, Scrub, Silicon Controlled Rectifier
SHFT ..... Shaft
SHLDR ..... Shoulder
SKT ..... Skirt, Socket
SLDR ..... Solder
SMB ..... Subminiature, B Type (Snap-On Connector)
SST ..... Stainless Steel

T

THD ..... Thread, Threaded
THK ..... Thick

V

VDC ..... Volts, Direct Current

W

W ... Watt, Wattage, White, Wide, Width, Wire

X

XSTR ..... Transistor

Y

YIG ..... Yttrium-iron-garnet

Z

ZN-P ..... Zinc Plate

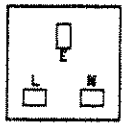
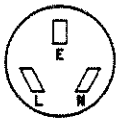
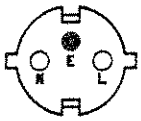
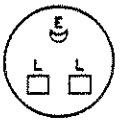
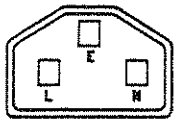
MANUFACTURERS CODE LIST

Mfr. Code	Manufacturer Name	Address		Zip Code
00000	Any Satisfactory Supplier			
28480	Hewlett-Packard Company Corp. Hq.	Palo Alto	CA	94304
55787	Gas Spring Corp.	Montgomervyille	PA	18936
71400	Cooper Industries Inc.	Houston	TX	77210

Table 6-4. Touch-up Paint

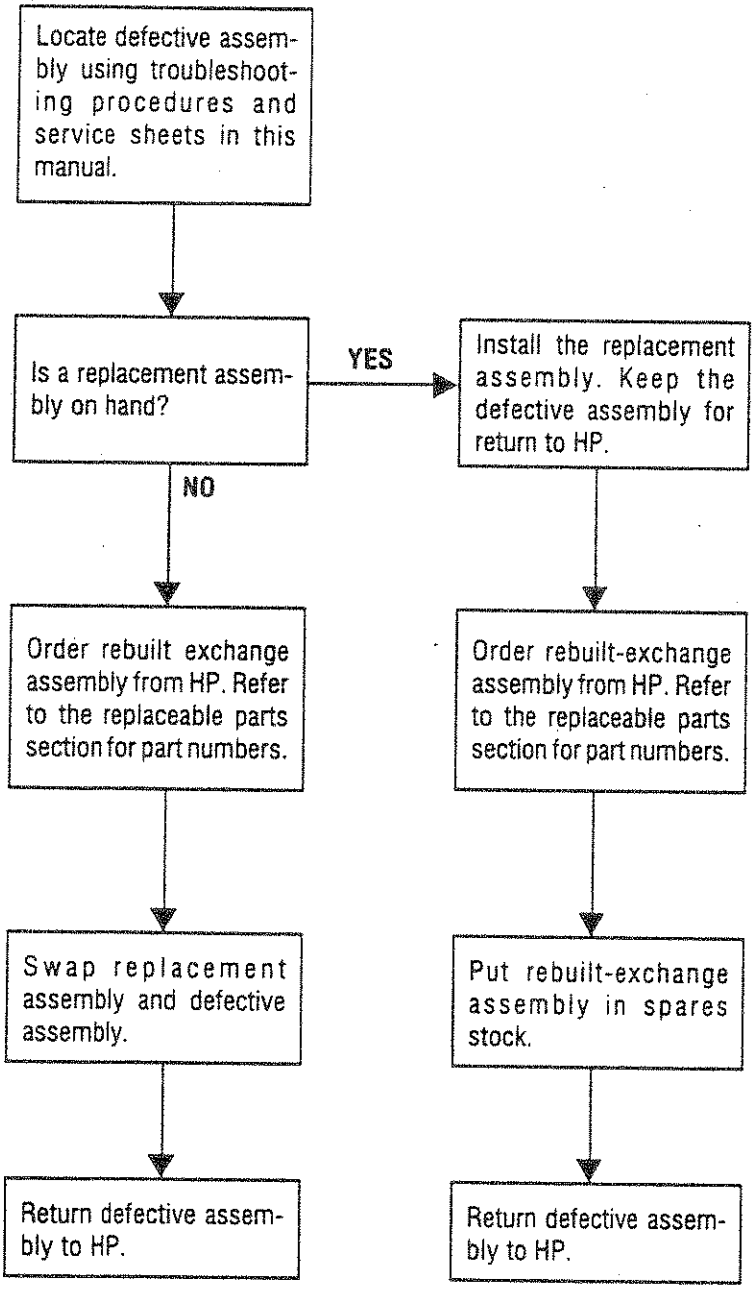
Color	Part Number	Applicable Use
Dove Grey	6010-1146	The frame around the front panel and painted portions of front handles.
French Grey	6010-1147	The side, top and bottom covers.
Parchment Grey	6010-1148	The rack mount flanges, rack support shelves and front panels.

Table 6-5. Power Cable and Plug Part Numbers

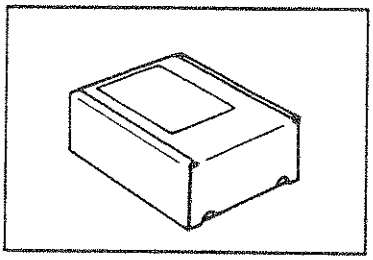
Plug Type[1]	Cable HP Part Number[2]	Plug Description[2]	Cable Length (inches)	Cable Color	For Use in Country
250V 	8120-1351 8120-1703	Straight BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
250V 	8120-1369 8120-0696	Straight ZNSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	Straight CEE7-VII 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, Republic of So. Africa, India (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	Straight NEMA5-15P 90° Straight NEMA5-15P Straight NEMA5-15P 90° Straight NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
250V 	8120-2104	Straight SEV1011.1959 24507,Type 12	79	Gray	Switzerland
250V 	8120-0698	Straight NEMA6-15P			United States, Canada
220V 	8120-1957 8120-2956	Straight DHCK 107 90°	79 79	Gray Gray	Denmark
250V 	8120-1860	Straight CEE22-VI (System Cabinet Use)			

1. E = Earth Ground; L = Line; N = Neutral
2. Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.

Use this fast, efficient, economical method to keep your Hewlett-Packard instrument in service.

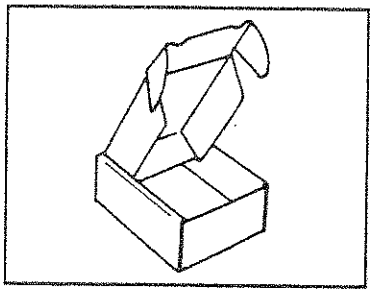


A.



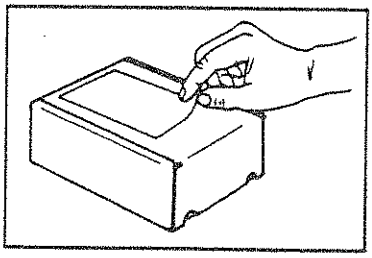
Rebuilt-exchange assemblies are shipped individually in boxes like this. In addition to the circuit assembly, the box contains:
Exchange assembly failure report
Return address label

B.



Open box carefully - it will be used to return defective assembly to HP. Complete failure report. Place it and defective assembly in box. Be sure to remove enclosed return address label.

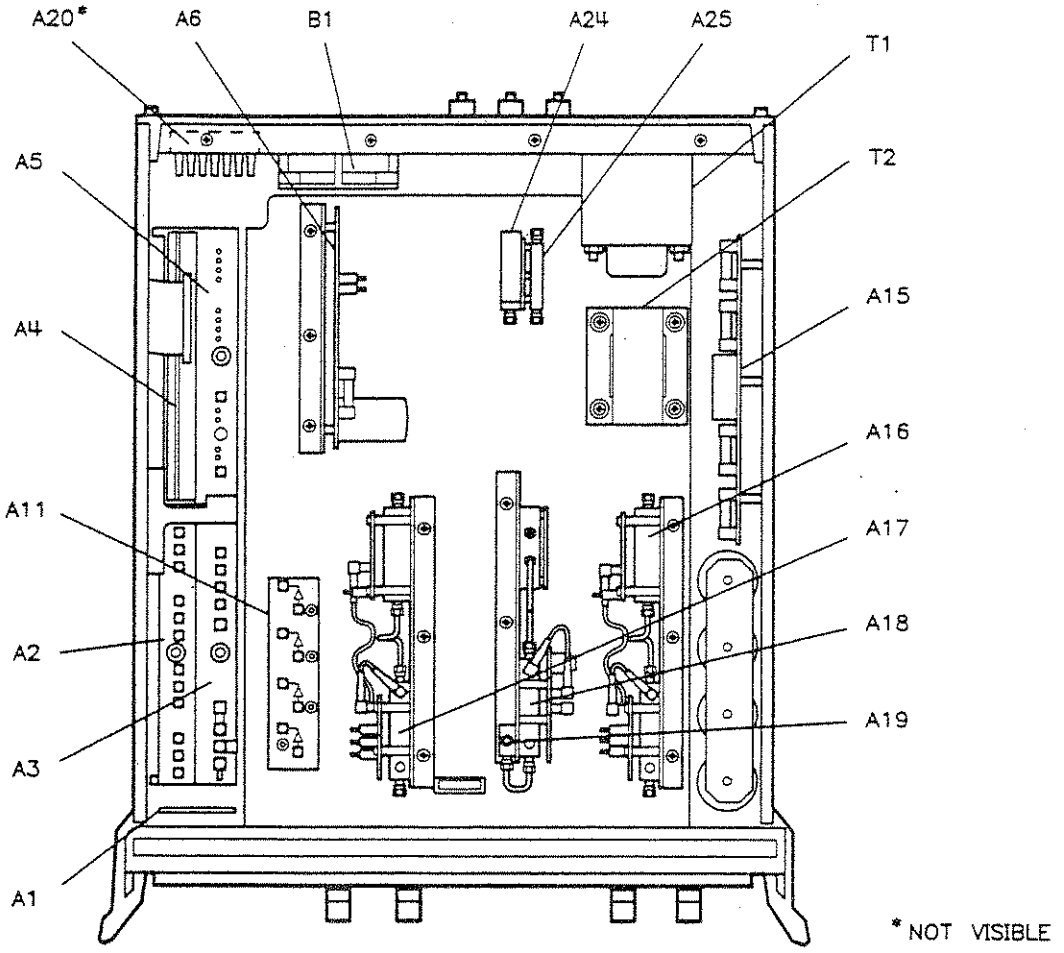
C.



Seal box with tape. Inside U.S.A.*, stick preprinted return address label over label already on box, and return box to HP. Outside U.S.A., do not use address label; instead address box to the nearest HP office.

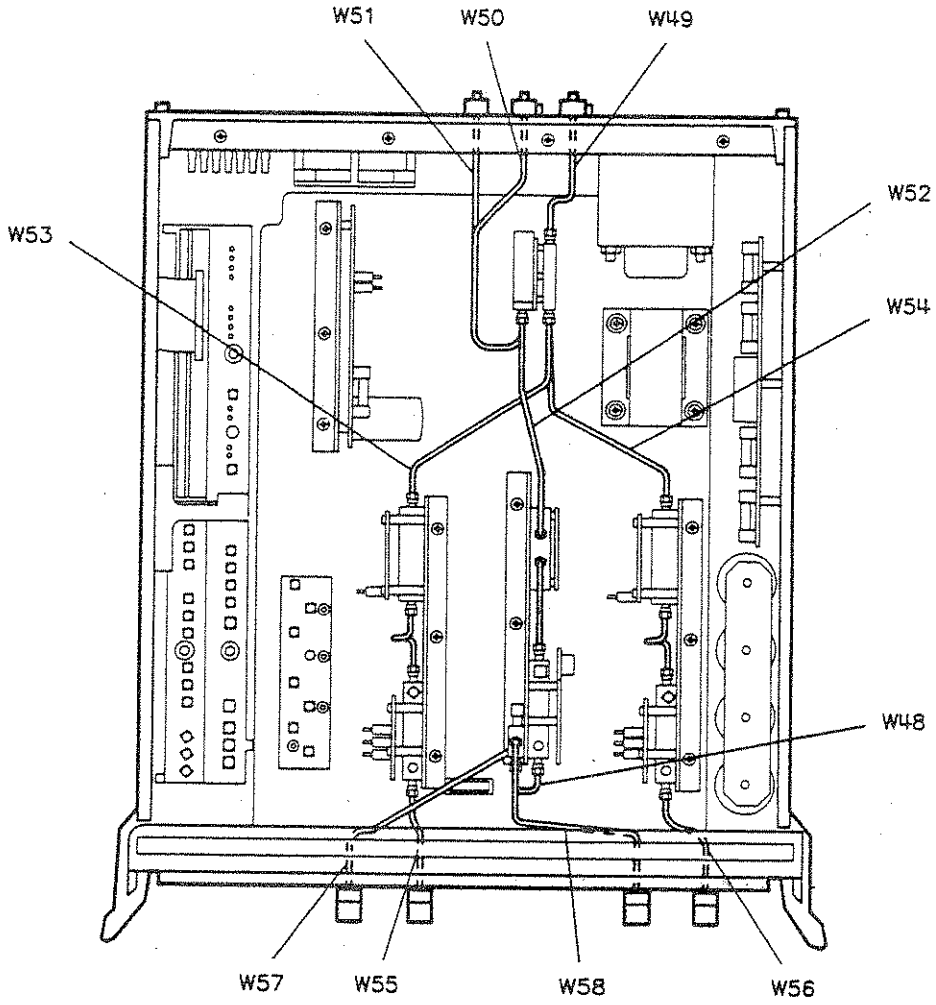
*HP pays postage on boxes mailed in U.S.A.

Figure 6-22. The Low-cost Rebuilt-Exchange Procedure



Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	08513-60005	1	FRONT PANEL INTERFACE BOARD ASSEMBLY	28480	08513-60005
A2	08513-60004	1	IF MULTIPLEXER BOARD ASSEMBLY	28480	08513-60004
A2	08513-69004	1	IF MULTIPLEXER BOARD ASSEMBLY (R-E)	28480	08513-69004
A3	85105-60016	1	VTO SUMMING AMPLIFIER BOARD ASSEMBLY	28480	85105-60016
A3	85105-69016	1	VTO SUMMING AMPLIFIER BOARD ASSEMBLY (R-E)	28480	85105-69016
A4	85105-60014	1	HP-IB BOARD ASSEMBLY	28480	85105-60014
A5	85105-60003	1	ATTENUATOR/SWITCH DRIVER BOARD ASSEMBLY	28480	85105-60003
A6	85105-60006	1	SECONDARY REGULATOR BOARD ASSEMBLY 9 Vdc	28480	85105-60006
A7-10			NOT ASSIGNED		
A11	85105-60011	1	IF AMPLIFIER ASSEMBLY	28480	85105-60011
A11	85105-69011	1	IF AMPLIFIER ASSEMBLY (R-E)	28480	85105-69011
A12-14			NOT ASSIGNED		
A15	85105-60002	1	PRIMARY REGULATOR BOARD ASSEMBLY +5, +8, ±15 Vdc	28480	85105-60002
A15	85105-69002	1	PRIMARY REGULATOR BOARDASSEMBLY +5, +8, ±15 Vdc (R-E)	28480	85105-69002
A16-A17	85105-60008	1	LO LEVELING AMPLIFIER ASSEMBLY, PORT 1 AND 2	28480	85105-60008
A16-A17	85105-69008	1	LO LEVELING AMPLIFIER ASSEMBLY, PORT 1 AND 2 (R-E)	28480	85105-69008
A18	85105-60009	1	RF LEVELING AMPLIFIER ASSEMBLY	28480	85105-60009
A18	85105-69009	1	RF LEVELING AMPLIFIER ASSEMBLY (R-E)	28480	85105-69009
A19	85105-60012	1	PIN SWITCH	28480	85105-60012
A20	08513-60006	1	HP-IB INTERFACE BOARD ASSEMBLY	28480	08513-60006
A21-23			NOT ASSIGNED		
A24	85105-60013	1	COAXIAL RF SWITCH	28480	85105-60013
A25	0955-0264	1	POWER DIVIDER 2-8 GHZ	28480	0955-0264
B1	08513-20031	1	FAN-TBAX 34-CFM 115V 50/60 HZ 1.5KVDIEL	28480	08513-20031
T1	5181-0161	1	POWER TRANSFORMER	28480	5181-0161
T2	5181-0178	1	POWER TRANSFORMER	28480	5181-0178

Figure 6-23. Major Assemblies



Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W48	85105-20032	1	SEMI-RIGID RF CABLE A19J1 TO A18 COUPLER	28480	85105-20032
W49	85105-20033	1	SEMI-RIGID RF CABLE A25 TO REAR PNL LO INPUT	28480	85105-20033
W50	85105-20034	1	SEMI-RIGID RF CABLE A24 TO REAR PNL RF INPUT	28480	85105-20034
W51	85105-20035	1	SEMI-RIGID RF CABLE A24 TO REAR PNL RF OUTPUT	28480	85105-20035
W52	85105-20036	1	SEMI-RIGID RF CABLE A24 TO A18 MOD AMP	28480	85105-20036
W53	85105-20037	1	SEMI-RIGID RF CABLE A25 TO A16 MOD AMP	28480	85105-20037
W54	85105-20038	1	SEMI-RIGID RF CABLE A25 TO A17 MOD AMP	28480	85105-20038
W55	85105-20039	1	SEMI-RIGID RF CABLE A16 COUPLER TO FRONT PNL J2	28480	85105-20039
W56	85105-20040	1	SEMI-RIGID RF CABLE A17 COUPLER TO FRONT PNL J4	28480	85105-20040
W57	85105-20041	1	SEMI-RIGID RF CABLE A19 TO FRONT PNL J1	28480	85105-20041
W58	85105-20042	1	SEMI-RIGID RF CABLE A19 TO FRONT PNL J3	28480	85105-20042

Figure 6-24. Semi-rigid RF Cables

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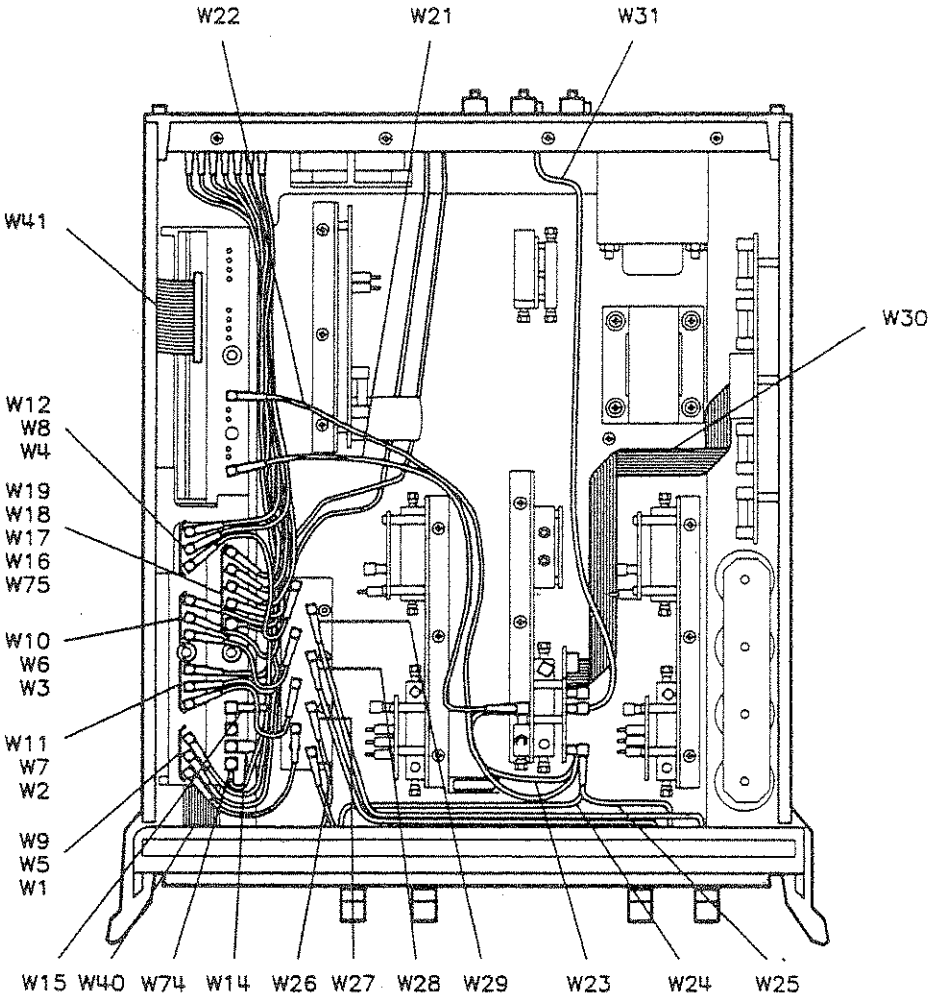
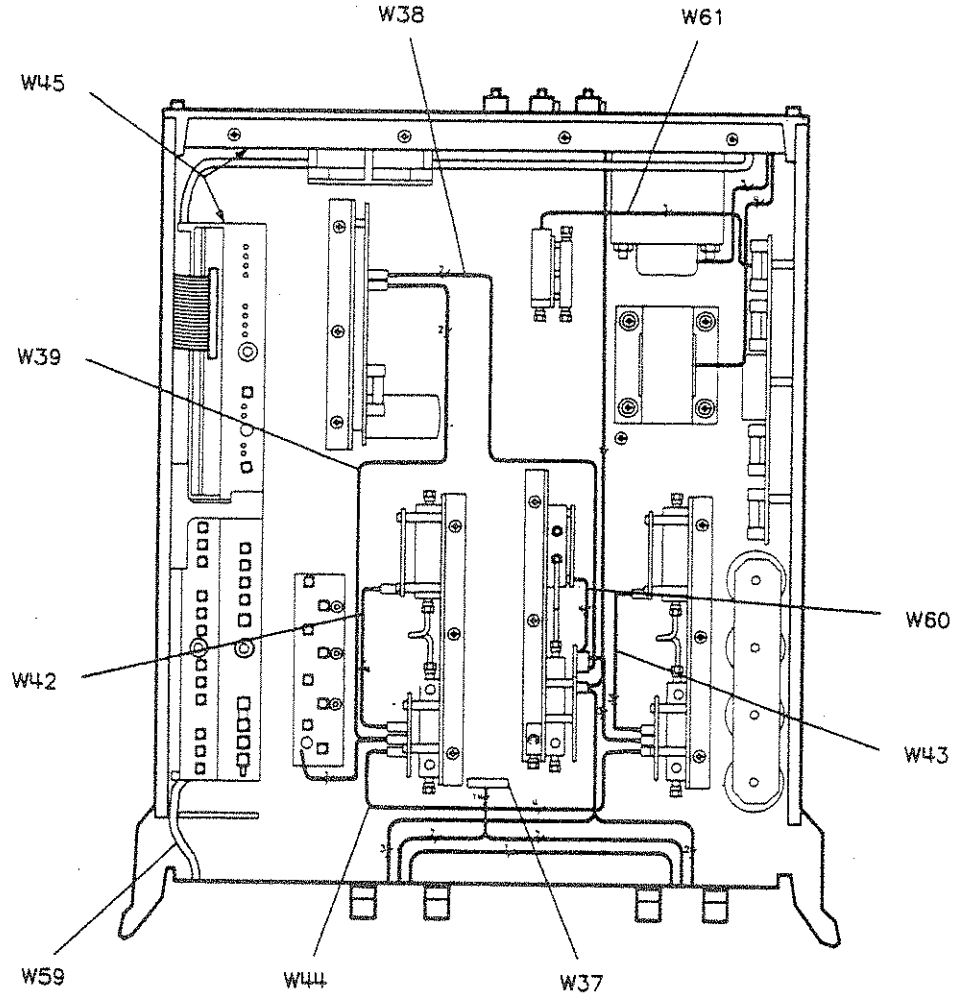


Figure 6-25. Flexible RF Cables (1 of 2)

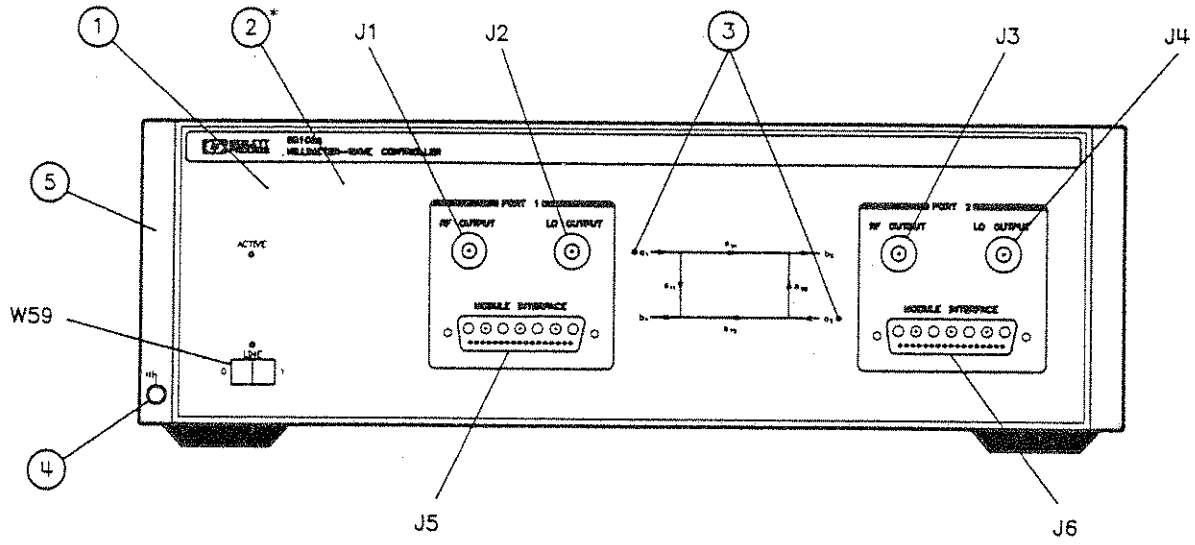
Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W1	85105-60111	1	FLEXIBLE RF CABLE A2J1 TO A11a1	28480	85105-60111
W2	85105-60111	1	FLEXIBLE RF CABLE A2J4 TO A11b1	28480	85105-60111
W3	85105-60111	1	FLEXIBLE RF CABLE A2J7 TO A11a2	28480	85105-60111
W4	85105-60111	1	FLEXIBLE RF CABLE A2J10 TO A11b2	28480	85105-60111
W5	08513-60125	1	FLEXIBLE RF CABLE A2J2 TO J11A1	28480	08513-60125
W6	08513-60126	1	FLEXIBLE RF CABLE A2J8 TO J11A4	28480	08513-60126
W7	08513-60127	1	FLEXIBLE RF CABLE A2J5 TO J11A2	28480	08513-60127
W8	08513-60128	1	FLEXIBLE RF CABLE A2J11 TO J11A3	28480	08513-60128
W9	08513-60129	1	FLEXIBLE RF CABLE A2J3 TO J10A1	28480	08513-60129
W10	08513-60130	1	FLEXIBLE RF CABLE A2J9 TO J10A4	28480	08513-60130
W11	08513-60131	1	FLEXIBLE RF CABLE A2J6 TO J10A2	28480	08513-60131
W12	08513-60132	1	FLEXIBLE RF CABLE A2J12 TO J10A3	28480	08513-60132
W13			NOT ASSIGNED		
W14	08513-60134	1	FLEXIBLE RF CABLE A3J2 TO J11A7	28480	08513-60134
W15	08513-60135	1	FLEXIBLE RF CABLE A3J3 TO J10A7	28480	08513-60135
W16	08513-60136	1	FLEXIBLE RF CABLE A3J5 TO J11A5	28480	08513-60136
W17	08513-60137	1	FLEXIBLE RF CABLE A3J6 TO J10A5	28480	08513-60137
W18	08513-60138	1	FLEXIBLE RF CABLE A3J7 TO J11A6	28480	08513-60138
W19	08513-60139	1	FLEXIBLE RF CABLE A3J8 TO J10A6	28480	08513-60139
W20			NOT ASSIGNED		
W21	85105-60101	1	FLEXIBLE RF CABLE A5J3 TO A19B2	28480	85105-60101
W22	85105-60102	1	FLEXIBLE RF CABLE A5J1 TO A18	28480	85105-60102
W23	85105-60103	1	FLEXIBLE RF CABLE A18J4 TO A19B1	28480	85105-60103
W24	85105-60104	1	FLEXIBLE RF CABLE A18 TO J5A4	28480	85105-60104
W25	85105-60105	1	FLEXIBLE RF CABLE A18 TO J6A4	28480	85105-60105
W26	85105-60106	1	FLEXIBLE RF CABLE A11a1 TO J5A2	28480	85105-60106
W27	85105-60107	1	FLEXIBLE RF CABLE A11b1 TO J5A6	28480	85105-60107
W28	85105-60108	1	FLEXIBLE RF CABLE A11a2 TO J6A2	28480	85105-60108
W29	85105-60109	1	FLEXIBLE RF CABLE A11b2 TO J6A6	28480	85105-60109
W30	85105-60121	1	RIBBON CABLE A15 TO A18	28480	85105-60121
W31	85105-60110	1	FLEXIBLE RF CABLE A18 TO REAR PNL ALC	28480	85105-60110
W40	08513-60013	1	RIBBON CABLE A1 TO A10	28480	08513-60013
W41	08513-60036	1	RIBBON CABLE A4 TO A20	28480	08513-60036
W74	85105-60133	1	FLEXIBLE RF CABLE A3J1 TO REAR PANEL TEST SET MODE SWITCH	28480	85105-61033
W75	85105-61034	1	FLEXIBLE RF CABLE A3J4 TO REAR PANEL TEST SET MODE SWITCH	28480	85105-61034

Figure 6-25. Flexible RF and Ribbon Cables (2 of 2)



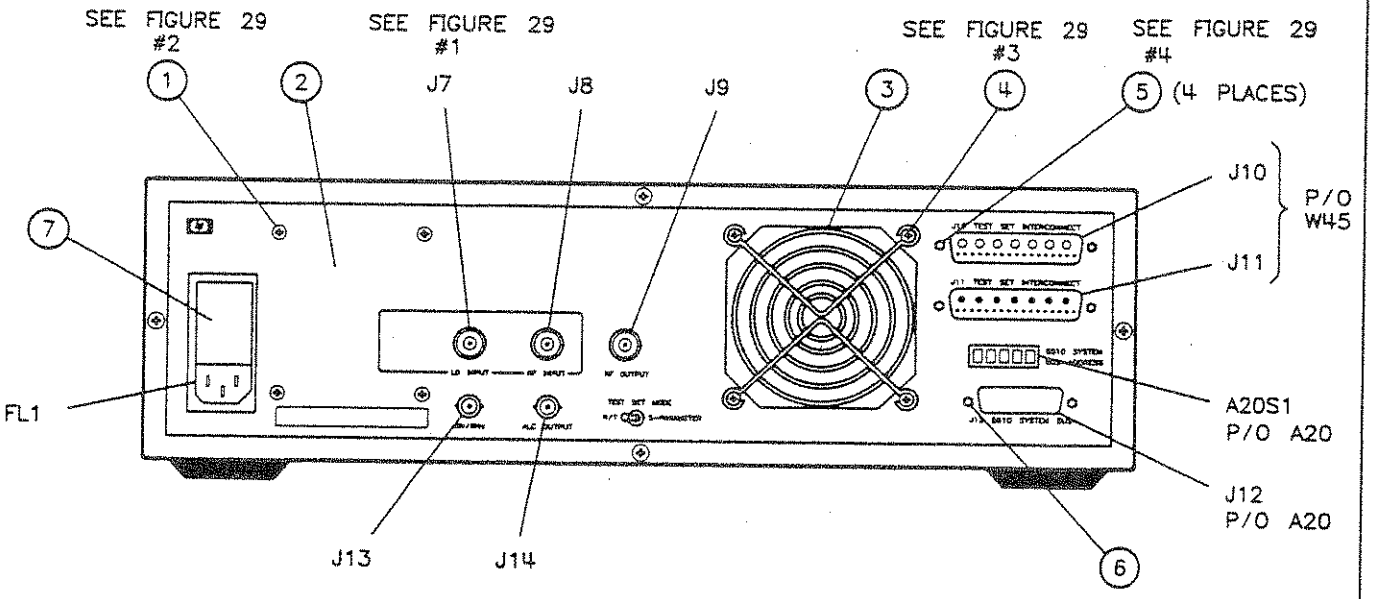
Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W42	85105-60117	1	CABLE ASSEMBLY A16 ALC TO BIAS BOARD	28480	85105-60117
W43	85105-60117	1	CABLE ASSEMBLY A17 ALC TO BIAS BOARD	28480	85105-60117
W37	85105-60114	1	CABLE ASSEMBLY A10J3 TO FRONT PNL J5 & J6, A18 & REAR PNL .5V GHZ	28480	85105-60114
W38	85105-60115	1	CABLE ASSEMBLY A6 TO A18 AND A17	28480	85105-60115
W39	85105-60116	1	CABLE ASSEMBLY A6 TO A16 AND A11	28480	85105-60116
W44	85105-60118	1	CABLE ASSEMBLY A16 ALC BOARD TO A17 ALC BOARD	28480	85105-60118
W45	08513-60014	1	CABLE ASSEMBLY J10 AND J11 TO J7 MOTHERBOARD	28480	08513-60014
W59	85102-60226	1	CABLE ASSEMBLY LINE SWITCH	28480	85102-60226
W60	85105-60119	1	CABLE ASSEMBLY A18 ALC TO BIAS BOARD	28480	85105-60119
W61	85105-60120	1	CABLE ASSEMBLY J3 MOTHER BOARD TO A24	28480	85105-60120
W62			NOT ASSIGNED		

Figure 6-26. Wire Harnesses



Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	85105-00001	1	FRONT PANEL DRESS	28480	85105-00001
2	85105-00002	1	SUB PANEL	28480	85105-00002
3	1990-0858	1	LED-LAMP 25 MA MAX	28480	1990-0858
	1450-0615	1	RETAINER LED	28480	1450-0615
	08340-40002	1	LED MOUNT	28480	08340-40002
4	1510-0038	1	BINDING POST ASSEMBLY	28480	1510-0038
	2190-0067	1	LOCK WASHER .25 IN	28480	2190-0067
	2950-0006	1	HEX NUT DOUBLE CHAM 1/4-32	28480	2950-0006
5	5021-8747	1	FRONT BEZEL	28480	5021-8747
J1-4	5061-5316	1	3.5 MM CONNECTOR ASSEMBLY	28480	5061-5316
	2190-0104	1	LOCK WASHER	28480	2190-0104
	2950-0132	1	HEX NUT	28480	2950-0132
J5-6	1251-2197	1	24 PIN CONNECTOR FEMALE	28480	1251-2197
W59			SEE FIGURE 6-26		

Figure 6-27. Front Panel Miscellaneous Parts



Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	2510-0270	1	MACHINE SCREW 8-32 3.25 IN	28480	2510-0270
	3050-0139	1	FLAT WASHER MTLC NO.8	28480	3050-0139
	2190-0017	1	LOCK WASHER NO.10	28480	2190-0017
	2950-0001	1	HEX NUT DBL-CHAM 3/8-32	28480	2950-0001
	0380-0010	1	ROUND SPACER .625-IN-LG	28480	0380-0010
2	85105-00003	1	REAR PANEL	28480	85105-00003
3	3160-0309	1	FINGER GUARD	28480	3160-0309
4	0400-0002	1	GROMMET-RND	28480	0400-0002
	0590-0926	1	THREADED INSERT STANDOFF	28480	0590-0926
	2360-0123	1	MACHINE SCREW 6-32	28480	2360-0123
	2420-0001	1	HEX NUT 3-32	28480	2420-0001
	3050-0227	1	FLAT WASHER NO.6	28480	3050-0227
5	1251-7812	1	CONNECTOR JACKSCREW	28480	1251-7812
	0590-0663	1	HEX NUT 4/40	28480	0590-0663
6	0380-0643	1	STANDOFF HEX	28480	0380-0643
7	5001-3907	1	LINE MODULE RETAINER CLIPS	28480	5001-3907
J7-9	08513-20016	1	GOLD NOSE CONNECTOR	28480	08513-20016
	5061-5394	1	PIN AND DEAD ASSEMBLY	28480	5061-5394
	08513-20017	1	BULKHEAD CONNECTOR	28480	08513-20017
	2190-0104	1	LOCK WASHER 7/16	28480	2190-0104
	2950-0132	1	HEX NUT 7/16	28480	2950-0132
J13-14	1250-0083	1	BNC CONNECTOR FEMALE 50 OHM	28480	1250-0083
	2190-0016	1	LOCK WASHER 3/8 IN	28480	2190-0016
	2950-0001	1	HEX NUT 3/8	28480	2950-0001
FL1	9135-0217	1	LINE MODULE-FILTERED	28480	9135-0217

Figure 6-28. Rear Panel Miscellaneous Parts

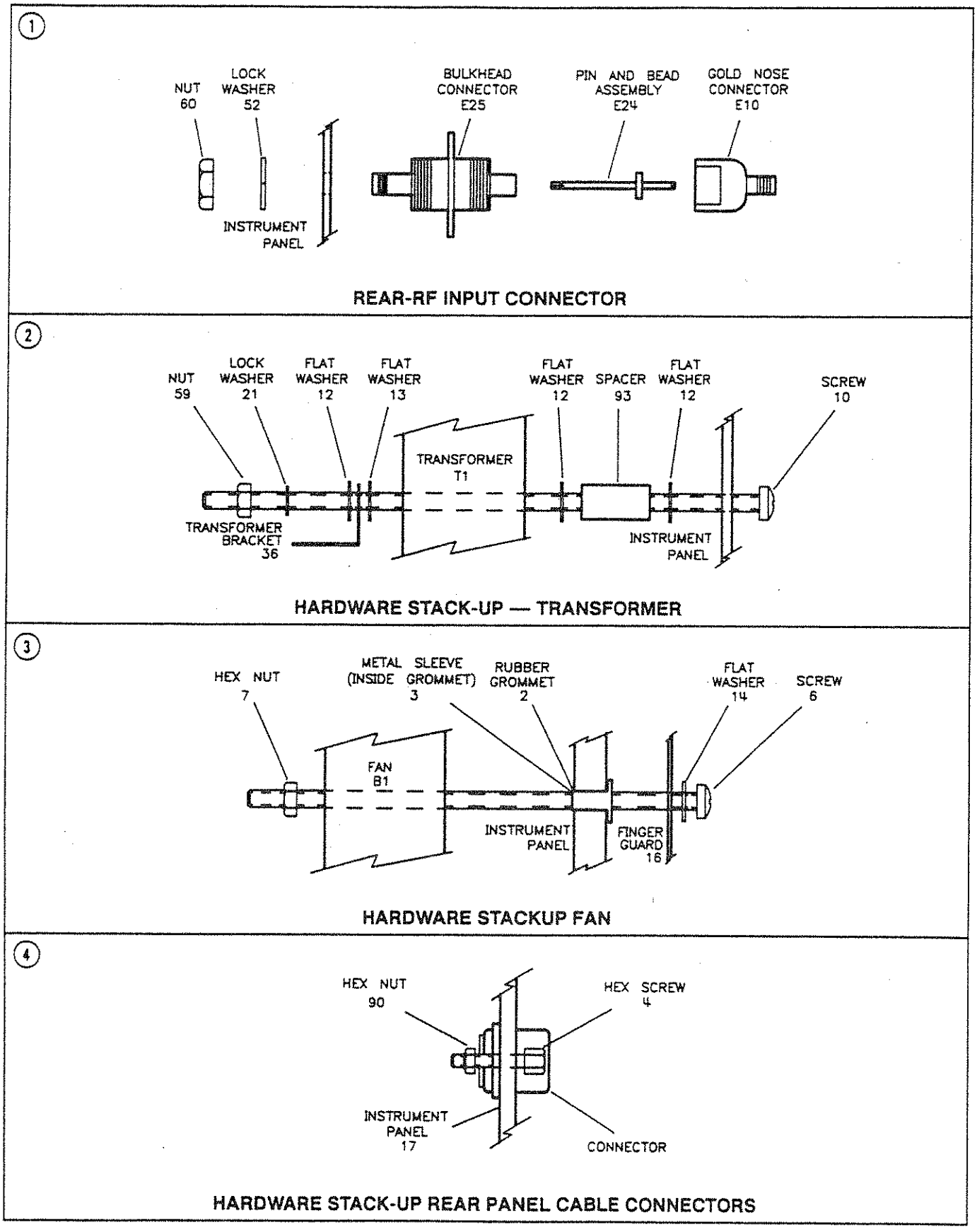
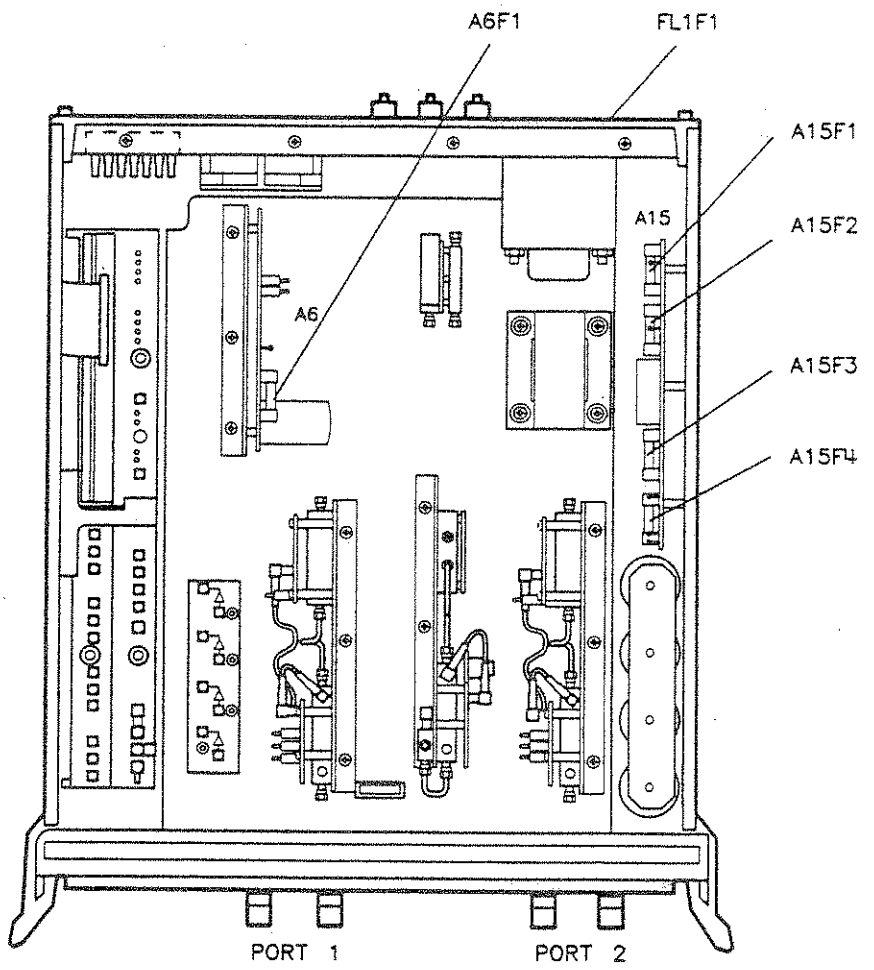
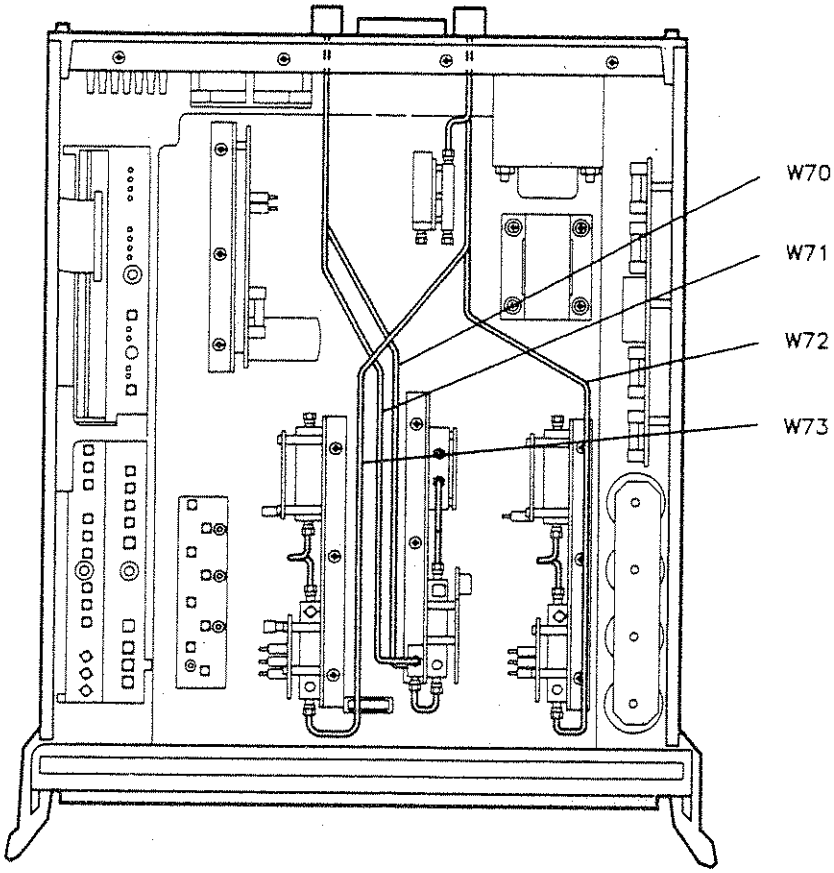


Figure 6-29. Detailed Views



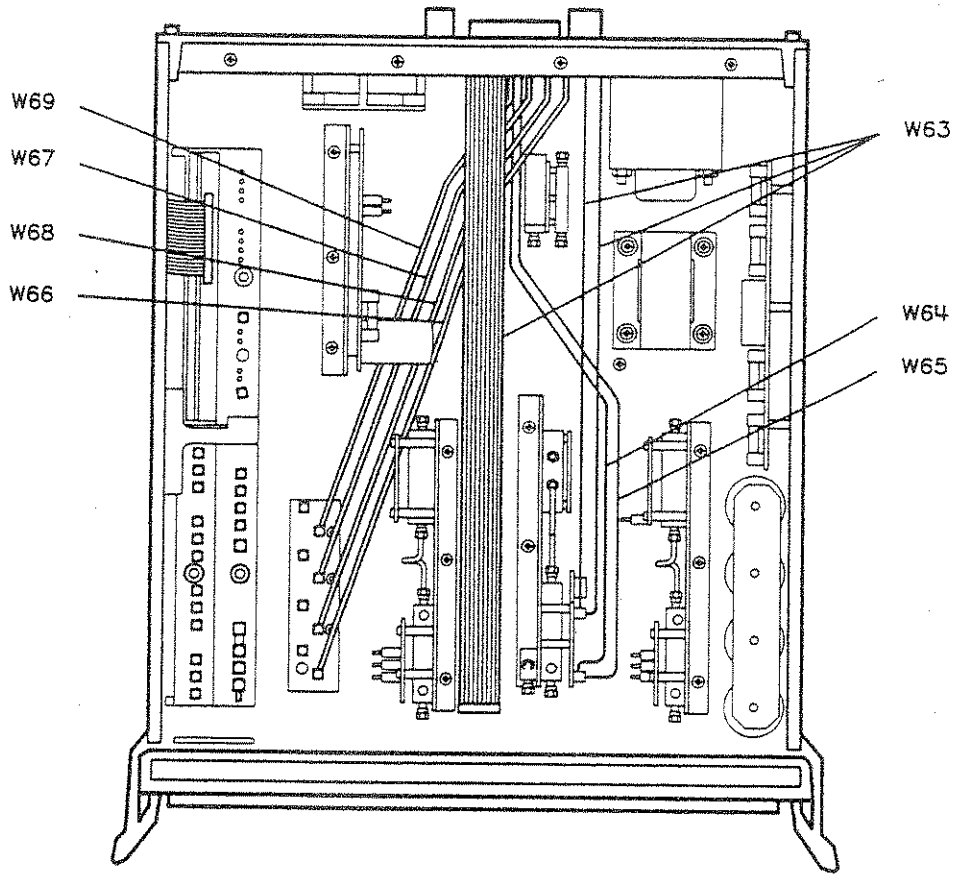
Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6F1	2110-0003	1	FUSE 4A 250V	28480	2110-0003
A15F1	2110-0003	1	FUSE 4A 250V	28480	2110-0003
A15F2	2110-0003	1	FUSE 4A 250V	28480	2110-0003
A15F3	2110-0043	1	FUSE 2A 250V	28480	2110-0043
A15F4	2110-0001	1	FUSE 1A 250V	28480	2110-0001
FL1F1	2110-0055	1	FUSE 4A 250V MAIN LINE	28480	2110-0055

Figure 6-30. Fuse Locations and Values



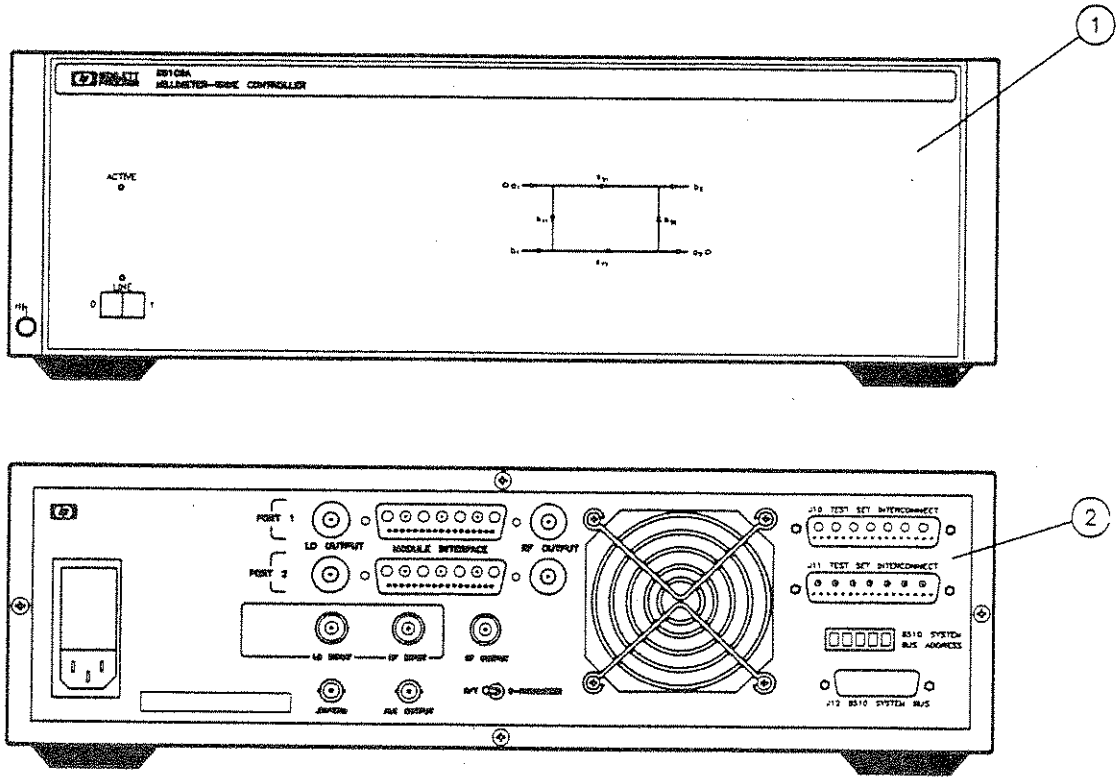
Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W70	85105-60129	1	SEMI-RIGID RF CABLE A19 PORT 2 TO REAR PNL J3	28480	85105-60129
W71	85105-60130	1	SEMI-RIGID RF CABLE A19 PORT 1 TO REAR PNL J1	28480	85105-60130
W72	85105-60131	1	SEMI-RIGID RF CABLE A17 TO REAR PNL J4	28480	85105-60131
W73	85105-60132	1	SEMI-RIGID RF CABLE A16 TO REAR PNL J2	28480	85105-60132

Figure 6-31. Cables Unique to Option 004



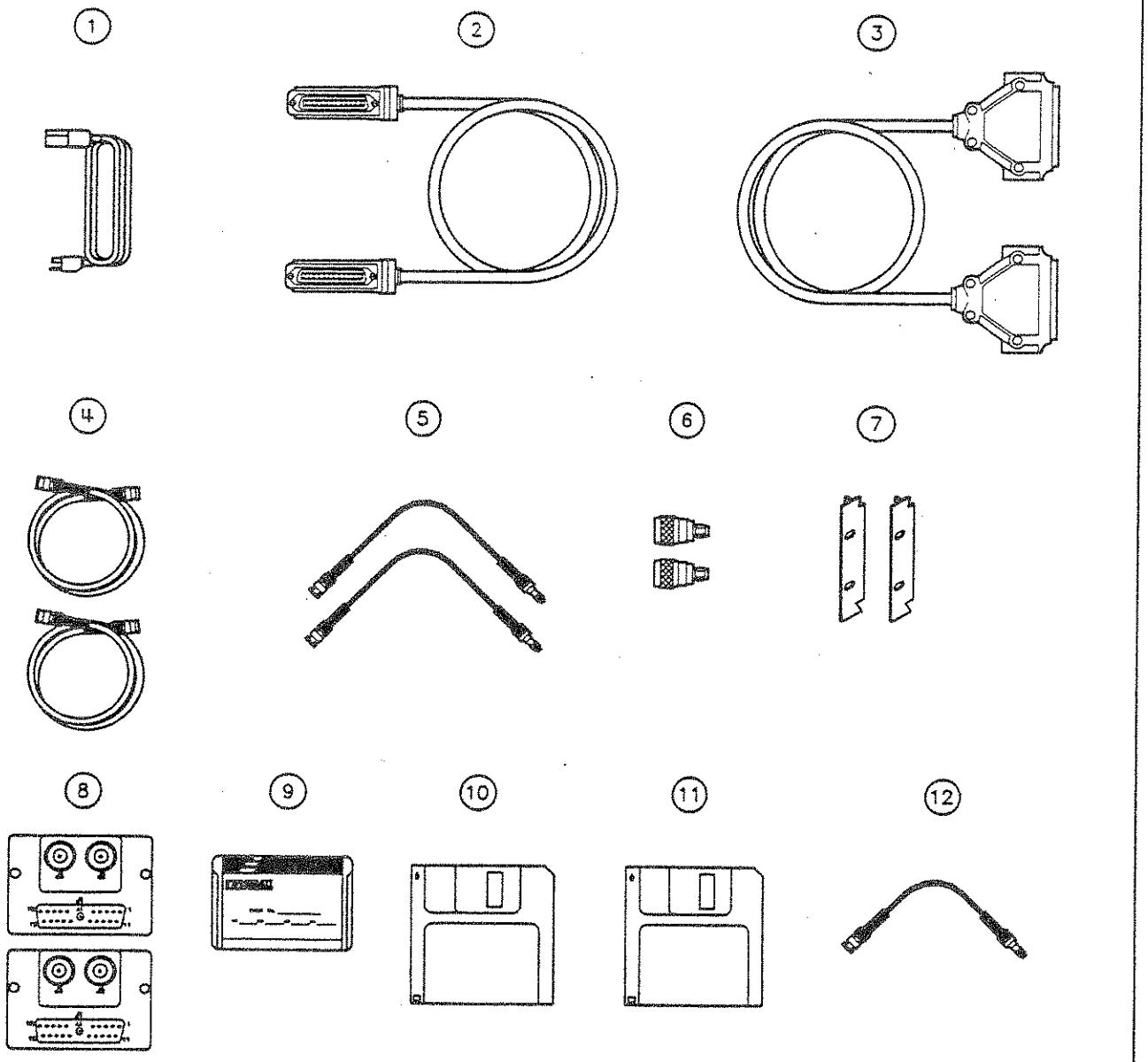
Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W63	85105-60122	1	CABLE ASSEMBLY A10J3 TO REAR PNL J5 & J6, A18 & REAR PNL .5V GHZ	28480	85105-60122
W64	85105-60123	1	FLEXIBLE RF CABLE A18 ALC TO REAR PNL J5	28480	85105-60123
W65	85105-60124	1	FLEXIBLE RF CABLE A18 ALCTO REAR PNL J6	28480	85105-60124
W66	85105-60125	1	FLEXIBLE RF CABLE A11a1 TO REAR PNL J5	28480	85105-60125
W67	85105-60126	1	FLEXIBLE RF CABLE A11a2 TO REAR PNL J6	28480	85105-60126
W68	85105-60127	1	FLEXIBLE RF CABLE A11b1 TO REAR PNL J5	28480	85105-60127
W69	85105-60128	1	FLEXIBLE RF CABLE A11b2 TO REAR PNL J6	28480	85105-60128

Figure 6-32. Cables Unique to Option 004



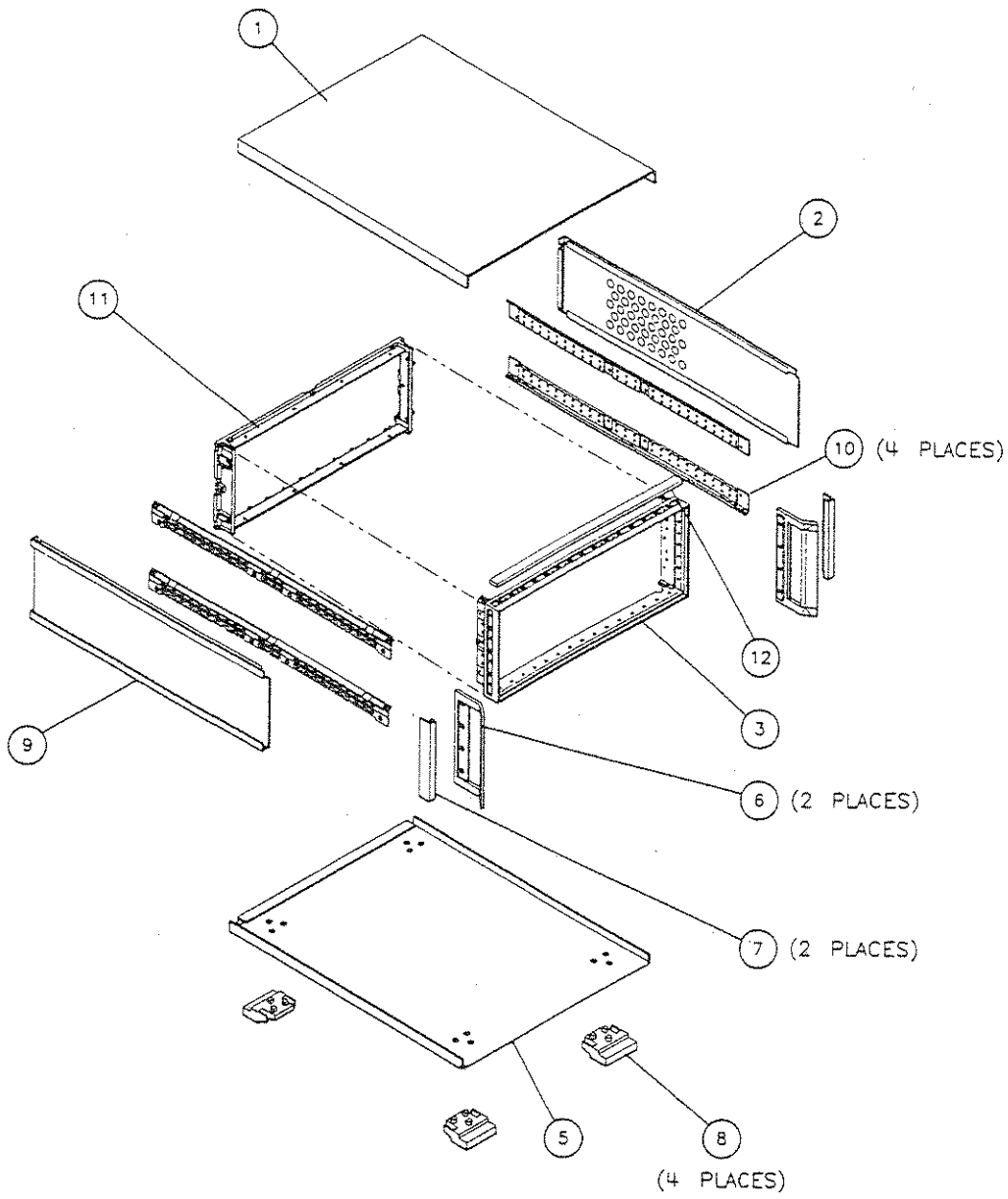
Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	85105-00010	1	FRONT DRESS PANEL	28480	85105-00010
2	85105-00011	1	REAR PANEL	28480	85105-00011

Figure 6-33. Miscellaneous Parts Unique to Option 004



Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	8120-1348	1	POWER CORD U.S.A.	28480	8120-1348
2	8120-3445	1	HP-IB CABLE	28480	8120-3445
3	08510-60106	1	TEST SET INTERFACE CABLE	28480	08510-60106
4	8120-1840	2	BNC CABLES	28480	8120-1840
5	85100-60002	2	FLEX SOURCE CABLE 30 IN.	28480	85100-60002
6	1250-1894	2	ADAPTER MALE N TO MALE SMA	28480	1250-1894
7	5062-4071	1	RACK MOUNT KIT	28480	5062-4071
8	85105-60015	2	FRONT PANEL ADAPTER	28480	85105-60015
9	85106-10004	1	SYSTEM CONFIGURATION TAPE HP 85106	28480	85106-10004
10	85106-10005	1	SYSTEM CONFIGURATION DISK HP 85106	28480	85106-10005
11	08510-10033	1	SPECIFICATION AND PERFORMANCE VERIFICATION SOFTWARE PROGRAM AND DATA DISK	28480	08510-10033
12	8120-4396	1	FLEXIBLE SOURCE CABLE 18"	28480	8120-4396

Figure 6-34. Accessories



Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	5062-3735	1	TOP COVER	28480	5062-3735
2	08513-00041	1	SIDE COVER PERF	28480	08513-00041
3	5021-8403	1	FRONT FRAME	28480	5021-8403
4	5040-7201	1	FRONT FOOT	28480	5040-7201
5	5062-3747	1	BOTTOM COVER	28480	5062-3747
6	5062-3799	1	HANDLE ASSEMBLY	28480	5062-3799
7	5020-8896	1	TRIM FRONT HANDLE	28480	5020-8896
8	5040-7221	1	REAR FOOT	28480	5040-7221
9	5062-3757	1	SIDE COVER	28480	5062-3757
10	5021-5837	1	18'' CORNER STRUT	28480	5021-5837
11	5021-5804	1	REAR FRAME	28480	5021-5804
12	5040-7202	1	TRIM STRIP	28480	5040-7202

Figure 6-35. Cabinet Parts

Appendix A

This Appendix contains information on HP-IB addresses, hardware states and instrument states for microwave and millimeter-wave HP 8510 systems.

HP 85106B Millimeter Wave System HP-IB Addresses

HP 8510 System Bus	millimeter-wave (waveguide)	microwave (coaxial)
Address of 8510	16	16
System bus	17	17
Source #1 (RF)	19	19
Source #2 (LO)	18	31
Test Set	21	20
Plotter	5	5
Printer	1	1
Disc	0	0
Pass-thru	31	31
RF switch	31	31

HP 85106B Millimeter-Wave System Important Hardware States

System Parameter	millimeter-wave (waveguide)	microwave (coaxial)
System Phaselock	None or Ext. (1)	Int.
Mult. Source	On	Off
Leveling Source #1	Ext.	Int.
Leveling Source #2	Int.	N/A

Note: 1. System Phaselock must be Ext. for HP 8350B source.

HP 85106B millimeter-wave System Important Instrument States[1]

System Parameter	millimeter-wave (waveguide)				microwave (coaxial)	unit
	Q (WR-22)	U (WR-19)	V (WR-15)	W (WR-10)		
Power Source #1[2]	−20	−20	−25	−30	10	dBm
Power Source #2	+3	+3	+3	+3	N/A	dBm
Sweep Mode	any except RAMP[3]				any	—
Z_0	1				50	Ohm
Delay	waveguide				coaxial	—
Waveguide Cutoff	26.338	31.386	39.873	59.024	N/A	GHz

1. Instrument states may be changed if the [PRESET] key on the HP 8510 is pressed.
2. Optimum power level for source #1 may vary from system to system. Adjust the power level to the maximum level without an "IF Overload" error. (Refer to "RF Signal Power Control" in Chapter 2.)
3. RAMP mode can be used if the LO source is a HP 8350B, but RAMP mode has no specifications.

HP 85106B millimeter-wave System Multiple Source Operating Frequencies

Waveguide Band	Start Freq. (GHz)	Stop Freq. (GHz)	Source #1		Source #2	
			Mult.	Offset Freq.	Mult.	Offset Freq.
R*	26.5	40.0	1/2	0.000000000	1/8	0.020000000
Q	33.0	50.0	1/3	"	1/10	"
U	40.0	60.0	1/3	"	1/10	"
V	50.0	75.0	1/4	"	1/14	"
W	75.0	110.0	1/6	"	1/16	"

Notes: 1. The Receiver Multiplier is set to 1 and Receiver Offset Frequency is set to 0.020000000 GHz for all bands.
2. The exact start and stop frequencies set by the source may be slightly different depending on the source model.
* R-band can only be used with the HP 83554A Source Module and R11643A Test Set Kit.

Appendix B

UPGRADE PATHS

From HP 85106A V-Band (HP 85100V) or W-Band (HP 85100W): If you want to use the HP 11643A Waveguide Test Set instead of the HP 85104A Test Set Module, the following must be changed:

1. The switch on the rear panel of the HP 85105 must be set to R/T (reflection/transmission).
2. The source 1 equation in the multiple source definitions must be changed to:

   V-band Source 1: 1/5 * (Freq + 0.000000 GHz)

   W-band Source 1: 1/5 * (Freq + 000000000 GHz)

See "Multiple Source" in Section 2 for examples of HP 85106B definitions.