Operating and Service Manual

Agilent Technologies
85310A Distributed
Frequency Converter

Agilent Technologies

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Hewlett-Packard to Agilent Technologies Transition

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Operating and Service Manual

HP 85310A Distributed Frequency Converter

HEWLETT PACKARD

HP Part No. 85310-90001
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Edition 5

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Printing History

New editions of this manual will incorporate all material updated since the previous editions. The manual printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates which are incorporated at reprint do not cause the date to change.) The manual part number changes when extensive technical changes are incorporated.

The following versions of this manual have been produced:

Edition	Date
Edition 1	April 1990
Edition 2	September 1990
Edition 3	September 1991
Edition 4	December 1992
Edition 5	August 1993

Manual Applicability

Each HP 85310A system has an individual serial number. This number is composed of a five-character prefix and a five-digit suffix. The prefix always stays the same unless there is significant change to the product. Because of this, the prefix can be used to keep track of major system revisions.

This manual applies to HP 85310A systems with the serial prefix shown in Table 0-1, below.

Where to Find the Prefix

The serial number is located on the back of the HP 85309A LO/IF Distribution Unit.

Table 0-1.

Edition	Date	HP 85310A Serial Prefix
Edition 1	October 1989	2944A
Edition 2	August 1990	3026A
Edition 3	September 1991	3136A
Edition 4	December 1992	3224A
Edition 5	August 1993	3224A

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 for warnings or cautions.

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 the product or loss of important data. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Safety Earth Ground

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power, cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

Before Applying Power

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

If this product is to be powered by an autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the AC power supply.

Servicing

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

Capacitors inside this product could 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.

Typeface Conventions

Bold	**Bold** type is used to introduce a new term. Terms that are highlighted in this way are defined in the glossary. For example: **mixer module**.
Italics	Italic type is used for emphasis and for the titles of manuals and other publications. It is also used when describing a computer *variable*. For example: "Type: `LOAD BIN` *filename* (Return)"
`Computer`	Computer type is used to depict on-screen prompts and messages and for keyboard entries that must be typed exactly as shown.
(Computer Keys)	Labeled keys on the computer keyboard are enclosed in boxes. For example: the instruction to press (Return) means to press the key on the computer keyboard that is labeled `Return`.
`Soft Keys`	Soft keys are the simulated keys that exist on the computer display.

Warranty

Certification

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

Warranty

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

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

LIMITATION OF WARRANTY. The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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Assistance

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Manufacturer's Declaration

Note This is to certify that this product meets the radio frequency interference requirements of Directive 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 test and measurement equipment is operated with unshielded cables and/or used for measurements on open set-ups, the user must ensure that under these operating conditions, the radio frequency interference limits are met at the border of his premises.

Model HP 85310A

Note Hiermit wird bescheinigt, dass dieses Gerät/System in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeight und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zustzinformation für Mess-und Testgeräte:

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

Sound Level Standards

Note

This statement is provided to comply with the requirements of the German Sound Emission Directive, from 18 January 1991.

This product has a sound pressure emission (at the operator position) < 70 dB.

- Sound Pressure Lp < 70 dB(A).
- At Operator Position.
- Normal Operation.
- According to ISO 7779 (Type Test).

Note

Herstellerbescheinigung: Diese Information steht im Zusammenhang mit den Anforderungen der Maschinenlärminformationsverordnung vom 18 Januar 1991.

- Schalldruckpegel Lp < 70 dB(A).
- Am Arbeitsplatz.
- Normaler Betrieb.
- Nach DIN 45635 T. 19 (Typprüfung).

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1

Receiving

Receiving

The HP 85310A is shipped in several separate boxes. Upon receipt, the system should be checked for damage and completeness. If there is damaged equipment, contact Hewlett-Packard and the shipping company. HP will repair or replace damaged equipment, without waiting for settlement of a damage claim. Hewlett-Packard will also ship any missing components to you.

Now move the system from the receiving dock to the range site.

Install any Special Enclosures

Install any special enclosures (such as a weatherproof enclosure). Use the instructions in the enclosure's manual.

Equipment Supplied

"Equipment Supplied" in Chapter 5 contains the list of equipment supplied with the HP 85310A. Check the equipment received with this list.

Performance Verification

System performance verification assures that the system meets its published specifications. Chapter 2 explains when performance verification should be done and how to prepare the system to perform a performance verification. See Chapter 4 for more information on Performance Verification.

Performance verification is normally performed as part of the installation.

Installation

Introduction

The three major components of the HP 85310A are the HP 85309A LO/IF Distribution Unit, the HP 85320A Test Mixer, and the HP 85320B Reference Mixer.

Note

These products can be installed in a variety of configurations. These installation instructions may not apply directly to your situation, but the basic installation information will still apply.

Caution

Damage to the LO/IF unit (HP 85309A) and mixers (HP 85320A/B) can result from ESD (electrostatic discharge). Use static-safe work procedures.

Installation Overview

The installation procedure is composed of the following basic steps:

1. Connect the components with all equipment and cables in the same room (Temporary Installation).
2. Turn on the system and perform a functional check.
3. If desired, verify the performance of the system components by referring to Chapter 4, "Performance Verification."
4. Install the system in its permanent configuration.

Preparing for Temporary Installation

Place all system components on a table near the receiver. Place the HP 85381 cables on the floor near the HP 85310A components.

During performance verification a test signal must be input to the HP 85320A and 85320B mixer RF inputs. This test signal must be at the same RF frequencies that you use during normal testing. When the mixers are mounted on towers it can be difficult to remove them for testing. For this reason, initial performance verification is performed *before* permanent installation.

Installing System Hardware

Many system problems are caused by improper system connections or incorrect HP-IB address settings. You can avoid time-consuming problems if you carefully read this section.

Interface Connections

There are three separate interface connections that provide the paths (busses) over which information is transmitted.

- The computer disk drive bus (1400 bus).
- The Hewlett-Packard Interface Bus (general-purpose HP-IB).
- The receiver System Bus.

All three busses use the same style of connectors and cables. The busses are not interchangeable. If any instrument is connected to the wrong bus the system will not work properly.

The Computer Disk Drive Bus

Some HP 9000 Series 300 workstations, such as the Model 320, use the general-purpose HP-IB connection to control its disk drives. Most other HP 9000 Series 300 workstations use a special disk drive bus, called the *1400 Bus*.

In most cases, you can easily see the difference between the HP-IB and the 1400 bus:

- The general-purpose HP-IB connection is clearly marked "HP-IB," and has the usual HP-IB rear panel connector.
- The 1400 bus cable is often permanently attached to the back of the HP 9000 Series 300, although this is not true in all cases. The following devices should be connected to the 1400 bus:
  - The floppy disk drive.
  - The hard disk drive.

No other devices should be connected to the 1400 bus. This bus uses standard HP-IB cables. It is important that you do not connect the general-purpose HP-IB and the 1400 bus together (this is easy to do because the connectors all look alike). The system will not work if the two busses are connected together.

Note

The Model 320 computer does not have a 1400 bus. Connect disk drives to the general-purpose HP-IB if using this computer.

The General-Purpose HP-IB

The computer retains full control over this bus, no other device can send commands unless the computer relinquishes control. The following devices should be connected to the general-purpose HP-IB:

- Printer
- Plotter
- Receiver (marked "HP-IB" connector on the rear panel)

- Positioner controller.

The computer uses 700-series addresses when talking to instruments and peripherals on this bus. The "7" accesses the general-purpose HP-IB, and the two digit suffix is the actual address of the device. For example, the address 705 talks to the device at address 05 (default address of the plotter) over the general-purpose HP-IB. For this reason, the general-purpose HP-IB is also known as the "700 bus".

The Receiver System Bus

The receiver must be able to send HP-IB commands to the LO and RF sources at any time, without waiting for "permission" from the computer. To facilitate this, a special HP-IB connection was created called the *System Bus* (marked `8510 INTERCONNECT` on the receiver rear panel). The following devices should be connected to the System Bus:

- HP-IB extender (if required for the RF source).
- RF source.
- LO source.

The instruments on the System Bus are accessed using the 2-digit suffix of the HP-IB "700" addresses.

Allowable HP-IB Cable Lengths

You are allowed 2 meters of cable length for each instrument that is connected to the general-purpose HP-IB. A typical system has a computer, printer (or plotter), receiver, and positioner-controller connected to the general-purpose HP-IB (four devices). The total HP-IB cable length allowed in this example system is:

2 (metres/device) x 4 (devices) = 8 meters allowable length.

Under *no* circumstances can the total cable length ever exceed 20 meters, no matter how many devices are in the system. If your system exceeds the allowed HP-IB cable length, you must use HP-IB extenders for one of the devices.

Cable Lengths in the Receiver System Bus

Calculate the System Bus limitation separately, using the same formula. There are generally two instruments connected to this bus, the LO and RF sources.

2 (meters/device) x 2 (devices) = 4 meters allowable length

Because the RF source is often far away from the receiver, HP-IB extenders are commonly used.

HP-IB Address Settings

There are three possible locations where you need to check and set the HP-IB addresses of the instruments.

- Check the actual HP-IB address setting of each instrument. The address chosen must be unique (no two instruments can have the same address). Address changes in some instruments are made using DIP switches, others accept an address change through the front panel keys. For those instruments using DIP switches, turn the instrument OFF, then ON to complete the address change.
- Check the HP-IB address settings entered in the receiver's HP-IB menu. The HP-IB address settings in the HP-IB menu must match the actual instrument HP-IB settings.
- Check the HP-IB configuration settings entered in the optional HP 85360A antenna measurement software. The HP-IB address settings in the Configuration menu must match the actual instrument HP-IB settings. (The Configuration menu is explained in the "Getting Started" chapter of the *HP 85360A Software Manual.*)

Each of the typical HP instruments named in Table 2-1 is sent from the factory with a default HP-IB address. The HP-IB configuration settings entered in the optional HP 85360A antenna measurement software call these default addresses. The one exception is the LO source. It is sent from the factory set at address 19 and will require a physical address change (two instruments cannot share the same address) to match the expected address of the program.

Table 2-1. Default HP-IB Addresses

Connect Device to:	Device	Typical Instrument	Default Address
General-Purpose HP-IB **"700 bus"**	Receiver	HP 8510 or HP 8530	716
	Plotter[1]	HP 7550A	705
	Printer[1]	HP LaserJet Printer	701
	Positioner		717
Receiver **System Bus**	Converter	HP 8511A	20
	Converter	HP 85310A	None
	LO	HP 8350B	19 (change to 18)
	RF Source	HP 836xx	19
	Plotter[2]	HP 7550A	05
	Printer[2]	HP LaserJet Printer	01

1 Connect to the HP-IB Bus if you want the computer to control this device.

2 Connect to the System Bus if you want the HP 8510 or 8530 to control this device.

All instruments that are connected to the general-purpose HP-IB "700 bus" require that you add a 7 to complete the address when using HP BASIC or the HP 85360A software. For example, you wish to address the plotter using HP BASIC, a line of code might look as follows:

```
100  OUTPUT 705; " ... programming codes ... " .
```

AC Power Connections

This section explains how to select the correct line voltage

Set the HP 85309A Line Voltage Selector

Confirm that the LO/IF unit voltage selector is set to match the AC line voltage before plugging in the unit. The voltage selector/power cable receptacle is on the rear panel.

Operating Line Voltages (48 to 66 Hz)

Nominal Setting	AC Line Voltage
100V	90V to 110V
120V	108V to 132V
220V	198V to 242V
240V	216V to 264V

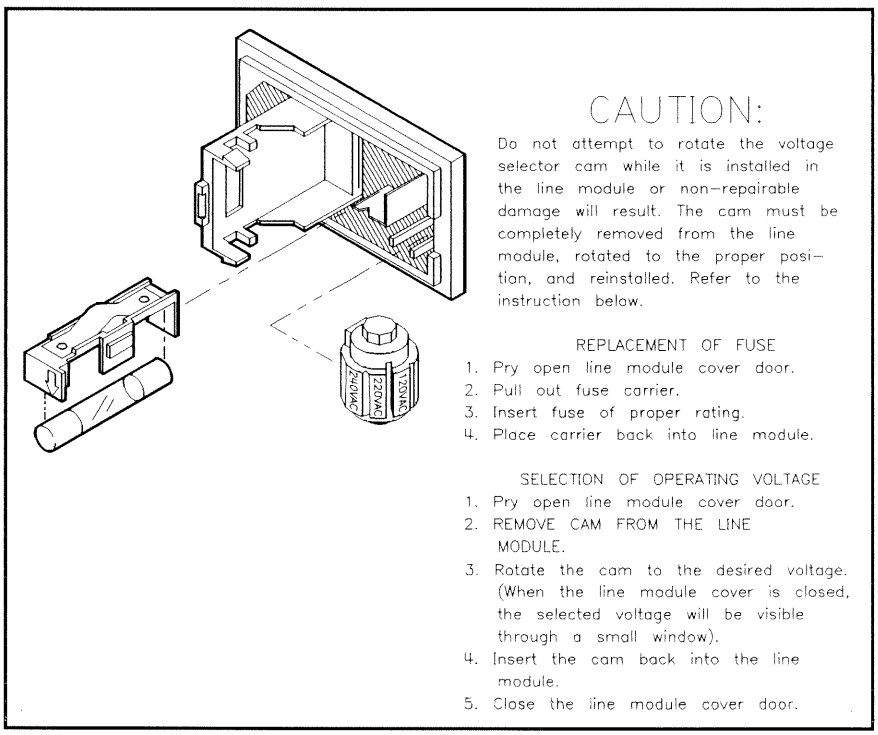


Figure 2-1. Power Line Module on HP 85309A Rear Panel

Fuse sizes and part numbers are shown below:

Table 2-2. Fuse Types and Part Numbers

Nominal Line Voltage	Amperage	Part Number
100/120	1.5A standard	2110-0043
	2.0A	2110-0002
200/240	750 mA	2110-0063
	1.0A	2110-0001

If the AC line voltage is not within range, use an autotransformer.

Warning

Avoid personal injury and instrument damage: use power outlets with a protective earth (third wire) contact only. If you use an autotransformer, make sure it provides third wire continuity to earth ground.

AC Line Power Cables

Use the three-wire power cable supplied with the instrument. These cables provide the required ground when connected to an appropriate outlet. Power cables with different plugs are listed in the "AC Power Cords" section of Chapter 5, "General Information."

Plug the unit into an appropriate AC power source.

Connecting the System Cables

The following sections show how to connect the various cables to each of the instruments in a typical antenna measurement system. *Torque each cable to the specifications supplied in Table 8-1. Correct torque is necessary so the system meets specifications. The performance verification may not pass if connectors are not torqued properly.* The following pages supply a number of tables and figures.

Label each cable as you connect it (use the supplied labels to identify each cable end). These labels will ease permanent installation later. Keep all equipment nearby when connecting cables.

Note

This initial setup is for system check and performance tests. Do not distribute the system components or run cables in their permanent conduits!

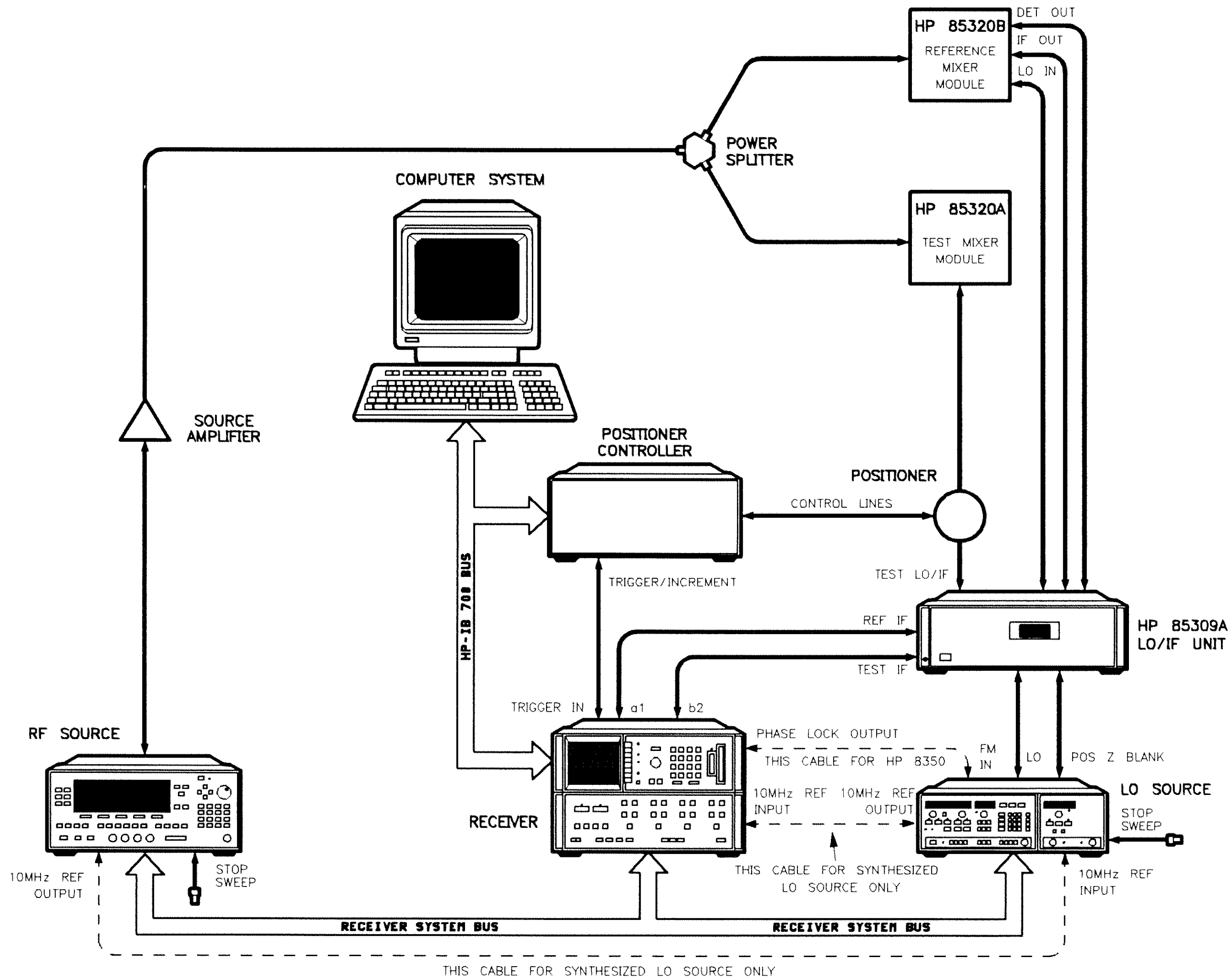


Figure 2-2. Typical Antenna Measurement Setup Using an HP 85310A Frequency Converter

LO/IF Unit and Receiver Connections

Connect the receiver to the LO/IF unit as shown in Figure 2-3.

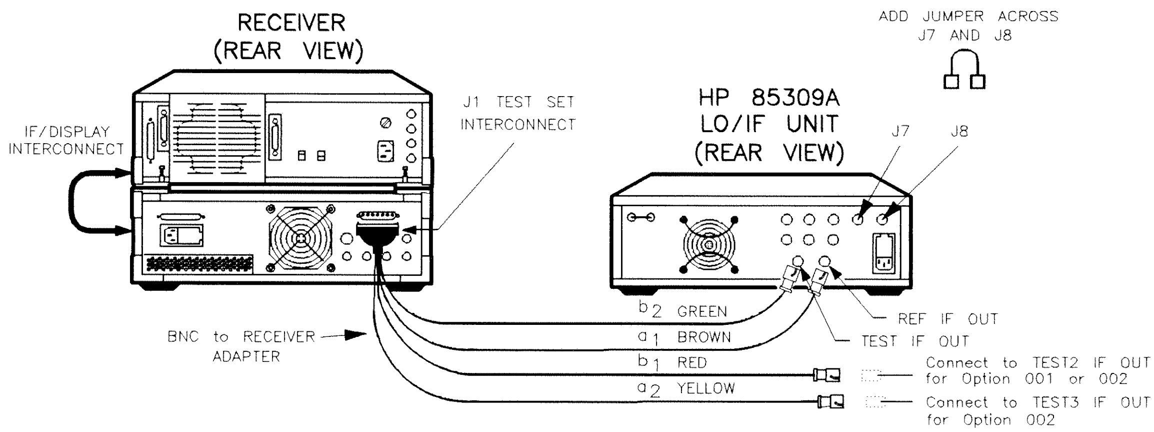


Figure 2-3. LO/IF Unit to Receiver Connections

LO/IF Unit, LO Source, RF Source, and Receiver Connections

Connections Using an HP 8350B as the LO Source

- Read the phase lock restrictions in "Maximum Phase Lock Loop Length" in Chapter 5.
- If HP-IB extenders are used anywhere on this bus, connect them now. Set the HP-IB extender (if used) to the SLOW mode. NORMAL mode may cause intermittent System Bus communications errors. Set other HP-IB extender configuration switches as explained in the extender's operating manual.
- *Make sure you connect the RF source to the receiver's SYSTEM BUS or the INTERFACE BUS connector, NOT to the connector marked "HP-IB."*

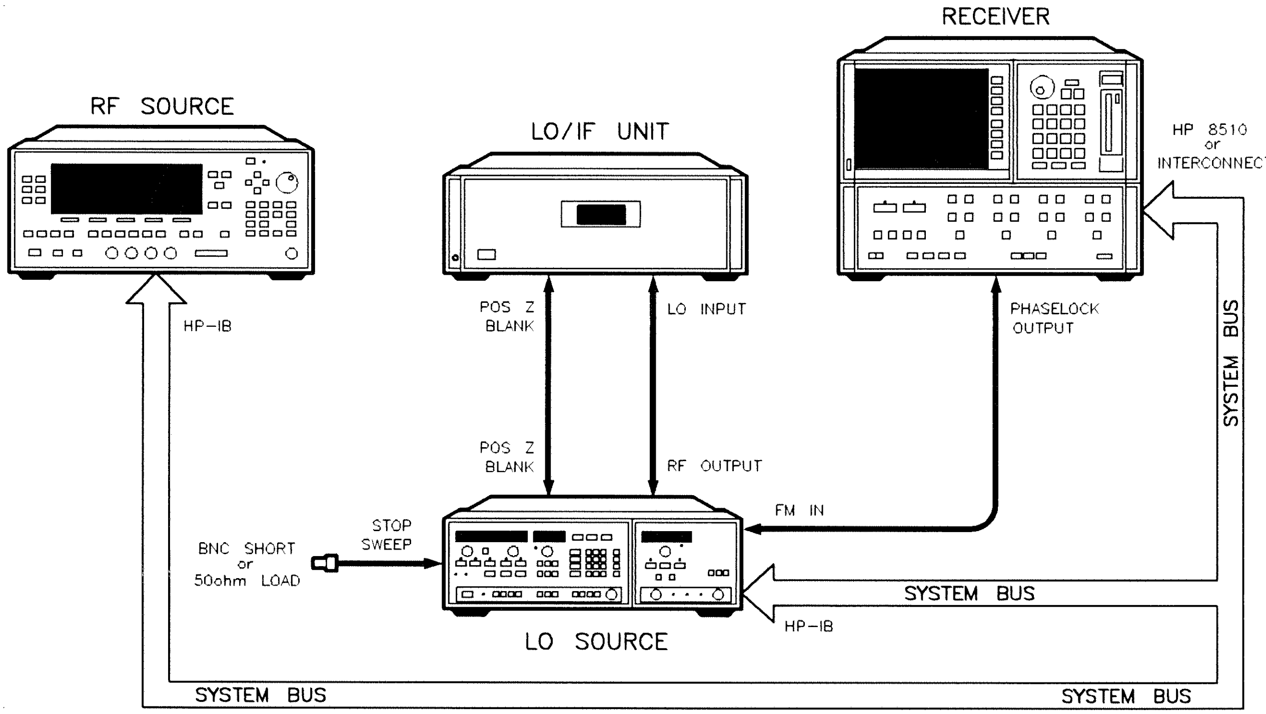


Figure 2-4. LO/IF Unit, 8530B LO Source, RF Source and Receiver Connections

Connections Using an HP 8360 Series Synthesizer as the LO Source

If you are using a synthesized LO source, the timebases of the RF source, the LO source, and the receiver should be connected together. If you know that the timebases can not be connected together (distance/height problems), then the timebases of the RF and LO sources *must* be adjusted to the same frequency at least once a year. If the system uses mm-wave frequencies, you will need to perform the adjustments more often. Refer to "Performance Verification", chapter 4, for more information. Refer to chapter 5, General Information, for maximum cable length information.

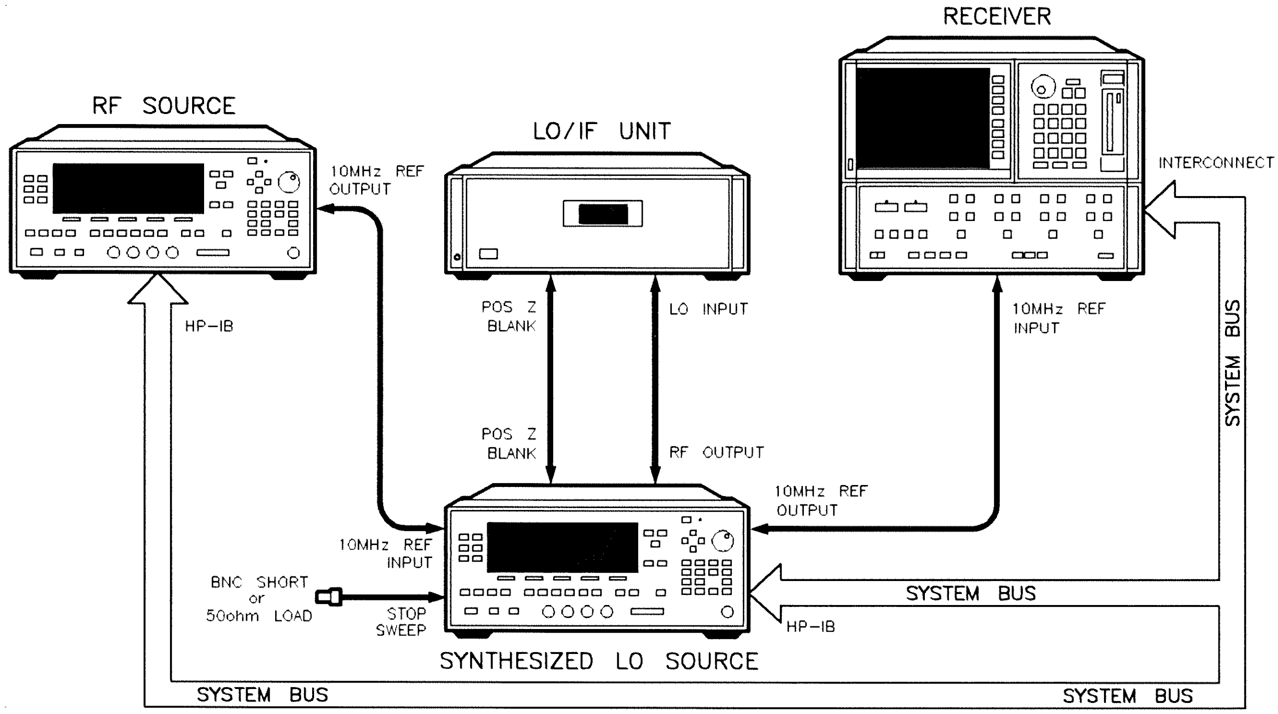


Figure 2-5. LO/IF Unit, Synthesized LO Source, RF Source, and Receiver Connections

Mixer to LO/IF Unit Connections

Make the connections shown in Figure 2-6 using HP 85381 cables of the correct length. If the 85310 has additional test channels (option 001 and 002), then connect these mixers also.

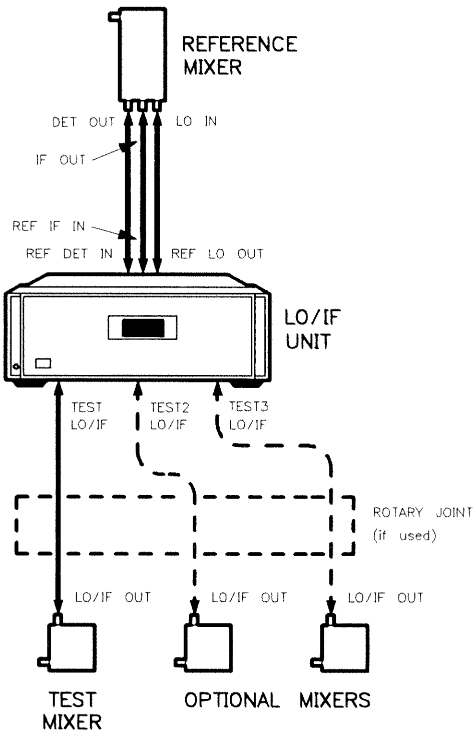


Figure 2-6. Mixer to LO/IF Unit Connections

Phase Stability

Optimum phase stability is provided if you follow these guidelines:

- The REFERENCE MIXER LO cable and TEST MIXER LO/IF cable must be the same model number. For example, they must all be HP 85381A cables, or all be HP 85381C cables.
- The REFERENCE MIXER LO cable and TEST MIXER LO/IF cable must be the same length.

RF Source Connections

The RF connections are temporary; They are made so you can check the system.

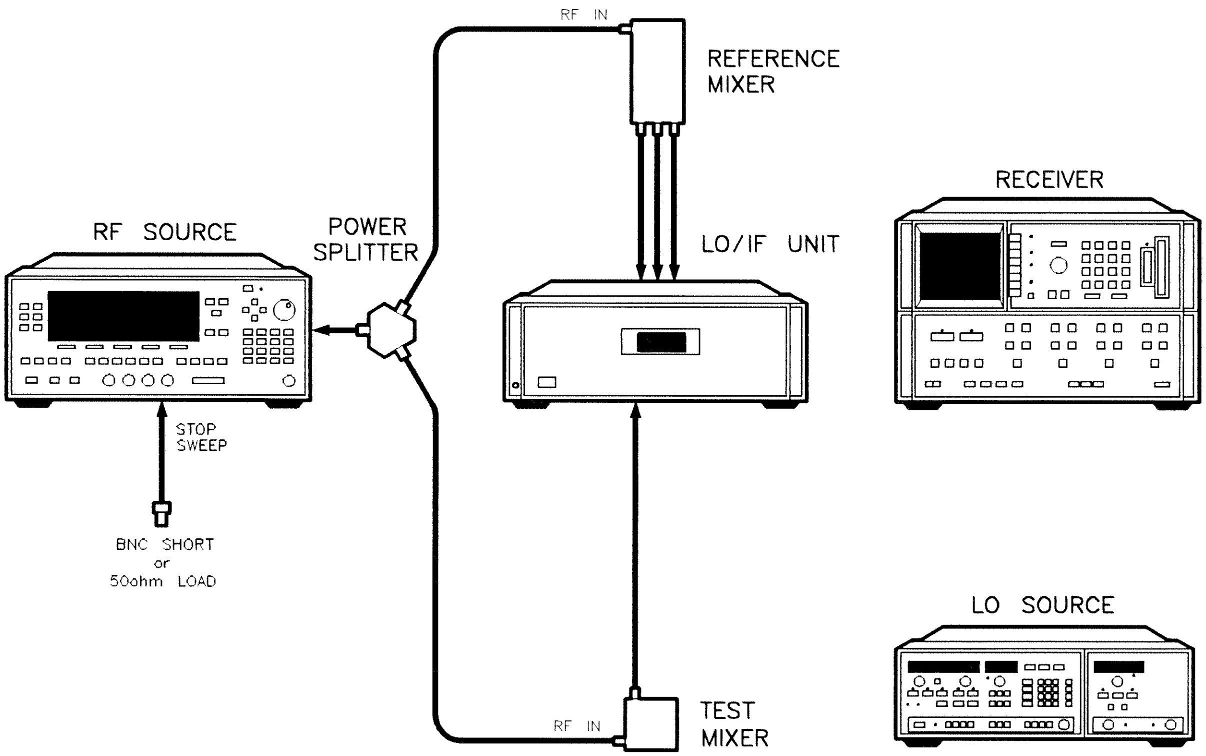


Figure 2-7. RF Source to Mixer Connections

Turn on the Instruments

Turn on the HP 85309A

Turn on the HP 85309 LO/IF unit, and observe the decimal point of the DETECTOR VOLTAGE display on the front panel:

- If the decimal point does NOT light: turn OFF the instrument immediately and refer to "In Case of Difficulty," Chapter 6.
- If the decimal point lights, continue with the following steps.

Turn on the RF Source

If Using an HP 8340/41 RF Source

If using an HP 8340/41, HP-IB ADRS = 19 should appear in the entry display when the instrument is turned ON. If the unit is already ON, press (SHIFT) (LOCAL) to see the address. If the address is not set to 19, press 19 (Hz AUTO).

If Using an HP 8360-Series (836xx) RF Source

Use the switch settings shown in Table 2-3 on the rear panel switch block of the HP 8360-series source.

Table 2-3.

L3	L2	L1	A5	A4	A3	A2	A1
0	0	1	1	0	0	1	1

Note You must turn an HP 8360 series synthesizer OFF and ON again so that it will recognize the switch changes.

Figure 2-8 shows the location of the synthesizer's HP-IB/Language switch block. These settings place the HP 85360 in the "Analyzer Language Mode" (using switches L1 through L3), and selects HP-IB address 19 (using switches A1 through A5). This should be all the information you need when using an HP 8360 series synthesizer during antenna measurements. If you want to learn more about HP 8360 "language modes" or HP-IB settings, refer to the Installation chapter of the *HP 8360 Series Synthesized Sweepers Users Handbook*.

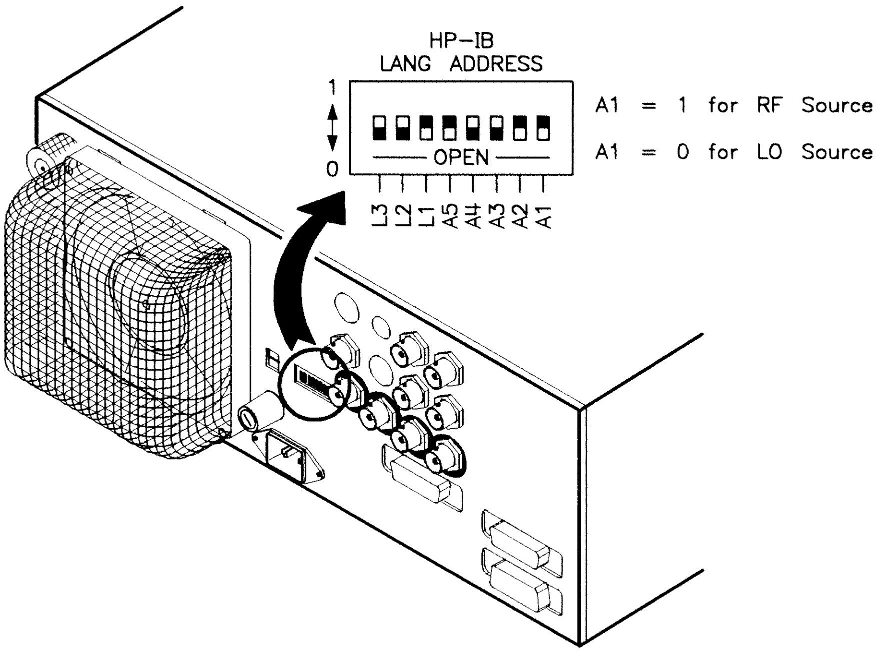


Figure 2-8. HP 8360 Series Source Rear Panel HP-IB Switch

Turn on the LO Source

Turn on the LO source and confirm that its HP-IB address is set to 18. If using an HP 8350, press (SHIFT) (LCL). The number 18 should appear in the frequency/time window. If the HP 8350 is not set to address 18, press 18 (GHz s).

If you are using an HP 836xx for an LO source, make sure it is in "Analyzer Language Mode" and check its HP-IB address as explained in "Turn on the RF Source," above. Table 2-4 shows the appropriate switch settings.

Table 2-4.

L3	L2	L1	A5	A4	A3	A2	A1
0	0	1	1	0	0	1	0

Note

You must turn an HP 8360 series source OFF and ON again so that it will recognize the switch changes.

Turn on the Receiver

Turn on the receiver. The receiver's System Bus addresses, and other settings, are set in "Configure the Receiver". This is explained below.

Note

Ignore any error messages or warning beeps that occur during the following procedure. You can turn off the receiver beeper by pressing (SYSTEM) BEEPER OFF .

Configure the Receiver

Confirm that the receiver will communicate with the sources and the "test set" (HP 85309A) at the correct HP-IB addresses:

1. If using an HP 8530A, press (DOMAIN) FREQUENCY .
2. On the receiver, press (SYSTEM) HP-IB ADDRESSES SOURCE #1 to check the address of the RF source. The address indicated should be 19. If it is not, press 19 (x1) to set it.
3. Perform one of the following sub steps, depending on the type of receiver you are using:
   a. If using an HP 8510, press TEST SET 31 (x1).
   b. If using an HP 8530A, press CONVERTER ALL OTHERS SET ADDRESS 31 (PRIOR MENU).
4. Press SOURCE #2 to check the address of the LO source (on the HP 8510 press MORE SOURCE #2 . It should be 18.
5. Perform a factory preset: Press RECALL MORE FACTORY PRESET .
6. The receiver will be controlling two sources which can drive the mixers in either fundamental or harmonic mode. The mode of operation is determined by the settings of the multiplier numerator and denominator of each source. When setting LO power, use the fundamental mode.
   a. Set the RF (#1) source. To do this, press the following keys on the receiver:

      (SYSTEM) MORE EDIT MULT. SRC. DEFINE: SOURCE 1
      MULTIPLIER NUMER. 1 (x1) MULTIPLIER DENOM. 1 (x1)
      OFFSET FREQUENCY 0 (x1) DONE

   b. Set the LO (#2) source. To do this, press the following keys on the receiver:

      SOURCE 2 MULTIPLIER NUMER. 1 (x1)
      MULTIPLIER DENOM. 1 (x1) (activates Fundamental Mode) or
      MULTIPLIER DENOM. 3 (x1) (activates 3rd Harmonic Mode)
      OFFSET FREQUENCY 20 (M/u) DONE

   c. Set the receiver. Press:

      RECEIVER CONSTANT FREQUENCY 20 (M/u)
      DONE

   d. Save and turn on multiple source mode. Press:

      MULT. SRC: ON/SAVE

   e. Then press:

SYSTEM PHASELOCK

Now press EXTERNAL for systems with an HP 8350 LO, or NONE for systems with a synthesized LO

LOCK SPEED: NORMAL

PRIOR MENU

POWER LEVELING SOURCE 1: INTERNAL

SOURCE 2: INTERNAL

f. Finally, press:

STIMULUS (MENU)

STEP

MORE CONTINUAL

PRIOR MENU

POWER MENU

POWER SOURCE 1 −10 (x1) This value can vary depending on the system in use.

POWER SOURCE 2 10 (x1)

Note

Under certain circumstances POWER SOURCE 2 (LO source power) should be set to +13 dBm. Refer to "Set the LO Power" for details.

7. PRIOR MENU

8. NUMBER of POINTS 101

Set the (START) and (STOP) frequencies as appropriate for the selected harmonic mode (fundamental or 3rd harmonic) and for the frequency range of the Antenna under test.

This completes the multiple source mode procedure.

Set the LO Power

About This Procedure

The front panel of the LO/IF unit shows the voltage coming from a power detector in the reference mixer. The voltage is directly proportional to the amount of LO power arriving at the mixer. A label on the reference mixer shows the precise voltage which corresponds to +10 dBm at the mixer's LO input. In this procedure you must adjust the LO POWER ADJUST so the DETECTOR VOLTAGE display matches the voltage on the mixer label.

Once set, the ALC loop will maintain the desired LO power level regardless of LO frequency. Repeat this procedure only if you change one of the mixer modules or the LO source.

Find the detector voltage value written on the reference mixer. Record the value in Table 2-5. (This could save you a great deal of time later!)

Table 2-5. Value Indicated on the Reference Mixer

Parameter	Value
mV (typically −40 to −80):	

Procedure

All keystrokes in this procedure are performed on the receiver. The receiver controls the LO source.

1. To set the LO power:
   a. Press (SPAN) 1 (M/u)
   b. Press (CENTER) 3.5 (G/n)
2. The LO power must be set to either +10 or +13 dBm. Refer to Table 2-6 to determine which value you should use.

Table 2-6. Proper LO Source Power Setting

Max. LO Frequency 8.4 GHz		Max. LO Frequency 12.4 GHz		Max. LO Frequency 18.0 GHz	
LO Cable Length	Proper LO Source Power	LO Cable Length	Proper LO Source Power	LO Cable Length	Proper LO Source Power
<12m	+10 dBm	<9m	+10 dBm	<7m	+10 dBm
≥12m	+13 dBm	≥9m	+13 dBm	≥7m	+13 dBm

Example of Table Use:

Assume the maximum LO frequency of your system is 12.4 GHz, and your LO cable (the RF cable that goes from the LO source to the input of the LO/IF unit) is 13 meters long.

Look in Table 2-6 under "Max LO Frequency 12.4 GHz." Since your cable is 13 meters long, find the ≥9m entry. Look to the right of ≥9m, at the value shown under "Proper LO Power," in this case the proper LO source power setting is +13 dBm.

3. To set LO power, press (on the receiver):

   STIMULUS (MENU) `POWER MENU`

   `POWER SOURCE 2` *numeric value* (X1)
   (*numeric value* represents the value in dB)
4. Observe the voltage displayed on the front panel of the LO/IF unit. Adjust the HP 85309A's `LO POWER ADJUST` until the leveling voltage is equal to the voltage written in Table 2-5 (also shown on the reference mixer label).

Note

The voltage in the LO VOLTAGE display window will vary with frequency. This is normal. The LO POWER OUT OF RANGE light will come on only if the system's automatic leveling loop cannot level the voltage sufficiently. This can happen if the LO source is disconnected, or if you are requesting more power than the LO/IF unit can supply for a given frequency range.

Operational Check

The system should now be operating without error messages or warning beeps. If error messages or beeps still occur, refer to Chapter 6, "In Case of Difficulty." Return to this page after performing the Operational Check.

Perform the Operational Check, located in Chapter 3. The Operational Check verifies that the system functions properly *before* permanent installation. This check also prepares the system for the more rigorous Performance Verification tests in Chapter 4.

After performing the Operational Check, proceed to performance verification, described below:

Performance Verification

Return to this page after performing the optional "Performance Verification."

If desired, perform the "Performance Verification" in Chapter 4. This procedure ensures that the system meets its published specifications.

After completing the verification proceed with permanent installation.

Permanent Installation

Place the LO/IF unit on a bench or rack mount it in a standard 19 inch rack. A weatherproof enclosure is available for the HP 85309A LO/IF unit.

The mixers are usually mounted directly to the connectors (or adapters) on the test and reference antennas. Alternatively, short (1 meter or less) cables can be placed between the mixer and antenna. The mixers are weatherproof and EMI shielded.

Environmental Considerations

Temperature, humidity, altitude, and storage conditions are described in the "Specifications" section of Chapter 5, "General Information."

Site Preparation

The LO/IF unit and mixers are connected to other system components with LO/IF cables. Prepare to run these cables by going through the following checklist:

Cable trenches or conduits are finished (if required).

All needed bulkhead RFI and environmental seals are installed.

All required cables have been checked and labeled at both ends.

AC power is available at the necessary amperage (see General Information).

The HP 85309A rear panel will not be directly illuminated by the transmitting antenna.

Installing the System Components

The instruments should now be moved to their final location. To do this, disconnect the instruments that must be moved. Use the information on the following pages to assist in permanent installation. System instruments should not be illuminated by the transmitting antenna.

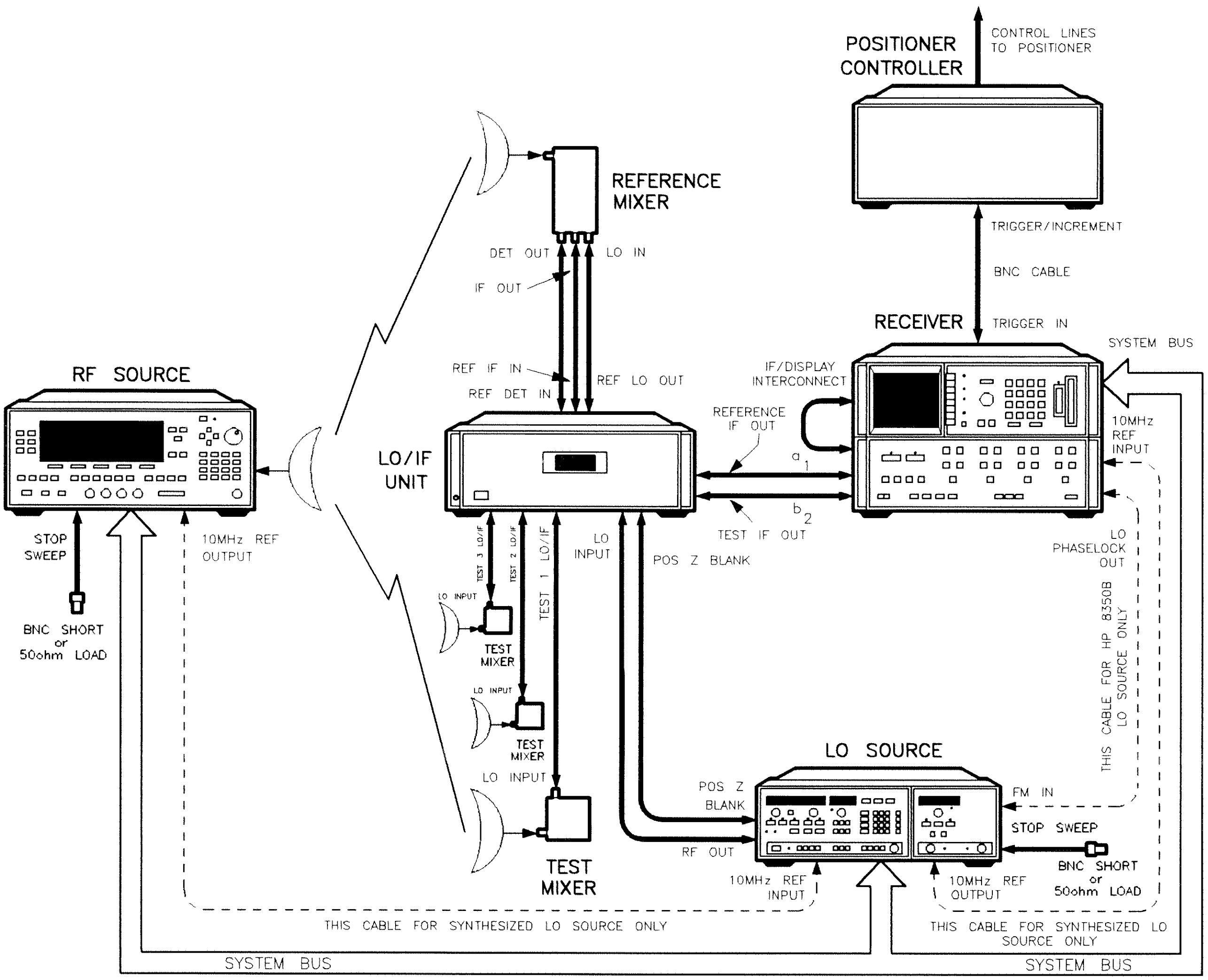


Figure 2-9. Overall Installation Diagram (including Option 001/2)

Installing the Receiver

Install the receiver in a location that meets the environmental conditions specified in its operating manual.

Installing the LO/IF Unit

The LO/IF unit (HP 85309A) should not be directly illuminated by the transmitting antenna, since the cables attached to the rear panel may pick up some of the signal and reduce system performance. Place rack handles on the LO/IF unit if necessary. Chapter 5 provides part numbers for rack mounting hardware, if needed.

There are several possible options when installing this unit.

Installing the LO/IF Unit in a Remote Location

The LO/IF unit need not be installed next to the receiver or LO source. However its separation must not exceed the limits specified in Table 5-11, Table 5-12, or Table 5-13.

Installing the HP 85309A Next to the Receiver

The LO/IF unit may be placed next to, on top of, or under the receiver. Make sure that the vents on the side and rear are not blocked. In racks, position is not important as long as ventilation is adequate.

Installing the LO/IF unit in the Weatherproof Enclosure (HP 85380A)

Install the enclosure as explained in the *HP 85380A Installation and Service Manual.*

Install the LO/IF unit as explained in the *HP 85380A Installation and Service Manual.*

Installing the LO Source

Place the LO source where desired (position is not important in a racked system). In some systems the LO source is placed in a different location than the receiver. However its separation must not exceed the limits specified in Table 5-11, Table 5-12, or Table 5-13.

The HP-IB address was set earlier during temporary installation. In the case of an HP 8360 series synthesizer, the language switch was already set to Analyzer Language Mode. If the LO source is an HP 8360 series synthesizer, the timebase of LO source, the RF source and the receiver need to be connected together. Refer to chapter 5, General Information, for maximum cable length information, and chapter 4, Performance Verification, for adjustment procedures if distance prohibits you from connecting the timebases together.

Connect a BNC short circuit in the LO source's STOP SWEEP BNC.

Installing The Mixers (HP 85320A/B)

Recommended Practices

HP strongly recommends that you use a "connector saver" or short cable between the mixer's RF input and the antenna. This is more important for the test mixer, where connections are made often. This practice has two very important advantages:

- The "connector saver" receives daily wear; the mixer's input connector does not. This greatly extends the life of the mixer connector.
- It is the connector saver that gets dirty with use, not the mixer connector.

When you must clean the connector saver, remove it from the mixer. This protects the static-sensitive mixer from being damaged during cleaning.

Here are the part numbers for commonly-needed connector savers:

Type	HP Part Number
3.5 mm male to 3.5 mm female	85027-60006
3.5 mm female to 3.5 mm female	85027-60005 (supplied)
Type-N male to 3.5 mm female	1250-1744
Type-N female to 3.5 mm female	1250-1745

Caution The HP 85309A and mixers contain static sensitive devices. Do not touch the center conductor of any connector or the center conductor of any cable connected to the HP 85309A or to the mixers. If you must clean a connector on the HP 85309A, or on one of the mixer's connectors, wear an anti-static ground strap.

The mixers must be installed within the distances specified by Table 5-11, Table 5-12, or Table 5-13.

Attach the test and reference mixers directly (or through adapters or cables) to the antennas. The mixers are compact, but make sure the test mixer does not strike anything when the test antenna moves. The mixers can be mounted to the antenna masts directly or through a mounting plate. The mount holes will accept 6 mm or 1/4 inch bolts. See Appendix A for mounting hole dimensions.

Note Do not support the mixers by their connectors. The mixer input connectors do not have enough structural strength to support the mixers. Do not turn the mixer body when connecting or disconnecting it, because this damages the connector's center conductor. Instead, turn the outer sleeve of the input connector.

Anchor the mixer cables to a nearby support structure. This provides strain relief so the mixers are not damaged if the cables are accidentally pulled.

Rotary Joint

If using a rotary joint, be sure it is in good operating condition. An intermittent or high-loss rotary joint can cause measurement error.

Installing the System Cables

Pertinent Diagrams

Install the system cables by referring to Figure 2-9, earlier in this chapter. Also refer to the labels on each cable end. (These labels should have been applied by the installer earlier in the temporary installation procedure.)

Use Proper Connector Torque

Use a torque wrench to tighten all HP 85381 cables. Torque values are provided in Table 8-1. This system comes with a torque wrench for all Type-N connectors.

The Importance of Proper Connector Torque

Proper connector torque may seem unimportant. However, in this system it is absolutely vital to system performance!

About the Supplied Type-N Torque Wrench. The supplied torque wrench is a costly precision wrench. The wrench is vital to accurate measurements, and is expensive to replace. Please keep the torque wrench in an obvious location near the system.

Caution

If you do not torque the cables to the required values, moisture can enter the connections and degrade system performance. If this occurs the cable must be replaced. Improper torque can cause excessive crosstalk in the system (from RF leakage at the connector), degrading system performance.

Helpful Information

Provide Strain Relief. Protect the cable connectors from being accidentally pulled. Do this with some type of strain relief (connect the end of the cable to something that will not move easily). Do this on each end of the cable if possible.

Another purpose of strain relief is to keep the cables from hanging directly off the mixer connectors.

Provide Some Excess Cable. Provide some excess length in all cables. The preferred way to do this is to provide some extra length at each end of the cable. Leave the extra cable in an S-shape, not a loop. Provide even more slack (extra length) in the test antenna cable—especially if your setup does not incorporate a rotary joint.

Make sure the cable can move without straining the connectors.

Rain Considerations. Make sure cables are traveling upwards as they enter a building. This ensures that rain will run away from the building, and not into it. Connectors should be protected from water.

Make sure rain will not run down the cable and get into one of the connectors. To prevent this from happening:

- Elevate the connector so it is higher than the cable.
- Make a U-shaped loop right next to the connector, with the bottom of the U pointing toward the ground. Rain will drip off the bottom of the U before it gets to the connector.

Increasing the Life Expectancy of Outdoor Connectors. Type-N cable connectors have a gasket that seals against the mating connector. This provides a weatherproof seal when you have torqued the connection properly. The life expectancy of the connector pair can be extended using a small amount of silicone grease.

Here's how to apply the grease *properly*.

1. Use a small paint brush that has approximately 10 fibers in it.
2. Apply a small amount of grease to the tip of the brush.
3. Insert the brush into the male connector, *do not get any grease on the connector threads.*

4. Apply a thin continuous coat of grease on the circular gasket.
5. Remove the brush carefully, *making sure you do not get any grease on the connector threads.*

Other Important Considerations.

- Prevent cables from being stepped on.
- Prevent dirt from getting inside connectors.
- Cables which must move should not rub against anything.
- Make sure a cable loop cannot be pulled in such a way that it places a sharp bend (kink) in the cable.
- Support cables every meter (about every 3 feet) unless they are in a cable trench. Outdoors, use plastic cable ties that resist damage from ultra-violet radiation.
- Make sure connector threads are properly aligned when attaching cables to instruments.
- Check local electrical codes to see if cables must be grounded as they enter the building.

Installing the RF Source

The HP-IB address was set earlier during temporary installation. In the case of an HP 8360 series source, the language switch was set to activate Analyzer Language Mode.

Connect a BNC short circuit on the RF source's STOP SWEEP BNC.

Install any RF amplifier used by the system, and connect the RF source components to the transmitting antenna.

Installing an HP-IB Extender

One extender is connected to the receiver System Bus, the other to the HP-IB connector of the RF source. Extenders may use wire cable, fiber optical cable, or a phone line to link the receiver with the RF source.

HP-IB extenders require you to set DIP switches on the back of each module. The position of the switches depend on how you are using them. For example, whether you are using wire cable or fiber optical cable. Make sure the NORMAL/SLOW dip switch is set to SLOW. (NORMAL mode may cause intermittent receiver System Bus communications errors.) Refer to the HP-IB extender manual for instructions concerning the other dip switches.

Most systems include other components, such as an RF source or RF amplifier. Refer to the HP 85301 system manual or the manuals of the individual components for instructions (if necessary).

The extender nearest the receiver should be set to "Master" mode using the extender's front panel switch. The last remote extender in the chain should be set to "End" mode. Any extenders placed between these should be set to "Middle" mode.

Final Checkout

The Operational Check should be performed again now that the system has been "permanently" installed. Perform the "Operational Check" in Chapter 3.

If the system passes the *Operational Check*, it ready for use. If the system does not pass, go back and review the permanent installation procedure for any errors in installation.

3

Operation

Introduction

Each of the procedures in this chapter can be used in the daily operation of the HP 85310A.

- *General Operation* explains basic system operation. This section also explains front and rear panel features of the HP 85309A LO/IF unit.
- *Configuring the System for Optimum Dynamic Range* explains how to optimize the measurement system's dynamic range. Dynamic range should be optimized after installation, or when testing antennas with different gain values. To aid in this task, a dynamic range worksheet is supplied in this chapter. A copy of the worksheet is supplied in Appendix B.
- *Operational Check* verifies that the system is operating properly. The operational check can be performed after installation, or after changing system configuration.

  The operational check can also be performed at the beginning of the day to verify system operation.
- *Setting the System to Fundamental or Harmonic Mode* explains how and when to change between the fundamental and harmonic measurement modes.
- *Connector Care* explains how to reduce wear on the mixers' RF input connectors, as well as how to inspect and clean connectors. Taking proper care of the connectors will improve the repeatability of antenna measurements.

General Operation

If your system uses the HP 85360A software, refer to the *HP 85360A User's Guide* for operational information. If your system is controlled by custom software, refer to the appropriate internal documentation.

HP 85309A Front Panel Features

Front panel features are shown in Figure 3-1.

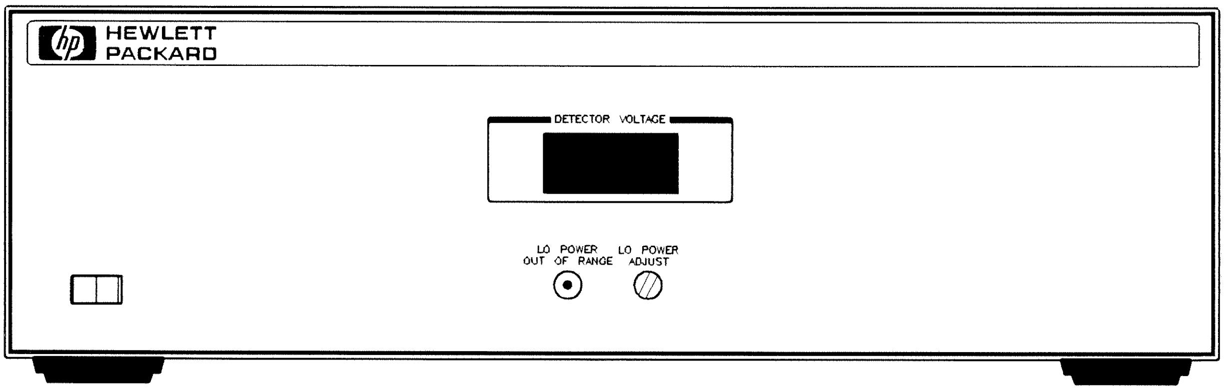


Figure 3-1. HP 85309A Front Panel Features

DETECTOR VOLTAGE Display

The reference mixer has a detector that measures the amount of LO power coming into its LO input. This voltage is sent to the HP 85309A where it is displayed in the DETECTOR VOLTAGE display. The voltage is directly proportional to the amount of LO power.

This display allows you to monitor the amount of LO power going to the reference mixer. It is assumed that the cable lengths to the reference and test mixers are the same. This ensures that the LO power going to the test mixer is the same as that going to the reference mixer.

LO POWER ADJUST

This adjustment controls the amount of LO power going to the mixers. The HP 85320A/B mixers require +10 dBm of LO power at their inputs. Because of losses through the LO cables, the HP 85309A and LO source must output more than +10 dBm. The power required from the LO source depends on the length of the LO cable (the cable that goes from the LO source to the LO/IF unit). "Set the LO Power" in Chapter 2 explains how to select the proper amount of power.

Now the LO power output of the HP 85309A must be adjusted to match the needs of your specific mixers. This is done using the HP 85309A `LO POWER ADJUST` control. To set the LO power level, refer to "Set the LO Power" in Chapter 2.

LO POWER OUT OF RANGE

This light indicates that the system is not supplying the amount of LO power requested by the `LO POWER ADJUST` control.

The LO POWER OUT OF RANGE circuit compares the `LO POWER ADJUST` setting with the voltage coming back from the reference detector. The amount of expected detector voltage varies depending on the `LO POWER ADJUST` setting. Normally the detector voltage is within the expected range, and the light stays off. However, if anything interrupts the ALC loop, or a relatively low detector voltage is measured, the light comes on. (The circuit activates the light if the detector voltage is not within 25% of the expected voltage.) If the light is on refer to Chapter 6, In Case of Difficulty. Refer to the main index under "LO power out of range, troubleshooting" for the page number.

HP 85309A Rear Panel Features

Caution The HP 85309A contains static sensitive devices. Never touch the center conductor of any connector. When cleaning connectors, wear a grounded wrist strap.

The standard rear panel features are shown in Figure 3-2. The HP 85309A can have additional test channels. Figure 3-3 shows the rear panel features with the additional test channels. Note that the connectors are arranged in the following groups:

- Antenna
- LO Source
- Receiver
- J7 and J8 are separate connectors that affect the operation of the LO/IF unit.

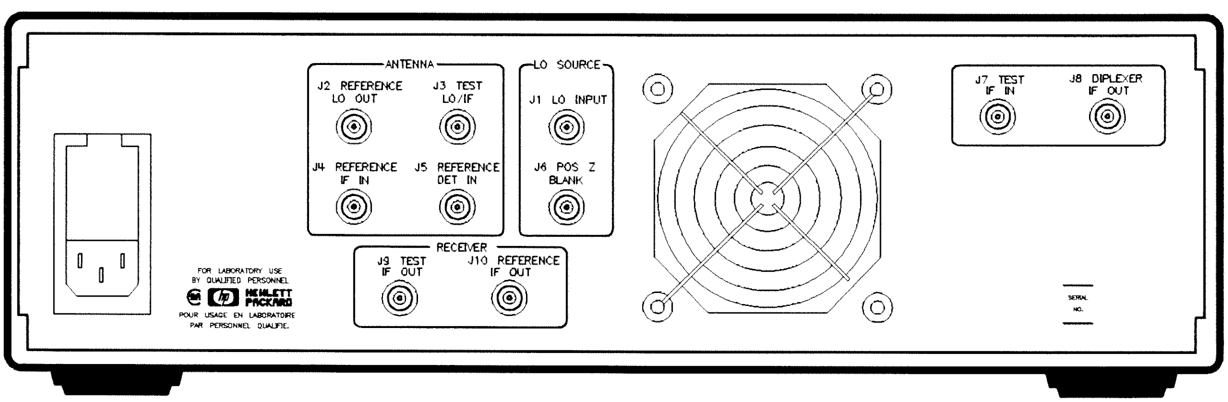


Figure 3-2. HP 85309A (Standard Instrument) Rear Panel Features

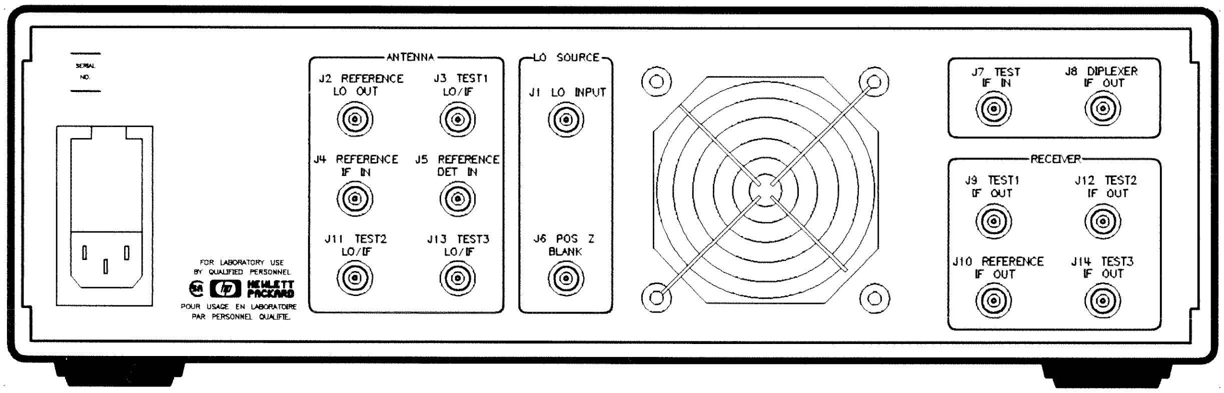


Figure 3-3. HP 85309A Option 002 (two additional test channels) Rear Panel Features

Antenna Connector Group

The connectors in the ANTENNA group go to the reference and test mixers. Three of the connectors, J2 REFERENCE LO OUT, J4 REFERENCE IF IN, and J5 REFERENCE DET IN are connected to the reference mixer. Besides the RF, LO, and IF ports, the reference mixer has an additional DETECTOR output.

There are three more possible connectors: J3 TEST 1 LO/IF (standard), J11 TEST 2 LO/IF (option 001), and J13 TEST 3 LO/IF (option 002). A test mixer only requires one connection. A **diplexer** allows the LO signal (which goes to the test mixer) and the IF signal (which comes back from the test mixer) to travel over the same physical cable. This allows both signals to go through a single-channel rotary joint.

Connections to the Reference Mixer

J2 REFERENCE LO OUT. This port sends the local oscillator signal to the reference mixer.

J4 REFERENCE IF IN. This port receives the IF from the reference mixer. The HP 85309A amplifies this signal and sends it to the receiver using the J10 REFERENCE IF OUT connector.

J5 REFERENCE DET IN. A power detector in the reference mixer measures incoming LO power and outputs a proportional voltage. This voltage enters the HP 85309A through this connector, and is used to level the LO power. The allowable input voltage range for this connector is 0 to −200 mV.

Connections to the Test Mixers

J3 TEST 1 LO/IF (standard). This port sends the local oscillator signal to the test mixer, and receives the IF signal over the same connection. A diplexer inside the test mixer and the HP 85309A makes this possible.

The IF signal from the test mixer is amplified and sent to the receiver through J9 TEST 1 IF OUT.

J11 TEST 2 LO/IF (option 001). This port operates the same as the TEST 1 LO/IF port. Option 001 adds a second test channel.

The IF signal from a second test mixer is amplified and sent to the receiver through J12 TEST 2 IF OUT.

J13 TEST 3 LO/IF (option 002). This port operates the same as the TEST 1 LO/IF and TEST 2 LO/IF ports. Option 002 adds a third test channel.

The IF signal from a third test mixer is amplified and sent to the receiver through J14 TEST 3 IF OUT.

LO Source Connector Group

The two connectors in this group J1 LO INPUT and J6 POS Z BLANK are connected to the LO source.

J1 LO INPUT

Receives the local oscillator signal from the LO source. The HP 85309A distributes this to the test and reference mixers.

J6 POS Z BLANK

The LO source sends out the POS Z BLANK (TTL logic) signal during sweep retrace. POS Z BLANK is monitored by the HP 85309A through this connector. The HP 85309A monitors this signal, and lowers the gain in the automatic leveling control circuit during retrace. This keeps the gain of the ALC from peaking during known power drops.

Receiver Connector Group

These ports output the test and reference IF signals to the receiver.

J9 TEST 1 IF OUT (standard)

This connector sends the test mixer's IF signal to the receiver. Generally, this signal is connected, through the BNC-to-RECEIVER ADAPTER cable, to the receiver `b2` input.

J10 REFERENCE IF OUT

This connector sends the reference mixer's IF signal to the receiver. Generally, this signal is connected, through the BNC-to-RECEIVER ADAPTER cable, to `a1` on the receiver.

J12 TEST 2 IF OUT (option 001)

This connector sends the test mixer's IF signal to the receiver. Generally, this signal is connected, through the BNC-to-RECEIVER ADAPTER cable, to the receiver `b1` input.

J14 TEST 3 IF OUT (option 002)

This connector sends the test mixer's IF signal to the receiver. Generally, this signal is connected, through the BNC-to-RECEIVER ADAPTER cable, to the receiver `a2` input.

J7 and J8 (Using Non-Diplexed Mixers)

J7 and J8 allow you to use a non-diplexed test mixer (a mixer that has separate connections for the LO and IF signal). This is done by removing the Type-N jumper that normally connects J7 and J8. With the jumper removed, make the following connections to your test mixer:

Table 3-1. Connections for non-HP test mixers

HP 85309A Connector	Mixer Connector
J3 TEST LO/IF	LO INPUT
J7 TEST IF IN	IF OUTPUT
J8 DIPLEXER IF OUT	50 Ohm Load[1]

1 It is recommended that you place a 50 Ohm load on this connector.

If you are using an HP test mixer (in other words, a mixer that uses a single LO/IF connection and a diplexer), always place the supplied Type-N jumper between J7 and J8.

Power Line Module

The power line module is illustrated in Figure 2-1. Fuse types and ratings are also listed in Chapter 2; refer to the index for the page number.

Configuring the System for Optimum Dynamic Range

Configuring the system for optimum dynamic range entails using the highest RF power settings possible without overdriving the mixers or the receiver. The optimum dynamic range may be different for different measurements. Two methods are provided for improving dynamic range:

- Simple Method for Improving Dynamic Range.
- Calculating Maximum Dynamic Range.

Simple Method for Improving Dynamic Range

The following steps provide a fast, easy way to improve the dynamic range of the system. A more complex method is provided below. The complex method takes longer to perform, but provides the highest measurement dynamic range.

1. Make all necessary settings on the receiver (such as frequency range).
2. Make sure the receiving antenna is at boresight.
3. Make a continuous measurement over the entire frequency range of interest.
4. Increase Power Source 1, RF source power, to maximum or until IF OVERLOAD is displayed.
5. If the receiver displays an IF OVERLOAD error:
   a. Decrease the RF source power by 2 dB. Press (ENTRY OFF) on the receiver. The IF OVERLOAD should go away.
   b. Measure your antenna over its full frequency range. If IF OVERLOAD comes on again decrease power another 2 dB and press (ENTRY OFF). Repeat steps a and b until the entire frequency range can be measured without an IF overload occurring.

Calculating Maximum Dynamic Range

This method of improving the dynamic range provides the highest measurement dynamic range. A copy of this worksheet (the illustration and calculations) is provided in Appendix B. Photocopy the worksheet in Appendix B for general use.

Set RF Source Power Level

Initially set the RF source power level to 0 dBm. This power level is a convenient starting point.

Enter Known Measurement System Gain/Loss Values

Figure 3-4 shows attenuation and gain values required for later calculations. Read the following before using Figure 3-4.

Configuring for Optimum Dynamic Range

This procedure mentions "wide" and "narrow" frequency ranges. These terms have very specific meanings in this procedure:

- Wide: A frequency range is called "wide" when system performance at the start frequency is different than system performance at the stop frequency.

  Each box in Figure 3-4 has two entry blanks. For example, look at Box E, Source Antenna Gain. When making "wide" frequency range measurements, enter the antenna's gain at the start frequency on one line, and its gain at the stop frequency on the other line. Do this for each box in Figure 3-4.

- Narrow: There is no noticeable change in system performance between start and stop frequencies. Use only one entry blank in each box of Figure 3-4.

- CW: Measurements occur only at single CW frequencies. Use only one entry blank in each box of Figure 3-4.

Photocopy the dynamic range worksheet (illustration and calculations) from Appendix B and fill it out. Item A is located in the lower-left hand corner of Figure 3-4. The other items (B through I) proceed clockwise from item A. A description of each entry box is provided after Figure 3-4.

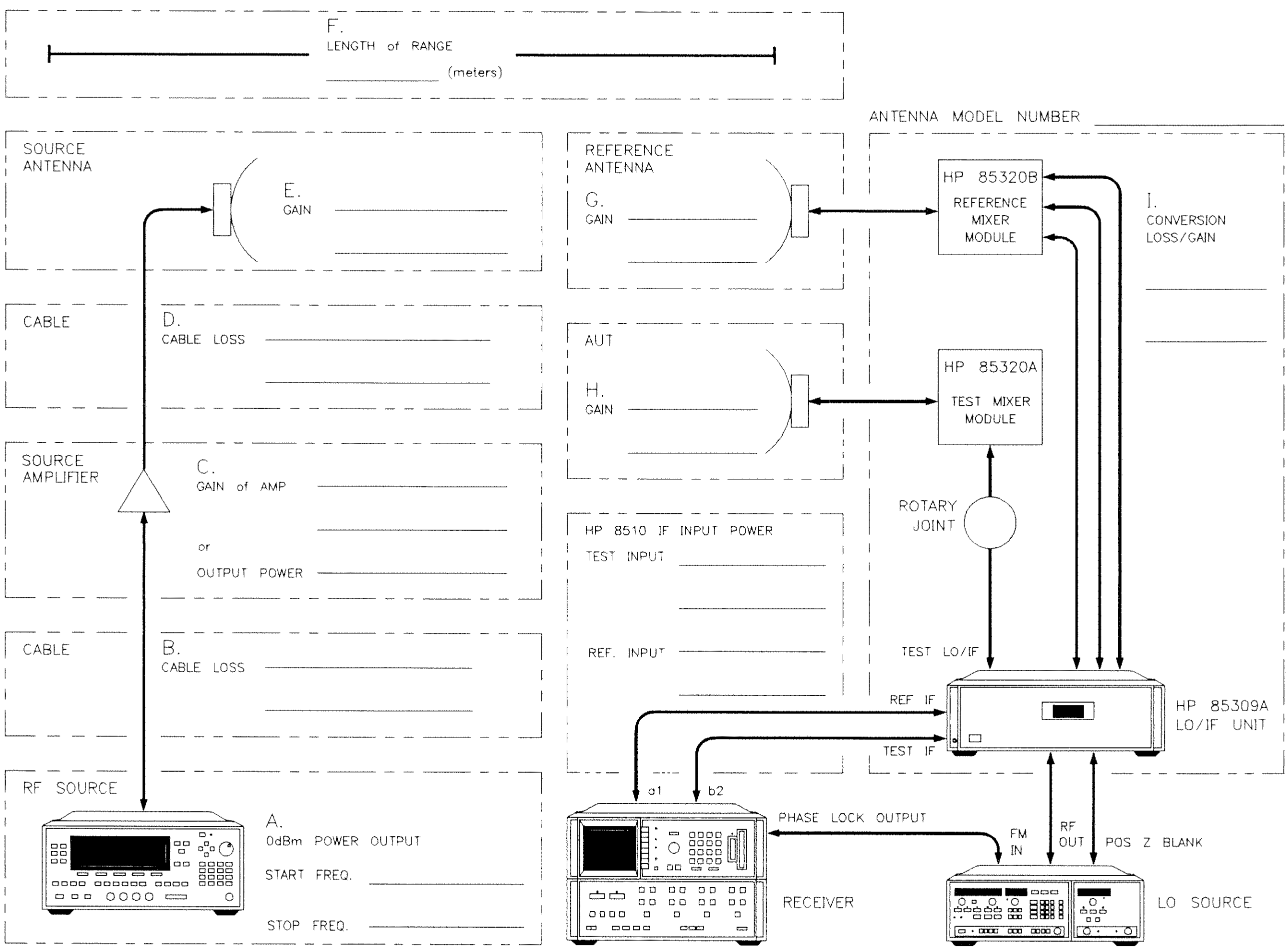


Figure 3-4. Known System Gain and Loss Values

A. Enter the start and stop frequencies, or CW frequency, that will be used in the antenna measurement.

If you are using a source amplifier, perform steps B and C. If not, proceed directly to step D.

B. Enter the loss of the cable connecting the RF source to the source amplifier. Refer to Figure 8-1.

C. Enter the actual gain of the amplifier in box C. Make sure you enter the actual gain of the amplifier (it is usually greater than the specified gain).

Helpful Hint

If you are using a source amplifier that shows actual output power (for example, an HP 8349B), write the actual power in box C. Use this value directly when calculating power levels in later steps.

D. Enter the loss of the cable that goes to the source antenna.

E. Enter the gain of the source antenna.

F. Enter the length of the test range (in meters). A meter is 3.28 feet.

G. Enter the gain of the reference antenna.

H. Enter the expected gain of the AUT (antenna under test) at boresight.

I. Enter the conversion gain of the HP 85310A system. Refer to the "Specifications" section in Chapter 5, "General Information." Remember that conversion efficiency varies with frequency and mixer mode (fundamental or third harmonic mode). Conversion loss (or gain) is a typical performance characteristic; it is not a warranted specification.

Calculate Unknown Measurement System Gain/Loss Values

Use the data entered in the worksheet illustration to calculate the following values. Write calculated values in the spaces provided.

If making *wide* frequency range measurements, perform each calculation twice, once with values applicable at the start frequency and once with values applicable at the stop frequency. If making *narrow* frequency range measurements, or CW measurements, perform each calculation once.

- *Effective Radiated Power* (E_{RP})

  E_{RP} (dBm) = RF source output power − source cable losses (+ source amplifier gain, if present) + source antenna gain. Alternatively, E_{RP} (dBm) = Actual source amplifier output power − cable losses + source antenna gain

  E_{RP} (at start frequency) = ____________________
  E_{RP} (at stop frequency) = ____________________

- *Power Dissipation*

  PD (dB) = 32.45 + 20 log Frequency + 20 log R, where frequency is in GHz and R is the length of the antenna range (in meters).

  PD (at start frequency) = ____________________
  PD (at stop frequency) = ____________________

- *Power at Mixers*

  □ Reference Mixer

  P_{RM} (power at reference mixer) = E_{RP} − P_D + Gain of Reference Antenna

  P_{RM} (at start frequency) = ____________________
  P_{RM} (at stop frequency) = ____________________

  This value must not exceed the "Compression Level" specified in Table 5-3. Add attenuation between the antenna and the mixer if necessary, or reduce the power of the RF source.

  □ Test Mixer

  P_{TM} (power at the test mixer) = E_{RP} − P_D + Gain of AUT

  P_{TM} (at start frequency) = ____________________
  P_{TM} (at stop frequency) = ____________________

  This value must not exceed the "Compression Level" specified in Table 5-3. Add attenuation between the antenna and the mixer if necessary, or reduce the power of the RF source.

The following calculations allow you to estimate actual IF levels at the receiver `a1` and `b2` inputs. These calculations are optional.

- *Power at the receiver a1 IF Input*

  □ P_{a1} (power at a1) = P_{RM} + conversion gain

  P_{a1} (at start frequency) = ____________________
  P_{a1} (at stop frequency) = ____________________

  This value must not exceed the maximum input power level of the receiver (−10 dBm). Reduce the power level of the RF source if necessary. If you are using an HP 8350 LO source, the power at the receiver a1 reference channel cannot be lower than −45 dBm or phase lock can be lost.

- *Power at the receiver b2 IF Input*

  □ P_{b2} (power at b2) = P_{TM} + conversion gain

  P_{b2} (at start frequency) = ____________________
  P_{b2} (at stop frequency) = ____________________

  This value must not exceed the maximum input power level of the receiver (−10 dBm). Reduce the power level of the RF source if necessary.

Increase RF Source Power if Possible

You may increase the power output of the RF source if BOTH of the following conditions are met:

- The power arriving at the mixers is below the maximum specified RF input power.
- IF OVERLOAD is not displayed on the receiver.

Power may be increased until an IF OVERLOAD error is displayed on the Receiver. Decrease the RF source power by 2 dB, and press (ENTRY OFF). The IF OVERLOAD error should not reoccur.

Perform a continuous sweep measurement over the entire frequency range. If IF OVERLOAD comes on again, reduce power by 2 dB and press (ENTRY OFF). Repeat this step until IF OVERLOAD does not come on.

Optimizing when the Mixers Receive Different Power Levels

Optimize the system for the path (test or reference) with greater gain. Set the RF source output power to the highest setting possible without over driving the respective mixer or the receiver input.

If the test channel has less gain than the reference channel, the dynamic range of the test channel can be improved by adding an attenuator to the reference mixer's RF input. This attenuator value can be as large as the difference between the reference and test channel gain. Now you can increase the transmitter power to increase dynamic range.

Check Actual IF Power Levels

Now that power levels have been estimated for the receiver test and reference IF inputs, check the actual input power levels to see if they meet expectations. *The instructions below assume you are using the receiver a1 input as the reference channel and b2 as the test channel.*

On an *HP 8510*, press:
PARAMETER (MENU) USER 1 a1

On an *HP 8530A*, press:
PARAMETER (MENU) SERVICE PARAMETERS SERVICE1 a1

Observe the power level of a1 (reference input). If you are using an HP 8350 LO, the reference input limits are −10 to −45 dBm. The limits for a synthesized LO are −10 to the noise floor. Power levels near the noise floor will reduce measurement accuracy.

Suspect a problem if the actual value is not within ±6 dB of the calculated value. Double-check the calculation first, then check the system for attenuators or other equipment which may have been added (without your knowledge). Next, check all system connections. Refer to "In Case Of Difficulty" if all this fails. On an *HP 8510*, press:
PARAMETER (MENU) USER 2 b2

On an *HP 8530A*, press:
PARAMETER (MENU) SERVICE PARAMETERS SERVICE2 b2

Configuring for Optimum Dynamic Range

Observe the power level of the b2 (test) input. Power to the test input cannot exceed −10 dBm. The minimum power level is equal to the sensitivity specification of the test mixer. Suspect a problem if the actual value is not within ±6 dB of the calculated value.

Operational Check

The following steps verify that the system is working properly. This procedure may also be used on a daily basis to ensure proper system operation.

Note

Look on the left side of the receiver display. "M" should appear on the left-hand side of the receiver display, showing that multiple source mode is active. If the "M" is not on the display, set the receiver to multiple source mode as explained in "Configure the Receiver" in Chapter 2.

LO Power Check

Check the LO source output power, it should be set to either +10 or +13 dBm. "Set the LO Power" in Chapter 2 explains how to determine which of these values is appropriate.

LO Leveling Check

Perform the following test to check LO power over the entire frequency range.

Note

All keystrokes in the following procedure are intended for the receiver.

1. Make sure the system is set up properly.

   On *HP 8530A* only, press:
   (DOMAIN) FREQUENCY .

2. Set the receiver to the fundamental mode by pressing:

   STIMULUS (MENU) MORE CONTINUAL (PRIOR MENU) STEP .

   (SYSTEM) MORE EDIT MULT. SRC.

   DEFINE: SOURCE 2

   MULTIPLIER DENOM. 1 (x1)

   DONE

   MULT. SRC ON/SAVE

3. Press (SPAN) 1 (M/u) (CENTER) 3.5 (G/n).
4. Observe the DETECTOR VOLTAGE displayed on the HP 85309A
5. Adjust the HP 85309A's LO POWER ADJUST, if necessary, so the DETECTOR VOLTAGE is within ±2 mV of the voltage printed on the reference mixer. (The voltage printed on the reference mixer should have been copied into Table 2-5 by the person who installed the system.)
6. Determine the maximum and minimum frequencies available while your system is in fundamental mode:

   The minimum frequency is 2 GHz. Refer to "Selecting Fundamental or Harmonic Mode," later in this chapter.
   The maximum frequency is the same as the maximum LO frequency available to the mixers. The maximum LO frequency is determined by the type of cables you are using, cable length,

or if cables are not a limiting factor, the maximum frequency of the LO source.

7. Set the receiver to single point mode. Press STIMULUS (MENU) followed by the SINGLE POINT softkey.
8. Set (CENTER) frequency to the lowest RF frequency in your measurement band.
9. Check for error messages. Correct any condition that causes an error message and press (ENTRY OFF) to clear the error message from the screen.
10. Observe the HP 85309A's LO POWER OUT OF RANGE light. If it is OFF then proceed. If it is ON then something is wrong; refer to "The LO POWER OUT OF RANGE Light is ON" in Chapter 6.
11. Set the center frequency to the lowest system frequency.
12. Now step center frequency from the lowest to the highest frequency in 1 GHz steps. At each step observe the LO POWER OUT OF RANGE light, which should stay OFF at each step. If the light comes on, there is not enough LO power available at that frequency. Refer to "The LO POWER OUT OF RANGE Light is ON" in Chapter 6.

Note

The voltage in the DETECTOR VOLTAGE display window may vary with frequency. This is normal. The LO POWER OUT OF RANGE light will come on only if the system's automatic leveling loop cannot level the voltage sufficiently. This can happen if the LO source is disconnected, or if you are requesting more power than the LO source can supply for a given frequency range.

Check RF Sensitivity

This procedure performs a rough check of the Mixer's RF sensitivity. This procedure does not measure sensitivity directly, rather, it allows you to approximate sensitivity by measuring IF noise floor. Because this test measures the IF signal, the conversion gain of the HP 85310A must be taken into account. This is done during the course of the procedure.

The instructions below assume you are using the receiver's a1 input as the reference channel and b2 as the test channel.

1. Place a 50 Ohm load on the RF input of the test mixer. If using an HP 8530A, make sure it is in the Frequency Domain.
2. On the receiver, press:
   a. STIMULUS (MENU) STEP
   b. (START) 2 (GHz) (or enter the lowest frequency in your measurement).
   c. (STOP) 18 (GHz) (or enter the highest frequency in your measurement).
   d. On the following models:
      i. On HP 8510, press:
      PARAMETER (MENU) USER2 b2

ii. On HP 8530A, press:
PARAMETER (MENU) SERVICE PARAMETERS SERVICE2 b2

e. On both HP 8510 and HP 8530A, press:
RESPONSE (MENU) SMOOTHING ON 20 (x1)

3. Determine an acceptable IF noise floor limit. (The IF noise floor you see on the receiver is equal to the RF sensitivity plus the conversion gain). The specifications table in Chapter 5 gives RF sensitivity and conversion gain values. These values change with frequency. In addition, fundamental mode has different conversion gain and sensitivity specifications than 3rd harmonic mode. (This is shown in the specification table.)

Acceptable noise floor is equal to:

RF Sensitivity Specification + Conversion Gain

To determine the acceptable noise floor in your system, use Table 3-2. An example is shown in Table 3-3.

Table 3-2.
Sensitivity, Conversion Gain, and Cable Loss Values

	2 to 3 GHz (fundamental)	3 to ____ GHz (fundamental)	____ to ____ GHz (3rd Harmonic)
RF Sensitivity:	−107 dBm	−113 dBm	−96 dBm
Typical Conversion Gain:	10.5 dB	9.5 dB	−2 dB
IF Noise Floor:	____	____	____
Noise Floor = Sensitivity + Conversion Gain			

Passing this noise floor test shows that the mixers are performing close to their specified RF sensitivity. This test is not intended to prove that the mixers meet their specifications. If you wish to verify conformance to specifications then refer to Chapter 4.

Example:

Our system can go to 12.5 GHz in fundamental mode, then must switch to 3rd harmonic mode to go to 18 GHz. Table 3-3 shows the RF sensitivity and conversion gains that apply to this example (these values are taken from the specification table). Table 3-3 also shows the minimum expected IF noise floor, which is the value you should see on the receiver if the mixers are meeting their RF sensitivity specification.

Table 3-3. Sensitivity, Conversion Gain, and Resultant Noise Floor Example

	2 to 3 GHz (fundamental)	3 to 12.5 GHz (fundamental)	12.5 to 18 GHz (3rd Harmonic)
RF Sensitivity:	−107 dBm	−113 dBm	−96 dBm
Conversion Gain:	10.5 dB	9.5 dB	−2 dB
IF Noise Floor:	−96.5 dBm or less[1]	−103.5 dBm or less[1]	−98 dBm or less[1]

1. "Or less" means "more negative." For example, −105 dBm is less than −104 dBm.

IF Power Level Check

1. Press RESPONSE (MENU) SMOOTHING OFF .
2. Reconnect the test mixer to the test antenna.
3. Observe the signal on b2. If you have previous experience with this type of antenna-under-test, compare the results you are now getting with the usual results. If current results are within approximately 5 dB of normal results then the system is working properly.

   If you have just set up the system, or have just made major changes to its configuration, calculate the expected power levels using the dynamic range worksheet procedure in this chapter. If measured results are within 5 dB of the calculated worksheet values then the system is working properly.

Note

If the test fails, check the LO power level as explained above. If the LO power is set correctly, then see "Low Level Noise Test Failure" in Chapter 7.

4. If the test passes, the antenna test system is now ready to make measurements.

   If the test fails, refer to Chapter 6.

Make Measurements

The system is now ready to make measurements. It is recommended that you read "Selecting Fundamental or Harmonic Mode," immediately following this paragraph.

Selecting Fundamental or Harmonic Mode

Fundamental mode provides excellent sensitivity, but it has an upper frequency limit: the maximum measurable RF frequency cannot exceed the maximum LO frequency of your system.

For example, if your system can deliver up to 8.4 GHz to the mixer's LO inputs, you can only measure RF frequencies up to 8.38 GHz using fundamental mode. (Fundamental mode requires the LO frequency to be 20 MHz away from the RF frequency.) The maximum LO frequency becomes the limiting factor because it is usually less than the system's highest RF frequency.

The maximum LO frequency of your system depends on the LO cables in use (type and length), or, if these are not limiting factors, upon the maximum frequency of the LO source. The maximum LO frequency of your system was documented in the configuration guide when the system was ordered. In any case, the maximum fundamental frequency possible is 18 GHz, due to the HP 85309A LO/IF unit. See Chapter 5 for more information.

To measure higher RF frequencies you must change to the harmonic mode. This mode allows you to measure RF frequencies that are greater than the maximum LO frequency. The HP 85320A/B mixers can operate up to 26.5 GHz in 3rd harmonic mode.

For example: Third harmonic mixers can measure RF signals three times the frequency of the maximum LO signal. To activate harmonic mode perform the procedure below:

Note If you are controlling the system with the HP 85360A software, use the instructions in the *HP 85360A User's Guide*. Look in the index under "harmonic mixing mode."

Look on the left side of the receiver display. The screen should indicate that you are in multiple source mode. If it is not in this mode, refer to "Configure the Receiver" in Chapter 2.

---

1. On the receiver, press:

   (SYSTEM) `MORE` `EDIT MULT. SRC.`

   `SOURCE 2`

   `MULTIPLIER DENOM.` 1 (x1) To select fundamental mode

   or

   `MULTIPLIER DENOM.` 3 (x1) To select third harmonic mode

   `DONE`

2. Save and turn on multiple source mode by pressing:

   `MULT. SRC: ON/SAVE`

No other changes are required other than setting the proper (START) and (STOP) frequencies for your measurement.

Connector Care

The condition of system connectors has a serious affect on measurement accuracy. Worn, out-of-tolerance, or dirty connectors degrade measurement accuracy. For more information on connector care, please see *Application Note 326 Coaxial Systems Principles of Microwave Connector Care.*

Recommended Practices

HP strongly recommends that you use a "connector saver" on the RF input of the mixers. This is especially important on the test mixer, which is connected and disconnected often. A "connector saver" is an adapter or short cable. This practice has two important advantages:

- The "connector saver" receives daily wear, the mixer input connector does not. This greatly extends the life of the mixer's input connector.
- It is the connector saver that gets dirty with use, not the mixer connector.

When you must clean the connector saver, remove it from the mixer. This protects the mixer from static discharge.

Here are the part numbers for commonly-needed connector savers:

Type	HP Part Number
3.5 mm male to 3.5 mm female	1250-1866
3.5 mm female to 3.5 mm female	1250-1865 (Supplied with the HP 85320A mixer)
Type-N male to 3.5 mm female	1250-1744
Type-N female to 3.5 mm female	1250-1745

Caution The HP 85310A contains static sensitive devices. Do not touch the center conductor of any connector, or the center conductor of any cable connected to the HP 85310A. Wear an anti-static ground strap when cleaning connectors.

How to Inspect Connectors for Wear

Look for metal particles from the connector threads and other signs of wear (such as discoloration or roughness). Visible wear can affect measurement accuracy. Discard or repair any device with a damaged connector. A bad connector can ruin a good connector on the first mating.

SMA Connector precautions

Use caution when mating SMA connectors to the mixer's precision 3.5 mm RF input. SMA connectors are not precision devices, and are often out of mechanical tolerances, even when new. An out-of-tolerance SMA connector can ruin the mixer's RF input connector on the first mating. If in doubt, gage the SMA connector before connecting it to the mixer. The center conductor must NEVER extend beyond the mating plane.

How to Clean Connectors

Part numbers for cleaning supplies are provided after the procedure.

1. Blow particulate matter from connectors using an environmentally-safe aerosol such as Ultrajet. This product is recommended by the United States Environmental Protection Agency, and contains chlorodifluoromethane. You can order this aerosol from Hewlett-Packard.
2. Next, use an alcohol wipe to wipe connector surfaces. It is best to wet a small swab with alcohol (from the alcohol wipe) and clean the connector with the swab.
3. Allow the alcohol to evaporate off the connector before making connections

Caution

DO NOT ALLOW EXCESSIVE ALCOHOL TO RUN INTO THE CONNECTOR! Excessive alcohol entering the connector collects in pockets in the connector's internal parts. The liquid will cause random changes in the connector's electrical performance. If excessive alcohol gets into a connector, lay it aside to allow the alcohol to evaporate. This takes up to 3 days. If you attach that connector to another device it can take much longer for trapped alcohol to evaporate.

Cleaning Supplies

- Ultrajet: 9310-6395
- Alcohol wipes: 92193N
- Lint-Free cloths: 9310-4242
- Small foam swabs: 9300-1270
- Large foam swabs: 9300-0468

4

System Performance Verification

Introduction

This performance verification should be done once a year, or as needed. This procedure verifies that the HP 85310A meets or exceeds its published specifications. Specifications are listed in Chapter 5. If traceability to a local standards organization is required, then it can be done with this procedure. One such standards organization is the United States National Institute of Standards and Technology (NIST, formerly NBS).

Torque Wrench

The Type-N torque wrench supplied with this system is a precision device and is very expensive to replace (if lost). It is also absolutely vital to proper system performance, and must be used during annual performance verification. The wrench must also be used when returning the system to its normal installation configuration. If the wrench is not kept in plain view, write its location here:

The Torque Wrench is Stored:

Recommended Test Equipment

Any of the following RF test sources may be used, as long as they can cover the frequency range required for the verification. You can use the antenna measurement system RF source, if convenient.

- HP 8340A/B
- HP 8341A/B
- HP 83620A or 83621A or 83623A or 83624A
- HP 83631A.
- HP 83640A or 83642A
- HP 83650A or 83651A

Table 4-1 lists the equipment that is mandatory when running the performance verification.

Table 4-1. Required Equipment

Qty.	Item	HP Part or Model Number	Use[1]
1	Computer with 2 Mbyte memory	HP Series 300	T, R
1	HP 85310A Verification Software	85309-10001	R
1	HP 836xx Verification Software	08360-10001 or 08360-10002	T
1	Power meter with HP-IB and cable	HP 436A opt 022, or 437A, or 438A	T, R
1	Power sensor (3.5 mm connector)	HP 8485A[2]	T, R
1	RF synthesized source	HP 8340/41 or 8360 Family[3]	R
1	Microwave frequency counter	HP 5351B option 001 or HP 5343A option 001	T
1	Digital Oscilloscope - Dual Channel[4]	HP 54501A or HP 54111D	T
1	3.5 mm adapter (f to f)	1250-1865 (supplied w/HP 85310A)	R
1	Power splitter	HP 11667B (or 5086-7408, part of receiver service kit)	R
2	RF cable, 3.5 mm (m) to (f)[5]	08513-60009 (or other low loss)	R
1	50 ohm load, 3.5 mm (m)	HP 909D (or 85052-60001, part of HP 85052A cal kit; or 85052-60010, part of HP 85052B)	R
1	50 ohm load, 3.5 mm (f)	HP 909D opt. 001 (or 85052-60002, part of HP 85052A cal kit; or 85052-60011, part of HP 85052B)	R
3	3 dB attenuator, 3.5 mm[6]	HP 8493C option 003	R
1	10 dB attenuator, 3.5 mm	HP 8493C option 010	T, R
3	20 dB attenuator, 3.5 mm	HP 8493C option 020	R
1	Torque wrench, 5 in-lb	8710-1582[7]	R
4	LO/IF Unit to Mixer cable[8]	Backup 85381A/B/C cable	R

1 T = transmitter performance verification; R = receiver performance verification;

2 You can use a different power sensor, if it covers the frequency range of the HP 85310A system.

3 The RF (transmitter) source may be used.

4 Required if LO source is a synthesizer and the LO, RF, and receiver timebases are *not* connected together.

5 Some sources may require a Type-N (m) to 3.5 mm (m) adapter.

6 During the compression calibration, one additional 6 dB 3.5 mm attenuators may be required: HP 8493C option 006.

7 Use this wrench for all SMA/3.5 mm connections in this procedure.

8 Required if the mixer/cable assembly cannot be removed from their normal location and therefore cannot be placed next to the verification system. These cables provide LO and IF signal paths for the test mixer and LO, IF, and detector voltage paths for the reference mixer.

Synthesized LO Source Timebase Check and Adjustment

If you are using an HP 8360 series synthesizer as the LO source and the timebase of the LO source, RF source, and receiver are not connected together you need to do the following procedure.

Description and Procedure

This procedure adjusts the frequency accuracy of the internal 10 MHz timebase of the LO source. This adjustment should be done on a regular basis if you cannot connect the timebases (LO, RF, and receiver) together.

This adjustment procedure should be done at least once a year. Millimeter wave systems should be done more often. See "Adjustment Interval," following this adjustment, for information on how to determine a periodic adjustment schedule. For best accuracy, readjust the 10 MHz timebase oscillator after the LO source and RF source have been ON or in STANDBY for 24 hours.

After the LO source timebase is adjusted, the timebase frequency should stay within the aging rate if the following things happen:

- The timebase oven does not cool down.
- The instrument keeps the same orientation with respect to the earth's magnetic field.
- The instrument stays at the same altitude.
- The instrument does not receive any mechanical shock.

If the timebase oven cools (the instrument is disconnected from AC power), you may have to readjust the timebase frequency after a new warm-up cycle. Typically, however, the timebase frequency returns to within ±1 Hz of the original frequency.

Note You can adjust the internal timebase after reconnecting AC power for 10 minutes, but for best accuracy, test again after the instruments have been ON or in STANDBY for 24 hours.

Frequency changes, due either to a change in orientation with respect to the earth's magnetic field or to a change in altitude, are usually eliminated when the instrument is returned to its original position. A frequency change due to mechanical shock usually appears as a fixed frequency error.

1. Connect the equipment as shown in Figure 4-1. Preset all instruments and let them warm up for one hour.

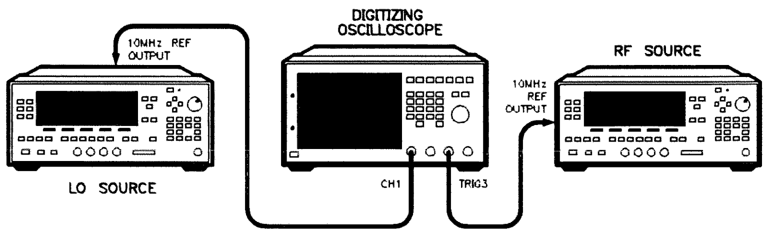


Figure 4-1. LO Source 10 MHz Timebase Adjustment Setup

Note

If the oscilloscope does not have a 50Ω input impedance, connect channel 1 and the Trig 3 input through a 50Ω feedthrough. Ensure that an external frequency standard is not connected to either of the synthesizers. (At instrument preset the synthesizers automatically choose the external standard as the reference if one is connected to the 10 MHz REF INPUT.)

2. On the oscilloscope, set:

Channel 1:	
Display	On
Volts/Division	200 mV
Input Coupling	dc
Input Impedance	50Ω
Channel 2:	
Display	Off
Timebase:	
Time/Division	10 ns
Trigger	External
Trigger:	
Trigger Mode	Edge
Trigger Source	Trig 3
Input Coupling	ac
Display:	
Display Mode	Real Time

3. On the oscilloscope, adjust the trigger level so that the sweep is synchronized to the synthesizer's internal standard. The waveform will appear to drift.
4. Using a non-metallic tool, adjust the LO source's A23 10 MHz standard (see Figure 4-2) for minimum horizontal movement of the oscilloscope waveform.

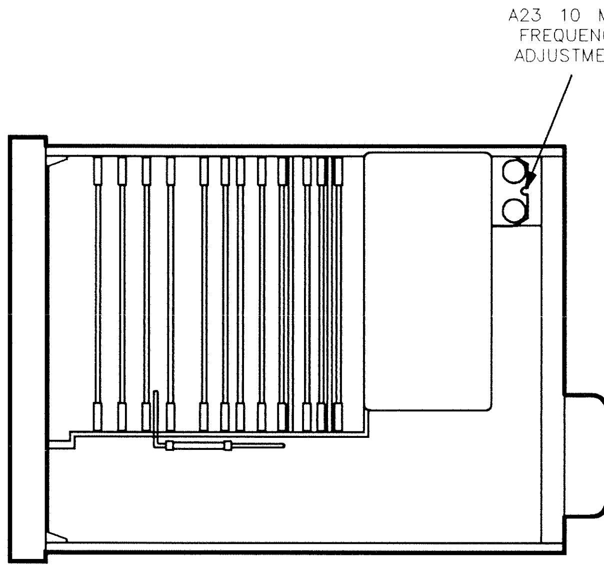


Figure 4-2. 10 MHz Standard Adjustment Location

Table 4-2 shows the required adjustment interval to maintain a given accuracy. If you know the aging rate, you can determine a more precise adjustment interval. See the HP 8360 series synthesizer Service Manual for more information.

Table 4-2.
Suggested Adjustment Interval for LO Sources

Highest Frequency Tested	Interval
≤26.5 GHz	1 year
Between 26.5 and 50 GHz	6 months
Between 50 and 110 GHz	3 months

Receiver Performance Verification

This procedure requires an HP 9000 Series 300 computer, power meter and sensor head, RF source, and miscellaneous attenuators and splitters. Performance traceability can be provided through the power meter, sensor head, and the RF source.

Commands that must be typed into the computer are shown in `computer typeface`. These commands should be typed in exactly as printed on the page, including any quotation or punctuation marks. You can type in commands like LOAD, RUN, etc., in upper or lower-case. Filenames must be entered in the same case as used when they were created. Front panel keys are shown in an outline box (PRESET). Function keys and display softkeys are shown in a shadowed box Done .

Setting Up The Equipment

1. Be sure that the correct BASIC operating system, drivers, and language extensions are loaded into the computer controller. If necessary refer to "Computers and BASIC", at the end of this chapter.
2. The receiver, LO/IF unit, mixers, LO source, and cables should be in the same configuration in which they are normally used. Make sure that all cables are connected properly, and that the receiver is in the same multiple source mode as used in your system. All connectors should be properly torqued, refer to Table 8-1.
3. Connect system components as shown in Figure 4-3, Configuration Diagram, and Figure 4-4, Splitter/Cables Diagram. The mixers must be placed near the verification system during the performance verification. If the RF SOURCE to SPLITTER cable is different than the recommended cable, then it must be as short as possible with very low RF loss.
4. This procedure assumes you will be using some of the cables from your actual range, specifically, the cables between the LO/IF unit and the mixers. This requires that the cables be pulled from their installation location so that the mixers can be placed near the verification system. If the cables cannot be pulled, they must be tested separately (see Chapter 8). In this case the mixers should be connected to the verification system with a backup set of HP 85381 cables of the same type and length as the cables normally used in the system.
5. Once set up, turn on all equipment and allow it to warm up for one hour.

Note

If you cannot bring the mixer down from the antenna tower, consider taking the RF source and power meter up to the mixers (if possible). Two additional HP-IB extenders will be required: One to connect the power meter to the general HP-IB "700 bus", and one to connect the RF source to the receiver System Bus.

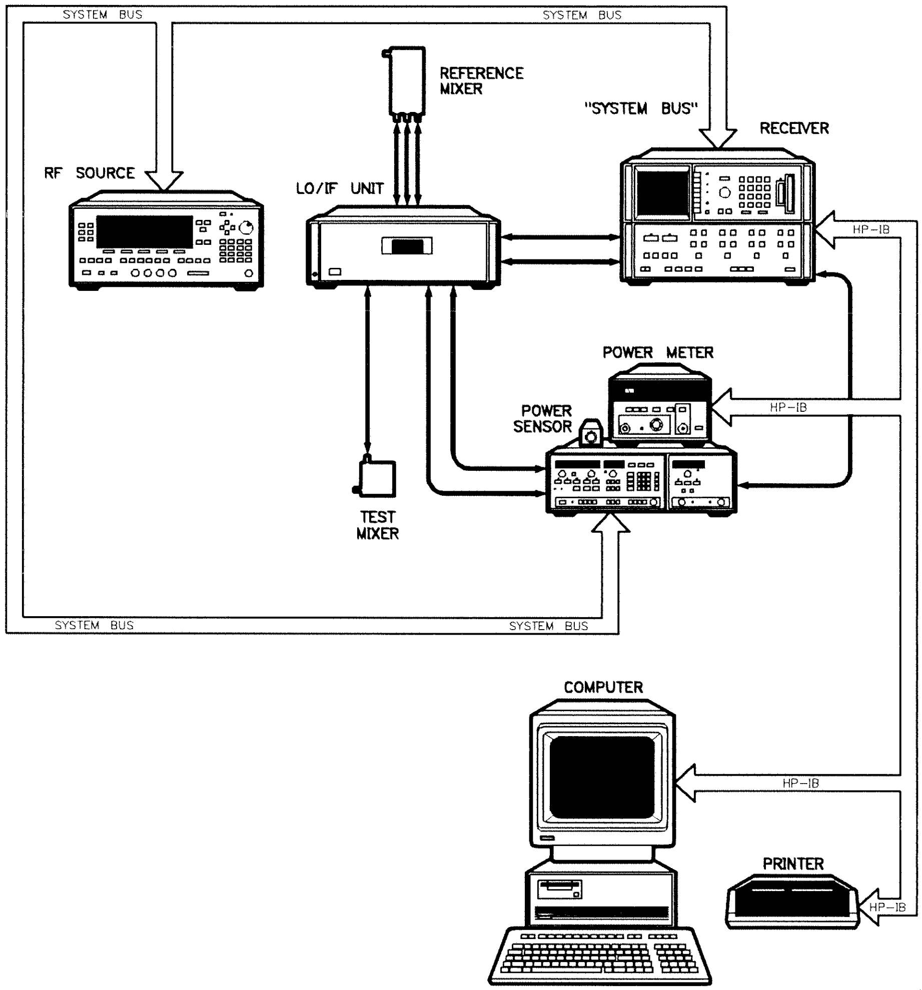


Figure 4-3. Instrument Configuration Diagram

Note This is a suggested bench configuration only. The HP 85309A LO/IF unit can be left in a system rack, so long as it is accessible by the verification system.

Connect the system printer or plotter to the general HP-IB “700 bus”.

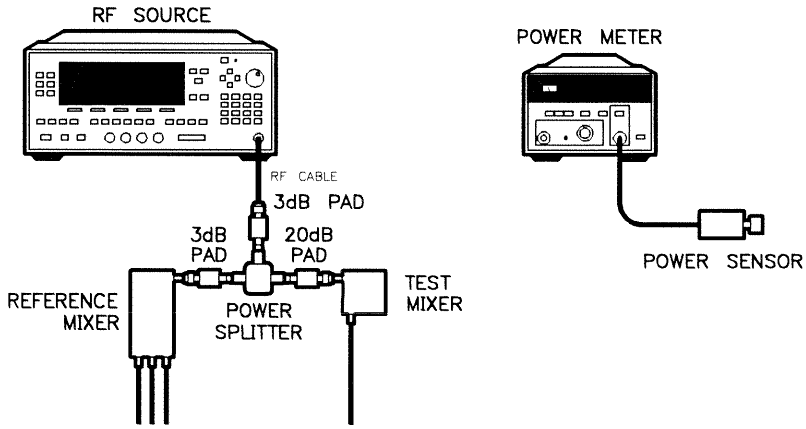


Figure 4-4. RF Test Signal Diagram

Check LO Power

The following steps verify that the LO is working properly.

LO Power Check

Check the LO source output power. The LO source should display a power level of either +10 or +13 dBm. "Set the LO Power" in Chapter 2 explains how to determine which of these settings is appropriate.

LO Leveling Check

Perform the following test to check LO power over the entire frequency range.

Note

All keystrokes in the following procedure are intended for the receiver.

1. Make sure the system is set up properly.

   On *HP 8530* only press:
   (DOMAIN) FREQUENCY .

2. Set the receiver to the fundamental mode by pressing:

   STIMULUS (MENU) MORE CONTINUAL (PRIOR MENU) STEP .

   (SYSTEM) MORE EDIT MULT. SRC. .

   DEFINE: SOURCE 2 .

   MULTIPLIER DENOM. 1 (x1).

   DONE .

   MULT. SRC ON/SAVE .

3. Press (SPAN) 1 (M/u) (CENTER) 3.5 (G/n).
4. Observe the DETECTOR VOLTAGE displayed on the HP 85309A.
5. Adjust the HP 85309A's LO POWER ADJUST, if necessary, so the DETECTOR VOLTAGE is within ±2 mV of the voltage printed on the reference mixer. (The voltage printed on the reference

mixer should have been copied into Table 2-5 by the person who installed the system.)

6. Determine the maximum and minimum frequencies available while your system is in fundamental mode:

   The minimum frequency is 2 GHz. Refer to "Selecting Fundamental or Harmonic Mode," later in this chapter.
   The maximum frequency is the same as the maximum LO frequency available to the mixers. The maximum LO frequency is determined by the type of cables you are using, cable length, or if cables are not a limiting factor, the maximum frequency of the LO source.

7. Set the receiver to single point mode. Press STIMULUS (MENU) followed by the SINGLE POINT softkey.
8. Set (CENTER) frequency to the lowest RF frequency in your measurement band.
9. Check for error messages. Correct any condition that causes an error message and press (ENTRY OFF) to clear the error message from the screen.
10. Observe the HP 85309A's LO POWER OUT OF RANGE light. If it is OFF then proceed. If it is ON then something is wrong, refer to "The LO POWER OUT OF RANGE Light is ON" in Chapter 6.
11. Set the center frequency to the lowest system frequency.
12. Now step center frequency from the lowest to the highest frequency in 1 GHz steps. At each step observe the LO POWER OUT OF RANGE light, which should stay OFF at each step. If the light comes on, there is not enough LO power available at that frequency. Refer to "The LO POWER OUT OF RANGE Light is ON" in Chapter 6.

Note

The voltage in the DETECTOR VOLTAGE display window may vary with frequency. This is normal. The LO POWER OUT OF RANGE light will come on only if the system's automatic leveling loop cannot level the voltage sufficiently. This can happen if the LO source is disconnected, or if you are requesting more power than the LO source can supply for a given frequency range.

Receiver Verification Software Introduction

This introduction includes a brief description of the tests in the performance verification, and a summary of the softkey functions. These tests will verify the performance of an HP 85310A downconverter operating with an HP 8510B/C receiver. These tests will not verify the performance of the converter without the receiver.

Brief Description of Tests

Required Tests

Each set of mixers in the system must be verified. Usually, a system only has *one* set of mixers - the HP 85320A/B. For *each* set of mixers, you must verify each available harmonic mode over the entire frequency range of each mixer set. For example, HP 85320 mixers must be tested twice. They must be tested first in the fundamental mode (from 2 GHz to the highest LO frequency available in your system), and once in the third harmonic mode (from 6 GHz to 26.5 GHz). If your HP 85310A has option 001 or 002, these mixers must be tested also.

- *Compression* measures the error in a ratio measurement due to compression of the HP 85310A at high input power levels.
- *Channel Isolation* measures signal leakage between the antenna reference and test channels.
- *Acquire Phaselock* checks that the receiver will phase lock at the specified power.
- *Low-Level Noise* measures sensitivity (the RMS noise level of the trace data when the channel is terminated with a 50 ohm load).

Refer to "Detailed Description of the Tests" at the end of this section for additional information.

Optional Tests

- *Mixer Port Return Loss* - of each of the HP 85320A/B mixer RF inputs may be measured using a network analyzer. This test is optional and is not required for performance verification. See the end of this chapter for more information on measuring return loss.
- *Cable Test Procedure* - is required if you were not able to include the LO/IF UNIT to MIXER cables originally installed in the system. Generally this occurs when the cables could not easily be removed from their conduits.

Softkey Summary

`HELP` presents instructions or further information about the current test or menu. This key appears throughout the test menus and does not disrupt the test sequence.

`ABORT` stops the current test or menu and returns to the last menu or the test menu. (It will take effect at the end of a sweep.)

`RESTART` displays the current connection diagram and restarts a single test without returning to the test menu. This softkey will appear after a test has been made.

`RECALIB` erases the results of the current test and restarts the entire test including calibration. Use this function when a test fails due to a faulty or questionable calibration. This softkey will appear after a test has been made.

`REMEAS` repeats a measurement with the same setup and calibration (without viewing the current connection diagram or returning to the test menu). This softkey appears following tests and calibrations.

`IO MENU` displays a menu with the following softkeys and program features:

`Print`	Prints to the printer on the HP-IB or System Bus.
`File`	Saves data to or loads data from disk.
`Equip`	Displays the required equipment list.
`Sys Confg`	Records the test instruments used in this test.
`Sys Info`	Records system serial numbers.
`Sys Frq`	Sets test frequencies and harmonic.
`MAINmenu`	Returns to main test menu.
`END_prog`	Exits the program.

Data Storage

Use the `FILE` softkey in the I/O menu to save data on a separate data disk. This feature enables you to return to an incomplete test and continue the test where you had stopped. Refer to the "Save/Load Instructions" later in this section.

Running The Program

1. Turn on the computer and load the BASIC operating system.
2. Run the program as follows:
   a. Insert the performance verification disk in the drive and type LOAD "PERF85310A" (RETURN). Remember, the computer is case-sensitive with regard to file names.
   b. When the program is loaded, run it by pressing the RUN key on your computer or by typing RUN (RETURN).

      If an error message is displayed now, it is usually because a driver or language extension (or both) have not been loaded. See "Computers and BASIC" for more information.
3. When the system is configured and the program is running, the program title banner will appear on the computer's screen.
4. You can exit the program any time by pressing END_prog (in the I/O menu). However, END_prog *erases calibration data* from the program unless you previously saved the calibration data to disk. In addition, make sure the *verification data* has been printed, or has been saved on a disk before ending the program.

The appearance of the program title banner on the computer display indicates that the hardware is properly configured and the software is running properly:

```
*********************************************
* HP 8510 / 85310A PERFORMANCE VERIFICATION *
* HP P/N 85309-10001                        *
* Revision : x.xx.xx                        *
* Copyright:                                *
*********************************************

Accompanying text with a list of compatible RF Sources.
```

If this banner is not on the screen, check the following items:

- Are the instruments and cables set up properly? (see Figure 4-3).
- Are BASIC and its extensions loaded properly? (see "Computers and BASIC" at the end of this chapter).
- Are the individual instruments functioning properly? (Run self-tests, refer to the troubleshooting information in the receiver manual set.)

Use the computer softkeys when making program selections. For example, when prompted to PRESS CONTINUE, press the softkey labeled CONTINUE, not the keyboard (CONTINUE) key.

Initial Setup

1. With the title banner displayed, press the program softkey CONTINUE. The computer now asks if you want to see the test equipment list, press YES or NO as desired. When you are finished, press Done.

   The following System Configuration menu will now appear:

```
        System Configuration

Display/Processor:     HP 85101
IF/Detector:           HP 85102
RF Source:             HP 83xxx

Power meter:           HP 43xA

Printer connected to: HP-IB

LO Source:             HP 83xxx
LO Plug in:            HP 835xxx

Mixers:                HP 85320
```

2. Toggle each softkey until the System Configuration menu displays the instruments in your system. Press Done when the displayed information is correct.
3. The System Information menu will now appear (see below). Use the NEXT and PREVIOUS softkeys to move the cursor and use the computer keyboard to enter each instrument's serial number (and other information).

   System information is saved to the data disk when the verification data is saved. This information can also be printed after verification, otherwise it will be erased as soon as another program is run or the computer is turned off.

```
        HP 8510/85310A Performance Tests

System information:   Date:
Temperature            C  :
Humidity               %  :
HP 85101               S/N:
HP 85102               S/N:
HP 85309A              S/N:
HP 85320               S/N:
Power Meter            S/N:
HP RF Source           S/N:
HP LO Source           S/N:
HP Plug-In             S/N:
NOTE:
```

4. Press Done when all of the displayed information is correct.
5. The harmonic and start/stop frequency information menu will now appear (see below). Use the NEXT and PREVIOUS softkeys to move the cursor and use the computer keyboard to enter

the harmonic number that will be used for this test. Enter the required start and stop frequencies. (The frequencies you select are dependent on whether you select fundamental or a harmonic mode, and on the equipment you are using. These frequencies are also limited by the highest and lowest LO frequency available in the mixer's fundamental or harmonic mode.)

The entire performance verification should be performed in fundamental mode and again in the harmonic mode. If you are using mixers that have more than one harmonic mode, run the performance tests for each of these modes.

The harmonic and start/stop frequency information is saved to the data disk when the verification data is saved. This information can also be printed after verification; otherwise it will be erased as soon as another program is run or the computer is turned off.

```
        HP 8510/85310A Performance Tests for Mixer

  Mixer Test Harmonic:      1
  Start Test Freq. in GHz:  2
  Stop Test Freq. in GHz:   8.4
  LO Source Power in dBm:   13
```

6. Press `Done` when all of the displayed information is correct.
7. To re-enter any of the above menus, press `IO Menu` followed by the appropriate softkey.

   To leave this menu, press `DONE` (after you have entered as much of the above information as you need). You can get back to the Main menu later by pressing `MAINmenu`.
8. Calibrate the power meter and the power sensor by using the power meter POWER REF OUTPUT as explained in the power meter manual.
9. The Main test menu will now appear on the screen. This menu allows you to select and perform any of the four tests. You can display additional instructions with the `HELP` key or access the I/O menu.

```
  HP 8510/85310A PERFORMANCE VERIFICATION
  RF Source: HP 83xxx

  Compress:   Compression & Channel Isolation tests
  AquireLk:   Acquire Phase lock test
  Low-Lev:    Low-Level Noise tests
  Help:       Testing instructions
  I/O menu:   Print to printer or Save to disk
               a summary of test data.
```

10. Choose one of the tests from the Main menu. You can perform the tests in any order, but performing the tests from top to bottom is recommended. The four tests are required to ensure that the HP 85310A meets its published specifications.

The next section explains how to perform each of the verification tests.

Verification Test Procedures

Introduction

The following instructions augment the screen prompts of the program. They are step-by-step instructions intended for novice operators. The screen prompts are sufficient for technicians who are familiar with the HP 85310A system.

With the Main menu displayed on the computer display, read the instructions for each test below and follow the steps carefully. If an error message repeatedly appears during any part of the procedure, or if the program will not continue as the instructions indicate, you may have to rerun the program from the beginning. This should only be done if no other program softkey can provide a solution.

Note

This verification software allows you to verify up to 4 channels; a1, b1, b2, and a2. The standard HP 85310A uses only channels a1 and b2. Do not perform the other channel tests unless your converter system has more than the two channels, such as an HP 85310A Option 001.

Saving and Loading Test Results

To stop the verification at any time and save the tests you have completed, or to recall those same tests later, refer to the "Save/Load Instructions" immediately following the last test described in this section.

Making the Connections for the Test

The program will tell you to connect RF signals to each of the mixers at different times. The instructions will also show the LO/IF unit and show the connections that must be made to the receiver. Under normal operation, the LO/IF unit is connected as follows:

- The reference mixer channel is connected to the receiver a1 input.
- The test mixer channel is connected to the receiver b2 input.

Some tests require you to connect the test mixer to the a2 port of the receiver (instead of b2). This allows the a1 channel to be tested at a time when it is not the phase lock reference. Figure 4-5 and Figure 4-6 show an example of the computer instructing you to connect the test channel to a2.

Here's how to change from a2 to b2:

1. Disconnect the green b2 cable from the LO/IF unit's *TEST IF OUTPUT*.
2. Connect the yellow a2 cable to the *TEST IF OUTPUT*.

The wire colors mentioned above exist on the "J1 Test Set Interconnect" cable that is attached to the J1 connector on the back of the receiver. If you had to extend these cables with black HP 85381A cables, determine which of them is connected to the yellow and green wires.

If the receiver displays NO IF FOUND, see if the test channel IF cable is going to b2. If it is, try moving the test cable from b2 back to a2 and try the test again. (You may have connected the test channel to the wrong port for that test, or maybe you did not notice an instruction to change the connections.)

The reference mixer channel IF is never changed from the receiver a1 port.

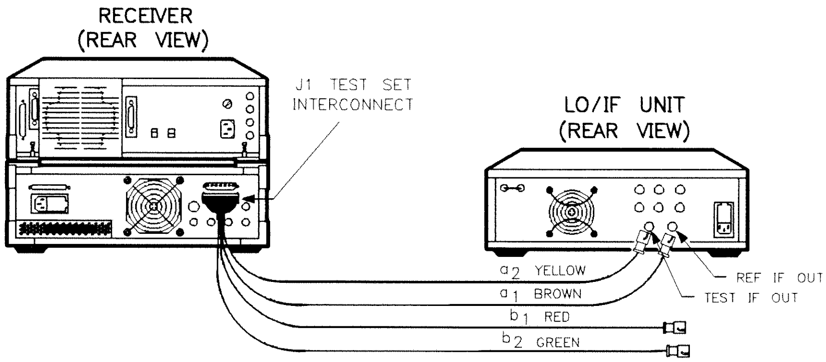


Figure 4-5. Example Receiver IF Connections

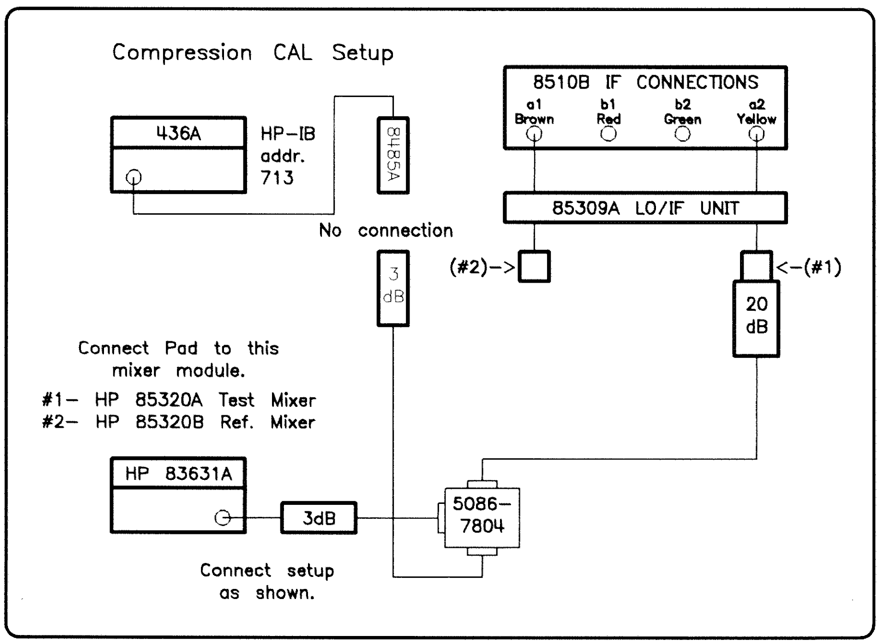


Figure 4-6. Equivalent Connection Diagram Shown on the Computer Screen

Compression and Channel Isolation Test Procedure

1. Press `Compress` to display the Compression and Channel Isolation menu. The test defaults to the reference mixer (a1 channel) compression and channel isolation tests. This default setting can be changed, however.
2. Press `Port`. Notice that the selected port changes the combination of channel isolation tests listed below it. Press `Port` until a1 is displayed.

Calibration

3. Press `a1 Compr` to begin. The program will search through the computer memory for compression calibration data. If data which matches the current hardware setup is found, the program will use that data and set up for the compression test (proceed with step 4).

If a Calibration is Not in Computer Memory

If the program does not find an existing calibration, it will display the following message:

```
A Compression calibration is required.

CAL:        Perform Compression calibration
LOAD:       Load Compression calibration from disk

Select a softkey
```

If there is already a valid calibration on disk. If a calibration was saved on your disk earlier in the day, press `LOAD` to display the following menu: (Do not use a calibration that is more than one day old.)

```
Default data drive is:

:xxx

Press RETURN if okay.
If not okay the enter
the MASS STORAGE UNIT SPECIFIER
of the disk drive used for data storage.
```

The default data drive will be the drive from which the program was loaded. If you want to load the calibration data from another drive, enter the address (MSUS) of that drive and press (RETURN).

Error messages may result from using the wrong disk, not having a disk in the drive, not having a calibration on the disk, or specifying the wrong drive.

Note

The computer system's general HP-IB "700 bus" uses addresses from 700 through 799. The receiver is connected to the computer through this bus. The HP 9000 series 320 computer uses this bus for disk drives as well.

All other HP 9000 computers use a special high speed disk drive bus. The disk drive bus is only for disk drives, and uses addresses from 1400 to 1499. Be sure that you are using the correct bus address (14XX or 7XX) when specifying the drive address.

A calibration will not work unless two requirements are met:

Condition 1: All system hardware used during the test must be the same as the equipment used during the calibration.

Condition 2: The frequency range of the calibration must be the same as the frequency range used during the test.

The configuration file contains a record of the hardware and frequency range used when the configuration was created. The system compares the current setup to the information in the calibration file, and displays an error message if they do not match.

If You Must Create a New Calibration

- Press `CAL`.
- Enter the power sensor cal factors listed on the power sensor. The power meter sensor should not be connected to RF power at this time. Unless the program prompts "Power meter doesn't respond," assume the power meter's address is correctly set to 13 (see power meter manual) and the instrument is on the HP-IB bus (see the receiver Installation chapter in the On-Site Service Manual).
- Press `Continue` to automatically zero the power meter. If the meter does not zero, confirm that the power sensor is disconnected from RF power. Press the `TRY AGAIN` softkey.
- When the meter is zeroed, the program will display the same setup except that, now, the power meter sensor is reconnected to the pad/cable/splitter.
- Press `CONTINUE` to find the reference levels for each frequency data point. This will take approximately 10 minutes. The computer will display the results on the screen. *If the program says that the RF power is too low with the message* `Decrease Attenuation`, *then remove the 3 dB pad from RF SOURCE to SPLITTER cable.*

  When using an HP 436A power meter, the program will sometimes report that the power meter is `Out of Range`. If this occurs, press `Try Again`.
- After the last frequency point, the program will ask whether you want to save the data to disk. This is the only time that the calibration can be saved. You should save a calibration only if you intend to use it within 24 hours. Place a blank initialized disk in the drive and press `YES`. The program will automatically save the file after you tell it which drive to use.

Compression Test

- When the display shows the reference mixer a1 Compression setup, connect the hardware exactly as shown. Remember that the program performs the following tests using the results of the calibration (for accuracy enhancement). The calibration will be degraded by excess connections and disconnections. When possible, disconnect test set-ups at the junction between the mixer RF port and attenuator; do not disconnect the attenuators (from the cables) or switch the cables unless it is unavoidable.

Note

For the standard HP 85310A, only the a1 compression, a1 x b2 isolation, and b2 compression tests are performed.

- Press CONTINUE for the program to perform the a1 Compression test. The measured compression (dB) at each frequency point will be displayed on the computer display. When the test is finished, the results will be displayed similar to this:

A1 Compression

PARAMETER	LIMIT MIN.	LIMIT MAX.	UNITS	MEAS	PASS/FAIL
Compr. @−24 dBm @ 2-18 GHz	0	0.1	dB	.0356	Pass

Here, the PASS/FAIL column indicates that the HP 85310A has passed the reference mixer compression test.

- If the test passed, go to step 7. If the test failed, press one of the other softkeys. Press REMEAS to repeat the measurement. If it fails again, press RESTART to return to the setup display. Check all connections and addresses before restarting the a1 compression test. Alternatively, press RECALIB to erase the current calibration and perform another calibration.

Channel Isolation

- Press CONTINUE to begin the Channel Isolation tests by displaying the Compression/Channel Isolation test menu. The word PASS in the Pass/Fail column indicates that the a1 Compression test has passed.
- Press a1 x b2 and the a1 x b2 channel isolation setup will be displayed. Connect the hardware exactly as shown. You will use the two 50 ohm terminations (HP 909D) in this test. The test and reference mixers should be approximately .5 meters (2 feet) apart.
- Press CONTINUE to perform the a1 x b2 Channel Isolation measurement.
- When the a1 x b2 Channel Isolation test is complete, the results will be displayed on a menu similar to this:

A1 x B2 Isolation

PARAMETER	LIMIT MIN.	LIMIT MAX.	UNITS	MEAS	PASS/FAIL
Isolation @ 2-18 GHz	−150	−100	dB	−108.02	Pass
Averaging = 1024					

The measurement result displayed is the worst case measurement. The example shows a value of −108.02 dB. In this case the measurement passed.

If your instrument did not pass, press the appropriate softkey to remeasure, restart, or recalibrate. You can also increase the averaging factor and remeasure. Remember, averaging only recognizes factors of two. For example, if you entered an averaging factor of 100, the actual averaging factor would be reduced to the nearest factor of 2. In this case 64 would be used.

- Press `CONTINUE` to display the `a1` Compression/Channel Isolation menu and the status of the test. As indicated by the display, there are two optional tests you can perform: `a1 x b1` and `a1 x a2`. These additional tests are for those systems that have additional measurement channels. The steps are the same as used in the `a1 x b2` test.
- When the test set has passed all of the `a1` Compression/Channel Isolation tests, test the next port, `b2`. Press `PORT` until the Compression/Channel Isolation test menu shows that `Port is set to : b2`. Then press `b2 Compr` and complete that test in the same manner that you completed the `a1` Compression test.

Note Perform the following tests only if you have more than two channels in your system.

- When the test has passed the `b2` Compression test, select the Channel Isolation tests for `b2` by pressing the appropriate softkeys.
- Complete the `b2` Channel Isolation tests in the same manner that you completed the `a1` Channel Isolation tests. If necessary, refer to the steps above and substitute `b2` for `a1` as you proceed.
- Perform the Compression/Channel Isolation tests for both of the untested ports: `b1` and `a2`. The end result should be a “Pass” indication on each Compression/Channel Isolation menu (Ports: `a1`, `a2`, `b1`, `b2`). When all of the Compression/Channel Isolation tests have passed, press `MAINmenu` to access the main test menu.

Acquire Phase Lock

1. Select `Aquirelk` from the Main menu for the program to initialize the receiver and to set up the system to check the a1 phase lock level.
2. If the LO source is a synthesizer, this test is not required. The program will recognize this and automatically send you back to the main menu.
3. If the LO source is a HP 8350 the program will prompt you to set up the RF test signal.
4. Press `CONTINUE` to perform the test.
5. The results will be displayed on the computer screen.

Low-Level Noise Test Procedure

1. Select `Low-Lev` from the Main menu. The program will initialize the receiver.
2. Press `Normaliz` to see the first normalization setup. You will normalize for each port to be measured (normally ports a1 and b2) and then you will perform the tests. Make all the connections exactly as shown, then press `Continue`. You must disconnect the RF signal from the power meter/sensor to zero the meter. Reconnect the RF signal to make the measurement.
3. Follow the prompts to normalize and test the ports that are used in the HP 85310A system.

Printing Results

If you want a copy of the results and the system information (either a printed copy or a disk file), access the I/O menu and press `PRINT` or `FILE` as desired. Make sure that the printer is properly connected, turned on and loaded with paper. The disk drive must be correctly specified, with a data (not the program) disk inserted.

Repeat Procedure for Each Harmonic

The tests should be performed again for each mixer harmonic:

1. Press `Test_frq` in the `IO Menu`.
2. Change the mixer harmonic number and enter the correct start and stop frequencies.
3. Press `Done`, `MAINmenu`.
4. Perform each test again.
5. Print the results or save them to disk.

To exit the program, press `END_prog` in the I/O menu.

When Finished with All Tests

If the HP 85310A does not pass the performance verification tests refer to the service chapter.

Perform the following steps when you have completed the verification:

1. Make sure the system has been tested while in the fundamental and in each harmonic mode. The HP 85320 mixers only have one harmonic mode (third harmonic).
2. Configure the system for normal use.
3. Place the test mixer IF output to b2.

Save/Load Instructions

Calibrations and normalizations are not automatically saved by the various performance test procedures. They must be saved on a data disk immediately after they are performed. Follow the screen instructions when the program allows you to save calibration or normalization data.

However, as long as the computer stays ON or until another program is run, calibrations, normalizations, system information and test results will remain in the computer memory.

Use the following procedures to save and load both test results and the current system information.

How To Save Test Results

1. Insert an initialized blank disk in the drive.
2. While in the Main menu, press `IO Menu` `File` to begin the save process.
3. Enter the mass storage unit specifier (MSUS) of the data disk drive and press (RETURN). The computer will present the File menu.
4. Press the `Save` softkey, type in a name for the file and press the keyboard (RETURN) key. The computer will save the test results and system information onto disk. When saving files remember that HP 9000 computers are case-sensitive with regard to file names. When you recall saved files you must use the exact case for the file name. Keep this in mind when saving file names, use a system of naming files that you can easily remember.

How To Load Test Results to Continue Testing or Print-Out Data

Note

The file called for in the following procedure must have been saved in the procedure above.

1. Insert the data disk in the drive.
2. Access the Main menu and press `IO Menu` `File` to begin the load process.
3. Enter the mass storage unit specifier of the data disk drive and press (RETURN).
4. Press the `LOAD` softkey, type in a file name (using proper upper and lower-case characters) and press (RETURN). The program will load the test results and system information into the computer from the data disk.
5. Press `DONE` to return to the I/O menu.
6. To print out a copy of this data, press `PRINT`. Only the printer, disk and computer need be connected and turned on to make a print-out.

7. To continue testing an instrument, press MAINmenu to re-enter the test selection menu. Select one of the tests with a softkey. Connect the devices as shown in the configuration diagram and proceed with the test.

Other File Menu Functions

In addition to save and load capabilities, the File menu can catalog and purge files. The File menu is shown below.

```
HP 8510/85310A PERFORMANCE VERIFICATION
     Source: HP 83xx

Select the desired disk function:

CAT    :  CATALOG of files.
LOAD   :  LOAD from a data file.
SAVE   :  SAVE to a data file.
PURGE  :  PURGE a data file.
DONE   :  Return to I/O menu.
```

Optional Tests

Cable Test Procedure

The cables can be verified with the rest of the system if they are pulled out of their conduits and placed near the HP 85310A. In this case, do not perform a separate cable performance verification. The characteristics of the cables have already been measured.

If you can not pull the cables (you used a backup set of cables to perform the HP 85310A performance verification) then the normal set of cables are not verified with the rest of the system. In this case, run the cable verification tests. This test is documented in the cable manual, or in Chapter 8.

Mixer Port Return Loss Test Procedure

The return loss specification for each mixer's RF input is typical. Measuring mixer return loss is not required in the performance verification procedure.

A microwave network analyzer is required to measure return loss. A scalar or vector network analyzer can be used. The network analyzer must be able to cover the entire frequency range of the mixer module. Hewlett-Packard recommends a vector network analyzer with error correction, such as the HP 8510B, 8510C, or 85107A.

Note This test can only be performed on HP 8530A receivers that are equipped with option 011 (HP 8510C operation). In addition, the HP 8530 must be in the HP 8510 "mode".

The following procedure is for measuring the HP 85310A's RF input return loss.

1. The HP 85310A uses the same equipment setup as the performance verification except that the RF source, splitter, and attenuators are not required. However, the RF input ports of each mixer module must be accessible to the network analyzer.
2. Press the following keys on the analyzer:
   a. (SYSTEM) MORE EDIT MULT. SRC. DEFINE: SOURCE 2 MULTIPLIER DENOM. 1 (X1) DONE MULT. SRC: ON SAVE.
   b. STIMULUS (MENU) SINGLE POINT.
   c. (CENTER) 1 (G n).
3. Set the test network analyzer (START) and (STOP) frequencies to cover the entire range of the mixer under test.
4. Set the test network analyzer for an S_{11} measurement, with a scale of 5 dB per division, and a reference level of 0 dB.
5. Calibrate the network analyzer with a S11 ONE PORT (Open, Short, Load) calibration.
6. Connect the mixer module to the network analyzer test set's S_{11} port.

7. The S_{11} response of the mixer module on the network analyzer will normally meet, or exceed, the value shown in Chapter 5, "General Information."

Detailed Description of the Tests

The following description explain the tests using the HP 85320A/B as example mixers. The mixers are assumed to be in fundamental mode (harmonic = 1). If other harmonics are used, the signal levels and specifications change accordingly.

Compression

This test measures the error in a ratio measurement caused by compression of the mixer output at high input power levels. Each channel is tested over the test frequency range. Data is taken at 25 frequency points for two mixer input power levels.

For example, at the harmonic equal to 1, −29 dBm mixer input power is applied. The test mixer output is ratioed to the reference mixer output and the trace data is put into memory. Then the divide function is used to normalize the trace data to 1. In other words, it is divided by itself to provide a flat trace.

Next, the input level is increased to −24 dBm and the test port is again ratioed to the reference port. Now, the data that was taken at −24 dBm is compared to the data taken at −29 dBm. This comparison should result in no more than a 0.1 dB change for any of the 25 measured frequency points. The program will display the greatest amount (or worst case) of measured compression and it will also indicate pass or fail for each port tested.

Channel Isolation

This test measures the signal leakage from one channel to another channel. In this test a high power signal is input to one channel (mixer), and the other channel is terminated with a 50 ohm load. Either the a1 or a2 channel is used to phase lock the system.

First the reference mixer is measured in the fundamental mode with −24 dBm going into its RF input.

Then the test mixer is terminated with a 50 ohm load and measured while power is applied to the reference mixer.

The test mixer data is then compared to the reference data to determine relative levels. Each mixer is tested in combination with the other channel or channels. 101 data points are taken over the test frequency range. The program will display the results (worst case) for each combination of channels. It will also indicate pass or fail for each combination tested.

Acquire Phase Lock

This checks that the reference (a1) channel will acquire and maintain phase lock at the specified minimum power level.

The a2 channel is used as a phase lock reference during the calibration portion of the test. During this part of the test, the a1 channel is calibrated in absolute power at −29 dBm at 25 frequency points.

Then the RF test signal is reduced to (approximately) the specified minimum phase lock power of −55 dBm. The calibrated channel (a1) is then used to adjust the RF test signal to exactly −55 dBm (exactly how the program does this is explained later).

The RF signal is then reduced until the receiver loses phase lock.

The phase lock reference is switched from a2 to a1. The test signal is then increased to −55 dBm. After the receiver phase locks to test signal, the program waits two seconds to insure the receiver will remain locked. The program will then indicate a pass or fail at each of the 25 frequency points.

How the Program Sets RF Power to Precisely −55 dBm.

In an earlier test the source was calibrated to output exactly −29 dBm across the test frequency band. This is the starting point for accurately setting the source power to −55 dBm.

The receiver measures the −29 dBm power level at 25 frequency points. Any differences between the measured values and −29 dBm are noted by the program. These discrepancies are caused by cable losses and gain in the LO/IF unit.

When the program sets source power to −55 dBm, it measures the source again. The program mathematically removes the measurement discrepancies it noted earlier. Now it knows the exact power being produced by the source. If the source isn't producing exactly −55 dBm, the program adjusts it as necessary.

Low-Level Noise

Low-level noise is the RMS noise level of the trace data when the channel is terminated with a 50 ohm load. Each channel (mixer) is tested at three different frequencies to determine the RMS noise level. Source power is monitored at the power meter to reference the input power to an absolute value. RF power is input to the HP 85310A to phase lock the system. The test channel mixer power is measured by the receiver with a fixed 50 ohm load attached to the specific channel. The measured test data is then compared to the normalized level. The results (worst case) are displayed in dBm along with the minimum and maximum limits and the pass or fail indication.

Computers and BASIC

The software can be run on most HP series 300 computers with a BASIC operating system of 3.0, 4.0, or 5.0 and the BIN (binary) drivers and language extensions specified below. Follow the instructions below to load BASIC and the BIN files from floppy disks. Refer to your BASIC manual set for detailed instructions about your system. The BASIC operating system will load automatically if it is already on a hard disk.

Loading BASIC 3.0 OR 4.0 and BIN Files

With the computer OFF, insert the BASIC system disk into the default drive and turn the computer ON. When BASIC has finished loading, remove the disk.

Load the first driver by inserting the drivers disk and typing:

LOAD BIN "DISC" (RETURN).

When the binary file named DISC has finished loading, load the second driver by typing:

LOAD BIN "HPIB" (RETURN).

When HPIB has finished loading remove the drivers disk.

Insert the extensions disk. Load the needed extensions by pressing:

```
LOAD BIN "CLOCK" (RETURN)
LOAD BIN "GRAPH" (RETURN)
LOAD BIN "ERR" (RETURN)
LOAD BIN "IO" (RETURN)
LOAD BIN "KBD" (RETURN)
LOAD BIN "MAT" (RETURN)
LOAD BIN "MS" (RETURN)
```

If you have any of the following system configurations, you must load additional drivers, extensions, or both. See Table 4-3.

Table 4-3.
Special Configurations and their required drivers

Configuration	Driver	Extension
SRM	DCOMM	SRM
HP 9885 drive	HP9885	none
CS80 disk drives (such as HP 9122, 9133D, 9134D, 7908, 7911)	CS80	none

Loading BASIC 5.0 and BIN Files

With the computer OFF, insert the BASIC system `DISC ONE` into the default drive, turn on that disk drive, then turn the computer ON. When `DISC ONE` has finished loading, you will switch disks until the `AUTOST` program displays this message:

```
The BASIC system is now ready for use.
```

5

General Information

Description

The HP 85310A Distributed Frequency Converter is designed to operate with the HP 8510B/C or 8530A as the receiver. The converter provides a convenient means of measuring antenna performance in the frequency range of 2 to 26.5 GHz. The converter provides full performance even when the AUT and reference antenna are separated by up to 30 meters (100 feet).

The HP 85310A consists of a HP 85309A LO/IF unit, HP 85320A Test Mixer, and HP 85320B Reference Mixer. The cables that connect these instruments (HP 85381A/C/D or 85382A) must be ordered separately.

Options

HP 85310A Option 001 - One Additional Test Channel

Adds one additional test antenna measurement channel to the LO/IF unit. Changes the rear panel to include J11 TEST 2 LO/IF and J12 TEST 2 IF OUT. To obtain this item after receiving the HP 85310A, contact your nearest HP sales office.

HP 85310A Option 002 - Two Additional Test Channels

Adds two additional test antenna measurement channels to the LO/IF unit. Changes the rear panel to include J11 TEST 2 LO/IF, J12 TEST 2 IF OUT, J13 TEST 3 LO/IF, and J14 TEST 3 IF OUT. To obtain this item after receiving the HP 85310A, contact your nearest HP sales office.

Option 908 - Rack Mount Kit Without Handles

LO/IF unit rack mount kit *without handles*. To obtain this item after receiving the HP 85310A, order part number 5062-3977.

Option 913 - Rack Mount with Handles

LO/IF unit rack mount kit *with handles*. To obtain this item after receiving the HP 85310A, order part number 5062-3983.

Option 910 - Additional Manual

This provides an additional manual. To obtain this item after receiving the HP 85310A, order part number 85310-90001.

Option W30 - Extended Warranty (Return to HP)

Converts the standard warranty to three years of return-to-HP service. The warranty period begins at the time of product delivery. This warranty option does not include annual calibration.

Option W31 - Extended Warranty (On-site)

The warranty period begins at the time of product delivery. This warranty option does not include annual calibration.

Equipment Supplied

The following equipment is included in the HP 85310A system:

Table 5-1. HP 85310A System Equipment

Description	Part Number
HP 85309A LO/IF\Distribution Unit	HP 85309A
HP 85320A Test Mixer Module	HP 85320A
HP 85320B Reference Mixer Module	HP 85320B
AC Power Cord	See Figure 5-4
3.5 mm female to female adapters	85027-60005
Qty 2 Standard	
Qty 3 Option 001	
Qty 4 Option 002	
Type-N male to BNC female adapters	1250-1476
Qty 3 Standard	
Qty 4 Option 001	
Qty 5 Option 002	
Receiver IF adapter cable	08510-60025
Performance verification disk	85309-10001
(8) Cable labels	7124-1628
BNC short circuit	1250-0929
Operating and service manual	85310-90001
Torque Wrench	8710-1935

Available Accessories

Connector Savers

A "connector saver" is an adapter or short cable that saves wear-and-tear on the mixer input connectors. Hewlett-Packard recommends that you use connector savers on the RF inputs of the mixers. This is especially important on the input of the test mixer, because the test antenna is often changed. Use an appropriate connector saver from the following list:

Type	HP Part Number
3.5 mm male to 3.5 mm female	85027-60006
3.5 mm female to 3.5 mm female	85027-60005 (supplied with HP 85320A/B)
Type-N male to 3.5 mm female	1250-1744

Type-N female to 3.5 mm female 1250-1745

If you need a short cable, order a 0.5 meter cable such as the HP 85381C with 3.5 mm connector on one end. Choose a connector for the other end that will mate with the antennas you test.

A cable has an additional benefit: It allows you to mount the mixer a short distance away from the test antenna. This provides more flexibility when mounting the modules.

Touch Up Paint

Touch up paint is shipped in spray cans. Spray a cotton swab with paint and apply it to the damaged area.

Table 5-2. Touch Up Paint

Color	Where the Color is Used	Part Number
Dove Gray	Front panel frames, portions of front handles, mixer modules	6010-1146
French Gray	Side, top, and bottom covers	6010-1147
Parchment Gray	Rack mount flanges, front panels	6010-1148

Operating and Safety Precautions

Operating

Do not exceed the operating level inputs noted on the mixer labels.

Caution

ESD (electrostatic discharge) can damage the highly sensitive microcircuits in the converter and mixers. Such damage is most likely to occur as they are connected or disconnected. To avoid ESD damage, wear a grounding strap or ground yourself by touching any grounded instrument chassis before touching the connectors. Do not touch the center contacts of the connectors.

Service

Service should be performed by qualified personnel only. See Chapter 7 for detailed service information.

Recommended Test Equipment

For information on recommended test equipment for performance verification and troubleshooting, see Chapter 4 and Chapter 7, respectively. For a detailed list of equipment required for performance verification, see Table 4-1.

Instrument Charateristics

HP 85310A System Specifications

Definitions

The specifications in Table 5-3 include warranted specifications and typical performance characteristics. Typical performance characteristics are not warranted. The HP 85310A is only warranted to meet specifications under the following conditions:

- The HP 85310A components must be connected within the limits described in Table 5-11, Table 5-12, or Table 5-13.
- The HP 85310A must be installed as shown in Chapter 2.
- All system instruments must be at a stable operating temperature.
- All the instruments used with the HP 85310A must be compatible, as shown in "Compatible Instruments", later in this chapter.
- All cable connections have been torqued as specified in Chapter 8.

Table 5-3. HP 85310A (Combined HP85309A/85320A/85320B/8530) Specifications

Specifications. These performance parameters are field verifiable using the supplied software and performance verification tests documented, except as noted.			
FUNDAMENTAL MIXING Frequency Range->	1 to 2 GHz[1]	2 to 3 GHz	3 to 18 GHz
Sensitivity[2,3]	−80 dBm[1]	−107 dBm	−113 dBm
Compression Level[4]	−24 dBm[1]	−24 dBm	−24 dBm
Dynamic Range[5]	70 dB[1]	83 dB	89 dB
Crosstalk[6,7]	−100 dB[1]	−100 dB	−100 dB
Minimum Phase Lock Power[8]	−35 dBm[1]	−55 dBm	−55 dBm
RF Input Match	6 dB[1]	8 dB[1]	8 dB[1]
Conversion Gain[9] (±2 dB)	4.5 dB[10]	10.5 dB[10]	9.5 dB[10]
THIRD HARMONIC MIXING Frequency Range->		6 to 26.5 GHz	
Sensitivity[2,3]		−96 dBm	
Compression Level[4]		−15 dBm	
Dynamic Range[5]		81 (89[1]) dB	
Crosstalk[6,7]		−100 dB	
Minimum Phase Lock Power[8]		−40 dBm	
RF Input Match		8 dB[1]	
Conversion Gain[9] ±2 dB		−2 dB[10]	

1 **Typical**, not guaranteed (see glossary).

2 Sensitivity is defined as when the signal is equal to the noise floor (with IF bandwidth = 10 kHz and 0 averages). Averaging will improve sensitivity by 10 $\log_{10}(N)$.

3 If the HP 85309A to HP 8530A IF cable exceeds 25 meters, sensitivity is reduced by 0.1 dB/meter above 25 meters.

4 RF level for 0.1 dB compression.

5 Dynamic range is measured from Compression Level to the RMS Noise Floor.

6 Crosstalk is the coherent RF leakage from the reference channel to the test channel with 1024 averages.

7 If a test set/converter with option 001 is used with this downconverter, crosstalk is reduced to 85 dB.

8 Refers to systems that use an HP 8350 LO source. Minimum phase lock power is the minimum RF power into the reference mixer to achieve phase lock. This does not apply to systems with a synthesized LO.

9 RF to IF conversion gain through the LO/IF Unit and Mixer.

10 **Operating Characteristic** (see glossary).

Other Information

Connector Type

HP 85309A: Type-N female
HP 85320A/B: Type-N male except for RF Input (3.5 mm male)

Environmental Characteristics of HP 85310A:

Operating conditions: 0°C to +55°C
Non-operating conditions: -40°C to +75°C; 5 to 90% relative humidity, non-condensing

Radio Frequency Interference: Any radiated fields at 20 MHz ±10 kHz must be ≤ 1 volt/meter.

Power Consumption information

47.5 to 66 Hz; 100, 120, 220, 240 Vac (±10%); 125 VA maximum (for HP 85309A only)

Table 5-4. Size and Weight Information

Product	Net Weight	Shipping Weight	Size
HP 85310A: HP 85309A with HP 85320A and B	17 kg (37 lb)	30 kg (66 lb)	N/A
HP 85309A only	15.5 kg (34 lb)	N/A	460 mm (18.1 in) W x 133 mm (5.25 in) H x 533 mm (21 in) D
HP 85320A only	615 g (1.35 lb)	N/A	83 mm (3.25 in) W x 122 mm (4.8 in) H x 33 mm (1.3 in) D
HP 85320B only	840 g (1.85 lb)	N/A	92 mm (3.6 in) W x 185 mm (7.3 in) H x 25 mm (1.0 in) D

Note

Do Not apply DC voltage to any HP 85309A LO Input or Output Connectors.

J7 and J8 allow you to use a test mixer that is not equipped with a diplexer.

Cables

The recommended RF, IF, and LO system cables are the HP 85831 A/C/D and HP 85382A microwave cables . They are described in Chapter 8.

HP 85309A LO/IF Distribution Unit Operational Charateristics

The Typical performance values shown apply to the LO/IF Distribution Unit itself. This performance data is intended to help customers who wish to build their own custom downconverters. For more details refer to “LO Signal Path” in Chapter 7, “IF Amplifiers A14, A15, A26, and A29” in Chapter 7, and “LO Amplifiers A17, A12, A13, A24, and A27” in Chapter 7in if necessary.

Table 5-5. Typical Channel Performance

	300 MHz	1 GHz	6 GHz	9 GHz	15 GHz	20 GHz
Tracking[1]	±2 dB	±2 dB	±2 dB	±2 dB	±2 dB	±2 dB
Minimum Channel Gain[2]	+10dB	+20 dB	+22 dB	+22 dB	+19 dB	+19 dB
Min Output Power[2]	+16 dBm	+20 dBm	+22 dBm	+22 dBm	+19 dBm	+19 dBm
Input Return Loss	9 dB	9 dB	9 dB	9 dB	9 dB	9 dB
Output Return Loss	7 dB	7 dB	7 dB	7 dB	7 dB	7 dB

1 At 300 MHz, this specification is measured with a −10 dBm input level. Above 300 MHz, it is measured with a −20 dBm input level.

2 At 300 MHz, this specification is measured with a 6 dBm input level. Above 300 MHz, it is measured with a 0 dBm input level.

Table 5-6. IF Amplifier Gain

Frequency Range	Minimum Gain	Maximum Gain	Conditions
20 MHz	21 dB	25 dB	−35 dB Input

Table 5-7. IF Amplifier Return Loss at 20 MHz

Connector	Minimum Return Loss	Equivalent SWR
J1 IF Input	12 dB	1.7:1
J2 IF Output	10 dB	1.9:1

HP 85320A/B Mixer Module Operational Characteristics

Frequency Range

Fundamental Mode: 2 to 18 GHz

Third Harmonic Mode: 6 to 26.5 GHz

Maximum Input Levels

Do not exceed the following levels at either mixer input:

Maximum DC voltage at input: 10V
Maximum RF Level at RF or LO inputs: +26 dBm

Minimum LO Input Level

Table 5-8. Mixer LO Signal Power Level

LO Frequency	Minimum Power	Typical Power	Maximum Power
1 to 18 GHz	+7.5 dBm	+11 dBm	+16 dBm

Conversion Loss

The typical performance values shown apply to the mixer modules themselves. This performance data is intended to help customers who wish to build their own custom downconverters.

Table 5-9. Typical HP 85320A/B Conversion Loss

Frequency Range	LO Harmonic	Typical Loss	Maximum Loss
1 to 2 GHz	1	18.0 dB	22 dB
2 to 3 GHz	1	12.0 dB	16 dB
3 to 5 GHz	1	11.0 dB	15 dB
5 to 18 GHz	1	14.7 dB	17 dB
6 to 8 GHz	3	23.8 dB	26 dB
8 to 16 GHz	3	26.5 dB	28 dB
16 to 26.5 GHz	3	28.5 dB	33 dB

Table 5-10. HP 85320A/B Return Loss

	1 to 2 Ghz	2 to 3 GHz	3 to 18 GHz	18 to 26.5 GHz
RF Output	6 dB	8 dB	8 dB	8 dB
LO /IF Input	8 dB	8 dB	8 dB	8 dB

Connector Types

HP 85320A/B: type-N female except for RF Input (3.5 mm male)

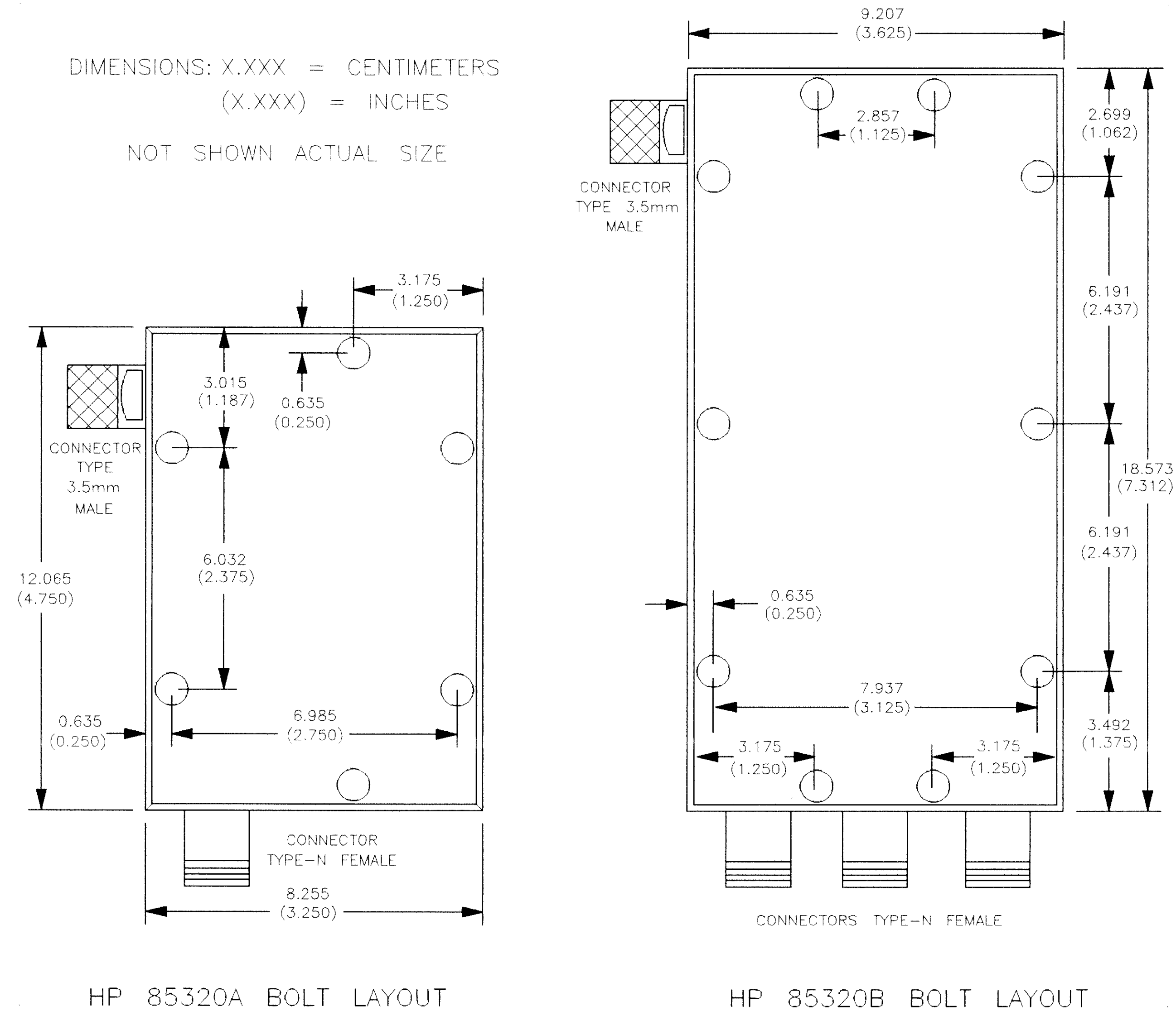


Figure 5-1. HP 85320 Mounting Bolt Layout

HP 85381 A/C Cable Length Limits

**Table 5-11.
System Cable Limits with Fundamental Mixing to 8.4 GHz**

	Minimum	Maximum
LO Source to LO/IF Unit	0	27 m (90 ft)[1]
LO/IF Unit to Mixers	3 m (10 ft)	15 m (50 ft)
Combined[2]	3 m (10 ft)	30 m (100 ft)[1]

1 If using the HP 83621A or 83631A LO source reduce the maximum distance by 3.5 m (12 ft).

2 The lengths of the LO SOURCE-TO-LO/IF UNIT cable *and* LO/IF UNIT-TO-MIXER cable, when added together, cannot exceed this maximum.

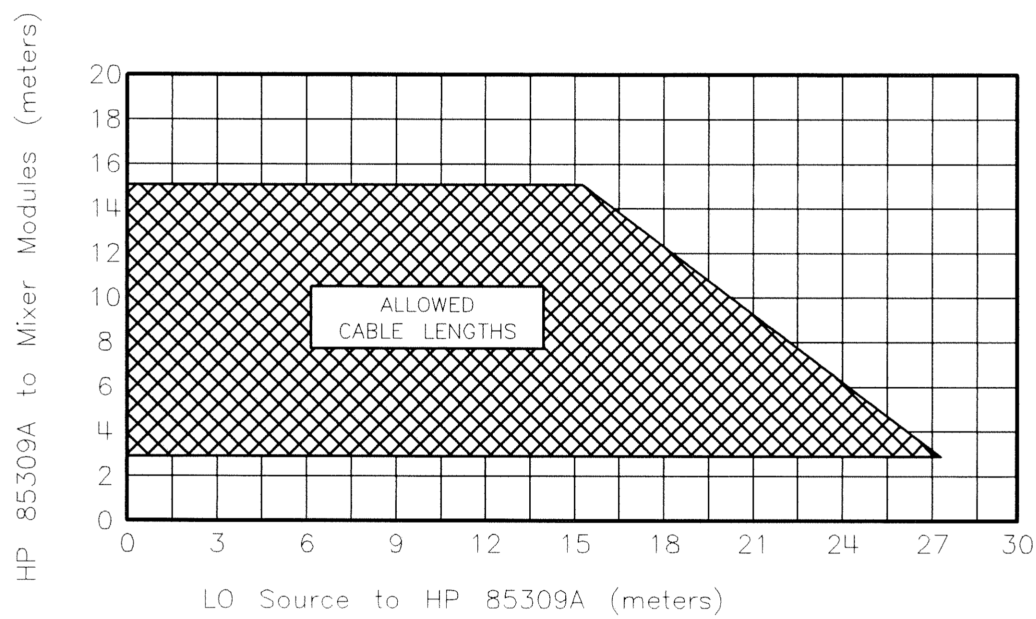


Table 5-12.
System Cable Limits with Fundamental Mixing to 12.4 GHz

	Minimum	Maximum
LO Source to LO/IF Unit	0	18 m (59 ft)[1]
LO/IF Unit to Mixers	3 m (10 ft)	9 m (29.5 ft)
Combined[2]	3 m (10 ft)	21 m (69 ft)[1]

1 If using the HP 83621A or 83631A LO source reduce the maximum distance by 2.8 m (9 ft).

2 The lengths of the LO SOURCE-TO-LO/IF UNIT cable *and* LO/IF UNIT-TO-MIXER cable, when added together, cannot exceed this maximum.

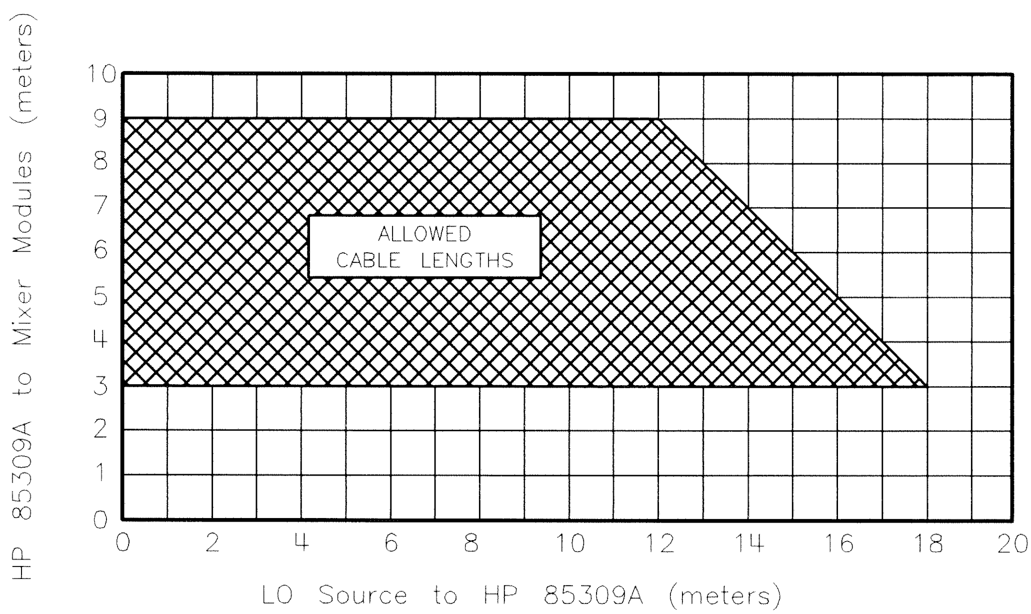
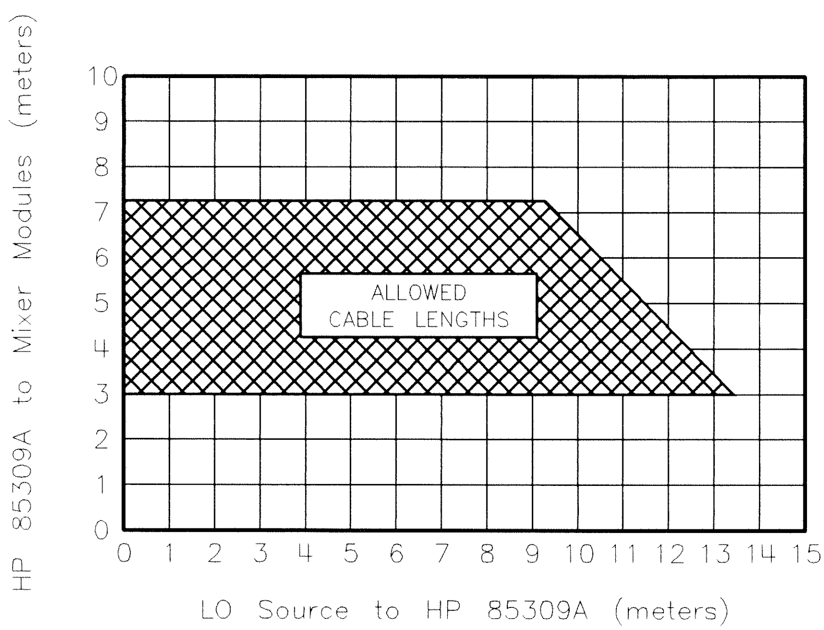


Table 5-13.
System Cable Limits with Fundamental Mixing to 18 GHz

	Minimum	Maximum
LO Source to LO/IF Unit	0	13.4 m (44 ft)[1]
LO/IF Unit to Mixers	3 m (10 ft)	7.3 m (24 ft)
Combined[2]	3 m (10 ft)	16.5 m (54 ft)[1]

1 If using the HP 83621A or 83631A LO source reduce the maximum distance by 2 m (7 ft).

2 The lengths of the LO SOURCE-TO-LO/IF UNIT cable *and* LO/IF UNIT-TO-MIXER cable, when added together, cannot exceed this maximum.



Maximum Phase Lock Loop Length

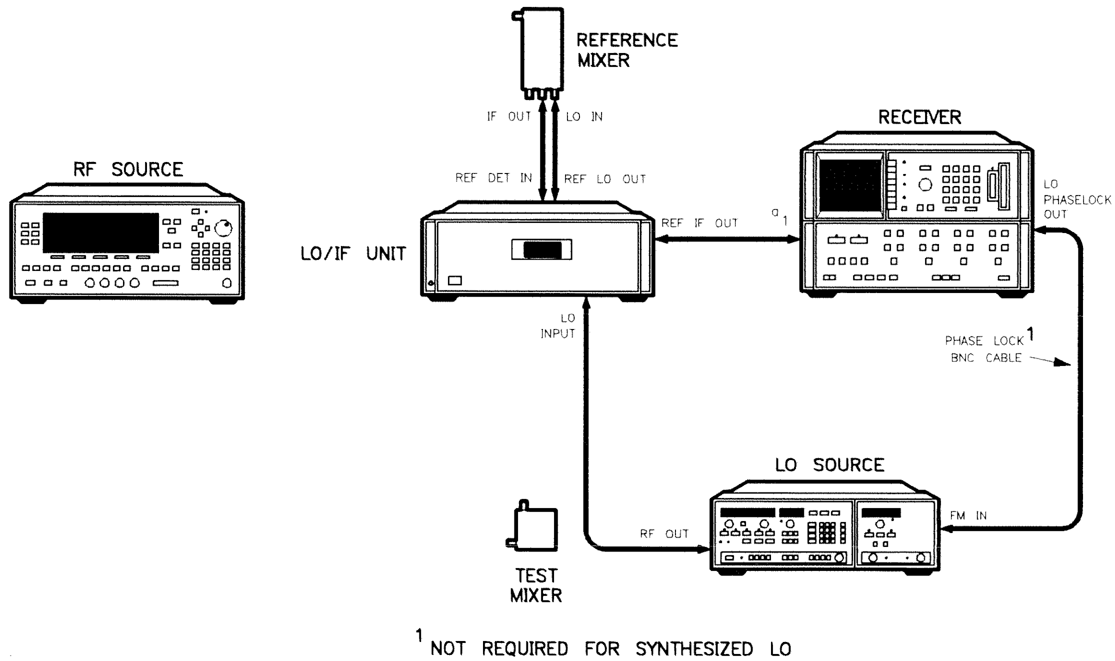


Figure 5-2. Phase Lock Loop Path

An HP 8350 LO source must be phase-locked to the receiver. This is done by connecting the receiver LO PHASELOCK OUT to the HP 8350 FM INPUT. When using the HP 8350, The maximum PLL length is 91 meters (300 feet). Refer to Figure 5-2.

The PLL starts at the HP 8350 *RF Out* and goes through the LO/IF unit, reference mixer, LO/IF unit (again), out the receiver's *LO PHASELOCK OUT*, and finally back to the HP 8350. Figure 5-2 shows the entire phase lock loop.

Long Phase Lock Paths

If the total phase lock path is greater than 16 meters (50 feet) then refer to the following considerations:

Phase Lock Path	Considerations
>16 m (50 feet)	If your HP 8510B serial number is less than 2844A05265 then it must be equipped with option H15.
>91 m (300 feet)	To install the LO/IF unit more than 91 meters from the receiver, use a synthesizer as the LO source. A synthesizer does not require a phase lock signal.

Maximum 10 MHz Reference Oscillator Length

The standard antenna measurement system uses two synthesizers; one for the RF transmitter source, and one for the LO source for the receiver. The 10 MHz reference oscillator timebases on these synthesizers should be connected together for best measurement accuracy. Refer to Figure 5-3.

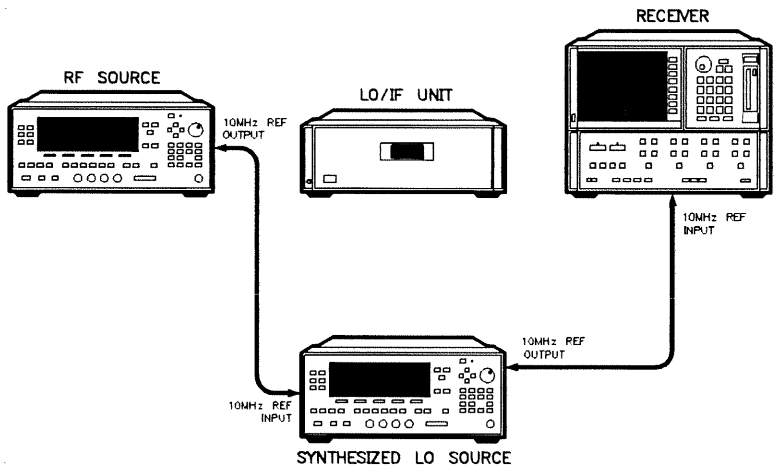


Figure 5-3. Timebase Connections

The allowable maximum total RF lose at 10 MHz between the RF source, LO source, and the receiver is 10.5 dB. If you use an HP 85382A cable to connect the timebases together, the maximum total length is 200 meters.

If the timebases can not be connected together, then the timebase of LO source must be adjusted to the same timebase frequency of the RF source on a regular interval. See chapter 4, "Synthesized LO Source Timebase Check and Adjustment", for the adjustment procedures and adjustment interval information.

Compatible Instruments

The following instruments are compatible with the HP 85310A.

Compatible Receivers

Receiver	Firmware	Option
HP 8530A	All Revisions	All
HP 8510C	C.06.04 or greater	All
HP 8510B	B.05.00 or greater	H15[1]

1 Only required if using an HP 8510B with a serial number less than 2844A05265, and total phase lock loop length is greater than 30 meters (100 feet).

Compatible LO Sources

The LO source firmware revision must be compatible with the receiver.

HP 8350 Plug-Ins

HP 83525A	HP 83592A	HP 83540A
HP 83592B	HP 83590A	

HP 8360 Family Sources

Table 5-14. Required Options for HP 8360 LO Sources

Model	Recommended Options	Special Option Requirements
HP 83620A	008	HP 83620A's with a serial prefix less than 3103A require option H87. If cable length between the LO source and HP 85309A is greater than 7 meters, contact your local HP representative.
HP 83621A	None	HP 83621A's with a serial prefix less than 3103A require option H87.
HP 83622A	008	HP 83622A's with a serial prefix less than 3103A require option H87. If cable length between the LO source and HP 85309A is greater than 7 meters, contact your local HP representative.
HP 83623A	008	HP 83623A's with a serial prefix less than 3103A require option H87.
HP 83624A	008	HP 83624A's with a serial prefix less than 3103A require option H87.
HP 83630A	008	
HP 83631A	None	HP 83631A's with a serial prefix less than 3103A require option H87.
HP 83640A	008	None
HP 83642A	008	None
HP 83650A	008	None
HP 83651A	None	None

Fast Measurement Speed and Quick Step Mode

Older sources such as HP 8340/41 or early HP 8360 had slower frequency switching speeds than newer HP 8360 sources. Typically, these slower sources limited the receiver to Frequency Domain measurement speeds of 35 to 70 ms per frequency point. "fast measurement speed" refers to receiver operation with a newer, faster, HP 8360 source.

Quick step mode is a different way of making faster measurements, it increases the speed of Step Sweep measurements by up to six times. Refer to "Phaselock Controls" in Chapter 17 of the *HP 8530A Operating and Programming Manual* for more information.

The following table shows the hardware and firmware requirements for fast measurement speed and Quick Step mode. Any source with firmware *not* listed on this table will have Frequency Domain measurement speeds similar to an HP 8340-family source, and it will not be compatible with the Quick Step mode. Both RF and LO sources must be equipped as shown below to attain fast measurement speed. Some older sources cannot be upgraded.

Table 5-15.
Sources Compatible with Fast Measurement Speeds and Quick Step Mode

HP Model	Hardware Serial Prefix	Firmware Revision[1]	Upgrade Kit
83630A, 83650A or 83651A	All	≥March 8, 1991[2]	Compatible-None required
83621A or 83631A	< 3103A	≥March 8, 1991[2]	Requires HP 83601A hardware kit[3]
	3103A	≥March 8, 1991[2]	Requires 08360-60167 firmware kit
	3104A to 3111A	≥March 8, 1991[2]	Requires 08360-60201 firmware kit
	≥3112A	≥March 8, 1991[2]	Compatible-None required
83620A, 83622A, 83623A, 83624A, or 83640A	<3145A	≥Nov 14, 1991[2]	Not Compatible[4]
	≥3145A	≥Nov 14, 1991[2]	Compatible-None required
83642A	Not Compatible		Not Compatible[4]

1 For millimeter wave band "W" compatibility, Firmware revision date must be ≥October 23, 1992

2 If the firmware revision is dated earlier than March 8, 1991, it is *not* compatible, even if the hardware *is* compatible.

3 Includes installation.

4 Cannot be upgraded.

Compatible RF Sources

- Any HP 8340/41 synthesized source (see note below).
- Any HP 8360 (836xx) family synthesized source.

Note

Although any HP 8340 or 8341 will function with this receiver, units with firmware dated 11 May 1988 (and later) allow you to make faster Step Sweep measurements than earlier units. The firmware date is displayed whenever you turn the HP 8340/41 ON. To utilize the faster measurement capability, you must either:

Connect the HP 8340/41 STOP SWEEP BNC to the receiver's STOP SWEEP BNC.

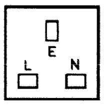
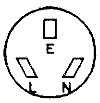
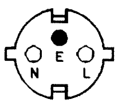
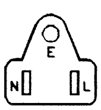
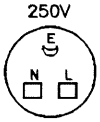
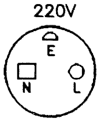
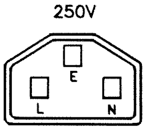
or

Place a BNC short on the HP 8340/41 STOP SWEEP connector.

If you do not have this firmware revision, and wish to upgrade, you can order the HP 11875A upgrade kit. Contact your local sales office for details.

Refer to "Fast Measurement Speed and Quick Step Mode" for information on fast measurement speed and quick step mode.

AC Power Cords

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 for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.

Figure 5-4. Main Plugs and AC Power Cords

6

In Case of Difficulty

Introduction

This chapter explains:

- How to solve common operation problems.
- What to do when a common error messages are displayed on the receiver.
- How to solve basic hardware problems.
- How to do checks on two different models, the HP 8510 and the HP 8530A.

Common Operation Problems

IF Signal Level Problems

To check the receiver's IF signal levels, press the following keys:

1. If using an *HP 8510*, press:
   PARAMETER (MENU)
   a. `USER1 a1` to check the Reference channel IF signal level.
   b. `USER2 b2` to check the Test channel IF signal level.

   If your HP 85310A has more than one test channel, the following channels can be checked:

   c. `USER3 a2` to check the `a2` Test channel IF signal level.
   d. `USER4 b1` to check the `b1` Test channel IF signal level.
2. If using an *HP 8530A*, press:
   PARAMETER (MENU)
   a. `SERVICE PARAMETERS` `SERVICE1 a1` to check the Reference channel IF signal level.
   b. `SERVICE PARAMETERS` `SERVICE2 b2` to check the Test channel IF signal level.
   c. `SERVICE PARAMETERS` `SERVICE3 a2` to check the `a2` Test channel IF signal level.
   d. `SERVICE PARAMETERS` `SERVICE4 b1` to check the `b1` Test channel IF signal level.

a1 Reference Channel Level

If the LO source is a HP 8350B sweeper source the reference channel level must be between −45 and −10 dBm. The signal level must remain at, or above the −45 dBm level to maintain phase lock.

If the LO source is a synthesized source there is no minimum reference channel level. This is because there is no phase lock loop. The maximum signal level is −10 dBm. It is recommended, but not required, that the reference channel signal level be greater than −45 dBm. This will keep the reference channel signal above the noise floor, improving measurement accuracy.

To calculate the reference channel IF signal level use the calculations in "Configuring the System for Optimum Dynamic Range" in Chapter 3. Suspect a problem if the actual measured value is not within ±6 dB of the calculated value.

b2, b1, a2 Test Channel Level

To calculate the test channel IF signal level use the calculations in "Configuring the System for Optimum Dynamic Range" in Chapter 3. Suspect a problem if the actual measured value is not within ±6 dB of the calculated value.

Possible Solutions

No IF Signal.

- Make sure the receiver system is installed correctly, or has not been modified. Chapter 2 shows how the system should be installed.
- Check that the timebases of a system using a synthesized LO source are connected together. If the timebases can not be connected, check the timebase frequency of the LO source with respect to RF source. See chapter 4, "Synthesized LO Source Timebase Check and Adjustment".
- Check to make sure that the IF signal cables from the LO/IF unit's IF OUT to the receiver's J1 TEST SET INTERCONNECT are connected to the correct channels.

Incorrect IF Signal Level.

- Double-check the calculation in "Configuring the System for Optimum Dynamic Range" in Chapter 3. Check the receiver system with a standard gain antenna to double-check the calculations.
- Check the detector voltage on the front panel of the LO/IF unit. The voltage should be approximately the value on the reference mixer module label, or in Table 2-5.
- Check the output power level of the transmitter source (and optional amplifier) for the correct level, especially at high frequencies.
- Make sure the receiver system is installed correctly, or has not been modified. Chapter 2 shows how the system should be installed.
- Check the timebase frequency of the LO source with respect to RF source. See chapter 4, "Synthesized LO Source Timebase Check and Adjustment".

LO Signal Level Problems

LO Signal Is Too Low

If the LO signal level is too low, check the following items:

- Adjust the LO signal level as shown in "Set the LO Power" in Chapter 2.
- Check the LO signal cables for damage, or high RF insertion loss.
- Check the rotary joint for high RF insertion loss.

UNLEVELED Display is ON During Measurement

The HP 85310A system is designed to operate correctly even with the LO source's unleveled display flashing. Perform a Operational Check in Chapter 3 to check the LO signal level.

Rotary Joints

Due to the fact that rotary joints must operate at microwave frequencies, and they must physically rotate around a center axis, they are a common source of problems. All of the problems cause measurement error and should be corrected immediately. Some common problems are:

- *Wow* is where the test signal level varies as the antenna positioner rotates. This causes measurement error at certain antenna positions.
- *High insertion loss* can reduce the LO signal level to the mixer's modules. This can increase the mixer's conversion loss, making the measurement system unusable. When the rotary joint is worn out, it will often have this problem.
- *Drop outs* are caused by the rotary joint having a high insertion loss at certain frequencies. This can cause measurement error only at certain frequencies.
- *Intermittent* rotary joints can cause the test signal to fade randomly. This can cause random measurement errors.
- *Noise on the signal* is caused by a intermittent rotary joint a with very fast intermittent fading. This can look like noise on the test signal.

Most of the above problems can be solved by cleaning the rotary joint. If the rotary joint can not be cleaned, or if cleaning does not solve the problem, replace the rotary joint.

Common Error Messages

See the HP 85360 software manual for program error message descriptions.

The following is a list of receiver error messages. This is not a comprehensive list, but represents commonly-seen messages, or messages that require explanation. If the error message continues to occur then use Chapter 2 to check for proper installation and setup.

N `NO IF FOUND`

The usual cause is inadequate power at the a1 input of the receiver. Verify that the appropriate power levels are available, especially at the a1 phase lock input by pressing:

On *HP 8510*:
PARAMETER (MENU) USER1 a1

On *HP 8530A*:
PARAMETER (MENU) SERVICE PARAMETERS SERVICE1 a1

The signal level should be between −45 and −10 dBm if using an HP 8350B as an LO source.

Another cause of this error message is out-of-band IF frequency. If the system is using a synthesized LO source and the timebases of the LO source, RF source, and receiver are not connected together, it is possible that the generated IF frequency is outside the bandwidth detection of the receiver.

- Make sure the receiver system is installed correctly, or has not been modified. Chapter 2 shows how the system should be installed.
- Check that the timebases of a system using a synthesized LO source are connected together. If the timebases cannot be connected, check the timebase frequency of the LO source with respect to RF source. See chapter 4, "Synthesized LO Source Timebase Check and Adjustment".

Still another possible cause of this error message is that the receiver is in SWEEP mode. With the HP 85310A the receiver should be in the STEP mode.

P `PHASE-LOCK LOST`

This error message occurs when the receiver is not receiving a signal at the a1 input while a measurement is in process. The usual cause is inadequate power at the a1 input of the receiver. Verify that the appropriate power levels are available, especially at the a1 phase lock input.

S SWEEP SYNC ERROR

This error may occur if the receiver is in the SWEEP mode. Change the receiver to the STEP mode by pressing STIMULUS (MENU) STEP .

If using an HP 8530A, make sure the receiver is in Frequency Domain mode. Otherwise the STEP choice will not appear in the STIMULUS menu.

The error may also occur if the STOP SWEEP on the RF and the LO source is not connected to the receiver. If the RF and LO source's STOP SWEEP cannot be connected to the receiver, connect a BNC short circuit or a 50 ohm load to these two sources.

SYSTEM BUS ADDRESS ERROR

The receiver cannot communicate with the RF or LO source.

1. Make sure the RF and LO HP-IB cables are connected to the receiver System Bus.
2. Make sure the RF and LO sources are set to the correct HP-IB addresses. (Make sure the SOURCE 1 (RF) and SOURCE 2 (LO) addresses shown in the receiver's HP-IB menu match the actual addresses of the RF and LO sources.)
3. IF you are using HP-IB extenders between the receiver and source:
   a. Disconnect the extender from the receiver.
   b. Turn the receiver OFF, then ON.
   c. Reconnect the extender.
4. Check multiple source settings on the receiver. See "Configure the Receiver" in Chapter 2 for more information.
5. IF these steps do not remedy the problem suspect a bad HP-IB cable.

U UNABLE TO RAMP THIS DUAL SOURCE SETUP

The caution message will occur if you attempt to put the receiver in RAMP mode with two synthesized sources. The receiver should be in STEP mode.

V VTO FAILURE

This message will occur when you perform a measurement with a non-synthesized LO source such as a HP 8350B. Check the following:

- Make sure the cable is connected between the receiver's LO PHASELOCK OUT and the LO source's FM INPUT.
- Make sure the receiver is set for external phase lock by pressing: (SYSTEM) MORE PHASELOCK EXTERNAL

Hardware Problems

This section is not intended to be a comprehensive hardware troubleshooting guide. Instead this section discusses common potential problems and how to fix them. Refer to Chapter 7 for detailed information on troubleshooting and repair of the measurement system.

The Receiver Locks Up

"Lock up" is a condition where the receiver refuses to operate and will not respond to front panel keystrokes, including (LOCAL).

When you turn on external phase lock mode, the receiver expects to find an HP 8350 connected as the LO source. The receiver can lock up under the following circumstances:

- An HP 8350 is not connected to the System Bus.
- An HP 8350 is connected, but is turned off.
- An HP 8350 is connected, but its HP-IB address does not match the "Source 2" address set in the receiver Local menu.
- A synthesizer (such as an HP 8340/41 or 836xx-series) is connected to the bus instead of an HP 8350.

If any of the above problems existed, correct it and press (USER PRESET) or the TEST button on the receiver. It should now operate properly.

An Instrument Will Not Respond

This section applies to instruments that will not respond to remote control.

1. Make sure each instrument is plugged in and switched on. If an instrument's display is dark, check its line fuse.
2. Press (LOCAL) on the receiver and try to control the instrument from the receiver front panel. If the receiver can control the instrument, suspect an improper HP-IB connection between the receiver and the computer. (If the connection looks proper, try replacing the HP-IB cable.)
3. If the receiver cannot control the instrument, set the instrument to local mode and try to operate it manually.

If the Instrument Operates Manually

1. Check the HP-IB cable to see if it is connected to the proper bus.
2. Make sure the instrument's HP-IB addresses matches the addresses shown in the program's Configuration menu.
3. If the problem is with either source or the test set, make sure the HP-IB addresses for these instruments match the addresses shown in the receiver's Local menu.

Note With a HP 85310A frequency converter the receiver test set address should always be set to 31.

If the Instrument Does Not Operate Manually

Suspect a failure within the instrument itself.

HP 85309A (LO/IF Unit) Problems

LO/IF Unit Does Not Turn ON

If the DETECTOR VOLTAGE display on the front panel does not light up when the unit is turned on, check the following:

1. Make sure the instrument is plugged into an operating AC power outlet.
2. Check the instrument's voltage setting. Is it set to your AC power voltage?
3. Check the HP 85309A's fuse.
4. Refer to Chapter 7 to check the power supply.

The LO POWER OUT OF RANGE Light is ON

This can be caused by the following:

- The LO source is not set to output a sufficient amount of power, increase power output (if possible) to +13 dBm. Make sure your LO source can put out sufficient power at the maximum LO frequency.
- The LO POWER ADJUST is not set properly on the HP 85309A LO/IF unit, refer to Chapter 2 for instructions.
- The LO source's RF OUTPUT is not connected to the HP 85309A, or if the LO source is turned off. This can also happen if the LO source is on, but its RF output is turned off.
- The LO source is not able to supply the requested amount of power in the measurement frequency range. Make sure your LO source is specified to produce +13 dBm in the desired frequency range. If the LO cannot produce enough power at high frequencies, the LO POWER OUT OF RANGE light will come on during the high-frequency portion of the measurement. During this time LO power will not be correct.
- The reference mixer is not connected to the REFERENCE LO OUTPUT of the HP 85309 (in other words, if the reference mixer is not getting sufficient LO power).
- The reference mixer's Detector Voltage output is not connected to the HP 85309A.
- When there is a failure of the HP 85309A's ALC circuitry. An ALC failure will usually cause the light to come on permanently, even though all equipment is connected properly.

7

Service

This chapter covers six main areas:

- Theory of Operation (how the system and the distributed frequency converter work).
- Recommended Test Equipment (what equipment is required for servicing this instrument).
- Receiver Troubleshooting (how to determine which part of the antenna system, or which part of the distributed frequency converter, is faulty).
- Performance Verification Troubleshooting (how to determine which part of the antenna system may be causing the receiver to be out of specifications).
- Replaceable Parts (how to identify and order parts).
- Adjustments (how to adjust parts following troubleshooting or replacement).

System Theory of Operation

An antenna measurement system using an HP 85310A frequency converter as a receiver consists of two sections:

- Transmitter System
- Receiver System

Figure 7-1 shows the block diagram of the antenna measurement system.

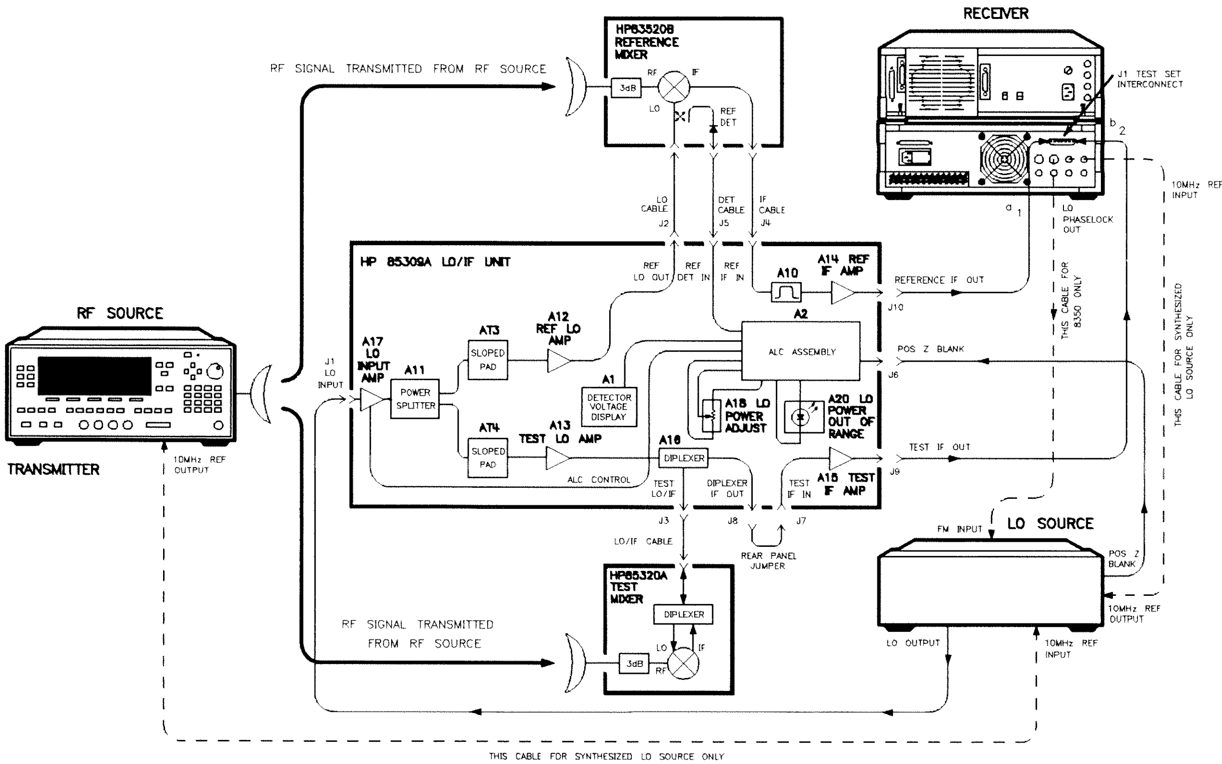


Figure 7-1. System Diagram

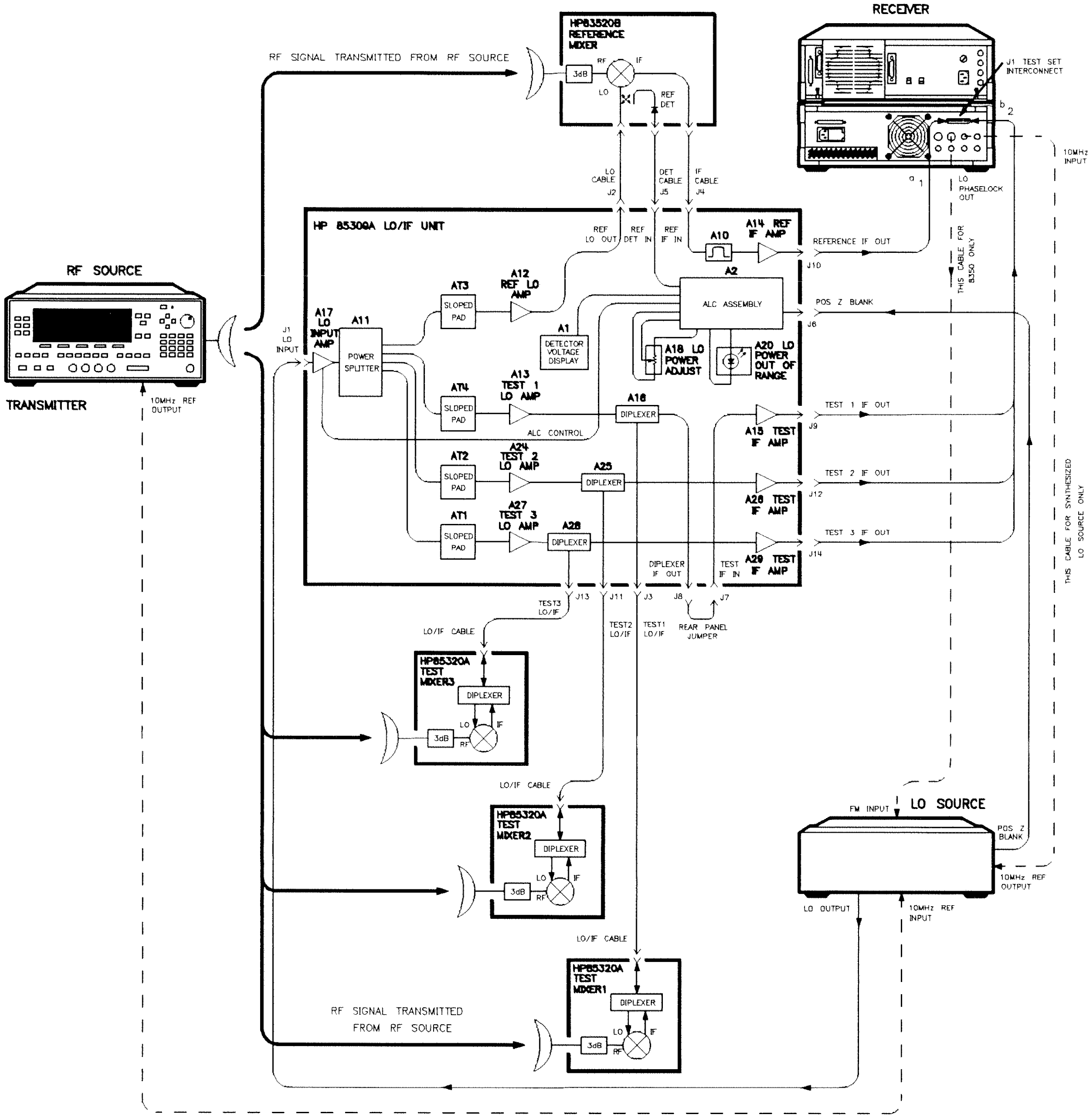


Figure 7-2. System Diagram (Option 001/002)

Transmitter System

The transmitter consists of a synthesized RF source and transmitter antenna. The RF source and transmitter antenna provide the stimulus signal for the Antenna Under Test. This source is controlled by the receiver using the System Bus. The receiver System Bus designates the transmitter source as SOURCE 1. If the length of the System Bus cable to the RF source exceeds the limits defined by IEEE 488.2, then HP-IB extenders are used. These length limitations are explained under "Allowable HP-IB Cable Lengths" in Chapter 2.

The RF source feeds the transmitting antenna. If the transmitter-to-receiver path losses (range losses) are excessive, an RF amplifier can be inserted between the RF source and the transmitting antenna to increase the transmitter power.

Receiver System

The receiver system consists of the antenna-under-test, reference antenna (or reference cable), a frequency converter, and a receiver.

Frequency Converter

Mixer Modules. The HP 85320 mixer modules convert the RF signal from the receiving antennas to the 20 MHz IF frequency required by the receiver. The reference mixer has an internal detector that measures the amount of LO power it receives. The detector's output voltage is sent to the HP 85309A LO/IF unit, where it controls the LO power level.

LO Source. Power from the LO source is amplified by the HP 85309A, which then splits the LO signal and routes it to both mixer modules. The LO source is controlled by the receiver using the System Bus. The receiver's System Bus designates the LO source as `SOURCE 2`. Synthesized LO sources require that the timebase reference oscillators of the RF source, LO source, and receiver are connected together. Connecting the timebases together ensures that the mixed down IF frequency is exactly 20 MHz. If distance prohibits the timebase connections, then adjustments to the LO timebase must be performed periodically.

Non-synthesized LO sources require a phase lock reference signal from the receiver.

HP 85309A LO/IF Unit. The HP 85309A LO/IF unit performs the following tasks:

- It amplifies the LO and IF signals.
- It reduces crosstalk between the channels.
- It monitors the LO power level at the input of the reference mixer. This is possible because the mixer has a built-in power detector. This circuit detects the amount of power at the mixer's LO input, and sends an equivalent voltage back to the HP 85309A. The LO/IF unit monitors this voltage, and maintains a constant amount of power to the mixer.

Receiver

The HP 8530A takes the 20 MHz IF signals from the mixers and converts them into digital data. The data is processed by the receiver, and features such as smoothing, bandwidth, and averaging are mathematically performed. The receiver can output data to a computer, and you can choose data from several points in the data processing sequence. For example, you could get measurement data before averaging is incorporated, and so on.

If the LO source is not synthesized, then the receiver will provide a FM drive voltage to phase lock the LO source.

HP 85310A Theory of Operation

The HP 85310A Distributed Frequency Converter is composed of the HP 85309A LO/IF unit and the HP 85320A/B mixers. There are two signal paths in the HP 85310A:

- The reference signal path.
- The test signal path.

Reference Path

This path consists of two loops: the Reference Phase Lock Loop and the Automatic Level Control (ALC) Loop. If the LO source is a synthesizer, then the phase lock loop is not used. Figure 7-3 and Figure 7-4 show the reference signal path and the ALC signal path respectively.

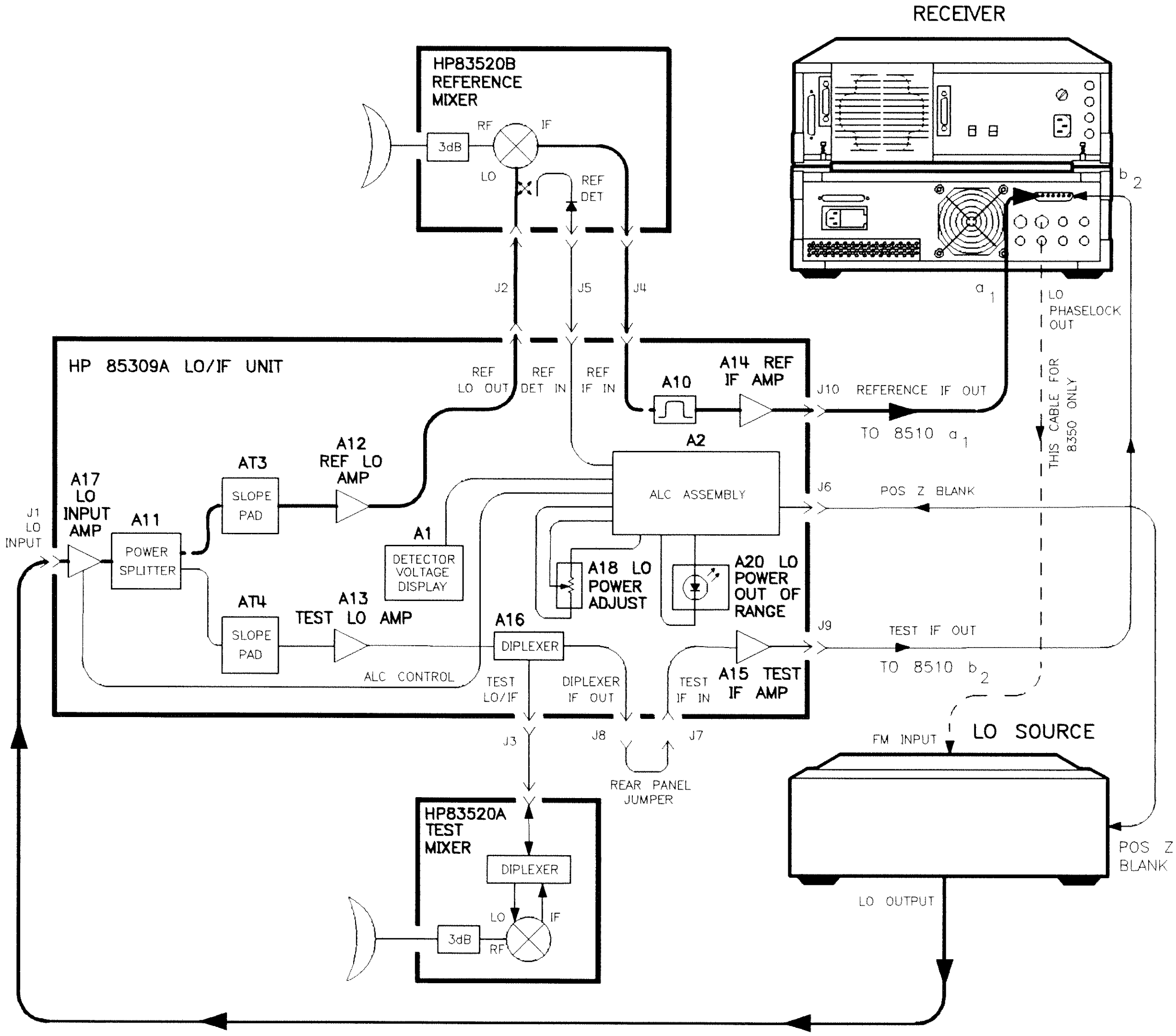


Figure 7-3. Reference Phaselock Loop Signal Path

Reference Phase Lock Loop

The LO signal from the LO Source enters the HP 85309A at the LO input connector. The signal passes through the LO input amplifier, the 3 dB power splitter, sloped pad, and the reference LO amp. The sloped pad compensates for the uneven attenuation of the system's cables (a cable has low attenuation at low frequencies, and higher attenuation at high frequencies). The sloped pad has just the opposite characteristics. The result is that the overall system has approximately the same amount of loss across the entire LO frequency range.

The LO signal exits the LO/IF unit and travels through coax cable to the reference mixer's LO input.

The reference mixer converts the RF signal to a 20 MHz IF reference signal. This signal travels through coax cable back to the HP 85309A LO/IF unit. When it arrives at the LO/IF unit, the IF signal passes through 20 MHz band pass filter (A10), and the reference IF amplifier (A14). (The 20 MHz filter removes any spurious signals that can interfere with the phase lock loop.)

The output of the A14 amplifier goes to the receiver. The receiver uses the IF signal as a magnitude and phase reference.

Non-synthesized LO sources require a phase-lock signal from the receiver. The receiver provides phase lock control by outputting an FM signal to the source's FM Input. This FM signal is sufficient to counteract any frequency error detected in the reference IF signal.

Synthesized LO sources do not require a phase lock signal from the receiver, and therefore the FM signal is not used. Synthesized LO sources do require that the timebases of the LO source, RF source, and receiver be connected together. Connecting the timebases together ensures that the generated 20 MHz IF is always within the detection bandwidth of the receiver. When distance makes it impossible to connect the timebases together, the LO source timebase must be checked against the RF source timebase frequency and adjusted if necessary.

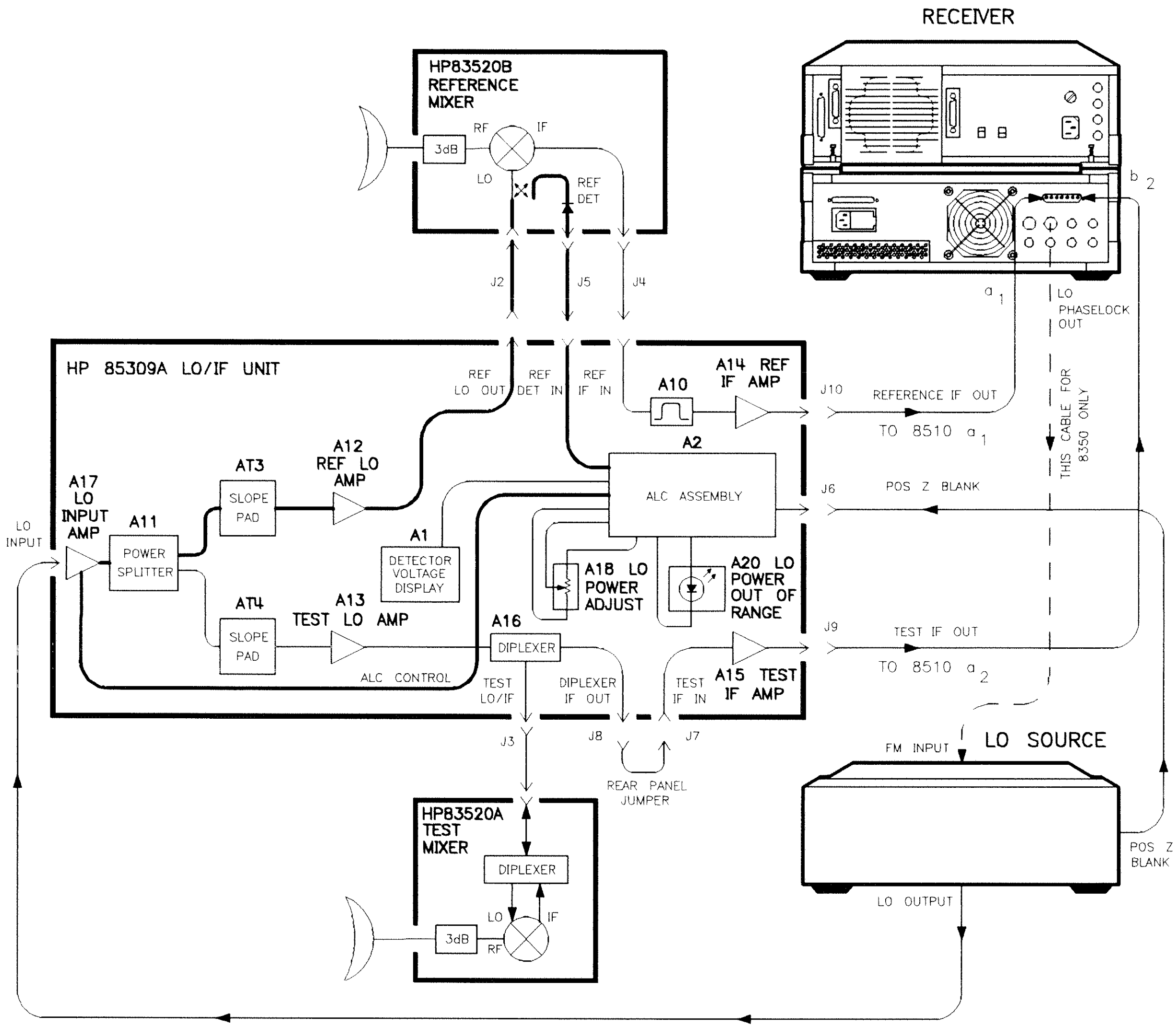


Figure 7-4. Reference ALC Signal Path

Reference Automatic Level Control Loop

The ALC loop maintains the amount of LO power required by the mixers. (The LO power level at the test mixer is the same as the level at the reference mixer due to similar gains and losses in the test mixer LO signal path.) At the reference mixer some of the LO signal is coupled off by a directional coupler. The LO signal level voltage is detected by a diode detector, which outputs a DC voltage that is proportional to the LO signal level. This voltages is used to perform the following tasks:

Display DETECTOR VOLTAGE
: Within the LO/IF unit, the ALC voltage passes through a unity gain amplifier, and is displayed in the DETECTOR VOLTAGE display on the front panel.

Maintain LO Power
: The detector voltage passes through a log amplifier and a comparator in the A2 assembly. The comparator compares the detector voltage to a

reference voltage. If the detector voltage is too high or too low (indicating improper power at the mixers), the A2 assembly increases or decreases the gain of A17 to compensate.

Adjust LO Power

The LO POWER ADJUST potentiometer on the HP 85309A front panel offsets the reference voltage mentioned above. This change affects the gain of the A17 LO amplifier, thereby changing the LO power to the mixers.

Out of Range Warning

If the detector voltage is not within 25% of its expected value, the LO POWER OUT OF RANGE light comes on. This light usually indicates an improper connection, either on the LO source, HP 85309A, or reference mixer. Other minor problems can also cause this, for example, if you inadvertently turn off the RF power on the LO source. More on this subject is explained in Chapter 6, "In Case of Difficulty." Look in the index under "LO power out of range" for the exact page.

LO power is known to drop during band switch points, sweep retrace, or when changing CW frequency. The POS Z BLANK signal is produced by the source during these sweep events. A circuit in the HP 85309A holds the ALC at a predetermined level when POS Z BLANK goes TTL HIGH. This ensures that the ALC will not surge in response to simple bandswitches, retraces, or CW frequency changes.

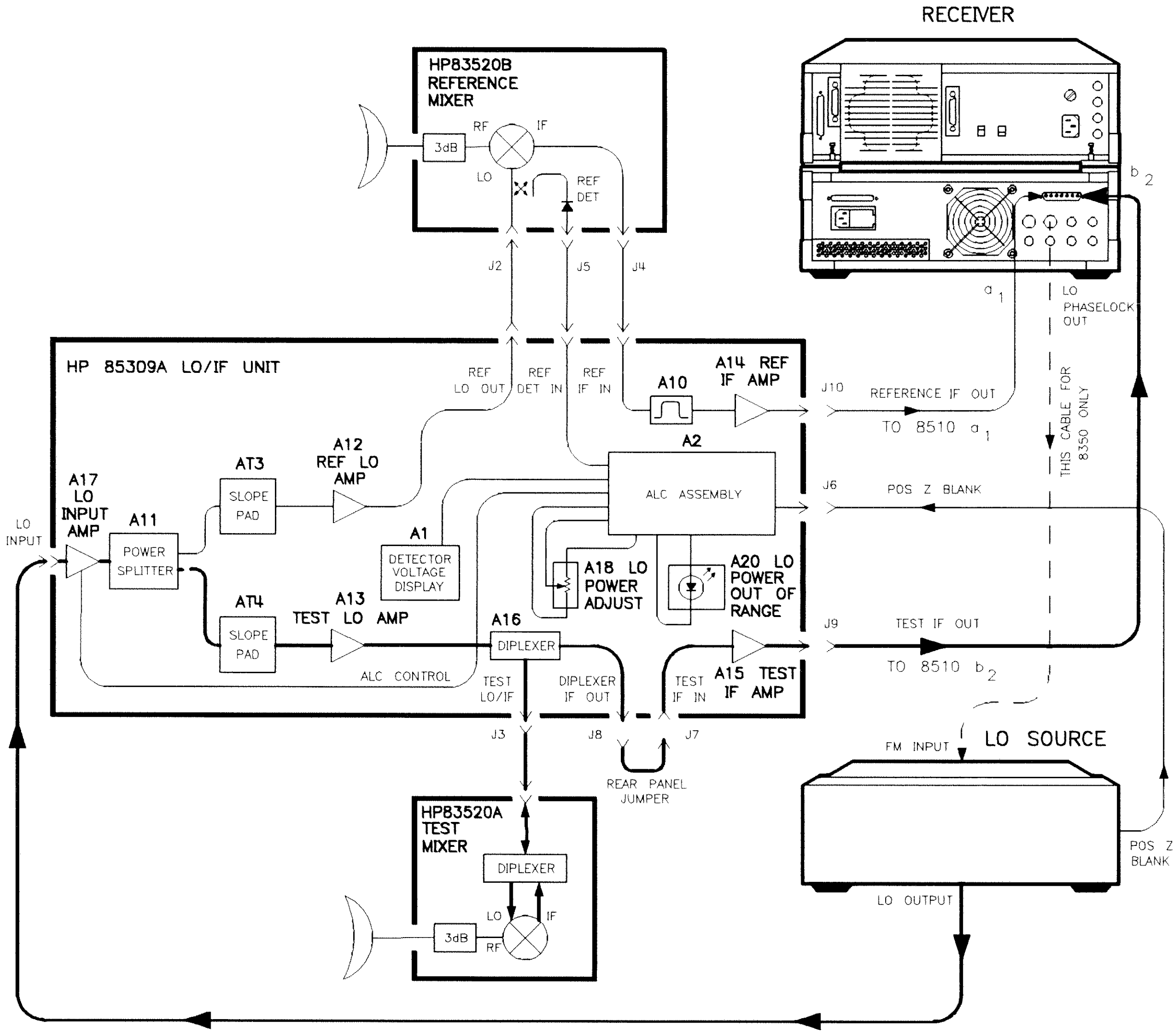


Figure 7-5. Test Signal Path

Test Path

The test path is simpler than the reference path because it does not perform phase lock or ALC functions. The test path shares components with the reference path: the A17 amplifier and A11 splitter. After passing through the splitter, the test signal goes through its own sloped pad and LO amplifier. Next the LO signal passes through the diplexer and external cables to the mixer. There it mixes with the RF signal and returns to the diplexer as a 20 MHz IF signal. The diplexer allows the LO and IF signals to be on the same coax cable.

Finally the IF test signal passes through an IF amplifier and on to the receiver. Note that the loop between the A16 diplexer and A15 IF amplifier provides a way to bypass the diplexer. As explained in Chapter 3, this allows you to use mixers which have a separate LO input and IF output.

Additional Test Paths (HP 85309A Options 001 and 002)

If the HP 85309A has option 001 installed, the A11 splitter changes to a four-way splitter. The reference path and the first test path remain the same. A second test path is added consisting of: a sloped pad AT2, an LO amp A24, a diplexer A25, and an IF amp A26. A load is placed on the fourth output of the four-way splitter.

With option 002 installed, a third test path is added. The reference path, test path 1, and test path 2 remain the same. Test path 3 consists of the following components: sloped pad AT1, LO amp A27, diplexer A28, and IF amp A29. Refer to Figure 7-2.

Recommended Test Equipment

The following table lists major instruments required for supporting the HP 85310A. Other instruments can be used if they meet or exceed the *Critical Specification* shown in the table. "No substitute" means you must use the listed HP device. Miscellaneous adapters and cables are also required.

Table 7-1. Recommended Test Equipment

Item	Critical Specification	Recommended Model (or Part Number)	Use[1]
Receiver	no substitute	see *Compatible Instrument*	I,O,P,T
LO Source	no substitute	see *Compatible Instrument*	I,O,P,T
RF Source	.3 to 26.5 GHz[2]	HP 83631A	I,O,P
RF Source	.3 to 26.5 GHz[3]	HP 83640A	T
Controller	no substitute	HP 9000 series 300[4]	P
Disk Drive	compatible with controller		P
Power Meter	no substitute	HP 436A,437A,438A	P,T
Power Sensors	no substitute	HP 8485A and 8481A	P,T
Attenuators	DC to 26.5 GHz	HP 8493C option 010 and 020	T
Power splitter	.3 to 26.5 GHz	HP 11667B (5086-7408)	I,P,T
Cables (2)	low loss, high stability	08513-60009	I,P,T
Connector Adapters	Type-N and 3.5 mm	Various[5]	I,P,T
Digital Multimeter	range: 0 to 50 Volts DC	3468A/B	T
Power Supply	−60 mV DC Output	HP 6214C	T[6]
Oscilloscope	50 MHz bandwidth	HP 54501A or 54111D	P,T
Network Analyzer	10 MHz to 26.5 GHz	HP 8757C system	T[6]
Spectrum Analyzer	.3 to 26.5 GHz	HP 8593A option 026	T[7]

1 I = installation
O = operation
P = performance verification test
T = troubleshooting and repair

2 Must be controllable by receiver. The transmitter source can be used.

3 Must be controllable independent of the receiver.

4 Requires HP BASIC revision 3.0 or higher.

5 Type-N(m) to 3.5(f),Type-N(f) to 3.5(f), 3.5(f) to 3.5(f).

6 Recommended, not required.

7 Recommended for on-site use.

Troubleshooting Instrument Failures

Assumptions

This section assumes that the system operated properly in the past, and that only one instrument or HP 85310A assembly has failed. If the system has never operated properly, review Chapter 2 and Chapter 6 in this manual. If the receiver system is working but it does not pass the performance verification tests, see "Troubleshooting Performance Failures" later in this chapter.

What this Section Provides

The goal of this section is to determine whether a problem is being caused by the HP 85310A and, if so, which internal assembly is faulty. The HP 85310A is defined as the HP 85309A LO/IF unit, the HP 85320A/B test and reference mixers, and associated cables. The system can also consist of a RF and a LO source, amplifiers, HP-IB extenders, and the receiver. To troubleshoot these products, refer to their respective manuals.

This section assumes that you have experience in troubleshooting HP 8510 or HP 8530 systems, and does not lead you through an exhaustive troubleshooting process. Instead, it provides information and suggestions to help you isolate the failed instrument or HP 85310A assembly. Troubleshooting suggestions are in order of the most likely failures first.

When Repairing the Equipment

To repair the LO/IF unit, replace the failed assembly and, if required, adjust the new assembly. If a mixer module fails, replace the entire module. The assembly part numbers are shown in "Replaceable Parts" later in this chapter.

Caution

The assemblies used in the HP 85310A are static sensitive. Use anti-static techniques when performing the following procedures. For example, wear an anti-static ground strap and work at a station equipped with an anti-static mat.

Do not apply any DC voltage to the HP 85309A's LO input or output connectors. Damage to an LO amplifier can result.

Note

When performing the following troubleshooting and adjustment procedures be aware of the measurement accuracies of the test equipment being used. Add the appropriate measurement error window to the measurement values published in this manual.

Troubleshooting to Instrument Level

This section assumes that the measurement system has stopped working. The following checks will help determine which instrument is faulty.

All of the instruments used in the measurement system work together, and are dependent on each other to make the intended measurement. For this reason, it is important to check the entire system to determine if the problem is in the HP 85310A, or somewhere else in the system.

Checking for Simple Problems

- Are all the instruments turned on? Are all the instrument front panels showing a lighted display?
- Have any connections, components, or instruments been changed since the system last worked?
- Have all instruments passed self-test?
- Are all the instruments set to the correct HP-IB addresses? Are they connected to the right "HP-IB" bus? All systems have at least two separate "HP-IB" connections:
  - The general-purpose HP-IB.
  - The Receiver System Bus.

  Most HP 9000 Series 300 workstations have a third "HP-IB" connection just for their disk drives. All three busses use standard HP-IB connectors. Make sure none of these busses are connected together.
- Are the timebases (10 MHz reference oscillator) of the synthesized LO source, RF source, and receiver connected together? If not refer to "Timebase Check".
- Is the receiver set up correctly for multiple source mode? See "Configure the Receiver" in Chapter 2 for more information.
- Is the system installed and set up properly as explained in Chapter 2?
- Perform an operational check as explained in Chapter 3.

The above checks should help determine what part of the system is causing the problem.

Transmitter or Receiver?

If you have not determined if the problem is in the transmitter or the receiver, the following tests will help.

Transmitter

- Use a spectrum analyzer and a test antenna at the receiver site to find out if the transmitter is sending out the correct power and frequency. Use Appendix B to determine the approximate power level at the receiver site.

or

- A power meter connected to the transmitter will show if the source is outputting the correct RF power.

  A frequency counter connected to the transmitter will show if the source is outputting the correct RF frequency.

Use the transmitter's manual to troubleshoot, if required.

Receiver

If transmitter is operating correctly, then the receiver system (frequency converter, receiver, or associated cables) is probably causing the problem.

Connect the transmitter source directly to the reference mixer's RF input and check the receiver's a1 input channel for a signal. Make sure the RF level into the reference mixer is less than −24 dBm and greater than −45 dBm.

Use the following section to help troubleshoot the receiver system.

Receiver System Troubleshooting

The following section assumes that the receiver system is not operating correctly. If you have already determined which instrument has failed then use that instrument's service manual to fix the failure. If the HP 85310A LO/IF unit or mixers have failed then refer to the next section for individual assembly testing.

Prepare the System for Testing

It is easier to test the receiver system on a bench because it is easier to measure and calibrate test signals. However, the receiver system can also be tested installed in the measurement system so long as care is taken in knowing the test signal levels.

The receiver should be set to Continual Mode by pressing:

STIMULUS (MENU), MORE CONTINUAL.

The start and stop frequencies should be set for the widest frequency range that is available for this system without changing the LO harmonic number.

Bench Setup

Set up the receiver system as it is normally used. Connect the signal generator to the receiver system as shown in Figure 7-6. Use a power meter to calibrate the test signal levels.

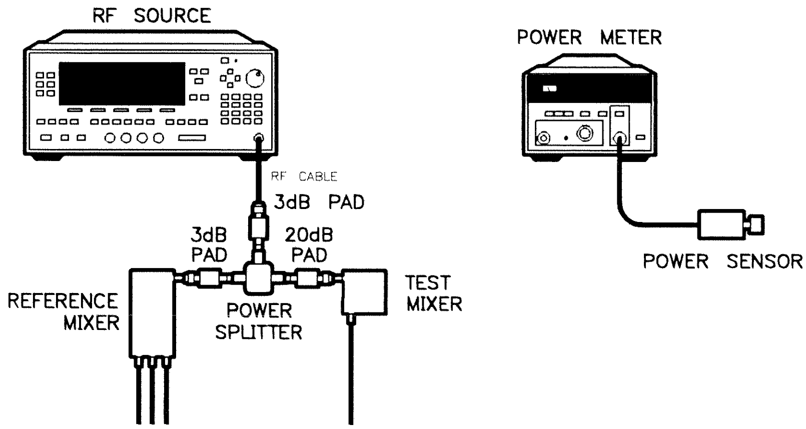


Figure 7-6. Troubleshooting Test Setup

Installed Setup

Do not remove any of the instruments from the installed system. Make sure that an antenna is connected to the reference channel and each test channel. Each antenna should be pointed directly at the transmitter antenna or bore-sighted. Calibrate the test signal levels by using a power meter or a spectrum analyzer. If this method is not available then an approximate signal level can be calculated by performing "Configuring the System for Optimum Dynamic Range" in Chapter 3.

Checking for Simple Problems

Check the following items to help determine which instrument might be at fault.

- Are all instruments turned on? Do all instrument front panels show a lighted display?
- Have any connections, components, or instruments been changed since the system last worked?
- Have the receiver and LO source passed self-test?
- Are instrument HP-IB addresses correct? Are instruments connected to the proper bus? Could the general HP-IB, receiver System Bus, or computer disk drive bus (if so equipped) be accidentally connected together?
- Is the receiver set up correctly for multiple source mode? See "Configure the Receiver" in Chapter 2 for more information.
- Is the system installed and set up properly as explained in Chapter 2?
- If the LO source is a synthesizer, are the timebases of the RF source and the LO source connected together? If not, see Figure 7-1 on the following pages.

Individual Tests for Faulty Signal Paths

Use the following tests to determine which signal path is faulty. Each signal path test is discussed after the tests.

The Receiver System Bus

Check for System Bus operation by adjusting the LO source power with the receiver. Perform the following steps:

1. Press STIMULUS (MENU) POWER MENU SOURCE 2.
2. Note the power setting.
3. Rotate the receiver's knob.
4. Make sure the Source 2 power level changes. Also watch the active function area on the receiver display.
5. Adjust the power setting back to the original setting.

Does the receiver display show a change in the LO source power? If not then proceed to "System Bus".

LO Signal Check

Check for an LO signal at the reference mixer by performing the following:

- Observe the detector voltage mV reading on the front panel of the LO/IF unit.

Is this voltage approximately equal to the LO voltage shown on the reference mixer? If not, proceed to "LO Signal Path".

LO ALC Check

Check for proper operation of the automatic leveling control (ALC) by performing the following steps:

1. If necessary, adjust the LO power level as shown in "Set the LO Power" in Chapter 2.
2. Note the detector voltage mV reading on the front panel of the LO/IF unit.
3. Disconnect the cable from REF DETECTOR IN (J5) on the HP 85309A rear panel.
4. The detector voltage mV reading on the front panel should go to approximately 0 mV, and the LO POWER OUT OF RANGE light should come on.
5. Reconnect the cable that goes to REF DETECTOR IN (J5). The detector voltage mV reading should go back to the original voltage reading, and the LO POWER OUT OF RANGE light should go off. If the light does not go off then refer to "Automatic Leveling Control (ALC) Signal Path".

Timebase Check

Note

This check applies to synthesized LO sources only.

If the timebase of the synthesized LO source is connected to the timebase of the RF source, check to make sure that the LO source is using the external 10 MHz reference signal supplied by the RF source.

1. On the synthesized LO (HP 8360 series source), press:

   (SYSTEM) `more 1/3` `Ref Osc Menu` `10MHz Freq Standard Auto`

2. Does an * (asterisk) appear next to `10MHz Freq Standard Extrnl` ?

   If yes, then the LO source is using the RF source as the 10 MHz standard. If not, the LO source is not using the RF source. Check for excessive 10 MHz RF loss in the coax cable between the RF source timebase and the LO source timebase.

   If, because of distance constraints, the timebase of the synthesized LO source is not connected to the timebase of the RF source, check the following:

   If everything else in the system appears to be working, but the a1 signal is very low in level or non-existent as measured on the receiver's display, refer to Chapter 4 and perform the synthesized LO timebase check and adjustment to verify that the LO source and the RF source can produce a 20 MHz (± 5 kHz) IF signal.

Phase Lock Loop Check

Check for proper operation of the phase lock loop by performing the following:

Note

If the LO source is synthesized then the phase lock loop is not required, and there is no need to perform the following steps.

The message area of the receiver's display may already show that there is a phase lock error. However, if it does not:

1. Disconnect the BNC cable from the FM INPUT of the LO source.
2. The message area of the receiver display should show `Phase Lock Lost` or `No IF Found` error messages.
3. Reconnect the BNC cable to the FM INPUT of the LO source.
4. Press (ENTRY OFF)
5. The error message should go off and stay off.

If there was a phase lock error message and it did not go away after pressing (ENTRY OFF), then go to "Phaselock Loop Signal Path".

Phaselock Loop Signal Path

If the LO Source is an HP 8350 sweeper, the LO frequency is controlled by the receiver *LO Phaselock Out*. The maximum phase lock loop length with the HP 8350 is 91 meters (300 feet). The phase lock loop (PLL) starts at the LO SOURCE (RF output) and goes to the LO/IF UNIT, REFERENCE MIXER, LO/IF UNIT, RECEIVER, and back to the LO SOURCE (FM input).

Reference Channel Check

Check for proper operation of the reference channel by pressing:

On the *HP 8510*:
PARAMETER (MENU) USER1 a1

On the *HP 8530A*:
PARAMETER (MENU) SERVICE PARAMETERS SERVICE1 a1

The signal level on the receiver's display should be equal to the RF source power level in to the mixer module plus the HP 85310A's conversion gain. See Table 7-2 for the conversion gain. If it is not at the proper level, then go to "Reference Signal Path".

Table 7-2. HP 85310A Conversion Gain

Frequency Range	LO Harmonic	Conversion Gain	Tolerance
1 to 2 GHz	1	4.5 dB	−5.5 dB, +9.5 dB
2 to 3 GHz	1	10.5 dB	−5.5 dB, +3.5 dB
3 to 5 GHz	1	11.5 dB	−5.5 dB, +2.5 dB
5 to 18 GHz	1	7.5 dB	−4.5 dB, +6.5 dB
6 to 8 GHz	3	−1.5 dB	−3.5 dB, +6.5 dB
8 to 16 GHz	3	−4.0 dB	−3.5 dB, +9.0 dB
16 to 26.5 GHz	3	−6.0 dB	−5.5 dB, +11.0 dB

Test Channel Check

Check for proper operation of the test channel by pressing:

On the *HP 8510*:
PARAMETER (MENU) USER2 b2

On the *HP 8530A*:
PARAMETER SERVICE PARAMETERS SERVICE2 b2

The signal level on the receiver's display should be equal to the RF source power level in to the mixer module plus the HP 85310A's conversion gain. See Table 7-2 for the conversion gain. If it is not at the proper level, then go to "Test Signal Path".

Checking Additional Test Channels. Instruments having additional test channels can be tested. For test channel 2:

If using an *HP 8510*, press:
PARAMETER (MENU) USER4 b1

If using an *HP 8530*:
PARAMETER (MENU) SERVICE4 b1

For test channel 3:

If using an *HP 8510*, press:
PARAMETER (MENU) USER3 a2

If using an *HP 8530*, press:
PARAMETER (MENU) SERVICE3 a2

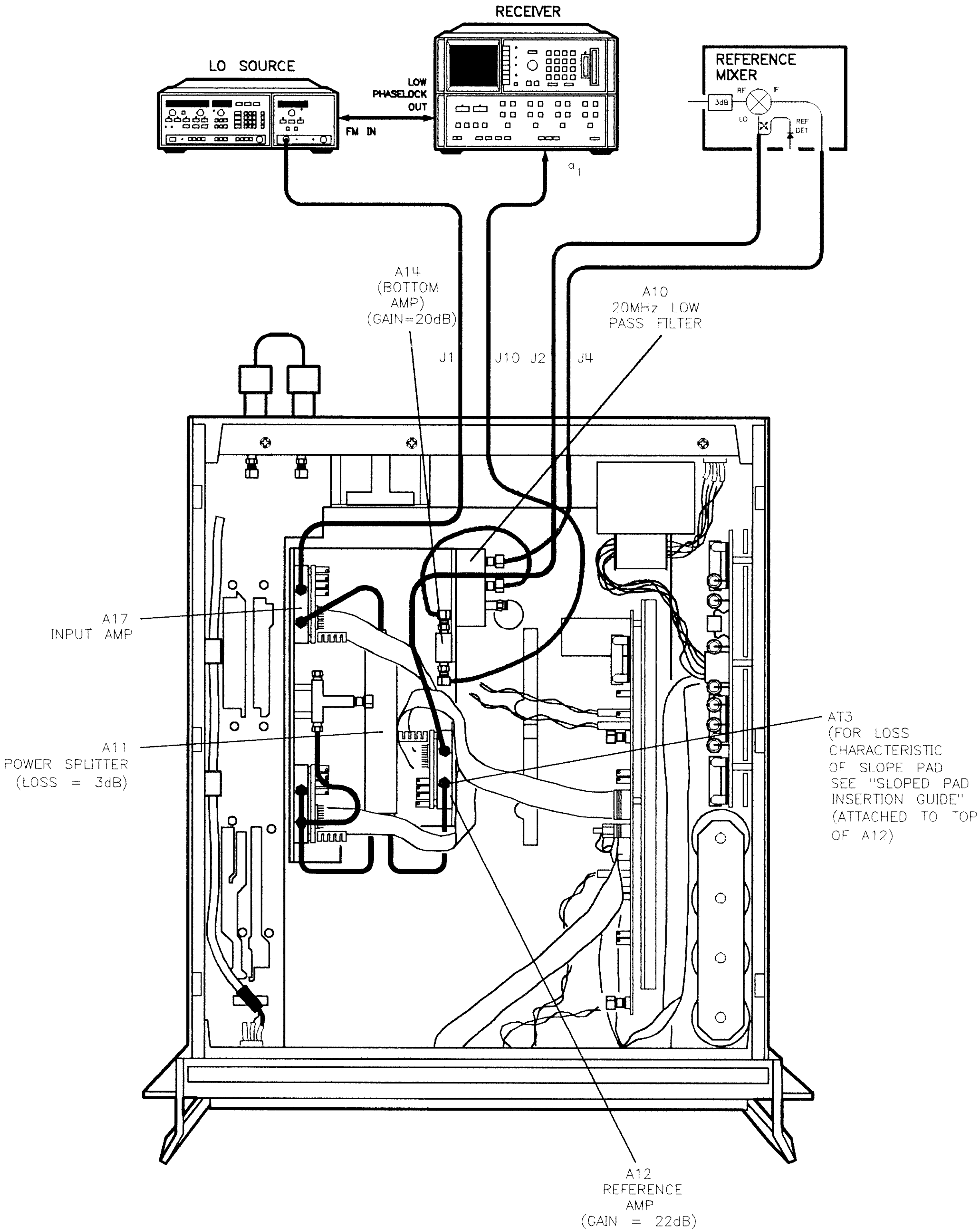


Figure 7-7. Phaselock Loop Path

Common Phase Lock Loop Problems

- If the total length of the phase lock loop signal path is greater than 30 meters (100 feet) then do the following:

  1. Check the serial number of your receiver. If it is less than 2844A05265 then you *must* have option H15 or the system will not phase lock. Reduce the length of the phase lock signal path or upgrade your receiver to option H15.
  2. If the serial number is greater than 2844A05265 then you do not need option H15. Read the other possible problems below.
  3. Is the receiver an HP 8510C? Check the firmware revision, press (SYSTEM) MORE SERVICE FUNCTIONS SOFTWARE REVISON. It should say C.06.04 or greater. If a lower revision is noted, contact your nearest HP sales office. If the revision is C.06.04 or greater, read the other possible problems below.

- If the receiver has option H15 the total length of the phase lock loop signal path, as shown in Figure 7-7, cannot be longer than 91 meters (300 feet).
- Check the receiver's a1 input by applying an RF signal to the reference mixer RF input. The RF level should be greater than −45 dBm. See Chapter 5 for more information. The receiver's a1 signal level should be between −10 dBm and −45 dBm. If the signal is less than −45 dBm check:

  1. The signal level at the Reference antenna.
  2. The reference mixer conversion gain.
  3. The LO/IF unit Reference IF gain.

- Check the receiver's a1 input for proper phase lock operation by performing the following:

  1. Connect the LO/IF unit's J10 Reference IF Out to the receiver J1 Test Set Interconnect's a2 input (yellow cable).
  2. Press PARAMETER (MENU).
     a. If using an *HP 8510*, press USER3 a2.
     b. If using an *HP 8530A*, press SERVICE PARAMETERS SERVICE3 a2 (PRIOR MENU)
  3. Redefine the a2 phase lock by pressing:

     REDEFINE PARAMETER, PHASE LOCK, a2, REDEFINE DONE Will a2 phase lock on this signal? If a2 will phase lock, then the a1 phase lock should be checked.
  4. Check the Reference IF level in channel a2. Is it greater than −45 dBm?
  5. If necessary, the Test IF Out can be used as a phase lock reference. Connect the Test IF signal to the receiver's a2 channel. The Reference IF can now be measured in another receiver channel. Make sure that the a2 channel IF level is between −45 dBm and −10 dBm.

6. Be sure and set the a2 phase lock back to its original state.

- If the phase lock is intermittent over a sweep:

1. Check the Reference IF signal level over the entire measurement frequency range. Make sure the IF level does not go below −45 dBm.
2. Check the A10 Filter in the LO/IF unit for out-of-band performance.

Automatic Leveling Control (ALC) Signal Path

The ALC loop maintains the amount of LO power required by the mixers. (The LO power level at the test mixer is the same as the level at the reference mixer due to similar gains and losses in the test mixer LO signal path.) At the reference mixer some of the LO signal is coupled off by a directional coupler. The LO signal level voltage is detected by a diode detector, which outputs a DC voltage that is proportional to the LO signal level. This voltages is used to perform the following tasks:

Display `DETECTOR VOLTAGE`
: Within the LO/IF unit, the ALC voltage passes through a unity gain amplifier, and is displayed in the `DETECTOR VOLTAGE` display on the front panel.

Maintain LO Power
: The detector voltage passes through a log amplifier and a comparator in the A2 assembly. The comparator compares the detector voltage to a reference voltage. If the detector voltage is too high or too low (indicating improper power at the mixers), the A2 assembly increases or decreases the gain of A17 to compensate.

Adjust LO Power
: The `LO POWER ADJUST` potentiometer on the HP 85309A front panel offsets the reference voltage mentioned above. This changes the gain of the A17 LO amplifier, thereby changing the LO power to the mixers.

Out of Range Warning
: If the detector voltage is not within 25% of its expected value, the `LO POWER OUT OF RANGE` light comes on. This light usually indicates an improper connection, either on the LO source, HP 85309A, or reference mixer. Other minor problems can also cause this, for example, if you inadvertently turn off the RF power on the LO source. More on this subject is explained in Chapter 6, “In Case of Difficulty.” Look in the index under “LO power out of range” for the exact page.

LO power is known to drop during band switch points, sweep retrace, or when changing CW frequency. The POS Z BLANK signal is produced by the source during these sweep events. A circuit in the HP 85309A holds the ALC at a predetermined level when POS Z BLANK goes TTL HIGH. This ensures that the ALC will not surge in response to simple bandswitches, retraces, or CW frequency changes.

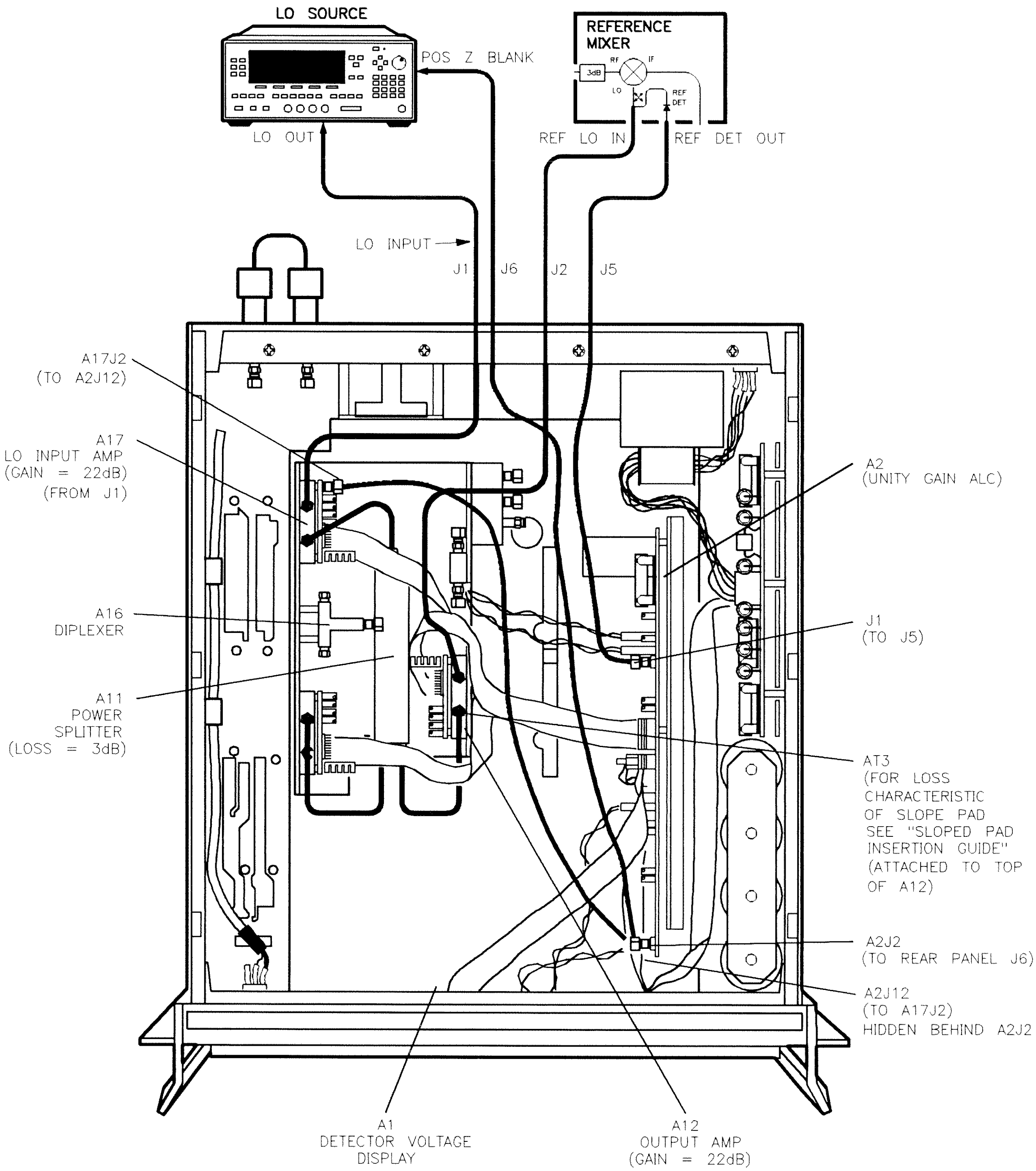


Figure 7-8. Reference ALC Signal Path

Common ALC Problems

- Make sure the LO source is internal ALC mode. The LO source should indicate that it is in the internal meter mode on its display. If necessary, check the receiver to make sure that its Source 2 is set for internal. See "Configure the Receiver" in Chapter 2 for more information in setting this mode.

- Make sure the LO source power level is set properly. "Set the LO Power" in Chapter 2 explains how to choose the appropriate power value.
- If the LO signal power (to the mixers) cannot be set to the correct level, perform the following:

1. Measure the maximum RF output power at the LO Source's output connector to make sure that the RF output power meets it's minimum specifications.
2. Set LO power such that 0 dBm arrives at the HP 85309A LO Input.
3. Measure the LO power at HP 85309A J2, Reference LO Out. It should be around +15 to +20 dBm. If power is low at J2, trace the power level back through the HP 85309A until you find the problem. Table 7-3 show appropriate power levels at various points in the HP 85309A.
4. Measure the LO power at HP 85309A J3, Test LO/IF. It should also be around +15 to +20 dBm. If the power is low, trace the power through the HP 85309A as explained in the last step.

Table 7-3.
Typical Power Levels Inside the HP 85309A

Location	Typical Power Level
A17 output	+14 to +18 dBm
A11 output	+9 to +15 dBm
AT3 or AT4 output	+3 to +8 dBm
A12 or A13 output[1]	+15 to +20 dBm
A16 output[2]	+14 to +20 dBm

1 The output of A12 can be measured at rear panel J2.

2 Measured at HP 85309A rear panel J3.

Reference Signal Path

The reference RF signal comes from the Reference antenna and goes into the reference mixer module. The mixer module converts the RF signal to a 20 MHz IF signal. The IF signal travels through a coax cable to the LO/IF unit. The LO/IF unit filters the IF signal to reduce non-IF spurious responses. This reduces the interference with the phase lock loop. The LO/IF unit then amplifies the IF signal before sending it through coax cable to the receiver's a1 channel input.

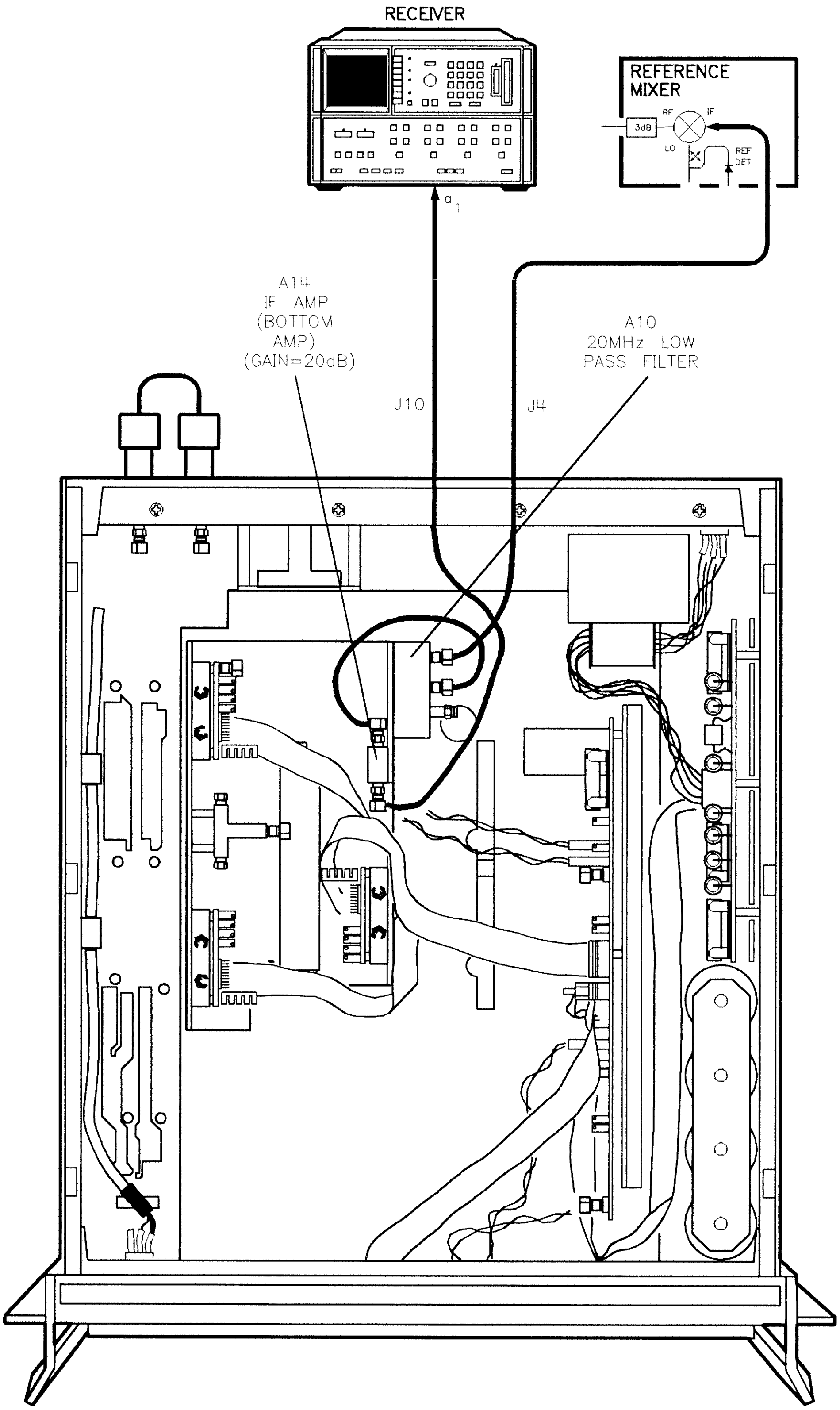


Figure 7-9. Reference IF Signal Path

Common Reference Signal Path Problems

- Is the RF signal at the reference mixer input at the correct level?
- Check the conversion gain of the mixer as shown in "Reference Mixer Conversion Gain".
- Check the insertion loss in the IF cable from the IF OUT connector on the mixer to the Reference IF IN on the LO/IF unit. See the cable manual or Chapter 8 for more information on measuring cable loss.
- Test the IF gain of the Reference channel of the LO/IF unit at 20 MHz.

Table 7-4. Minimum Reference Channel IF Gain

Frequency Range	Minimum Gain	Maximum Gain	Conditions
20 MHz	21 dB	25 dB	−35 dBm Input

- Check the signal level of the receiver's a1 channel by pressing:

  On *HP 8510*:
  PARAMETER (MENU), USER1 a1

  On *HP 8530A*:
  PARAMETER (MENU), SERVICE PARAMETERS SERVICE1 a1

  Is a1 at the correct level? The level should normally be between −10 dBm and −45 dBm. If the a1 channel does not appear to be operating correctly, measure the Reference IF level on the receiver's a2 channel as explained below:

  1. Connect the LO/IF unit's J10 Reference IF Out to the receiver J1 Test Set Interconnect's a2 input.
  2. On *HP 8510*, press:
     PARAMETER (MENU), USER3 a2 .

     On *HP 8530*, press:
     PARAMETER (MENU), SERVICE PARAMETERS SERVICE3 a2
  3. Redefine the a2 phase lock to a2 by pressing REDEFINE PARAMETER , PHASE LOCK , a2 , REDEFINE DONE .
  4. Check the Reference IF level. Is it greater than −45 dBm?
  5. If necessary, the Test IF Out can be used as a phase lock reference. Connect the Test IF signal to the receiver's a2 channel. The Reference IF can now be measured in another receiver channel. Make sure that the a2 channel IF level is between −45 dBm and −10 dBm.
  6. Be sure and set the a2 phase lock back to its original state.

- Check the insertion loss in the cable that goes from the HP 85309A Reference IF OUT to the Receiver. See the cable manual or Chapter 8 for more information on measuring cable loss.

Test Signal Path

The Test RF signal comes from the Test antenna and goes into the test mixer module. The mixer module converts the RF signal to a 20 MHz IF signal. The IF signal is transmitted through coax cable to the LO/IF unit. The LO/IF unit then amplifies the IF signal before sending it (through coax cable) to the receiver's b2 channel input. Any additional test channnels (HP85309A option 001/002) can be checked in the same way .

Common Test Signal Path Problems

- If your system uses a rotary joint, make sure it meets its insertion loss specifications. Check for loose connections.
- Make sure there is enough RF power arriving at the mixer module.
- Check the conversion gain of the mixer module as shown in "Test Mixer Conversion Gain".
- Check the insertion loss in the IF cable from the IF OUT on the mixer module to the Test IF IN of the LO/IF unit. See the cable manual or Chapter 8 for more information on measuring cable loss.
- Check the J7 to J8 jumper on the back panel of the LO/IF unit for damage or loose connectors.
- Test the IF gain of the Test channel of the LO/IF unit at 20 MHz.

Table 7-5. Minimum Test Channel IF Gain

Frequency Range	Minimum Gain	Maximum Gain	Conditions
20 MHz	21 dB	25 dB	−35 dBm Input

- To check the signal level of the receiver's b2 channel, press:

  On *HP 8510*:
  PARAMETER (MENU), USER2 b2
  On *HP 8530*:
  PARAMETER (MENU), SERVICE PARAMETERS SERVICE2 b2

- For test channel 2, press:

  On *HP 8510*:
  PARAMETER (MENU), USER4 b1
  On *HP 8530*:
  PARAMETER (MENU), SERVICE PARAMETER SERVICE4 b1

- For test channel 3, press:

  On *HP 8510*:
  PARAMETER (MENU) USER3 a2
  On *HP 8530*:
  PARAMETER (MENU), SERVICE PARAMETER SERVICE3 a2

  Is it at the correct level as per the worksheet in Appendix B? The level should normally be between minus 10 dBm and the noise floor depending on the test antenna. If the b2/b1/a2 channel does not seem to be operating correctly, measure the Test IF level on the receiver's b1 channel as explained below:

  1. Connect HP 85301A J9 Test IF Out to another receiver J1 Test Set Interconnect such as b1, b2, a2 input.
  2. Check the receiver's input by pressing:

     On *HP 8510*:
     PARAMETER (MENU), USER 4 b1

     On *HP 8530*:
     PARAMETER (MENU), SERVICE PARAMETER SERVICE 4 b1
  3. Check the Test IF level. Is it at the correct level?

- Check the insertion loss of the cable that goes from the HP 85309A Test IF OUT to the Receiver. See the cable manual or Chapter 8 for more information on measuring cable loss.

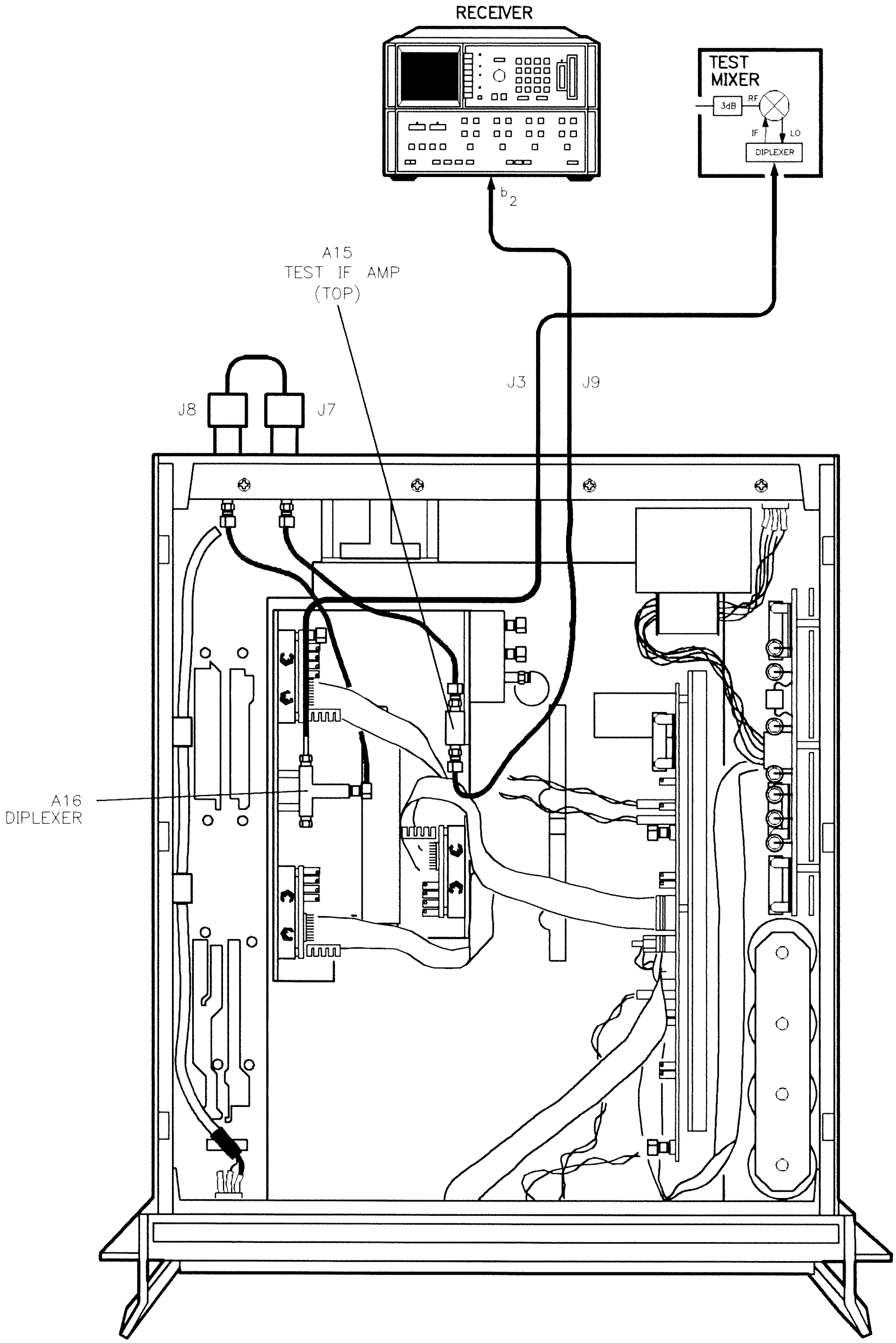


Figure 7-10. Test IF Signal Path

LO Signal Path

The LO source supplies the LO signal to the LO/IF unit through a coax cable. The LO signal is then amplified and divided into two paths in the LO/IF unit. The LO signals are then output to the two mixer modules through coax cables.

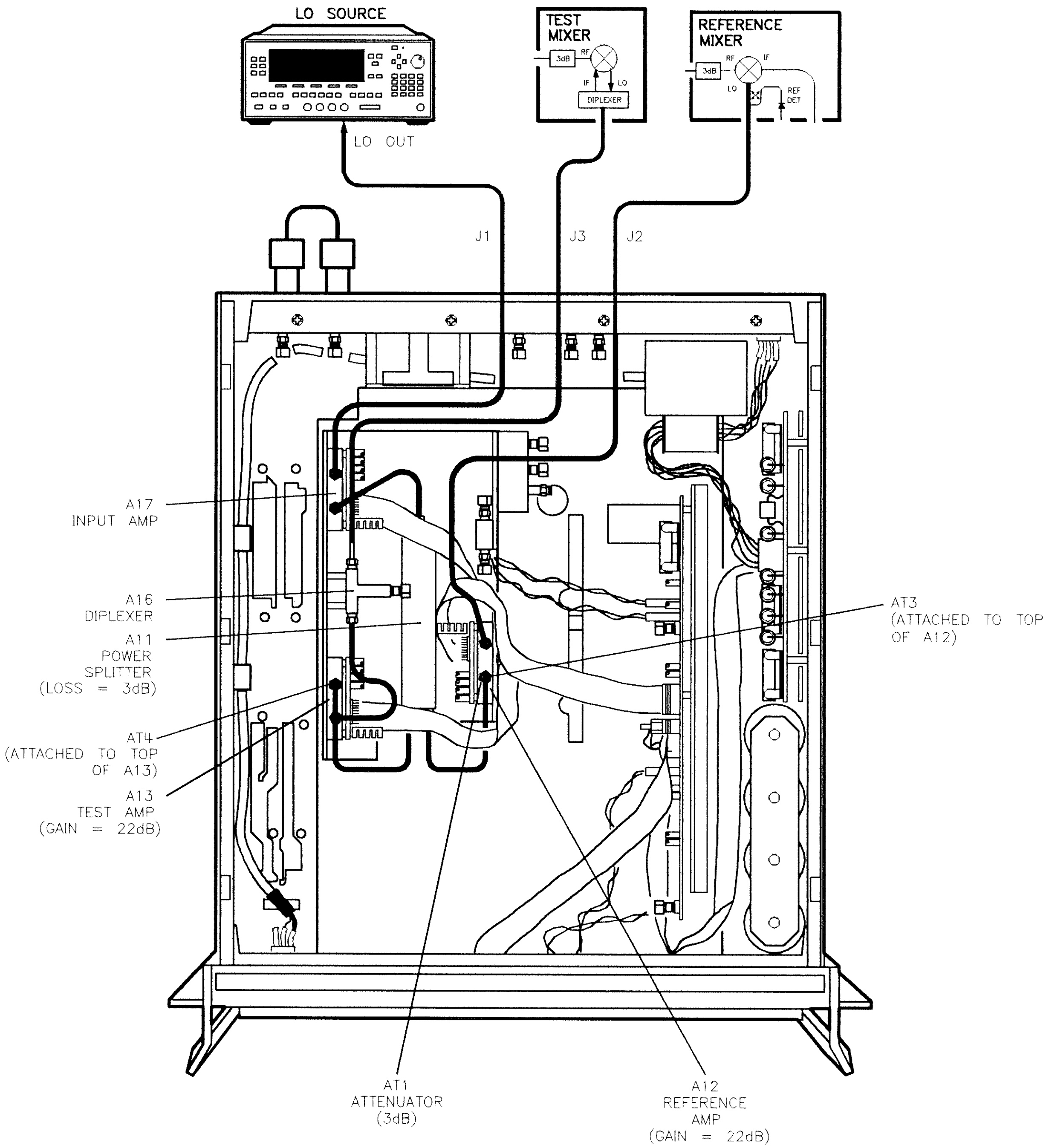


Figure 7-11. LO Signal Path

Common LO Signal Problems

- Check the insertion loss of the cable that goes from the LO source to the HP 85309A LO Input. See the cable manual or Chapter 8 for information on the cable insertion loss.

- Check the insertion loss of the cables that go from the HP 85309A to each mixer module. See the cable manual or Chapter 8 for information on the cable insertion loss.
- Check the gain of the Reference and the Test LO channel in the HP 85309A. Both channels' gain should closely match. Each channels' minimum gain and balance is shown in Table 7-6. If the channel performance does not meet Table 7-6 then see "LO Amplifier Adjustments" for adjustment procedures, or replace the amplifier.
- Check the maximum output power level for each LO channel. Table 7-6 shows the minimum output power at amplifier saturation.

Table 7-6. LO/IF Unit LO Channel Performance

	300 MHz	1 GHz	6 GHz	9 GHz	15 GHz	20 GHz
Tracking[1]	±2 dB	±2 dB	±2 dB	±2 dB	±2 dB	±2 dB
Minimum Channel Gain[2]	+10dB	+20 dB	+22 dB	+22 dB	+19 dB	+19 dB
Min Output Power[2]	+16 dBm	+20 dBm	+22 dBm	+22 dBm	+19 dBm	+19 dBm
Input Return Loss	9 dB	9 dB	9 dB	9 dB	9 dB	9 dB
Output Return Loss	7 dB	7 dB	7 dB	7 dB	7 dB	7 dB

1 At 300 MHz, this specification is measured with a −10 dBm input level. Above 300 MHz, it is measured with a −20 dBm input level.

2 At 300 MHz, this specification is measured with a 6 dBm input level. Above 300 MHz, it is measured with a 0 dBm input level.

Checking Minimum Channel Gain

To check minimum channel gain:

1. Connect an LO source to the LO input of the HP 85309A.
2. Set the source to −20 dBm output at a CW frequency of 1 GHz.
3. Turn the `LO POWER ADJUST` control on the HP 85309A fully clockwise. It is normal for the `LO POWER OUT OF RANGE` light to come on at this time.
4. With a power meter, measure the power output of J2, REFERENCE LO OUT on the rear panel of the HP 85309A. The power should equal or exceed the value shown in "Minimum Channel Gain" for 300 MHz shown in Table 7-6.
5. With a power meter, measure the power output of J3, TEST LO/IF on the rear panel of the HP 85309A. The power should equal or exceed the value shown in "Minimum Channel Gain" for 300 MHz shown in Table 7-6.
6. Repeat these steps at an LO frequency of 1, 6, 9, 15, and 20 GHz.

System Bus

The receiver System Bus allows the receiver to have total control of the LO and RF source, without having to get permission from the computer. This is why the special receiver System Bus was created. Refer the receiver's service manual for detailed service information on this bus.

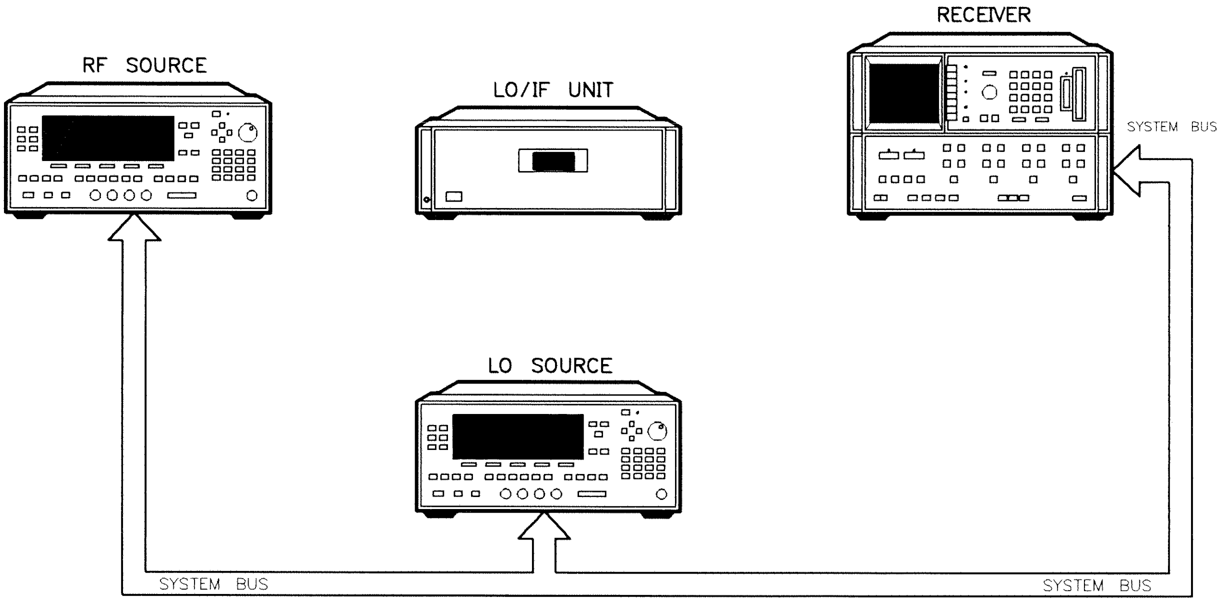


Figure 7-12. HP-IB Connections

Common System Bus Problems

- Check for loose or disconnected HP-IB connectors on the System Bus.
- Make sure the System Bus has not been connected to the main HP-IB bus. Since all the connectors look the same it's easy to make this error.

  Make sure the RF and LO source are connected to the System Bus, not the main HP-IB bus. Refer to Chapter 2 for more information.
- Make sure the sources are set to the proper HP-IB address. Refer to "Configure the Receiver" in Chapter 2 for more information.
- Make sure the receiver multiple source menu shows the correct addresses for the sources. Refer to "Configure the Receiver" in Chapter 2 for more information.

HP-IB Bus Extenders

HP-IB bus extenders allow the receiver's System Bus to be longer than the normal HP-IB maximum. (The maximum length for HP-IB cables is given in "Allowable HP-IB Cable Lengths" in Chapter 2. Refer to the HP-IB extender manual for information on servicing these instruments. Some potential problems when using bus extenders are shown below:

- The extender should be set to SLOW mode. NORMAL mode can cause intermittent System Bus communication errors.

- Check the transmission line between the bus extender modules for damage.
- Bus extenders can cause the System Bus to lock if the remote instrument is not responding to HP-IB commands. Make sure the remote instrument will respond to System Bus commands without a bus extender.

HP 85309A Troubleshooting

The following tests check the HP 85309A's individual assemblies. The tests assume that the assembly is being tested individually and is not connected to other assemblies.

The following tests do not define the exact test procedures. The procedures only describe the performance specifications for each assembly, and any specific test requirements. It is up to the tester to translate the tests to the available test equipment and testing situation. All of the tests can be performed with a microwave power meter and a digital voltmeter. A microwave scalar analyzer, if available, can reduce the time required to perform some of the tests.

Caution

The assemblies used in the HP 85310A are static sensitive. Use anti-static techniques when performing the following procedures. For example, wear an anti-static ground strap and work at a station equipped with an anti-static mat.

Do not apply any DC voltage to the LO amplifier's input or output connectors as damage to an LO amplifier can result.

Note

When performing the following troubleshooting and adjustment procedures be aware of the measurement accuracies of the test equipment being used. Add the appropriate measurement error window to the measurement values published in this manual.

Power Supply A2 and A22

Regulated Supplies

Confirm that the LO/IF unit power supplies are functioning by observing the five LEDs on the power supply assemblies. The LEDs for the +5, +15, −15, +10 Volt, and −10 Volt supplies should be on steadily (not dim or blinking).

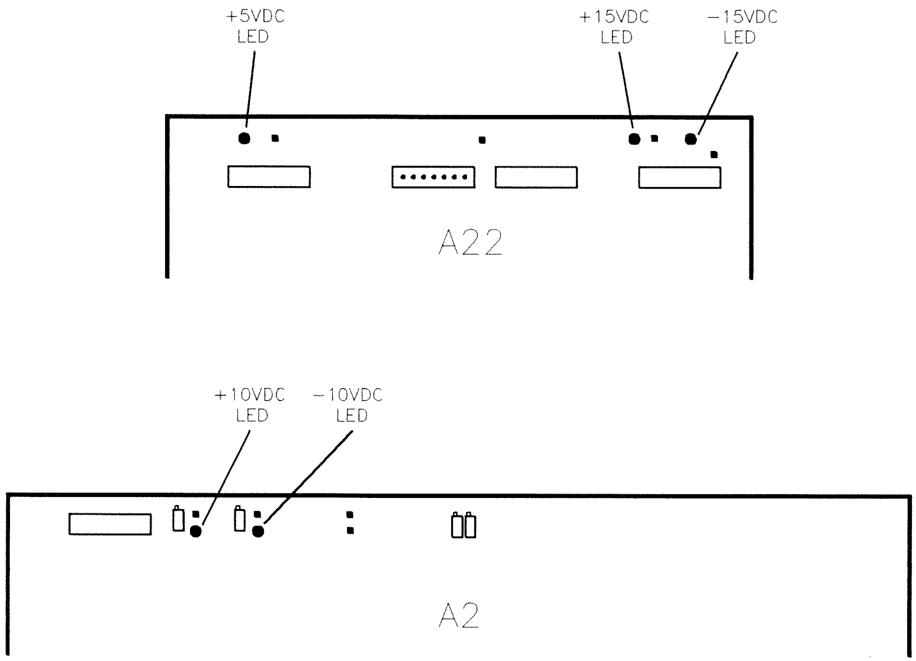


Figure 7-13. Location of Power Supply LEDs

The LO/IF unit has five independent power supplies on 2 assemblies (A2 and A22). The 10 volt supplies on A2 are adjustable; the supplies on A22 are not adjustable.

In troubleshooting the power supplies, remember to check the line fuse and the various supply fuses on A22. Make sure the line voltage selector (on the rear panel) is set correctly. Check all connectors for continuity and proper polarity. If the A22 supplies (+5, +15, and −15) are not correct, check the voltages from the transformer as shown below.

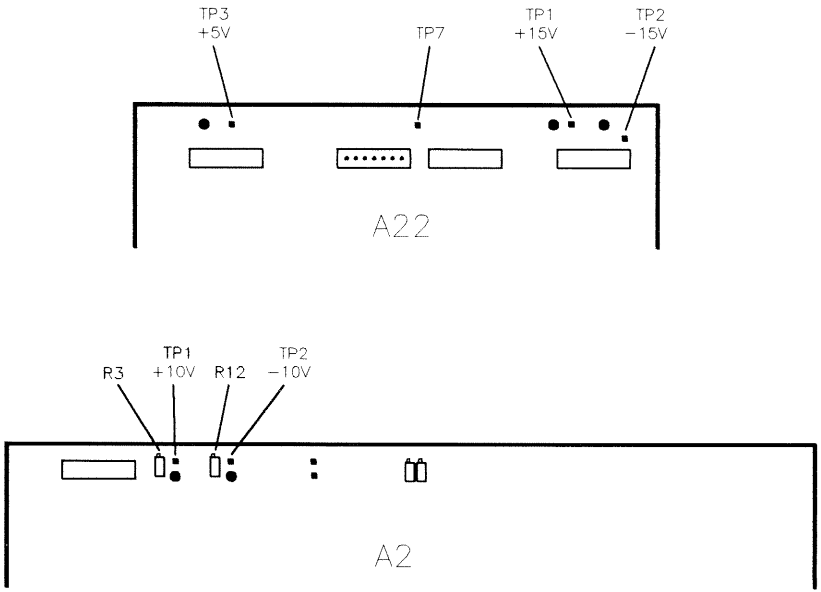


Figure 7-14. Location of Power Supply Test Points

Table 7-7. Power Supply Test Points

Supply	Test Point	Adjustment	Range (volts)	Line/Regulation
Ground	A22TP7	none	N.A.[1]	N.A.
+5 Volt	A22TP3	none	+4.9 to +5.2	10 mV
+15 Volt	A22TP1	none	+14.2 to +15.5	10 mV
−15 Volt	A22TP2	none	−14.2 to −15.5	10 mV
+10 Volt	A2TP1	A2R3	+9.95 to +10.05	30 mV
−10 Volt	A2TP2	A2R12	−9.95 to −10.05	30 mV

1 Not Applicable

Power Supply Transformer

The unregulated DC transformer voltages can be measured at each of the fuses on the A22 and A2 boards. Connect the voltmeter to one side of the fuse terminal and measure the voltage.

Table 7-8.
Power Supply Transformer Voltages and Fuses

Fuse	Rating (Amps)	Part Number	Regulated Supply	Minimum DC Voltage[1]
A22F1	3.0	2110-0043	+5 volts	+8 volts
A22F2	Not Used			
A22F3	1.0	2110-0643	+15 volts	+18 volts
A22F4	1.0	2110-0003	−15 volts	−18 volts
A2F1	3.0	2110-0003	+10 volts	+13 volts

1 Unregulated DC voltage measured at the fuse.

Assembly DC Voltage Test Points

The power supply voltage to each assembly can be measured at the board's power supply cable as shown below.

Table 7-9. DC Voltages for Each Assembly

Board	Connector(Pin)	Test Point	Supply	Supply Location[1]
A1	J1(6 or 16)		Ground	A2J6
	J1(8)		+5 volts	A2J6
	J1(12)		−15 volts	A2J6
A2	J7(1 or 2)		−15 volts	A22J3
	J7(3 or 4)		Ground	A22J3
	J7(7,8,9,10)		+15 volts	A22J3
	J7(15,16)		+5 volts	A22J3
A12, A13, A17	J1(1 or 9)	TP3	Ground	A2J3,4,5
	J1(2 or 10)		+15 volts	A2J3,4,5
	J1(14)		−10 volts	A2J3,4,5
	J1(15)		+10 volts	A2J3,4,5
		TP1	+8.3 volts[2]	A2J3,4,5
		TP2	+8.0 volts[2]	A2J3,4,5
A14	Black Wire		Ground	A2J8(1)
	Red Wire		+15 volts	A2J8(3)
A15	Black Wire		Ground	A2J9(1)
	Red Wire		+15 volts	A2J9(3)

1 Power supply board and connector providing the voltage for each assembly.

2 Approximate voltage. Voltage can vary with different amplifiers.

LO Amplifiers A17, A12, A13, A24, and A27

The LO/IF unit uses three or more (HP85309A, option 001/002) identical LO amplifiers; the A17 input amplifier, the A12 reference amplifier, and the A13, A24, and A27 test amplifiers. These amplifiers are interchangeable.

The typical minimum gain of the amplifiers are shown in Figure 7-15. However, the performance of each amplifier is adjusted at the factory so the test and reference channels have the same output power. If you have replaced an amplifier refer to "LO Amplifier Adjustments". Also refer to "LO Amplifier Adjustments" when checking the overall balance of the LO channels.

A17, A12, and A13 Checks

The minimum gain of the reference path (A17 and A12) is the same as in each test path (A17 and A13), (A17 and A24), and (A17 and A27). The minimum gain is called *minimum channel gain*, and is given in Table 5-5, earlier in this chapter.

Checking Test and Reference Path Gain

1. Connect an LO source to the LO input of the HP 85309A.
2. Set the source to –20 dBm output at a CW frequency of 300 MHz.
3. Turn the LO POWER ADJUST control on the HP 85309A fully clockwise. It is normal for the LO POWER OUT OF RANGE light to come on at this time.
4. With a power meter, measure the power output of HP 85309A J2, Reference LO Out. The power should equal or exceed the value shown in Figure 7-15.
5. With a power meter, measure the power output of J3, TEST LO/IF on the rear panel of the HP 85309A. The power should equal or exceed the value shown in Figure 7-15.
6. Repeat these steps at an LO frequency of 1, 6, 9, 15, and 20 GHz.

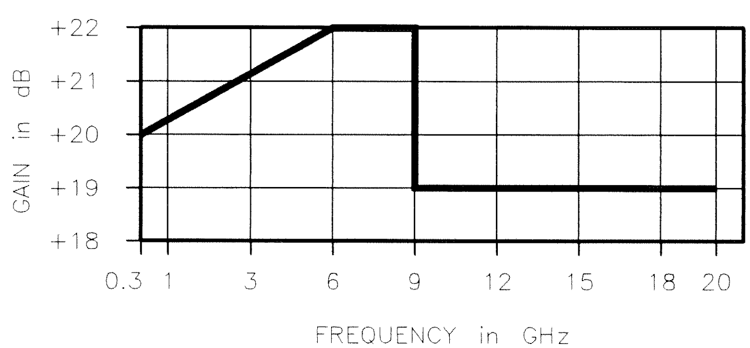


Figure 7-15. LO Amplifier Typical Minimum Gain with 0 dBm Input

Checking the Return Loss of J1 and J2

Perform a return loss measurement using the receiver or other appropriate network analyzer. **Return Loss** is the difference in power between the signal injected into a connector, and the amount of power that the connector "reflects" back at the injecting source. A low return loss value (for example 2 dBm) is bad because it shows that too much power is being reflected back out of the system. This indicates a bad connection somewhere in the system.

LO Amplifier Return Loss from .3 to 20 GHz

Connector	Minimum Return Loss	Equivalent SWR
J1 LO Input	9 dB	2.1:1
J2 LO Output	7 dB	2.6:1

IF Amplifiers A14, A15, A26, and A29

A14 is the amplifier for the reference signal path. A15 is the standard test signal path amplifier. A26 and A29 are added with HP85309A, option 001/002.

Caution The power supply pins on the A14, A15, A26, and the A29 IF amplifiers are fragile. When removing or installing the IF amplifiers be careful not to bend or strike the pins.

Power Meter If you are using a power meter to perform this test, be sure the power sensor is specified at 20 MHz.

Each IF amplifier should have the following minimum gain with a −35 dBm input signal at 20 MHz:

Table 7-10. Minimum IF Amplifier Gain

Frequency Range	Minimum Gain	Maximum Gain	Conditions
20 MHz	21 dB	25 dB	−35 dB Input

Table 7-11. IF Amplifier Return Loss at 20 MHz

Connector	Minimum Return Loss	Equivalent SWR
J1 IF Input	12 dB	1.7:1
J2 IF Output	10 dB	1.9:1

IF Filter A10

Power Meter

If you are using a power meter to perform this test, be sure the power sensor is specified down to 10 MHz.

The IF filter should have the following performance:

Table 7-12. IF Filter Insertion Gain Response

Frequency	Maximum	Minimum
10 MHz	−4.5 dB[1]	
20 MHz		−1.25 dB
40 MHz	−4.5 dB[1]	
80 MHz	−35 dB[1]	
100 MHz	−15 dB[1]	
1.0 GHz	−30 dB[1]	

1 Loss referenced to 20 MHz response.

Power Splitter A11

The power splitter should have the following performance:

Table 7-13. A11 Power Splitter Performance

Category	Performance
Frequency Range:	.3 to 18 GHz
Insertion Gain:	−3.25 − 0.02xf(GHz) dB Minimum
Amplitude Balance:	0.4 dB Maximum
Isolation:	12 dB Minimum, .3 to 2.5 GHz 22 dB Minimum, 2.5 to 18 GHz

Table 7-14.
A11 Power Splitter (Option 001/2) Performance

Category	Performance
Frequency Range:	.3 to 18 GHz
Insertion Gain:	− 7.8 dB Maximum
Amplitude Balance:	0.5 dB Maximum
Isolation:	17 dB Minimum

Sloped Pads AT1, AT2, AT3, and AT4

AT1, AT2, AT3, and AT4 are identical sloped pads. AT3 is the reference path sloped pad. AT4 is the standard test channel sloped pad. AT2 and AT1 are added with HP85309A, option 001 and option 002.

The sloped pad should have the following performance:

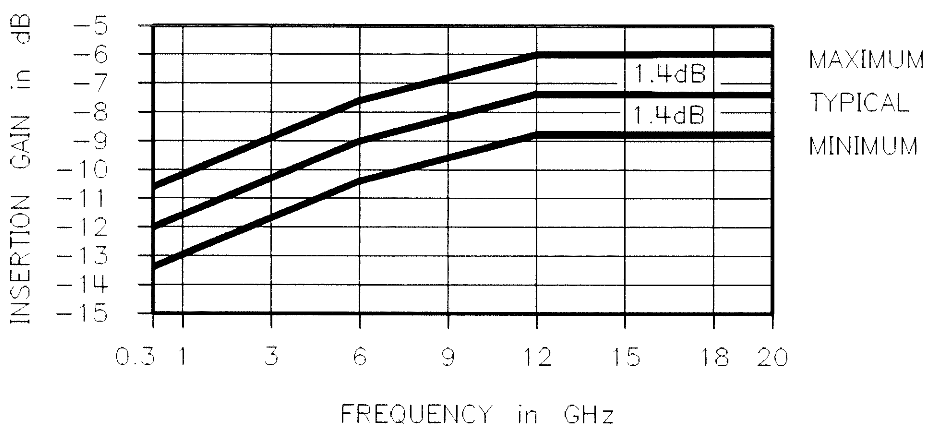


Figure 7-16. Sloped Pad Insertion Gain

Diplexers A16, A25, and A28

A16 is the standard test signal path diplexer. A25 and A28 are added with HP85309, option 001/002. The diplexers are identical. One of the diplexers is shown in Figure 7-17. Its performance characteristics are shown in Table 7-15 and Table 7-16.

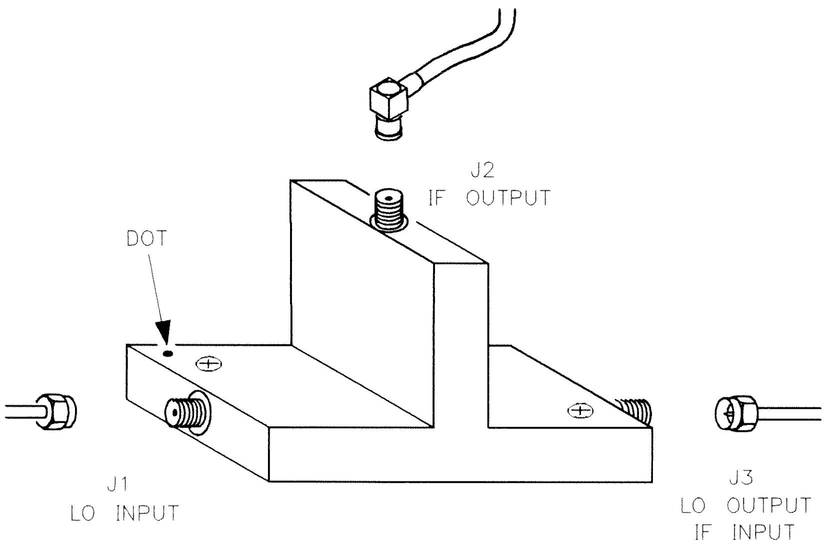


Figure 7-17. Diplexer

Table 7-15. Diplexer Insertion Gain

Signal Path	20 MHz	.3 to 20 GHz
J1 to J3	−10 dB[1]	−1.5 dB[2]
J2 to J3	−1.2 dB[2]	−15 dB[1]

1 Maximum Gain.

2 Minimum Gain.

Table 7-16. Diplexer Return Loss from .3 to 20 GHz

Connector	Minimum Return Loss	Equivalent SWR
J1 LO Input	10 dB	1.9:1
J3 LO/IF Out/In	10 dB	1.9:1

ALC Assembly A2

To test the A2 ALC assembly, perform the following:

Note

A22TP7 can be used for the common ground in all of the following voltage measurements.

1. Apply −60 mV DC to A2J1 or to HP 85309A rear panel J5.
2. Measure the DC voltage at A2TP4. The voltage should be −60 ±4 mV DC.
3. Measure the DC voltage at A2TP6. The voltage should be −600 ±40 mV DC.
4. Measure the DC voltage at A2TP7. The voltage should be 10 ±.2 Volts DC.

Check the POS Z BLANK gain-limiter circuit as follows:

1. Connect a source to the HP 85309A. Set the source to continuously sweep from 2 to 18 GHz.
2. Connect a BNC tee to the POS Z BLANK line. Connect channel A of an oscilloscope to one side of the tee, connect POS Z BLANK to the other side of the tee. Trigger off channel A.
3. Connect oscilloscope channel B to A2TP12, the signal should look like that shown in Figure 7-18.

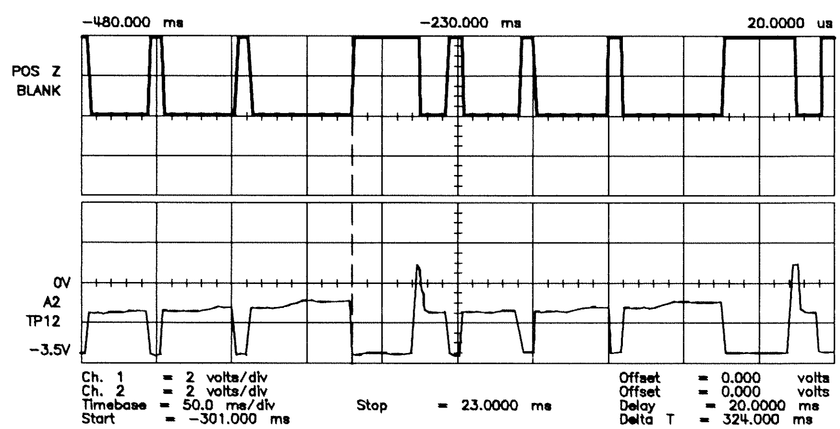


Figure 7-18. Typical Signal at A2TP12

4. Make sure that the flat areas on channel B are at approximately −3V, and that they correspond to the POS Z BLANK signal on

channel A. The narrow flat areas correspond to band switching points, the wide ones correspond to sweep retrace.

Also perform the following ALC checks:

1. Apply a +10 dBm LO signal to the reference mixer LO input. Connect the reference mixer Detector Out to HP 85309A rear panel J5.
2. Measure the DC voltage at A2J1 or at HP 85309A rear panel J5.
3. Measure the DC voltage at A2TP4. The voltage should be the voltage measured in step 2 ±4 mV DC.
4. Measure the DC voltage at A2TP6. The voltage should be 10 times the voltage measured in step 2 ±40 mV DC.
5. Measure the DC voltage at A2TP12. The voltage should be between 0 and −5V.

Detector Display A1

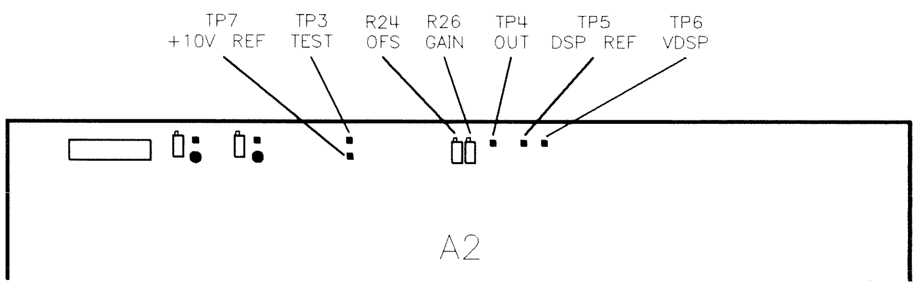


Figure 7-19. Location of Display Adjustments.

The A1 detector display should be tested while it is still installed in the LO/IF unit. First test the A2 assembly as shown in "ALC Assembly A2", then perform the following:

Note A22TP7 can be used as the common ground in all of the following voltage measurements.

1. Apply −60 mV DC to A2J1 or to HP 85309A rear panel J5.
2. Measure the DC voltage at A2TP6. The voltage should be −600 ±40 mV DC.
3. The front panel detector display should show −60 ±3 mV.

1. Apply a +10 dBm LO signal the reference mixer module LO input. Connect the reference mixer Detector Out to the HP 85309A rear panel J5.
2. Measure the DC voltage at A2J1 or at HP 85309A rear panel J5.
3. Measure the DC voltage at A2TP6. The voltage should be 10 times the voltage measured in step 2 ±40 millivolts DC.
4. The front panel detector display should show the voltage measured in step 2 ±3 mV.

If the front panel display does not show the correct voltage, see "Front Panel Display Adjustments" for the adjustment procedure.

Mixer Troubleshooting

To determine if the mixer modules are operating correctly, the LO power levels and conversion gain can be measured by the following procedures. If the RF cables and LO/IF unit are operating correctly, it can be assumed that the mixer module has failed.

HP 85320A Test Mixer

LO Signal Level

Check the LO signal power level at the mixer according to the following instructions. It is assumed that this test is done on a fully installed measurement system.

1. Adjust the LO power level as shown in "Set the LO Power" in Chapter 2.
2. Disconnect the test mixer module from the cable connected to the mixer's LO In/IF Out connector.
3. Connect a power meter to the cable. If using an HP 8530A, press (DOMAIN) FREQUENCY.
4. Set the receiver to the single point mode by pressing: STIMULUS (MENU), SINGLE POINT.
5. Measure the LO power level over the entire LO frequency range. Step through six frequency points from the lowest to the highest LO frequency by pressing (CENTER), then the frequency. The LO power should not exceed the following:

Table 7-17. Mixer LO Signal Power Level

LO Frequency	Minimum Power	Typical Power	Maximum Power
1 to 18 GHz	+7.5 dBm	+11 dBm	+16 dBm

Test Mixer Conversion Gain

To check the conversion gain of the test mixer (in an installed measurement system or on the bench), perform the following:

1. The LO/IF unit, test mixer, reference mixer, LO source, and cables should be set up the same as in normal system use.
2. Make sure that the correct LO signal power and frequency is being applied to the test mixer module LO Input/IF Output. See the procedure above to check the LO power level.
3. Calibrate the power meter as shown in its manual.
4. Set the receiver to the single point mode by pressing:

   STIMULUS (MENU), SINGLE POINT.
5. Change the RF test frequency to the lowest test frequency used in your measurements:

   Press (CENTER), followed by the desired frequency.

6. Set the RF test signal power level. The signal should be less than the gain compression power level and greater than the minimum phase lock level. The recommended signal level is −29 dBm. See Chapter 5 for more information on these levels. An actual signal from an antenna is acceptable.
7. Measure the power level at this frequency. Write down the power level and frequency.
8. Step through five more frequencies, ending at the highest test frequency used in your measurements. Be sure and write down each power level and frequency.
9. Connect the RF test signal to the RF input of the test mixer module.
10. Remove the LO/IF unit rear panel test channel jumper from J7 and J8. Connect a 20 MHz-specified power sensor to the J8 Diplexer IF Out.
11. Measure the 20 MHz IF signal over the entire RF frequency range (used in your measurements) by stepping through the six RF test frequencies.
12. The mixer's conversion gain is equal to the J8 IF signal level, minus the IF cable insertion loss at 20 MHz, the A16 diplexer 20 MHz insertion gain, and the RF test signal level. An example of a typical measurement is shown below.

$$\text{Conversion Gain} = \text{IF Power} - \text{Cable Insertion Gain} - \text{Diplexer Conversion Gain} - \text{RF Power}$$

$$G_C = P_{IF}\ \text{dBm} - G_{Cable}\ \text{dB} - G_{Diplexer}\ \text{dB} - P_{RF}\ \text{dBm}$$

$$G_C = -38\ \text{dBm} - (-0.5\ \text{dB}) - (-1.0\ \text{dB}) - (-24\ \text{dBm})$$

$$G_C = -12.5\ \text{dB}$$

The mixer conversion gain is shown in Table 7-18.

13. The above test can be repeated for the third LO harmonic.

Table 7-18. HP 85320A/B Conversion Gain

Frequency Range	LO Harmonic	Typical Gain	Minimum Gain
1 to 2 GHz	1	−18.0 dB	−22 dB
2 to 3 GHz	1	−12.0 dB	−16 dB
3 to 5 GHz	1	−11.0 dB	−15 dB
5 to 18 GHz	1	−14.7 dB	−17 dB
6 to 8 GHz	3	−23.8 dB	−26 dB
8 to 16 GHz	3	−26.5 dB	−28 dB
16 to 26.5 GHz	3	−28.5 dB	−33 dB

HP 85320B Reference Mixer

LO Signal Level

To check the IF signal level of the reference mixer (in an installed measurement system or on a bench), perform the following:

1. The LO/IF unit, test mixer, reference mixer, LO source, and cables should be set up the same as in normal system use.
2. Make sure the correct LO signal power and frequency is being applied to the mixer module LO Input. The LO power level can be adjusted by the procedure described in "Set the LO Power" in Chapter 2.
3. Check the LO power level over the entire LO frequency range using the following procedure:
   a. Set the receiver for fundamental mode operation. (Chapter 3 describes this procedure.)
   b. If using an HP 8530A, press (DOMAIN) FREQUENCY.
   c. Press STIMULUS (MENU), SINGLE POINT.
   d. Set (CENTER) frequency to the lowest RF frequency in your measurement band.
   e. Observe HP 85309A's DETECTOR VOLTAGE Display.
   f. Repeat steps d and e at five more CW frequencies, starting at the lowest LO frequency and going to the highest frequency in your measurement band.
   g. The voltage should not increase more than 25% above the LO voltage marked on the reference mixer, (this value should have been written in Table 2-5). In addition, the voltage should not decrease more than 25% from the specified LO voltage. If the LO voltage drops more than 25% it must be adjusted. See "Set the LO Power" in Chapter 2.

Reference Mixer Conversion Gain

To check the conversion gain of the reference mixer (in an installed measurement system or on a bench), perform the following:

1. The LO/IF unit, test mixer, reference mixer, LO source, and cables should be set up the same as in normal system use.
2. Make sure the correct LO signal power and frequency is being applied to the mixer module LO Input. The LO power level can be adjusted by the procedure described in "Set the LO Power" in Chapter 2.
3. To maintain LO source phase lock, the test mixer channel can be used as a phase lock reference when you perform the following procedure:
   a. Make sure that the RF test signal is applied to the test and reference mixers. The signal level should be less than the gain compression power level and greater than the minimum

phase lock level. The recommended signal level is −29 dBm. See Chapter 5 for more information on these levels. An actual signal from an antenna is acceptable.

b. Connect the LO/IF unit's J9 Test IF Out to the a1 channel (brown wire) of the receiver J1 Test Set Interconnect.

c. Connect the LO/IF unit's J10 Reference IF Out to the b2 channel (green wire) of the receiver J1 Test Set Interconnect.

d. Be sure to return the LO/IF unit and the receiver Test Set Interconnect to their original configuration when the tests are concluded.

4. Calibrate the power meter as shown in the power meter's manual.
5. If using an HP 8530A, press (DOMAIN) FREQUENCY.
6. Set the receiver to the single point mode by pressing:

   STIMULUS (MENU), SINGLE POINT.
7. Change the RF test frequency to the lowest test frequency in your measurement band

   Press (CENTER) and enter the correct frequency.
8. Set the appropriate RF test signal level. The signal level should be less than the gain compression power level and greater than the minimum phase lock level. The recommended signal level is −29 dBm. See Chapter 5 for more information on these levels. An actual signal from an antenna is acceptable.
9. Measure the power level at this frequency. Write down this power level and frequency.
10. Step through five more frequencies, ending at the highest test frequency used. Be sure and write down each power level and frequency.
11. Connect the RF test signal to the RF input of the reference mixer module.
12. Connect a 20 MHz-specified power sensor to the IF OUT on the reference mixer module.
13. Measure the 20 MHz IF signal over your entire RF frequency measurement band by stepping through the six RF test frequencies.
14. The mixer's conversion gain is equal to the IF signal level less the RF test signal level. An example of a typical measurement is shown below.

$G_C = P_{IF}$ dBm − P_{RF} dBm *Conversion Gain = IF Power − RF Power*

$G_C = -36$ dBm − (−24 dBm)

$G_C = -12$ dB

The mixer conversion gain is shown in Table 7-18.

15. The above test can be repeated for the third LO harmonic.

Detector Check

To check the LO detector on the reference mixer, perform the following:

1. Apply a 3.5 GHz LO signal at +11 dBm to the LO Input of the HP 85320B.
2. Connect a 2 KΩ load to the Detector Output.
3. Measure the DC voltage at the Detector Output. The voltage should be the same as the voltage shown on the label of the reference mixer ±4 mV DC.

Cable Troubleshooting

RF cables normally fail for three reasons:

- The cable is bent too many times, or it is bent at a sharp angle.
- The end of the cable is bent too many times, causing damage to the connector-cable interface.
- The cable is crushed or cut.

Determining the Cause

The cause of a cable failure can be difficult to detect. Several ways can be used to measure the cable:

Measuring Insertion Loss

Measuring the insertion loss of the cable will help detect a damaged or cut cable. The insertion loss of the cable will also help detect a cable that has been flexed too many times.

Measuring Return Loss (VSWR)

Measuring the return loss (VSWR) of the cable will show a damaged connector-cable interface. The return loss time domain can be beneficial to show the exact location of a cable failure. If the cable is physically long or has high RF insertion loss, a return loss measurement may not detect damage.

Use the cable manual or Chapter 8 for information on measuring the insertion loss and return loss of the cables.

Troubleshooting Performance Failures

This section of the troubleshooting guide assumes that while all instruments in the receiver system are functional, the system is not operating to specifications. Use this section to help isolate the problem. See "Troubleshooting Instrument Failures" for information on troubleshooting and instrument failure.

Basic Checks

Check the following areas to make sure that they are correct before proceeding further:

- Check for broken or damaged cables.
- Make sure all cable connections are tight. Is the connector tightened to its proper torque value? Proper connection torque is *absolutely vital* if the system is to meet specifications!

Compression Test Failure

Check the following areas:

- The most likely cause of failure is the HP 85102's IF section (HP 85102 will be mentioned often - this is the bottom box of the HP 8510 or HP 8530A).
- Check the mixer module for mixer failure.
- Check the HP 85310A conversion gain. Table 7-2 shows conversion gain specifications. Is the gain too high?

Isolation Test Failure

Check the following areas:

- Check the cables between the LO/IF Unit and the mixer for damage. Also check for loose connectors, torque them if necessary.
- Check the cables between the LO source and the LO/IF unit for damage. Also check for loose connectors, torque them if necessary.
- Check all adapters for damage.
- Check for loose or damaged instrument covers.
- Check for loose internal cables in the LO/IF unit.
- Check the HP 85102 IF crosstalk.
- Make sure the LO/IF unit is not being illuminated by the transmitting antenna.

Acquire Phase Lock Test Failure

Check the following areas:

- Make sure the receiver's `PHASELOCK` setting is set to `EXTERNAL`.
- Make sure the cables between the receiver, LO source, and LO/IF unit are connected properly.
- Check to make sure the LO source's FM modulation is working correctly.

- Check the HP 85310A reference channel for proper conversion gain.
- Check the HP 85102 a1 IF for proper phase lock operation.

Low Level Noise Test Failure

Check the following areas:

- Check the HP 85310 conversion gain. Table 7-2 shows conversion gain specifications. Is the gain too low?
- Check the LO power. See "Mixer Troubleshooting" for the testing procedures.
- Check the LO power at the test mixer. It should be within ±3 dB of the LO power at the reference mixer.
- Check for mixer damage.
- Check LO source for out of specification spurious signals, or phase noise.
- Are any nearby devices generating a 20 MHz radio frequency interference (RFI) field? See "Specifications" in Chapter 5 for specifications on 20 MHz RFI susceptibility.
- Make sure the LO/IF unit is not being illuminated by the transmitting antenna.

Replaceable Parts

Introduction

This section contains information for ordering replaceable parts for the HP 85310A Distributed Frequency Converter. The replaceable parts include major assemblies and chassis hardware.

Adjustments and Verification

Adjustments may be required after you replace an assembly. Performance verification will assure that the HP 85310A meets its published specifications after you have replaced an assembly. Chapter 4 describes the verification procedure.

Rebuilt-Exchange Assemblies Available

Some lower cost assemblies are available through the rebuilt-exchange program. These factory *rebuilt* (repaired and tested) assemblies meet all specifications required of a new assembly. They are offered on an *exchange* (trade-in) basis only. The defective assembly must be returned for credit, so rebuilt-exchange assemblies are not suitable for stock or spares. To stock spare assemblies, order a new assembly. Table 7-19, Table 7-20, and Table 7-21 show all major assemblies including those that can be replaced on an exchange basis. Figure 7-20 illustrates the rebuilt-exchange procedure.

If you have any questions, contact your HP Representative.

Use this fast, efficient, economical method to keep your Hewlett-Packard instrument in service.

Locate defective assembly using troubleshooting procedures and service sheets in this manual.

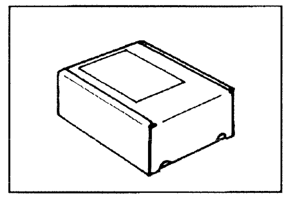
↓

Is a replacement assembly on hand?

YES → Install the replacement assembly. Keep the defective assembly for return to HP. → Order rebuilt-exchange assembly from HP. Refer to the replaceable parts section for part numbers. → Put rebuilt-exchange assembly in spares stock. → Return defective assembly to HP.

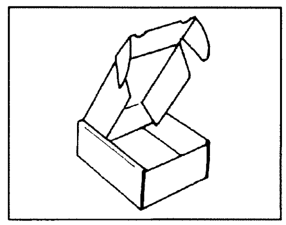
NO → Order rebuilt exchange assembly from HP. Refer to the replaceable parts section for part numbers. → Swap replacement assembly and defective assembly. → Return defective assembly to HP.

A.



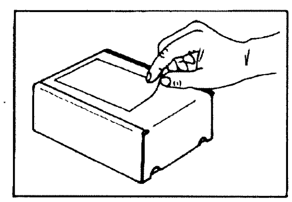
Rebuilt-exchange assemblies are shipped individually in boxes like this. In addition to the circuit assembly, the box contains:
- Exchange assembly failure report
- Return address label

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 7-20. Rebuilt-Exchange Procedure

Parts List Description

Table 7-19 through Table 7-26 show the location and identification of all replaceable parts. The corresponding lists provide the following information:

1. Reference designator identifies the part in the accompanying figure.
2. Hewlett-Packard part number.
3. Part quantity as shown in the corresponding figure. (There may or may not be more of the same part elsewhere in the instrument.)
4. Part description and identifying or functional name.

Ordering Information

To order a part, 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 serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

How to Order Parts Fast!

The fast ordering system only applies in the United States. Outside the United States, contact your nearest HP office.

When you know which parts you need, contact Hewlett-Packard's direct ordering team by calling this toll-free number:

800-227-8164 (Monday through Friday, 6 am to 5 pm PST)

The parts specialists have direct access to the replacement parts listed in this manual. There is a charge for hotline one day delivery, but four day delivery is standard. After hours and holidays, call 415-968-2347.

Table 7-19. Major Assemblies (Standard)

Reference Designator	HP Part Number	Qty	Description
A1	85309-60022	1	Display Assy
A2	85309-60030	1	10V Power Supply, Display Driver
A10	85309-60010	1	IF Filter Assy
A11	0955-0509	1	Power Splitter
A12	5086-7530	1	LO Amp, Reference
	5086-6530	1	LO Amp, Rebuilt/Exchange
A13	5086-7530	1	LO Amp, Test
	5086-6530	1	LO Amp, Rebuilt/Exchange
A14	0955-0511	1	Reference If Amp
A15	0955-0511	1	Test If Amp
A16	5086-7542	1	Diplexer
A17	5086-7530	1	LO Amp, Input
	5086-6530	1	LO Amp, Rebuilt/Exchange
A18	85309-60031	1	LO Power Adjust Potentiometer and Cable
A19	85309-60033	1	Motherboard
A20	85309-60032	1	LO Power Out of Range LED and Cable
A22	85309-60025	1	Power Supply
AT3	33340C KO3	1	Slope Pad, Reference
AT4	33340C KO3	1	Slope Pad, Test 1
AT5	1250-0676	1	SMB Load, 50 ohm
FL1	9135-0217	1	Line Module
SW1		0	Line Switch (part of Ca Assy)
T1	9100-4892	1	Transformer, Power
F1	2110-0043	1	Fuse, 1.5 amp 250 volt
F1	2110-0063	1	Fuse, .75 amp 250 volt
	85320-69001	1	HP 85320A Rebuilt/Exchange
	85320-69002	1	HP 85320B Rebuilt/Exchange

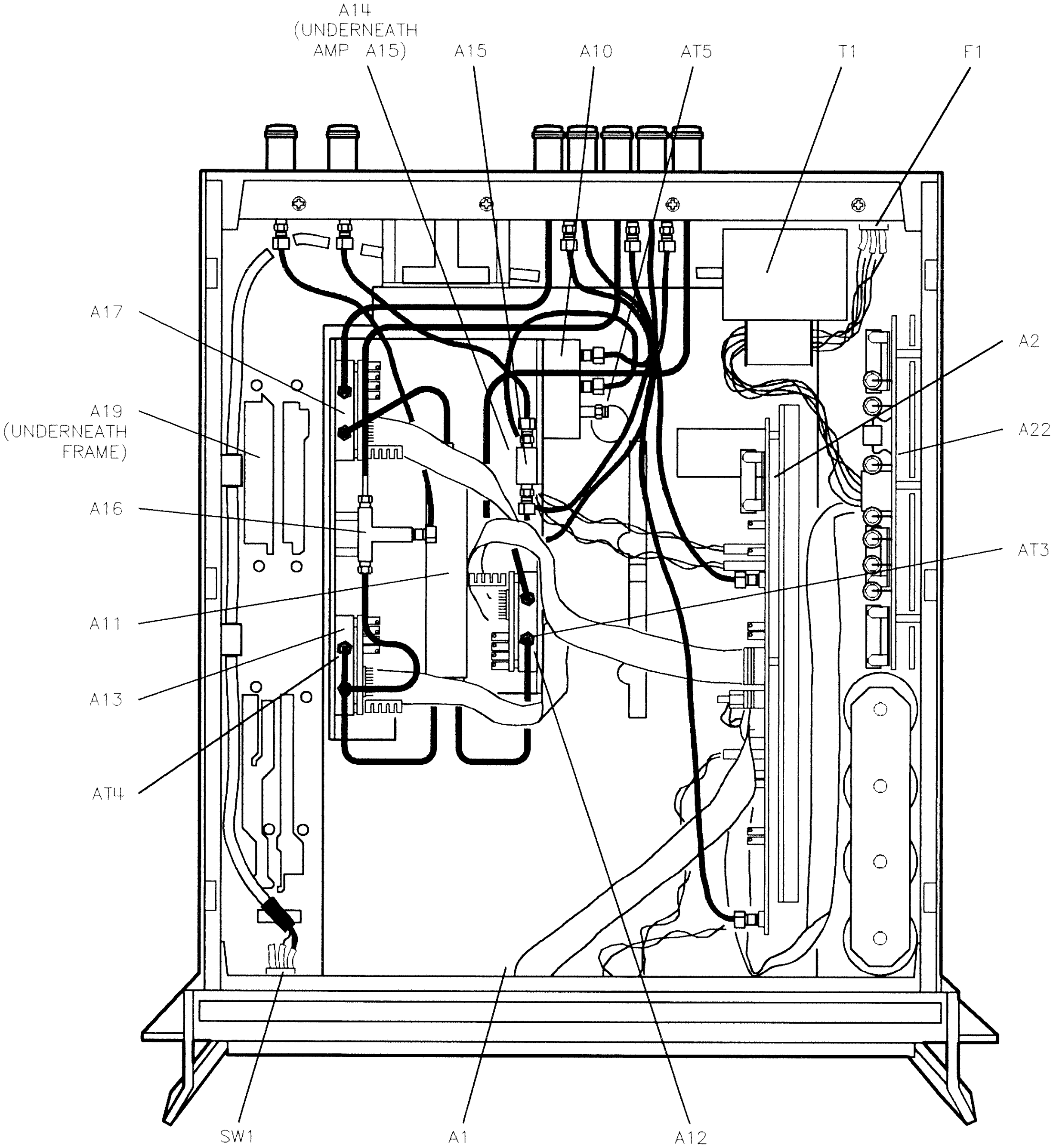


Figure 7-21. Major HP 85309A Assemblies (Standard)

Table 7-20. Major Assemblies (Option 001)

Reference Designator	HP Part Number	Qty	Description
A2, option 001	85309-60030	1	10V Power Supply, Display Driver
A11, option 001	0955-0566	1	Power Splitter
A19, option 001	85309-60033	1	Motherboard
A22, option 001	85309-60025	1	Power Supply
A24, option 001	5086-7530	1	LO Amp, Test 2
	5086-6530	1	LO Amp, Rebuilt/Exchange
A25, option 001	5086-7542	1	Diplexer
A26, option 001	0955-0511	1	IF Amp
AT1, option 001	33340C KO3		
AT2, option 001	33340C KO3	1	Slope Pad, Test 3
AT3, option 001	33340C KO3	1	Slope Pad, Reference
AT4, option 001	33340C KO3	1	Slope Pad, Test 1
AT6, option 001	0960-0053	1	Termination (4th Port)
T2, option 001	9100-4894	1	Transformer, Power
F1, option 001	2110-0002	1	Fuse, 2.0 amp 250 volt
F1, option 001	2110-0002	1	Fuse, 1.0 amp 250 volt

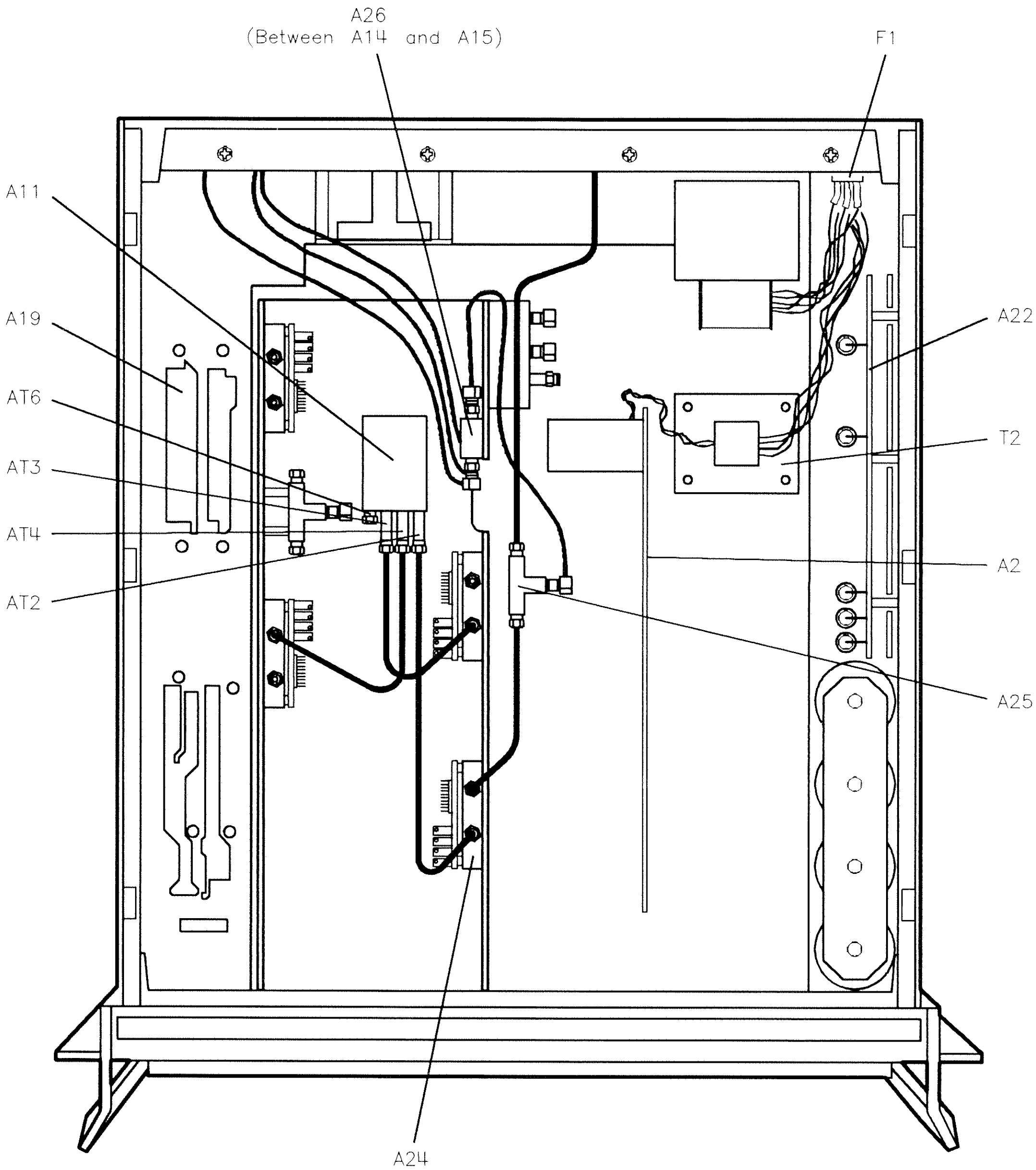


Figure 7-22. Major HP 85309A Assemblies (Option 001)

Table 7-21. Major Assemblies (Option 002)

Reference Designator	HP Part Number	Qty	Description
A2, option 002	85309-60030	1	10V Power Supply, Display Driver
A11, option 002	0955-0566	1	Power Splitter
A19, option 002	85309-60033	1	Motherboard
A22, option 002	85309-60025	1	Power Supply
A24, option 002	5086-7530	1	LO Amp, Test 2
	5086-6530	1	LO Amp, Rebuilt/Exchange
A25, option 002	5086-7542	1	Diplexer
A26, option 002	0955-0511	1	IF Amp
A27, option 002	5086-7530	1	LO Amp, Test 3
	5086-6530	1	LO Amp, Rebuilt/Exchange
A28, option 002	5086-7542	1	Diplexer
A29, option 002	0955-0511	1	IF Amp
AT1, option 002	33340C KO3	1	Slope Pad, Test 2
AT2, option 002	33340C KO3	1	Slope Pad, Test 3
AT3, option 002	33340C KO3	1	Slope Pad, Reference
AT4, option 002	33340C KO3	1	Slope Pad, Test 1
T2, option 002	9100-4894	1	Transformer, Power
F1, option 002	2110-0002	1	Fuse, 1.0 amp 250 volt
F1, option 002	2110-0002	1	Fuse, 2.0 amp 250 volt

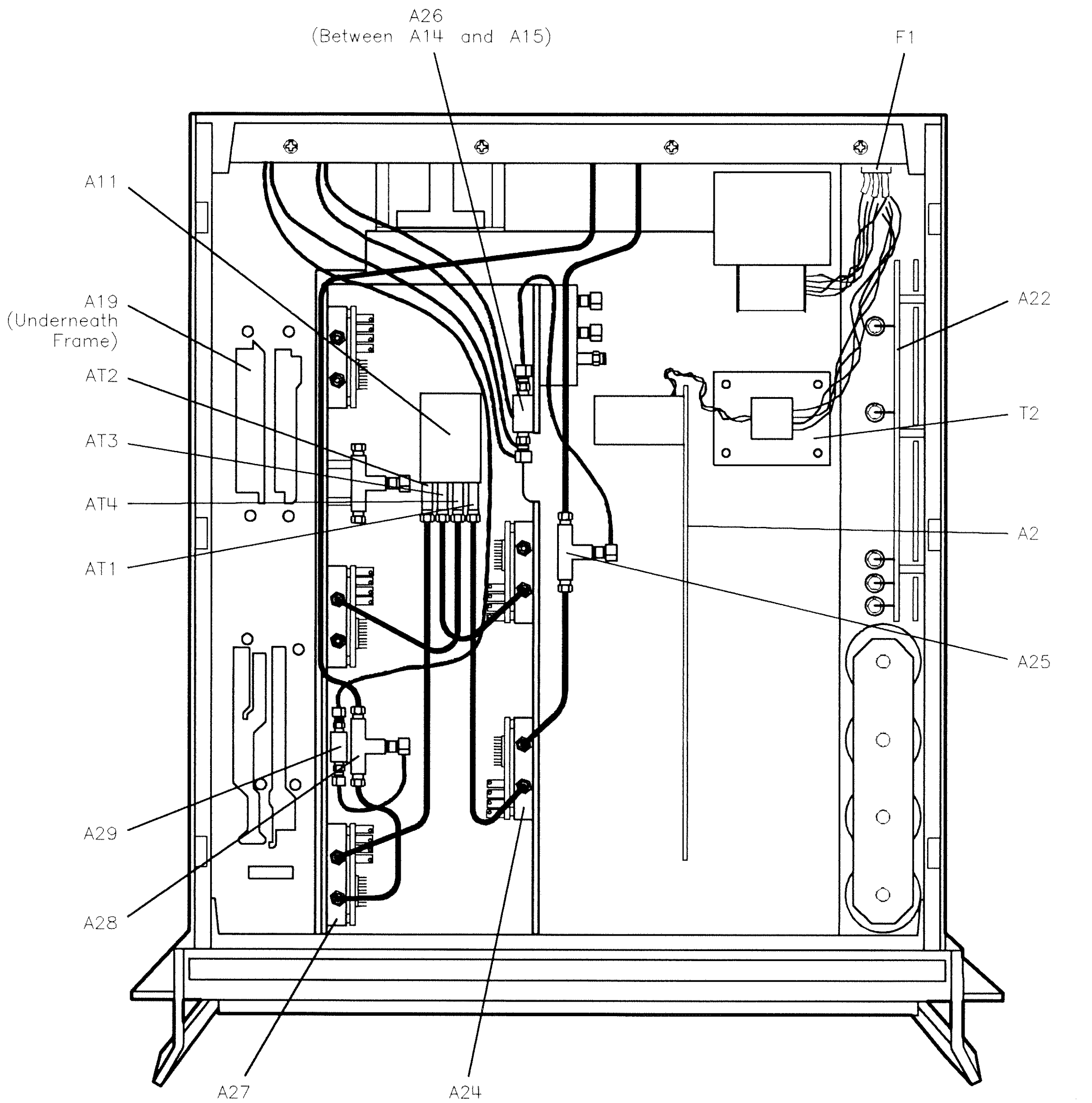


Figure 7-23. Major HP 85309A Assemblies (Option 002)

The diagram on the right-hand page shows the cables and major assemblies in a standard HP 85309A. On the following pages, you will see other diagrams (and explanatory tables) that show the location of standard and optional cables.

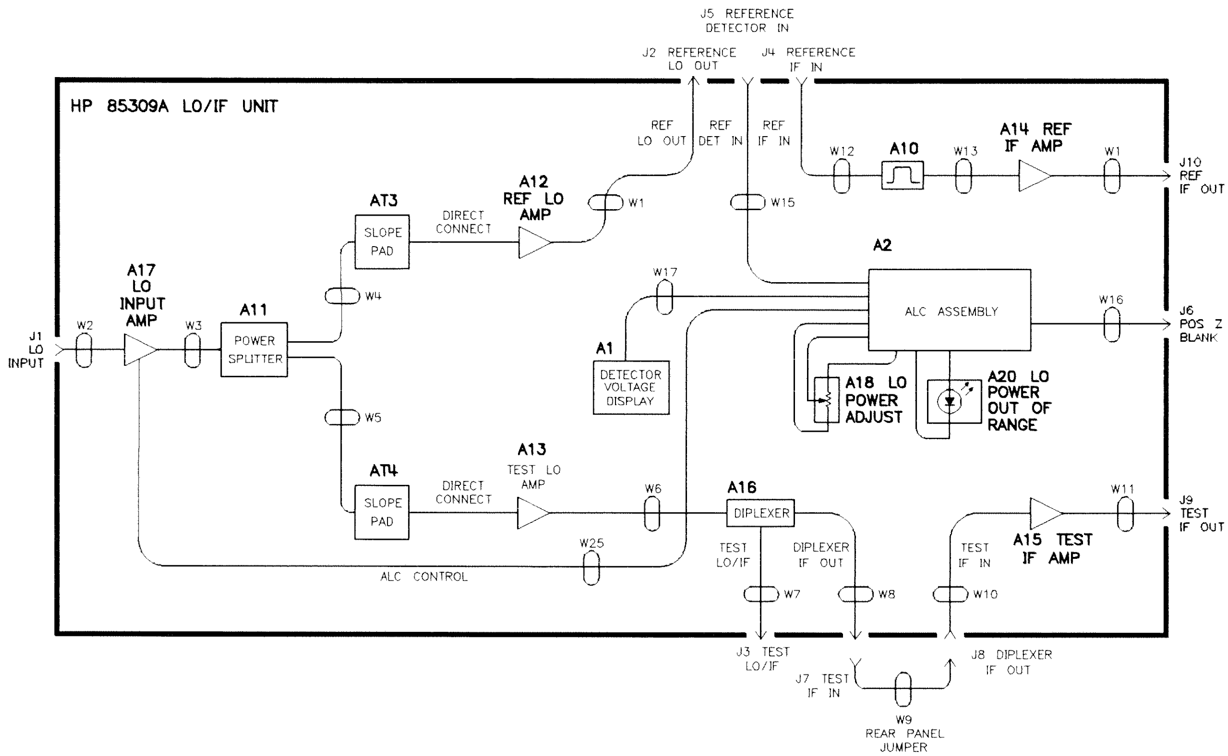


Figure 7-24. Cable Identification Diagram (Standard)

Table 7-22. Cables (Standard)

Reference Designator	HP Part Number	Qty	Description
W1	85309-20005	1	RPJ2-A12J2 Ca Assy
W2	85309-20001	1	RPJ1-A17J1 Ca Assy
W3	85309-20002	1	A17J2-A11J1 Ca Assy
W4	85309-20003	1	A11(AT3)-A12(J1) Ca Assy
W5	85309-20004	1	A11(AT4)-A13(J1) Ca Assy
W6	85309-20006	1	A16J1-A13J2 Ca Assy
W7	85309-20007	1	A16J3-RPJ3 Ca Assy
W8	8120-5105	1	A16J2-RPJ8 Flexible Ca Assy
W9	85309-20008	1	Jumper RPJ7-RPJ8 Ca Assy
W10	8120-5069	1	RPJ7-A15J1 Flexible Ca Assy
W11	8120-5069	1	A15J2-RPJ9 Flexible Ca Assy
W12	8120-5107	1	A10J1-RPJ4 Flexible Ca Assy
W13	8120-5107	1	A10J3-A14J1 Flexible Ca Assy
W14	8120-5069	1	A14J2-RPJ10 Flexible Ca Assy
W15	8120-5105	1	A2J1-RPJ5 Flexible Ca Assy
W16	85309-60035	1	A2J2-RPJ6 Flexible Ca Assy
W17	85309-60015	1	A2J6-A1J1 Ribbon Cable
W18	85309-60015	1	A2J3-A13 Ribbon Cable
W19	85309-60015	1	A2J4-A12 Ribbon Cable
W20	85309-60015	1	A2J5-A17 Ribbon Cable
W21	85309-60017	1	A2J7-A22 Ribbon Cable
W22	85309-60012	1	A2J8-A15 Twisted Pair Ca Assy
W23	85309-60012	1	A2J9-A14 Twisted Pair Ca Assy
W24	85102-60226	1	Line Switch, Ca Assy
W25	85309-60034	1	A2J12 to A17J2 ALC Control Cable

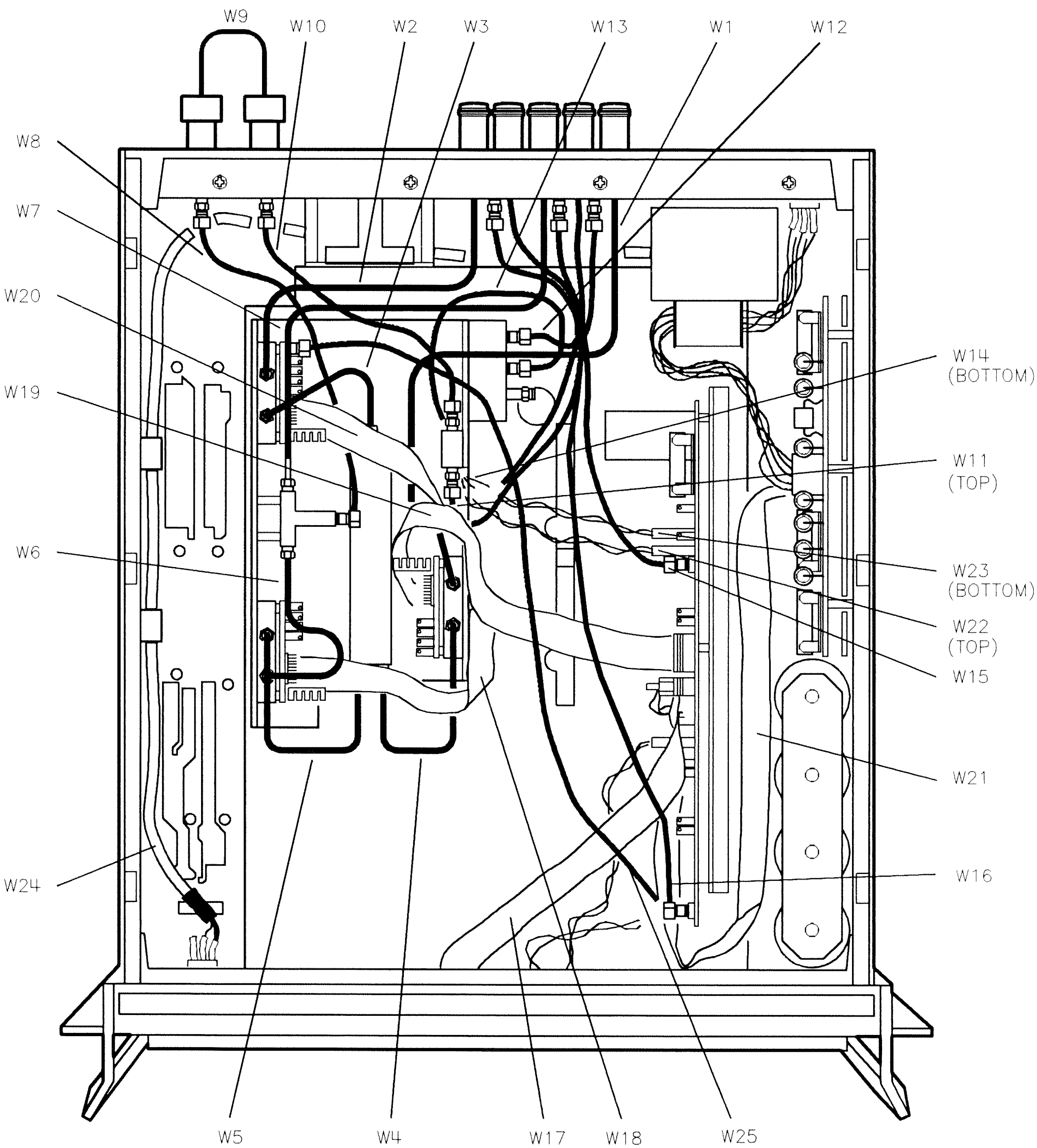


Figure 7-25. Cable Locations (Standard)

Table 7-23. Cables (Option 001)

Reference Designator	HP Part Number	Qty	Description
W4, option 001	85309-20027	1	A11(AT3)-A12(J1) Ca Assy
W5, option 001	85309-20026	1	A11(AT4)-A13(J1) Ca Assy
W11, option 001	8120-5069	1	A15J2-RPJ9 Flexible Ca Assy
W14, option 001	8120-5069	1	A14J2-RPJ10 Flexible Ca Assy
W18, option 001	85309-60027	1	A2J3-A13-A25 Ribbon Cable
W28, option 001	85309-60012	1	A2J13-A26 Twisted Pair Ca Assy
W30, option 001	85309-20023	1	A11(AT1)-A24(J1) Ca Assy
W31, option 001	85309-20024	1	A24(J2)-A25(J1) Ca Assy
W32, option 001	85309-20025	1	A25(J3)-RP(J11) Ca Assy
W33, option 001	8120-5105	1	A25(J2)-A26(J1)Flexible Ca Assy
W34, option 001	8120-5060	1	A26(J2)-RP(J12) Flexible Ca Assy

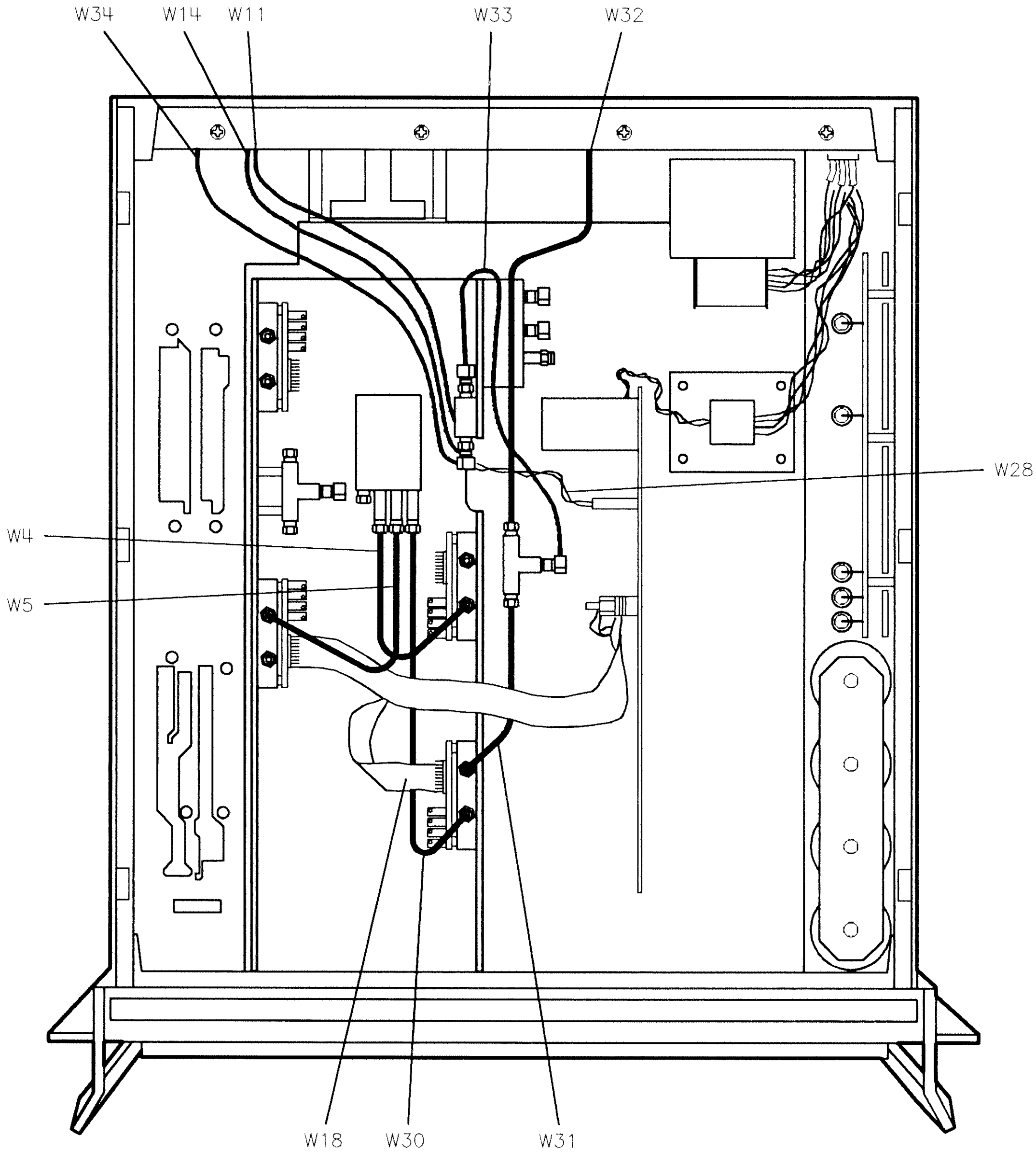


Figure 7-26. Cable Locations (Option 001)

Table 7-24. Cables (Option 002)

Reference Designator	HP Part Number	Qty	Description
W4, option 002	85309-20027	1	A11(AT3)-A12(J1) Ca Assy
W5, option 002	85309-20026	1	A11(AT4)-A13(J1) Ca Assy
W18, option 002	85309-60027	1	A2J3-A13-A25 Ribbon Cable
W20, option 002	85309-60027	1	A2J5-A17-A27 Ribbon Cable
W28, option 002	85309-60012	1	A2J13-A26 Twisted Pair Ca Assy
W29, option 002	85309-60036	1	A2J14-A29 Twisted Pair Ca Assy
W30, option 002	85309-20023	1	A11(AT1)-A24(J1) Ca Assy
W31, option 002	85309-20024	1	A24(J2)-A25(J1) Ca Assy
W32, option 002	85309-20025	1	A25(J3)-RP(J11) Ca Assy
W33, option 002	8120-5105	1	A25(J2)-A26(J1)Flexible Ca Assy
W34, option 002	8120-5060	1	A26(J2)-RP(J12) Flexible Ca Assy
W35, option 002	85309-20028	1	A11(AT2)-A27(J1) Ca Assy
W36, option 002	85309-20006	1	A27(J2)-A28(J1) Ca Assy
W37, option 002	85309-20029	1	A28(J3)-RP(J13)Ca Assy
W38, option 002	8120-5105	1	A28(J2)-A29(J1) Flexible Ca Assy
W39, option 002	85309-60038	1	A29(J2)-RP(J14) Flexible Ca Assy

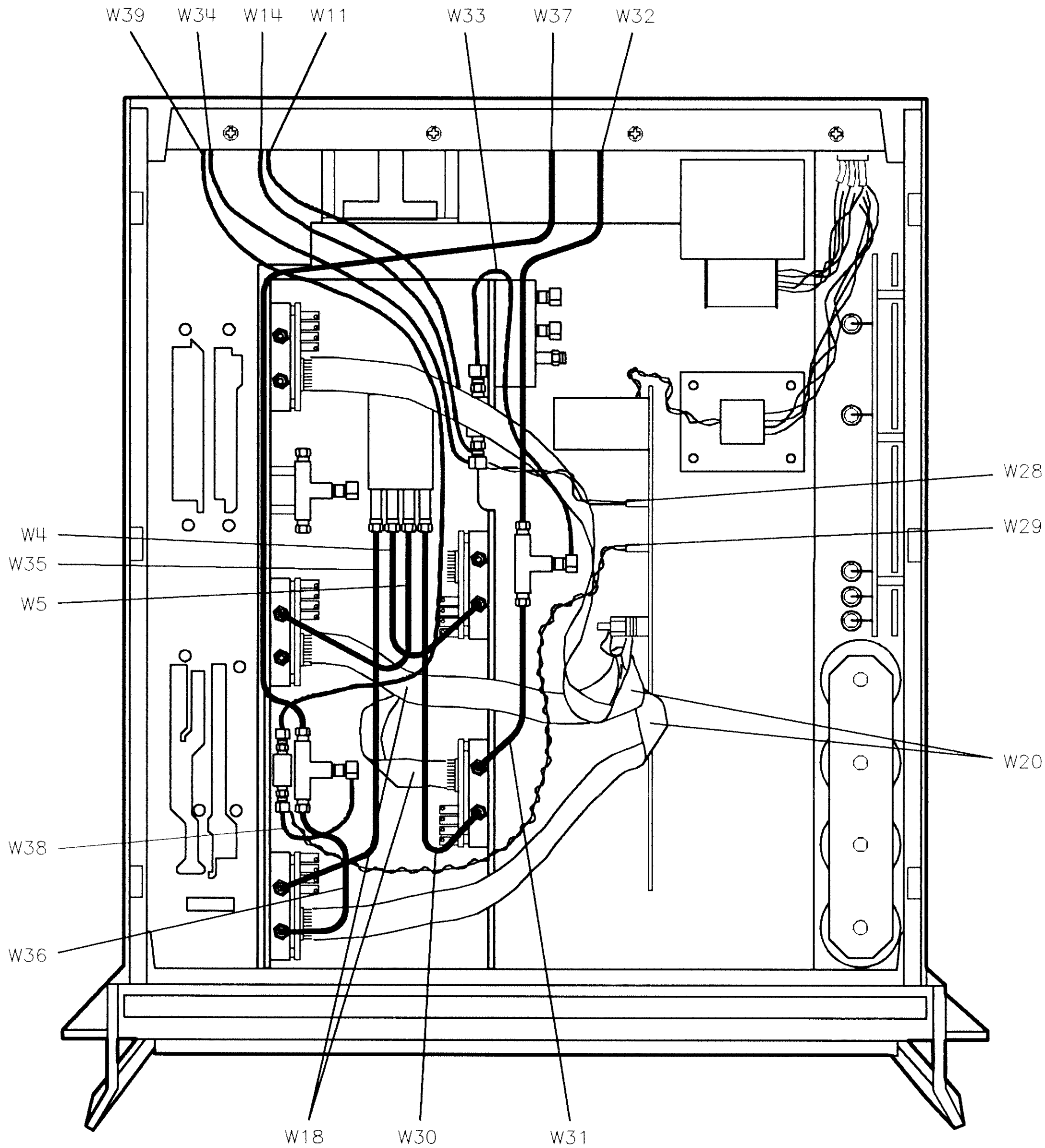


Figure 7-27. Cable Locations (Option 002)

Table 7-25. Chassis Parts

Reference Designator	HP Part Number	Qty	Description
1	5062-3735	1	Cover, Top
2	5021-5804	1	Frame, Rear
3	5021-8403	1	Frame, Front
4	5021-5837	4	Corner Strut
5	5062-3747	1	Cover, Bottom
6	5062-3757	1	Cover, Side
7	08513-00041	1	Cover, Side, Perforated
8	5062-3799	2	Handle Assy
9	5021-8496	2	Handle Trim
10	5021-8747	1	Front Bezel
11	5041-8802	1	Top Trim Strip
12	5041-8801	4	Bottom Foot
13	85309-00001	1	Front Subpanel
14	85309-00002	1	Rear Panel
14, option 001/2	85309-00011	1	Rear Panel
15	85309-00003	1	Main Deck
16	85309-00009	1	Front Panel, Dress
17	08754-40001	1	LED Display Window
18	5041-8821	4	Rear Panel Standoff
19	1510-0038	1	Ground Binding Post
20	85309-00004	1	Component Mount
20, option 001/2	85309-00012	1	Component Mount
21	85309-00006	2	Transformer Support
21, option 001/2	85105-00009	1	Transformer Support
21, option 001/2	85105-20027	2	Spacers
22	5061-5386	10	Type-N Connector
22, option 001	5061-5386	12	Type-N Connector
22, option 002	5061-5386	14	Type-N Connector
23	08513-20031	1	Fan
24	3160-0309	1	Finger Guard
25	08513-00015	1	Capacitor Support Plate

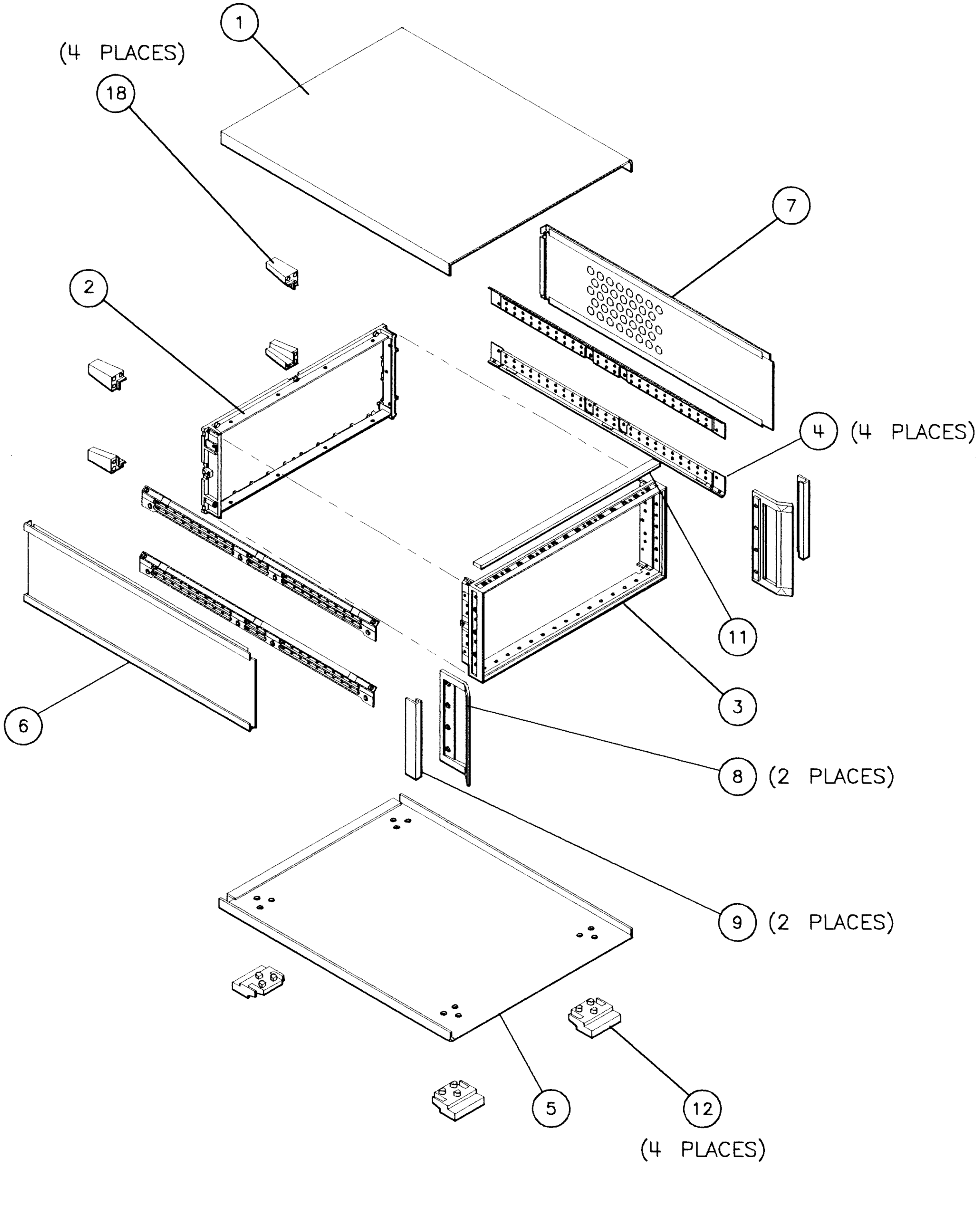


Figure 7-28. Chassis Parts

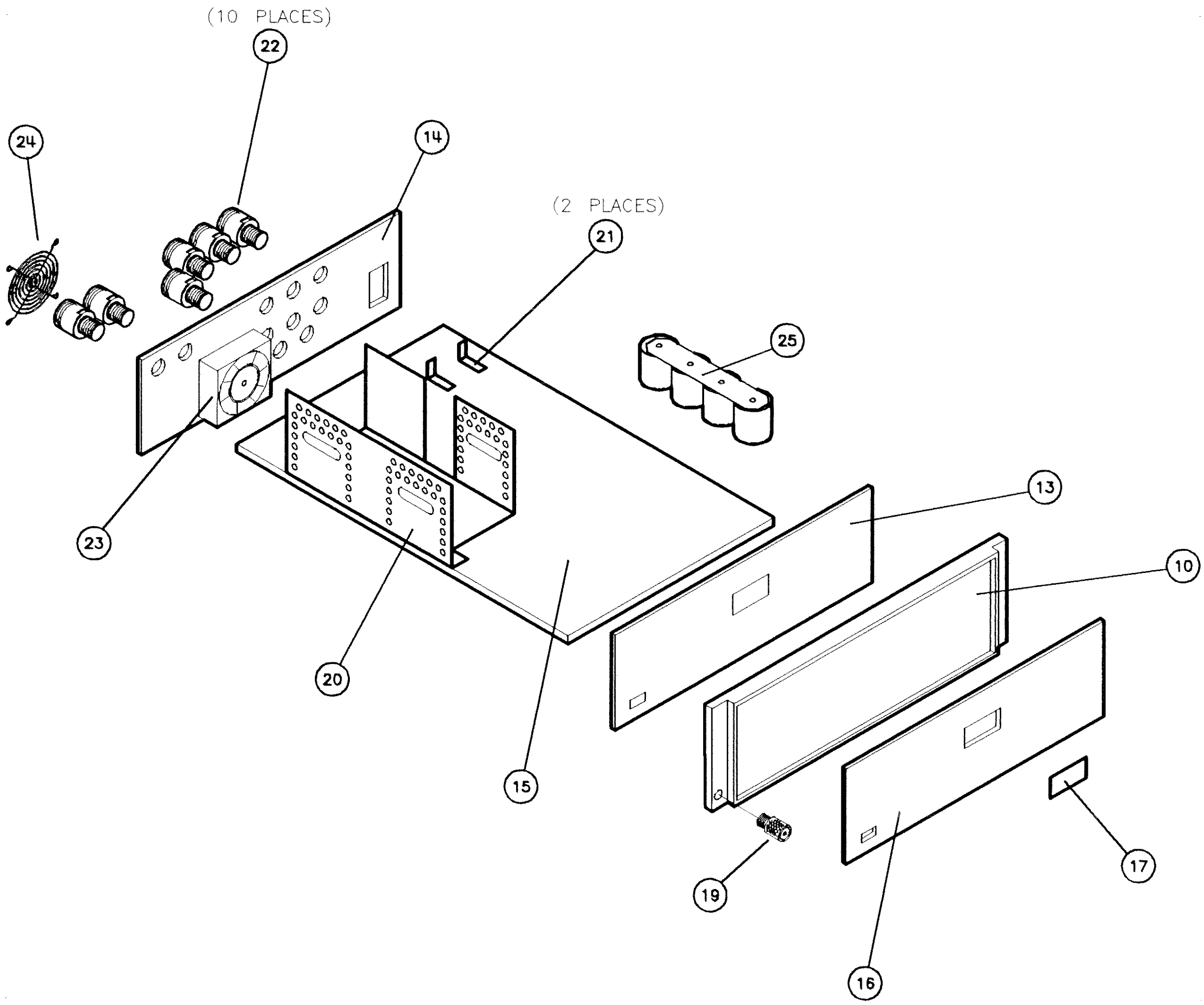


Figure 7-29. Chassis Parts

Table 7-26. Miscellaneous Parts

Reference Designator	HP Part Number	Qty	Description
	85301-90011	1	HP 85301A Manual, HP 85310A-based
	85301-90012		HP 85301A Microfiche Manual
	85310-90001	1	HP 85310A Manual
	85310-90002		HP 85310A Microfiche Manual
	85381-90001	1	HP 85381 Manual
	85381-90002		HP 85381 Microfiche Manual
	85027-60005	2	3.5 mm Adapter (female to female)
option 001	85027-60005	3	3.5 mm Adapter (female to female)
option 002	85027-60005	4	3.5 mm Adapter (female to female)
	1250-1476	3	Type-N (male) to BNC (female) Adapter
option 001	1250-1476	4	Type-N (male) to BNC (female) Adapter
option 002	1250-1476	5	Type-N (male) to BNC (female) Adapter
	08510-60025	1	Receiver's IF Adapter Cable
	85309-10001	1	Performance Verification Disk
	7124-1628	8	Cable Labels
	8710-1935	1	Torque Wrench 52 kg/m (45 ft/lb) ±5%
	1250-0929	1	BNC Short Circuit
	1540-0986	1	Disk Holder
	1540-1003	1	Tape Holder

Internal Adjustments

The following adjustment procedures are supplied in this section:

- Power Supply Adjustments
- Front Panel Display Adjustments
- LO Amplifier Adjustments
- ALC Adjustments

Power Supply Adjustments

The LO/IF unit has five independent power supplies on 2 assemblies (A2 and A22). The ten volt supplies on A2 are adjustable, the supplies on A22 are not.

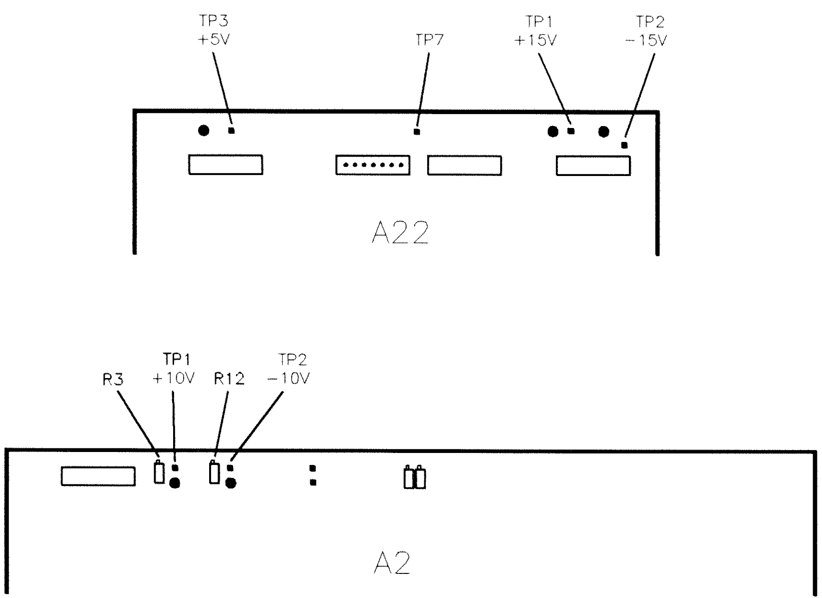


Figure 7-30. Location of Power Supply Test Points and Adjustments.

Table 7-27. Power Supply Test Points

Supply	Test Point	Adjustment	Range (volts)	Line/Regulation
Ground	A22TP7	none	N.A.[1]	N.A.
+5 Volt	A22TP3	none	+4.9 to +5.2	10 mV
+15 Volt	A22TP1	none	+14.2 to +15.5	10 mV
−15 Volt	A22TP2	none	−14.2 to −15.5	10 mV
+10 Volt	A2TP1	A2R3	+9.95 to +10.05	30 mV
−10 Volt	A2TP2	A2R12	−9.95 to −10.05	30 mV

1 Not Applicable

Front Panel Display Adjustments

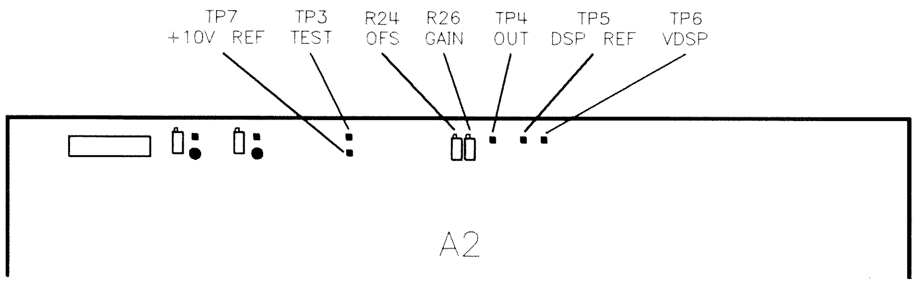


Figure 7-31. Location of Display Adjustments.

Power Supply Check

1. A22TP7 can be used at the common ground for all of the following voltage measurements.
2. Check the DC power supplies for proper operation as described in "Power Supply A2 and A22". Adjust the supplies if necessary as shown in "Power Supply Adjustments".
3. Check the DC voltage at A2TP7. The voltage should be 10 ±.2 Volts DC.

Front Panel Display Offset Adjustment

4. Remove the mixer cable from the rear panel J5 (Reference Detector Input) connector so no DC voltage is applied to A2J1.
5. Remove cable W25 going to A2J12.
6. Adjust "OFS" pot R24 on A2 (see Figure 7-31) for a front panel display reading of 0.0 ±.5 mV.
7. Make sure that the voltage between chassis ground and A2TP4 is less than ±3 mV DC.

Front Panel Display Gain Adjustment

8. Connect a jumper between A2TP3 and A2TP7 (Figure 7-31 shows the positions of these test points).
9. Adjust the "GAIN" pot A2R26 for a front panel display reading of +99.0 ±0.5 mV.
10. Make sure that the voltage between chassis ground and A2TP4 is +99.0 ±3 millivolts DC.
11. Reconnect W25 to A2J12.

LO Amplifier Adjustments

The LO gain for both the Reference and Test LO amplifiers are measured and adjusted for correct gain, and tracking between channels. The following adjustment procedure is written so that a power meter can be used. If a microwave scalar analyzer is available, the procedure can be modified for use with the analyzer.

Setup and Calibration

1. Set up the test equipment as shown in Figure 7-32. No other measurement system instruments should be connected to the LO source or LO/IF unit. If the 85309A has option 001 or 002, make some extra copies of Table 7-28 to use for the extra channels.
2. The `LO POWER ADJUST` control on the HP 85309A should be set anywhere in its middle or upper range during this test.
3. Make sure the HP 85309A rear panel J5 connector is disconnected from the reference mixer.

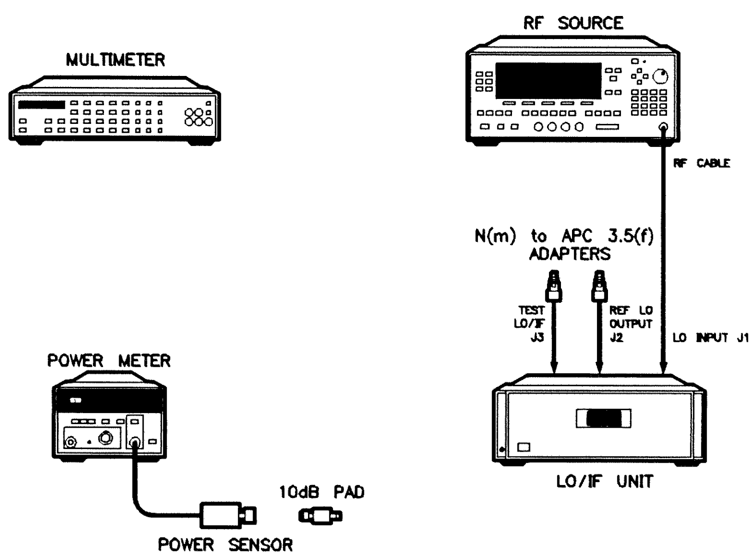


Figure 7-32. LO Amplifier Adjustment Test Setup

4. Calibrate the power meter and power sensor. Use the proper technique to zero the meter. Select the appropriate Cal Factor and internal power reference for setting the Calibration. See the power meter manual for more information.
5. Press (PRESET) on the LO source.
6. Disconnect the LO cable from the `J1 LO INPUT` of the LO/IF unit.
7. Connect the power sensor to the end of this LO cable.
8. Set the LO source to a CW frequency of 300 MHz.

Note

This procedure uses SLOPE to eliminate the LO losses through the LO cable. Some LO sources, such as the HP 8350B, have to be in a SWEEP mode to activate the SLOPE. On an HP 8350B set the source to manual sweep mode by pressing:

(START) 300 (MHz)

(STOP) 20 (GHz)

SWEEP (MAN)

9. Adjust the LO output power so that the power meter reads 0.0 dBm. Enter this source power setting into line (1) of Table 7-28.
10. Change the power meter Cal Factor to the value applicable for 20 GHz.
11. Rotate the FREQUENCY/TIME knob to change the LO source's frequency.
12. Set the LO source to 20 GHz, and adjust the SLOPE of the source so that the LO output power at 20 GHz is also 0.0 dBm. The above steps provide a flat output power from the LO source to the amplifiers. Do not turn off SLOPE during any of the following steps.
13. Connect a 10 dB pad between the power sensor and the LO cable.
14. Change the LO source's CW frequency to 1, 6, 9, 15, 20 GHz, and measure the power level at each frequency. Use this information to fill out line (2) of Table 7-28. Be sure and use the correct power meter Cal Factor for each frequency.

Table 7-28. LO Amplifier Adjustment Table

Step	300 MHz	1 GHz	6 GHz	9 GHz	15 GHz	20 GHz
Calibration						
(1) Source Power		——	——	——	——	——
(2) 0 dBm Cal						
Initial Gain						
(3) Ref Channe						
(4) Test Channel						
(5) Min Output Power	+16 dBm	+20 dBm	+22 dBm	+22 dBm	+19 dBm	+19 dBm
Tracking						
(6) Ref Channel						
(7) Test Channel						
(8) Track=|(6)−(7)||						
(9) Tracking Spec	±2 dB	±2 dB	±2 dB	±2 dB	±2 dB	±2 dB
Gain						
(10) Ref Channel						
(11) Test Channel						
(12) Min Output Power	+16 dBm	+20 dBm	+22 dBm	+22 dBm	+19 dBm	+19 dBm

Note

Perform each of the following adjustments for each channel of the HP 85309A.

Initial Gain Check

Note

This procedure uses a power meter, and requires you to change frequencies often. Always remember to change the power meter calibration factor as appropriate for each frequency, the procedure does not always remind you to do this.

15. If necessary, change the LO source output power to the value in line (1) of Table 7-28.
16. Connect the power sensor and the 10 dB pad to the `REF LO OUT J2` connector on the LO/IF unit.
17. Set the power sensor Cal Factor for a 300 MHz LO frequency.
18. Change the LO source's CW frequency to 300 MHz.
19. Measure the LO power level. Find the difference between the 300 MHz value in line (2) and the measured LO power level. Fill out line (3) of Table 7-28 with this new value.

Example:

```
The difference between:  −9.9 dBm        Line (2)
                   and:  +15 dBm         Measured value
                         -------
                    is:  +24.9 dB        Gain value, write in Line (3)
```

20. Repeat the above step at 1, 6, 9, 15, 20 GHz. Use this information to fill out the rest of line (3). Be sure and use the correct Cal Factor for each LO frequency.
21. Connect the power sensor and pad to the TEST LO/IF J3 connector on the LO/IF unit.
22. Change the LO source's CW frequency to 300 MHz.
23. Measure the LO power level. Find the difference between the 300 MHz value in line (2) and the measured LO power level. Fill out line (4) of Table 7-28 with this new value.
24. Repeat the above step at 1, 6, 9, 15, 20 GHz. Use this information to fill out the rest of line (4).
25. Compare the power levels in line (3) and (4) at each frequency to the minimum output power specification in line (5).
26. If line (3) is not within specification, adjust the gain of A12 (Reference output amplifier) by using the corresponding adjustment (A12R9) on the amplifier's PC board. Figure 7-33 shows the location of A12R9.

    While adjusting the amplifier gain, monitor the voltage between TP7 and TP1 on the amplifier to make sure it stays within 0.0 and 0.22 volts DC. If you have difficulty, Table 7-29 lists the initial settings for the bias voltages as adjusted at the factory.
27. If line (4) is not within specification, adjust the gain of A13 (Test output amplifier) by using the corresponding adjustment (A13R9). Figure 7-33 shows the location of A13R9. While adjusting the amplifier gain, monitor the voltage between TP7 and TP1 on the amplifier to make sure it stays within 0.0 and 0.22 volts DC. If you have difficulty, Table 7-29 lists the initial settings for the bias voltages as adjusted at the factory.
28. If one channel cannot be adjusted to meet the specification, then perform the following:
    a. Make sure the lower gain channel has been adjusted to its maximum gain, as explained above.
    b. Adjust the gain of A17 (input amplifier) by using the corresponding adjustment (A17R9). Figure 7-33 shows the location of A17R9. While adjusting the amplifier gain, monitor the voltage between TP7 and TP1 on each A17 to make sure it stays within 0.0 and 0.22 volts DC.
    c. If you have difficulty, Table 7-29 lists the initial settings for the bias voltages as adjusted at the factory.
29. If additional gain is still required, monitor the voltage between A17TP6 and A17TP1 and adjust the A17R10 until the gain specification is met. Do not exceed 2.20 volts DC.

Tracking Adjustment

30. Remove the pad from the end of the power sensor.
31. Change the LO source output power to –20.0 dBm. If the LO source does not have a built-in attenuator, use a 20 dB pad to reduce the source power.
32. Set the power sensor Cal Factor as appropriate for 300 MHz LO frequency.
33. Connect the power sensor to the `REF LO OUT J2` connector on the LO/IF unit.
34. Change the LO source's CW frequency to 300 MHz.
35. Measure the LO power level. Fill out line (6) of Table 7-28 with this value.
36. Repeat the above step at 1, 6, 9, 15, 20 GHz. Use this information to fill out the rest of line (6).
37. Connect the power sensor to the `TEST LO/IF J3` connector on the LO/IF unit.
38. Change the LO source's CW frequency to 300 MHz.
39. Measure the LO power level. Fill out line (7) of Table 7-28 with this value.
40. Repeat the above step at 1, 6, 9, 15, 20 GHz. Use this information to fill out the rest of line (7). Be sure and use the correct Cal Factor for each frequency.
41. Subtract line (7) from line (6) of Table 7-28 and put the results in line (8).
42. The value in line (8) should be within the dB range in line (9). In other words, the two channels must track each other within the dB value in line (9). Examples are shown below:

    ```
    Line (6) = +1.2 dB is within specification

    Line (6) = –2.8 is not within specification
    ```

43. If line (8) is not within specification, or you wish to improve the tracking, adjust the gain of A12 and A13 (output amplifiers) by using the corresponding adjustment R9 on each board. Adjust the output amplifier with the lowest gain first, so it matches the gain of the other amplifier. Line (5) and (6) show each amplifier's gain.
44. If you cannot increase the gain enough, then reduce the gain of the higher-gain amplifier.

    Figure 7-33 shows the location of R9. While adjusting the amplifier gain, monitor the voltage between TP7 and TP1 on each amplifier to make sure it stays within 0.0 and 0.22 volts DC. If you have difficulty, Table 7-29 lists the initial settings for the bias voltages as adjusted at the factory.

45. Repeat the tracking adjustments above until line (8) meets specifications in line (9).

Gain Adjustment

46. Change the LO source output power to the value in line (1) of Table 7-28.
47. Connect the power sensor and the 10 dB pad to the `REF LO OUT J2` connector on the LO/IF unit.
48. Set the power sensor Cal Factor as appropriate for 300 MHz.
49. Change the LO source's CW frequency to 300 MHz.
50. Measure the LO power level. Find the difference between the 300 MHz value in line (2) and the measured LO power level. Fill out line (10) of Table 7-28 with this new value.
51. Repeat the above step at 1, 6, 9, 15, 20 GHz. Use this information to fill out the rest of line (10). Be sure to use the correct Cal Factor for each LO frequency.
52. Connect the power sensor and pad to the `TEST LO/IF J3` connector on the LO/IF unit.
53. Change the LO source's CW frequency to 300 MHz.
54. Measure the LO power level. Find the difference between the 300 MHz value in line (2) and the measured LO power level. Fill out line (11) of Table 7-28 with this new value.
55. Repeat the above step at 1, 6, 9, 15, 20 GHz. Use this information to fill out the rest of line (11).
56. Compare the power levels in line (10) and (11) at each frequency to the minimum output power specification in line (12).
57. If either channel is not within specification, adjust the gain of A17 (input amplifier) by using the corresponding adjustment A17R9. Figure 7-33 shows the location of R9. While adjusting the amplifier gain, monitor the voltage between A17TP7 and A17TP1 to make sure it stays within 0.0 and 0.22 volts DC. If you have difficulty, Table 7-29 lists the initial settings for the bias voltages as adjusted at the factory.
58. If additional gain is still required, monitor the voltage between A17TP6 and A17TP1 and adjust A17R10 until the gain specification is met. Do not exceed 2.20 volts DC.

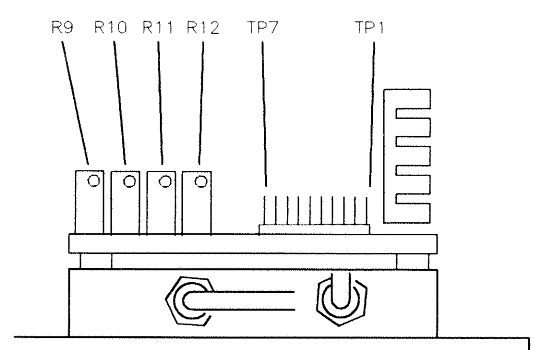


Figure 7-33. Location of LO Amplifier Adjustments.

Table 7-29.
LO Amplifier DC Bias Voltages Before Adjustment

Measure Between	Bias Control	Value (Before Re-adjustment)
TP7 & TP1[1]	R9	0.12 volts DC
TP6 & TP1[1]	R10	1.20 volts DC
TP5 & TP1[1]	R11	0.23 volts DC[2]
TP4 & TP1[1]	R12	0.23 volts DC[2]

1 TP1 is approximately +8.3 volts DC.

2 Fixed at factory. Do not adjust.

ALC Control Adjustments

Required Equipment

Table 7-30. Required Equipment

Qty	Item	Model Number or Minimum Requirements
1	Digital Voltmeter	Any
1	Digitizing Oscilloscope[1]	HP 54501A or HP 54100 family
1	Adjustment Tool	Any
3	Type-N Cables	Low Loss
1	BNC Cable	Any
1	BNC (f) to Type-N (m) Adapter	supplied

1 This test requires an oscilloscope with better-than-average triggering characteristics. The Hewlett-Packard digitizing oscilloscopes can meet this requirement.

VSET Verification

1. Refer to Figure 7-34. Connect a digital voltmeter (DVM) between A2TP8 VSET and A22TP7 (ground on the power supply board).
2. Adjust the front panel potentiometer, LO POWER ADJUST, fully counter-clockwise. VSET should be zero volts. Turn the LO POWER ADJUST fully clockwise, VSET should now read between 2.0 and 2.5 volts. The voltage should change in a linear fashion as you turn the front panel potentiometer.

Table 7-31. A2TP6 Maximum and Minimum Values

	Minimum	Maximum
Fully Clockwise	2.0V	2.5V
Fully Counter-Clockwise	−5 mV	5 mV

3. If the voltage does not correspond check for a miswired potentiometer or suspect a problem with the board.

ALC Rough Adjust

1. Preset the following potentiometers as shown in Figure 7-34.

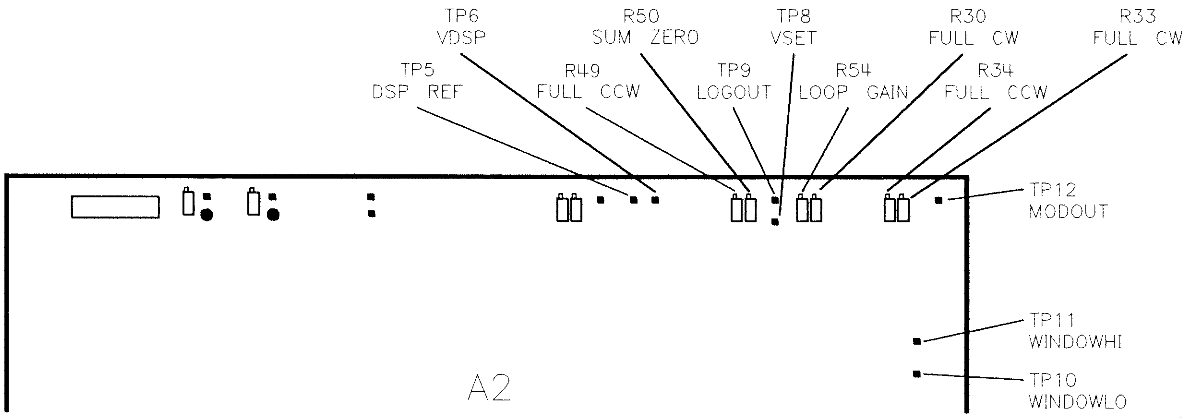


Figure 7-34. Location of ALC Potentiometers and Test Points

a. R49 fully counter-clockwise
b. R50 ignore at this time
c. R54 fully clockwise
d. R30 fully clockwise
e. R34 fully counter-clockwise
f. R33 fully clockwise

2. Connect the test equipment as shown in Figure 7-35:

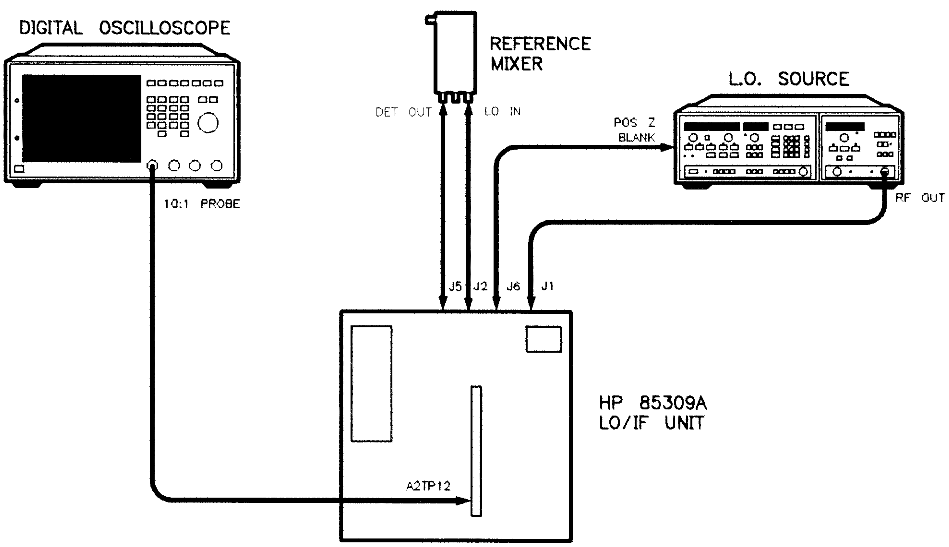


Figure 7-35. ALC Adjustments Test Setup

A. Connect LO source's RF OUT to the HP 85309A's LO input.
B. Connect the LO source's rear panel POS Z BLANK output to the HP 85309A POS Z BLANK input.

C. Connect the reference mixer's DETECTOR OUT to J5 on the HP 85309A.

D. Connect the reference mixer's LO IN connector to J2 on the HP 85309A.

3. Set the source to a CW frequency of 10 GHz. Set power to +13 dBm.
4. Set up the oscilloscope as follows:

A. Channel 1: 0.5 Volts/Div
B. Probe Atten: 10
C. Timebase: = 5 msec/div, Auto Sweep

5. Measure A2TP12 with digital oscilloscope.
6. If oscillations are observed on the oscilloscope turn R54 counter-clockwise until they cease.

Input Offset Adjust

1. Ensure that the HP 85309A is leveling properly (not oscillating) by monitoring A2TP12.
2. Connect a DVM to A2TP13 (SUM). Connect the ground lead to A22TP7 (ground).
3. Adjust R50 until a reading of 0 Volts ±0.5 mV is obtained. (Get it as close to zero as is possible.)
4. Disconnect the voltmeter.

ALC Fine Adjust

1. Move oscilloscope channel 1 to A2TP6 (VDSP) and set up the oscilloscope as shown below:

   Channel 1: 1 Volt/Div
   Offset: 0
   Trigger: Source channel 1, trigger level −0.1V, Slope: Neg, Mode: Edge
   Timebase: 20 μs/div, Triggered Sweep

2. Set the LO source to swept mode CF=10 GHz, Delta F=100 MHz, power +13 dBm.
3. Adjust R54 for minimum recovery (rise) time of the trace without excessive overshoot or ringing. Turning R54 counter-clockwise reduces ringing, but if turned too far it slows recovery time. Turning R54 clockwise has the opposite effect.

   Look at Figure 7-36, Figure 7-37, Figure 7-38. These figures show examples of a correct trace, a trace with excessive ringing, and a trace that has a recovery time that is too slow.

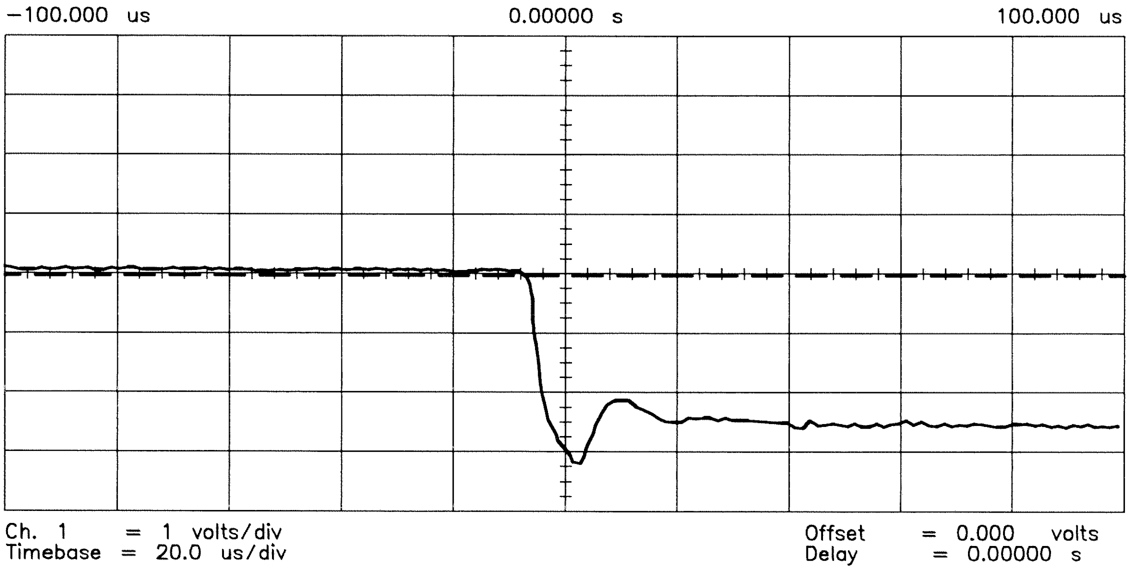


Figure 7-36. A2TP6 Trace Showing Correct Adjustment

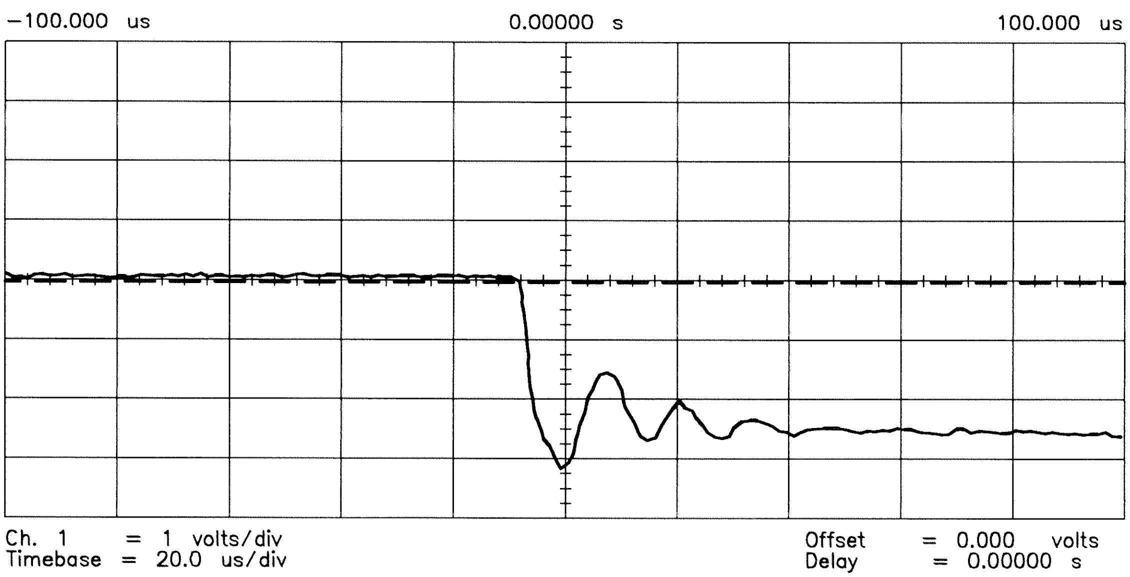


Figure 7-37. A2TP6 Trace Showing Excessive Ringing

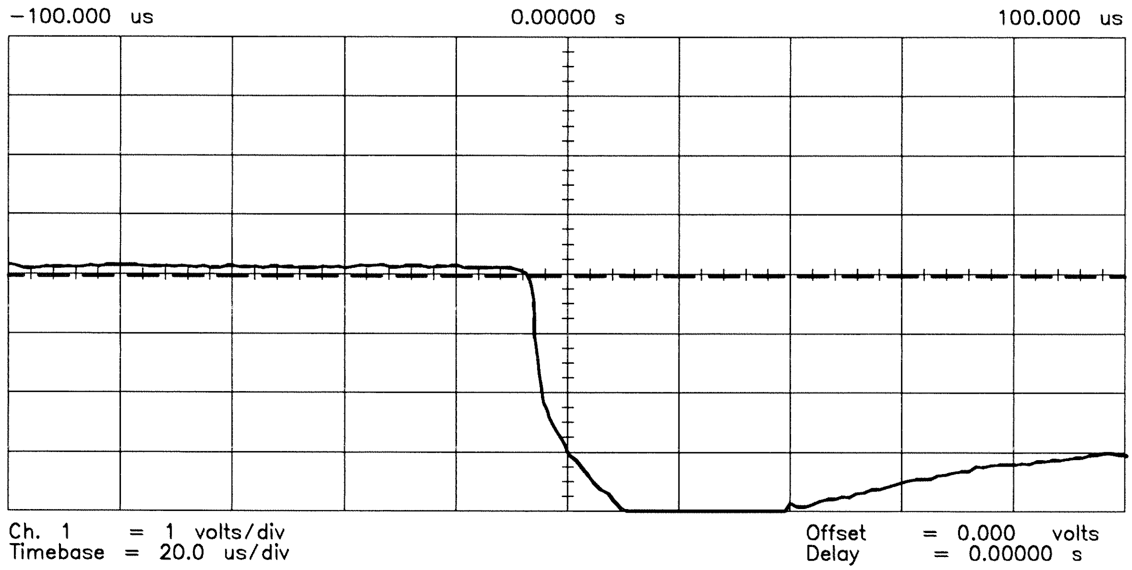


Figure 7-38. A2TP6 Trace Showing Slow Recovery Time

4. Look on the reference mixer and note the value (in millivolts) that is written on its label.
5. Turn the LO POWER ADJUST potentiometer until the DETECTOR VOLTAGE displays this value (typically between −40 mV and −70 mV).
6. Make sure the trace rise time is <100 μs. If it does not meet this adjust R54 clockwise. Figure 7-39 shows what the trace should look like.

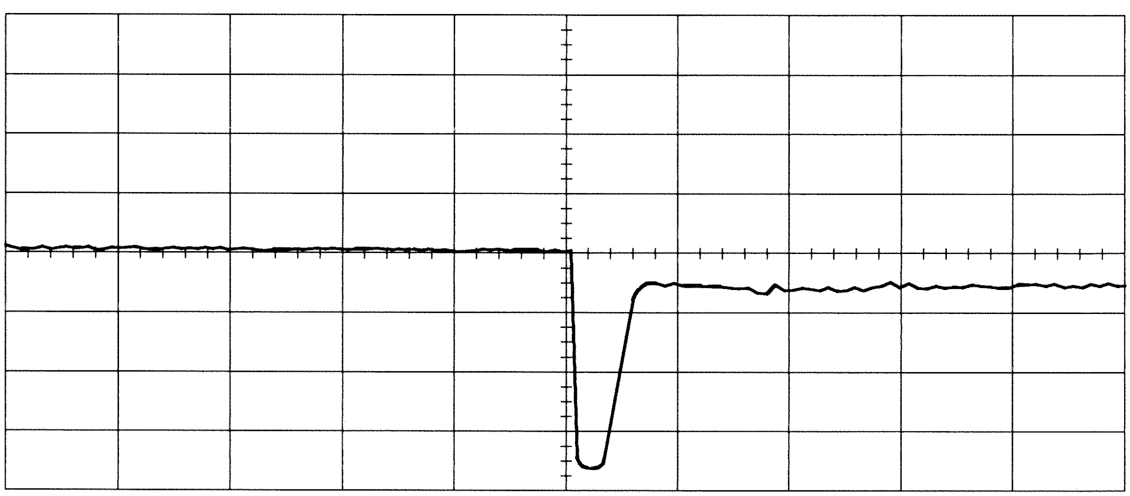


Figure 7-39. Appropriate Trace at A2TP6 After Performing Step 6

7. Turn LO POWER ADJUST fully clockwise. If you adjusted R54 in step 6, make sure the trace does not have excessive ringing at this time.

8. Set the LO source's power to 0 dBm. Make sure the trace still rises in <100 μs. Figure 7-40 shows what the trace should look like. If the rise time is too slow, adjust R54 and then repeat steps 2 through 8.

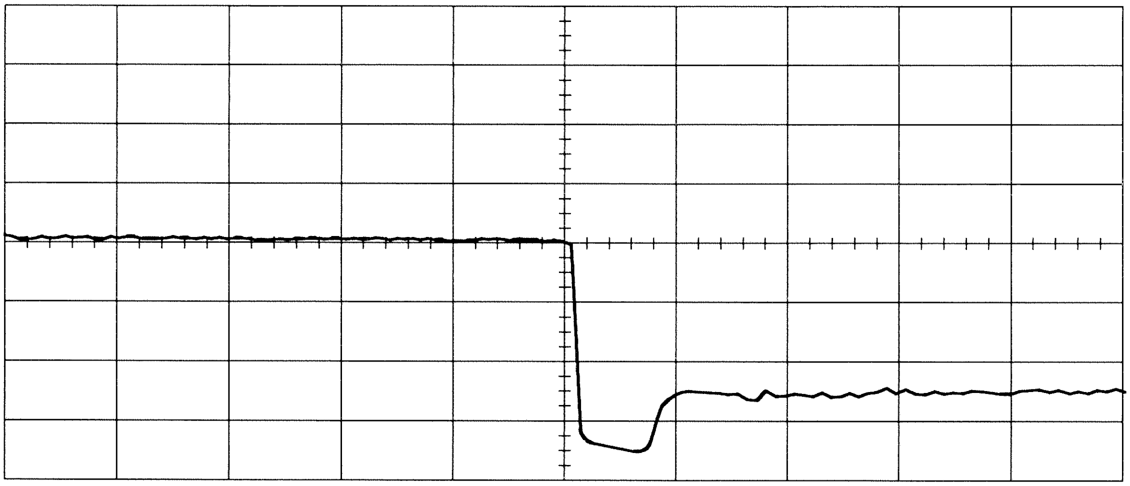


Figure 7-40. Appropriate Trace at A2TP6 After Performing Step 8

9. Turn `LO POWER ADJUST` fully counter-clockwise.
10. Make sure the `DETECTOR VOLTAGE` displayed on the front panel is <10 mV. If it is not, adjustment of R54.
11. Set LO power to +13 dBm. Set `LO POWER ADJUST` to the value shown on the reference mixer module.
12. Step the frequency in 0.5 GHz steps from 1 to 20 GHz. Make sure the oscilloscope trace is stable and rises in <100 μs.

8

HP 85381A/C/D and 85382A Microwave Cables

Introduction

The HP 85381/82 microwave cables have been designed for the HP 85310A distributed frequency converter, but can be used in other applications as well. HP 85381/82 cables can be used indoors or outdoors.

Available Lengths

Cables are available in 1 meter increments from 1 to 20 meters. A 0.5 meter length is also available.

Proper Use of Cables

The following can reduce the life of your cables:

- Repeated bending. (A single sharp bend can ruin a cable instantly.)
- Repeatedly connecting and disconnecting cable connectors.
- Using insufficient torque when connecting cables. Insufficient torque lets moisture into the connection. Moisture can ruin the cables.

To extend the life of your cables, observe these precautions:

- Minimize the number of times you bend the cables.
- Never bend the cable at a sharp angle.
- Do not bend cables near the connectors.
- Inspect the connectors before use; look for dirt, nicks, and other signs of damage or wear. A bad connector can ruin a good connector instantly.
- Clean dirty connectors. Dirt and foreign matter can cause poor electrical connections and connector damage.
- Minimize the number of connections/disconnections.

Refer to the "Microwave Connector Care" manual (HP part number 08510-90064) for inspection, gaging, and connection techniques.

If any of the cables will be flexed repeatedly, we recommend that a back-up cable be purchased. This will allow immediate replacement, and will minimize system down time.

Using the Cables

Before connecting the cables to any device, the following should be done:

- Check all connectors for wear or dirt.
- When making the connection, torque the connector to the proper value.

Caution

Gauge SMA connectors before using them, especially before mating an SMA device to a precision 3.5 mm connector. SMA connectors are not precision connectors and are often out of tolerance. Connecting an out-of-tolerance connector to a good connector will ruin the good connector instantly. Gauge any connector that has been damaged or abused. Instructions are provided Hewlett Packard's guide to microwave connector care, part number 08510-90064.

Specifications

HP 85381A Specifications

This flexible cable is useful in systems that do not have a rotary joint. It is also useful in any application that requires repeated bending.

- Frequency Range:
  - Type-N and SMA: DC to 18 GHz
- Typical Return Loss: 12 dB
- Dielectric: Air spaced teflon
- Outer Jacket: Polyethylene
- Cable Diameter:[1] 8 mm (.3 in)
- Minimum Bend Radius: 5 cm (2 in)

[1] Excludes labels and connector.

HP 85381C Specifications

This flexible cable is useful in systems that do not have a rotary joint. It is also useful in any application that requires repeated bending.

- Frequency Range:
  - Precision 3.5 mm: DC to 26.5 GHz
  - Precision Type-N: DC to 18.0 GHz
- Typical Return Loss:
  - Precision 3.5 mm: 18 dB
  - Precision Type-N: 17 dB
- Dielectric: Polytetra-Floroethylene tape
- Outer Jacket: Black Polyurethane
- Cable Diameter:[1] 7 mm (5/16 in)
- Minimum Bend Radius: 5 cm (2 in)

[1] Excludes labels and connector.

HP 85381D Specifications

This flexible cable is useful in systems that do not have a rotary joint. It is also useful in any application that requires repeated bending.

- Frequency Range: DC to 50 GHz
- Typical Return Loss: 12 dB
- Dielectric: Air spaced teflon
- Outer Jacket: Black Polyurethane
- Cable Diameter:[1] 4 mm (3/16 in)
- Minimum Bend Radius: 5 cm (2 in)

[1] Excludes labels and connector.

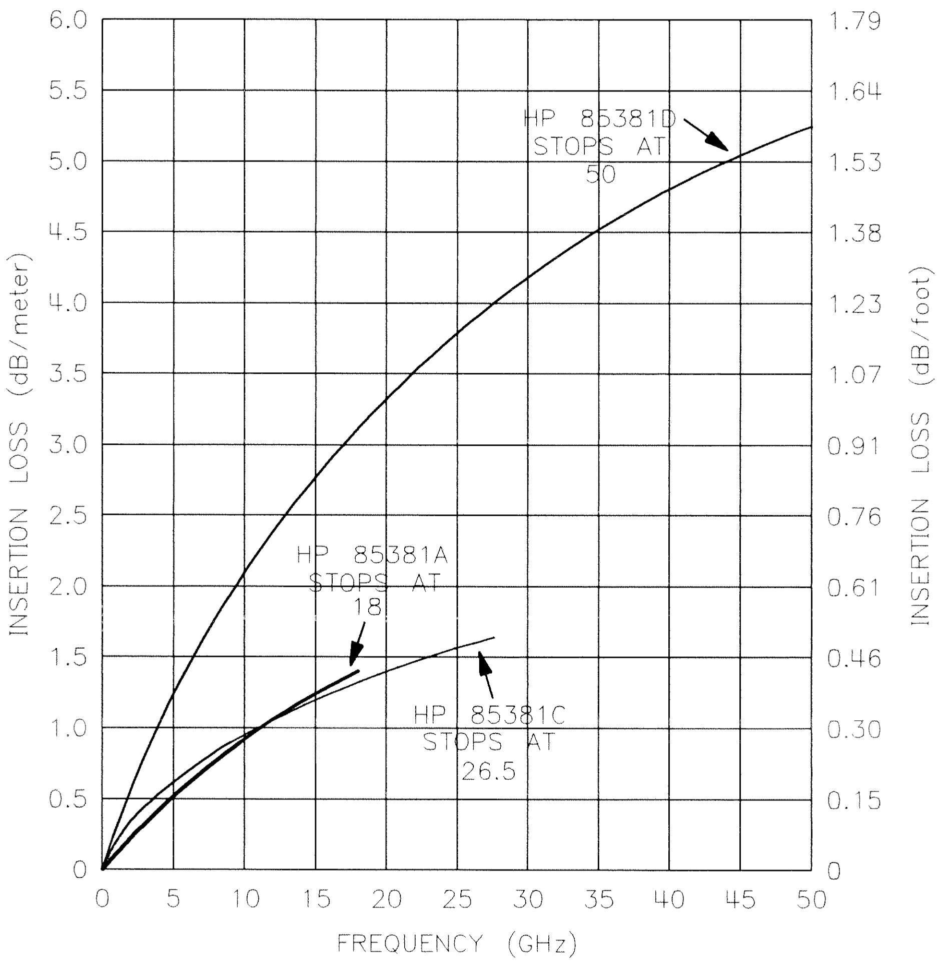
HP 85382A Specifications

This flexible cable is used in two places: as a 10 MHz reference cable, or as a 20 MHz IF cable. This cable is available with BNC male, BNC female, or Type-N male connectors.

- Frequency Range: DC to 1.0 GHz
- Typical Insertion Loss at 25° C:
  - At 10 MHz: <1.6 dB/100 feet (30.48 meters)
  - At 20 MHz: <2.7 dB/100 feet (30.48 meters)
- Typical Impedance at 25° C: 50 ±1 Ohm
- Dielectric: Solid Polyethylene
- Outer Jacket: Black Polyethylene IIIA
- Cable Diameter:[1] 6 mm (1.4 in)

- Minimum Bend Radius: 6 cm (2.5 in)

[1] Excludes labels and connector.



NOTE: When using this chart add 1dB of loss (caused by connectors)

Figure 8-1. HP 85381A/C/D Typical Insertion Loss at 25° C

Connector Torque Values

Proper connection torque keeps moisture out the connectors. It also eliminates radio frequency interference (RFI) from the connector interface. The amount of torque required depends on the type of connector. Table 8-1 lists the proper torque values. Do not over-tighten the connector. For more information on available connectors, see "How to Order Cables" later in this chapter.

Table 8-1. Proper Connector Torque

Connector	Torque cm-kg	Torque N-cm	Torque in-lbs	Wrench Part Number
Type-N	52	508	45	8710-1935
3.5 mm	9.2	90	8	8720-1765
SMA	5.7	56	5	8710-1582
2.4 mm	9.2	90	8	8720-1765

Caution Never exceed the recommended torque when attaching cables.

How to Order Cables

How to Choose the Proper Cable

Maximum frequency and flexibility are the two main criteria for cable choice. When considering maximum frequency requirements, think of your future needs as well as current needs.

If temperature and phase stability are important, buy cables that are the same length and model number. For example, in an HP 85310 Distributed Frequency Converter, the TEST MIXER-to-LO/IF UNIT cable and REFERENCE MIXER-to-LO/IF UNIT cable must match in model number and length. In other words, if one cable is a 10 meter HP 85381A, then the other cable must be a 10 meter HP 85381A as well.

When Using a Rotary Joint.

Most rotary joints do not add a significant amount of length to the cable path. However, if you use a large rotary joint (with .5 meters or more of cable inside it), you should add that much additional length to the other system cable.

For example:

In a typical Antenna Measurement System using an HP 85310A, the TEST MIXER-to-LO/IF UNIT cable path uses two cables and a rotary joint. The first cable goes from the LO/IF unit to the rotary joint. In this example the first cable is 5 meters long. The second cable goes from the rotary joint to the test mixer, and is 1 meter long.

The rotary joint in this example is very large, having 1 meter of cable length inside it. Of course, this "cable length" includes the length of internal cable lengths and the joint mechanism itself.

In this example the sum of the three cables from the LO/IF UNIT to the TEST MIXER is 7 meters. Therefore, the cable going from the REFERENCE MIXER to the LO/IF UNIT should also be 7 meters.

Cable Lengths

Determine the type and length (in meters) of cable required. Order the cable by type (HP 85381A, C, D, or 85382A) and option (Cxx). Each cable ordered must specify option Cxx where "xx" specifies the length of the cable in meters.

To convert feet to meters, multiply the number of feet by 0.3048.

Ordering example: to order a 19 meter flexible cable for use up to 26.5 GHz, order *HP 85381C option C19.*

To order a 23 foot cable for use up to 18 GHz, order *HP 85381A option C07* (23 feet x 0.305 = 7 meters).

To order a one-half meter cable, specify *option C00.*

Cable Connectors

The following connectors are available with the HP 85381 and 85382 cables. To order a cable with one connector type, order the option in Table 8-2. To order a cable with a different connector on each end, order the option for each connector in Table 8-2.

Here is an example:

You wish to order the 23 foot cable for use up to 18 GHz. The cable must have a Type-N (male) connector on one end, and an SMA (male) on the other end. In this case you would order *HP 85381A option C07 CNM CSM.*

Here is another example:

You wish to order a 9 meter flexible cable. It will be used to 26.5 GHz and must have 3.5 mm (male) connectors on each end. In this case you would order HP 85381C option C9 C3M C3M.

Table 8-2. Cable Connector Option

Connector Type	HP 85381A Option	HP 85381C Option	HP 85381D Option	HP 85382A Option
Type-N male	CNM	CNM		CNM
Type-N female		CNF		
3.5 mm male		C3M		
3.5 mm female		C3F		
SMA male	CSM			
SMA female	CSF			
BNC male	CBM			CBM
BNC female				CBF
2.4 mm male			C2M	
2.4 mm female			C2F	

Immediate Cable Replacement

Hewlett-Packard has the following cables in stock for fast replacement. These cables are made in specific lengths. If the stocked cables do not meet your requirements, you should consider owning a back-up set of custom cables. Contact your local HP office for ordering information on replacement cables.

Table 8-3. Replacement Cables

Cable	Part Number
85381A C03 CNM	85381-60103
85381A C07 CNM	85381-60107
85381A C14 CNM	85381-60114
85381C C03 C3M	85381-60203
85381C C07 C3M	85381-60207
85381C C14 C3M	85381-60214

Performance Checks

Cable problems are usually due to physical damage which can be seen with the naked eye. You can perform a visual inspection of each cable and not formally test it. If there are no sharp bends, kinks, abrasions, punctures, or moisture build-up, the cable should meet its specifications.

To check the cables more rigorously, check **insertion loss** (and, optionally, **return loss**). Insertion loss is the amount of energy lost in the device or cable you are testing, and is caused by resistance. Return loss is a measure of how much energy is reflected off the input of the cable or device back toward the energy source.

The following tests all require the use of a network analyzer and other equipment.

Recommended Cable Test Equipment

The following equipment can be used when checking the cables:

Table 8-4. Recommended Test Equipment

Network Analyzer	HP 8510B/C or 8530A option 011 with HP 8515 or 8516 test set or HP 8720A/B (only goes to 20 GHz)
Sources	HP 8340/41, HP 8350B, or HP 836xx (8360)

The HP 8510 or 8530 test ports should be the same connector types as the connectors on the cable under test. Use adapters if necessary. If using the HP 8530A, it must have the HP 8510C operating system loaded into it. The measurements require a calibration kit. This kit allows you to calibrate the accuracy of the network analyzer. Calibration kits are made for specific connector types, and cannot be adapted or they lose their accuracy.

Which Insertion Loss Test Should You Perform?

The insertion loss test you perform depends whether the cable is coiled (with both ends easily accessible) or installed (with one end less accessible).

Insertion Loss Test for Coiled Cables

This test assumes that you can easily access both ends of the cable under test. The check measures the insertion loss of the cable as a function of frequency. The measured loss should be less than or equal to the performance shown in “Specifications”. Note that insertion loss is a typical characteristic of the cables and is not warranted.

Note Remember to multiply the "loss dB/meter" value from "Specifications" by the length of the cable under test.

1. Set up and turn on the equipment. Press (PRESET) on the network analyzer.
2. Adjust the network analyzer to measure S_{21}. Set it to the correct frequency range and desired number of points.
3. Set the network analyzer to STEP SWEEP mode.
4. Perform a Full 2-Port calibration on the network analyzer. This type of calibration uses a "thru," short, open, and load.
5. Connect one end of the cable under test to port 1, the other end to port 2.
6. Perform an S_{21} measurement.
7. The loss indicated should be equal to or less than that shown in "Specifications", multiplied by the length of the cable (in meters).

Insertion Loss Test for Installed Cables

This test measures the insertion loss of the cable as a function of frequency. This test assumes that you can only connect one end of the cable under test to the network analyzer. This test is not as accurate as the previous one, and should be used only to find cable failures. Do not use this test to measure insertion loss values.

Note This procedure measures the "out-and-back" insertion loss. If the out-and-back insertion loss is greater than the typical return loss of the cable, then this test cannot be used to measure the insertion loss.

1. Set up and turn on the equipment. Press (PRESET) on the network analyzer.
2. Adjust the network analyzer to measure S_{11}. Set it to the correct frequency range and the desired number of points.
3. Set smoothing on the network analyzer to 2%.
4. Perform a S_{11} 1-Port calibration (with a short, open, and a load) on the network analyzer.
5. Connect the more accessible end of the cable under test to port 1.
6. Connect the short to the other end of the cable.
7. Perform an S_{11} measurement.
8. The measured insertion loss should be equal to or less than:

   2 × (value from "Specifications") × (length of cable in meters)

Return Loss Test (optional)

This test measures the return loss of the cable (coiled or installed). Since return loss is an operating characteristic, the figures are typical or nominal and need not be verified in the field. Measure S_{11} at both ends of the cable.

1. Set up and turn on the equipment. Press (PRESET) on the network analyzer.
2. Adjust the network analyzer to measure S_{11}, the frequency range, and the number of points desired.
3. Set the network analyzer to STEP SWEEP mode.
4. Perform a S_{11} 1-Port calibration (with a short, open, and a load) on the network analyzer.
5. Connect one end of the cable under test to port 1; connect the load to the free end.
6. Perform an S_{11} measurement.
7. The return loss should be equal to or greater than that shown in the cable specifications, earlier in this chapter.
8. Measure the return loss at the other end of the cable.

9

Special Options

If your HP 85310A Distributed Frequency Converter has any special options, the information on those changes will be in this chapter.

A

HP 85320 Mixer Module Mounting

Mounting the Mixer Modules

The HP 85320A and HP 85320B mixer modules may be mounted near the antennas. The modules may be mounted directly to the antenna mast, or on a mounting plate. The mounting hole layout is shown in Figure A-1 and Figure A-2. The mount holes will accept a 1/4 inch machine bolt, or a 6 mm bolt.

Changing Mixer Modules

If you change any of the mixer modules (for example changing the HP 85320 mixers to millimeter-wave mixers), perform the following steps:

1. Install the mixers as explained in "Installing The Mixers (HP 85320A/B)" in Chapter 2. Also refer to the manual of the other mixer modules.
2. Set LO power as explained in "Set the LO Power" in Chapter 2.
3. Perform the "Operational Check" in Chapter 3.
4. Perform the "Performance Verification" in Chapter 4 if desired.

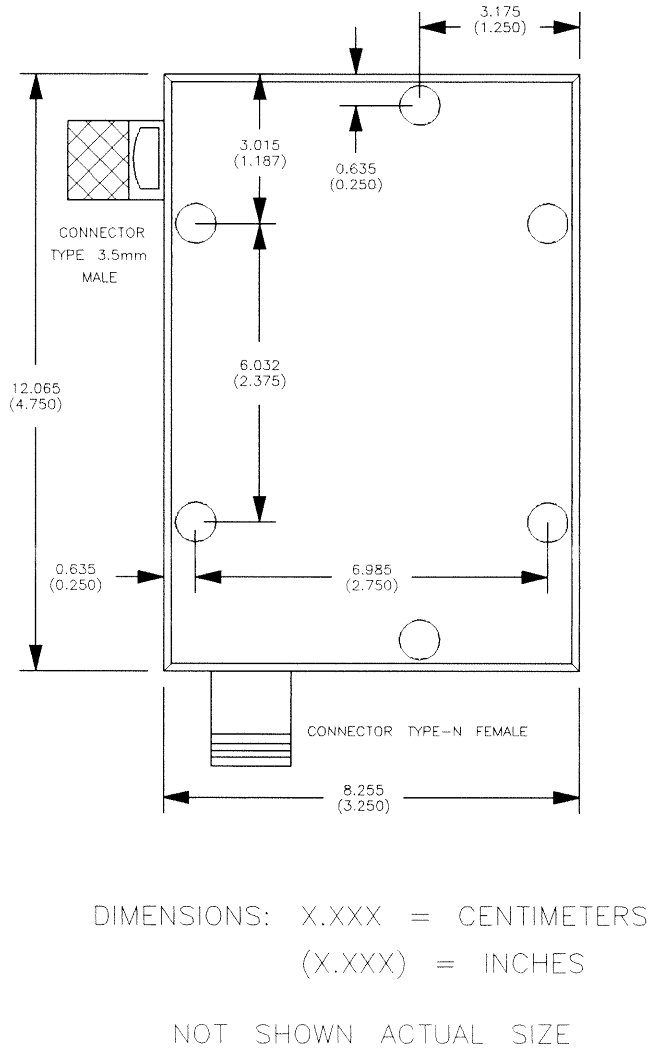


Figure A-1. HP 85320A Mixer Mounting Bolt Layout

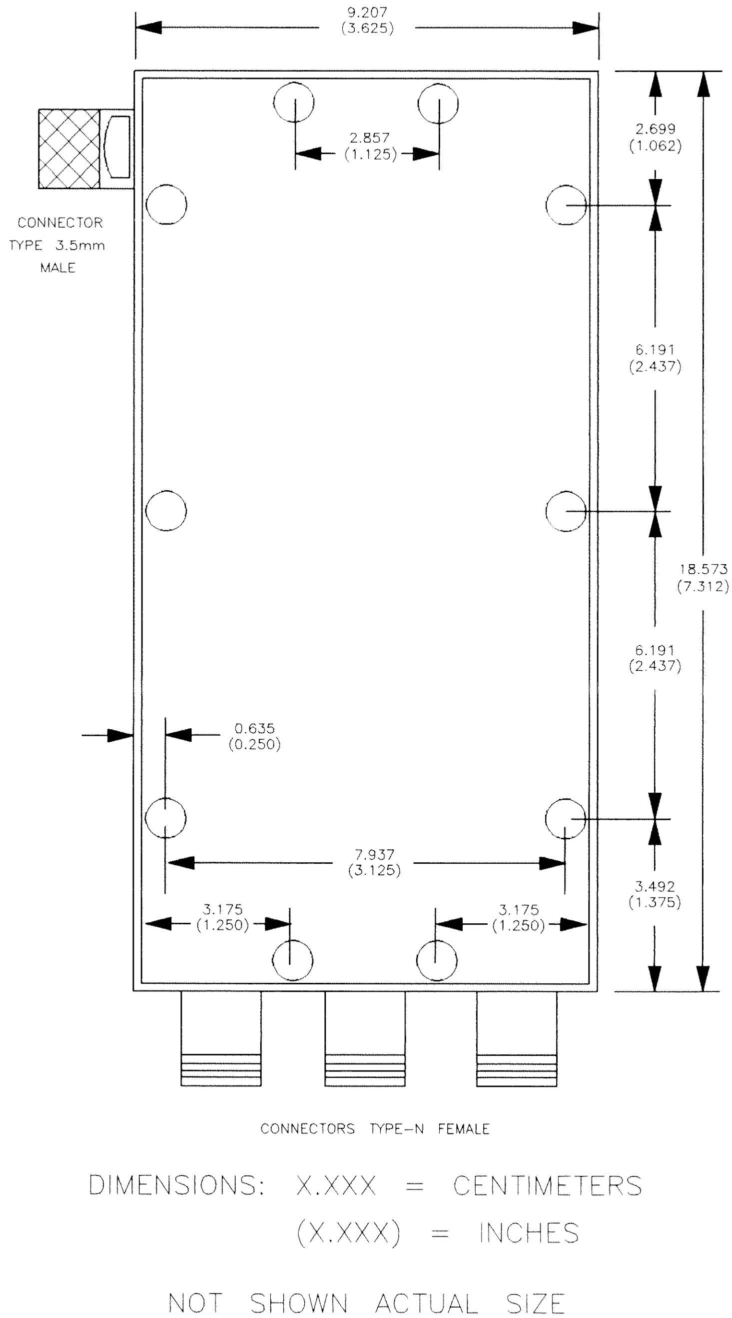


Figure A-2. HP 85320B Mixer Mounting Bolt Layout

B

Dynamic Range Worksheet

Photocopy Figure B-1 and the "Calculate Values" section. Enter the known gain or loss of system components into Figure B-1, then calculate power through the system using "Calculate Values." If you need help using this worksheet refer to "Configuring the System for Optimum Dynamic Range" in Chapter 3.

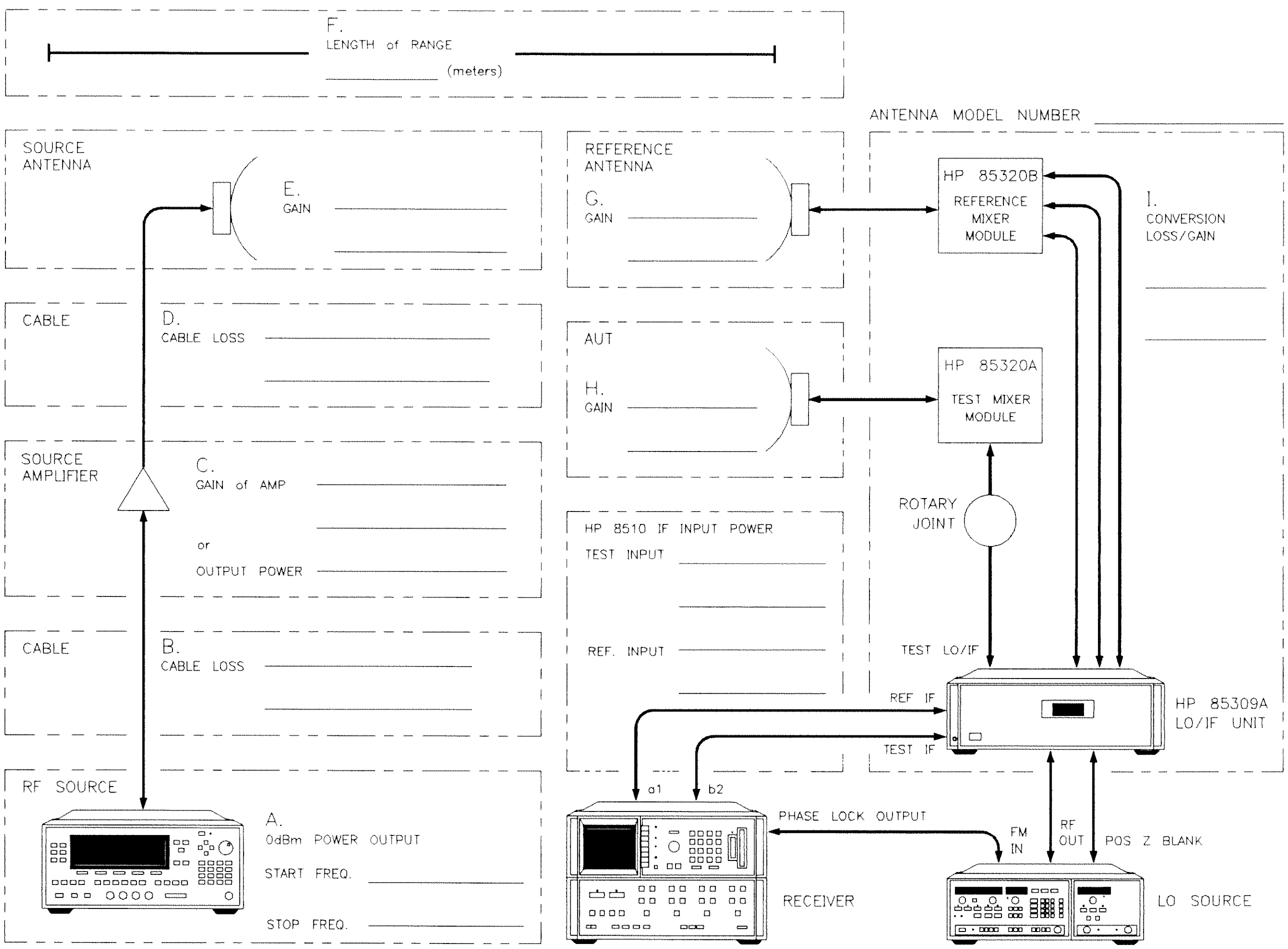


Figure B-1. Known System Gain and Loss Values

Calculate Values

- *Effective Radiated Power (E_{RP})*

  E_{RP} (dBm) = RF source output power - source cable losses (+ source amplifier gain, if present) + source antenna gain
  Alternatively, E_{RP} (dBm) = Actual source amplifier output power - cable losses + source antenna gain

  E_{RP} (at start frequency) = ______________________
  E_{RP} (at stop frequency) = ______________________

- *Power Dissipation*

  PD (dB) = 32.45 + 20 log Frequency + 20 log R, where frequency is in GHz and R is the length of the antenna range (in meters).

  PD (at start frequency) = ______________________
  PD (at stop frequency) = ______________________

- *Power at Mixers*

  □ Reference Mixer

  P_{RM} (power at reference mixer) = $E_{RP} - P_D$ + Gain of Reference Antenna

  P_{RM} (at start frequency) = ______________________
  P_{RM} (at stop frequency) = ______________________

  This value must not exceed the "Compression Level" specified in Table 5-3. Add attenuation between the antenna and the mixer if necessary, or reduce the power of the RF source.

  □ Test Mixer

  P_{TM} (power at the test mixer) = $E_{RP} - P_D$ + Gain of Antenna Under Test

  P_{TM} (at start frequency) = ______________________
  P_{TM} (at stop frequency) = ______________________

  This value must not exceed the "Compression Level" specified in Table 5-3. Add attenuation between the antenna and the mixer if necessary, or reduce the power of the RF source.

The following values can be calculated to estimate actual IF levels at the receiver a1 and b2 inputs, but these steps are not required.

- *Power at receiver a1 IF Input*

  □ P_{a1} (power at a1) = P_{RM} + conversion gain P_{a1} (at start frequency) = ______________________
  P_{a1} (at stop frequency) = ______________________

  This value must not exceed the maximum input power level of the receiver (−10 dBm). Reduce the power level of the RF source if necessary. If you are using an HP 8350 LO source, the power at the receiver's a1 reference channel cannot be lower than −45 dBm or phase lock can be lost.

- *Power at receiver's b2 IF Input*
  - □ P_{b2} (power at b2) = P_{TM} + conversion gain

    P_{b2} (at start frequency) = ______________________

    P_{b2} (at stop frequency) = ______________________

This value must not exceed the maximum input power level of the receiver (−10 dBm). Reduce the power level of the RF source if necessary.

Increase RF Source Power if Possible

You may increase the power output of the RF source if both of the following conditions are met:

- The power arriving at the mixers is below the maximum specified RF input power.
- *IF OVERLOAD* is not displayed on the receiver.

Power may be increased until an *IF OVERLOAD* error is displayed on the Receiver. Decrease the RF source power by 2 dB, and press (ENTRY OFF). The *IF OVERLOAD* error should not reoccur.

Perform a continuous sweep measurement over the entire frequency range. If *IF OVERLOAD* comes on again, reduce power by 2 dB and press (ENTRY OFF) again. Repeat this step until *IF OVERLOAD* does not come on.

C

Sales and Support Offices

Look in your telephone book for a local Hewlett-Packard office. If no office is listed, the offices shown below can tell you which Hewlett-Packard office is closest to you.

Europe, Asia, Africa

Africa Hewlett-Packard S.A. 7, rue du Bois-du-Lan CH-1217 *MEYRIN* 2, Geneva Switzerland. Tel: (41) 22/83 12 12 / Telex: 27835 hmea / Cable: HEWPACKSA Geneve

Australasia Hewlett-Packard Australia Ltd. 31-41 Joseph Street *BLACKBURN*, Victoria 3130, Australia. Tel: (61) 895-2895 / Telex: 31-024 / Cable: HEWPARD Melbourne

Benelux and Scandinavia

Hewlett-Packard S.A. Uilenstede 475 P.O. Box 999 NL-1183 AG *AMSTELVEEN* The Netherlands. Tel: (31) 20/43 77 71 / Telex: 18 919 hpner nl

Europe, South and East

Hewlett-Packard S.A. 7, rue du Bois-du-Lan CH-1217 *MEYRIN* 2, Geneva Switzerland. Tel: (41) 22/83 12 12 / Telex: 27835 hmea / Cable: HEWPACKSA Geneve

France Hewlett-Packard France, Parc d'activites du Bois Briard 2, avenue du Lac 91040 *EVRY* Cedex. Tel: 1 6/077 83 83 / Telex: 6923 15F

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Glossary

700 Bus
"700 bus" refers to the HP-IB bus located at address 700. Items connected to this HP-IB bus have addresses in the 700 number range.

`a1`
The reference IF channel of the HP 8510B. This channel can also be used as a phase lock reference.

`a2`
The test IF channel of the HP 8510B. This channel can be used as a phase lock reference.

ALC
Automatic Leveling Control. This is a feedback loop that maintains a constant power level at a specific point.

AUT
Antenna Under Test

`b1`
One of two test channels of the HP 8510B (the other is `b2`).

`b2`
One of two test channels of the HP 8510B (the other is `b1`).

Bold
Items defined in the glossary are shown throughout the manual in **BOLD** text.

Bold Text
See the entry for "Bold."

Channel
The path that allows a receiving system to receive a RF signal.

CW Measurements
A measurement where the test frequency is constant and does not change during the measurement.

Diplexer
A Diplexer allows two signals to travel over the same physical cable, both in opposite directions. In this system there is a diplexer in the HP 85309A, and one in the HP 85320A Test Mixer. From the point-of-view of the HP 85309A, the diplexer sends the LO signal to the test mixer, and receives the resultant IF signal coming back from the mixer.

Insertion Loss

A transmission measurement determines how much RF energy is lost as it passes through the device under test (DUT). Energy loss is measured in units called "insertion loss" and is measured in dB units. It is important to be aware of transmission losses in the system so you will not attribute them to the antenna or device under test.

For example: If you send 0 dBm down a cable with 10 dB of insertion loss, −10 dBm will come out the other end.

LO/IF Unit

Name for the HP 85309A LO/IF Distribution Unit.

Mixer Module

Name for the HP 85320A and HP 85320B mixers. These mixers convert the RF signal to an IF signal.

Narrow Frequency Range Measurement

A measurement where the test frequency changes during the measurement. For a narrow frequency range, the bandwidth of the measurement range (from start to stop frequency) is typically less than 10% of the measurement systems's frequency range. In the case of the HP 85310A this range would be 1.5 GHz or less.

Operating Characteristic

The term "operating characteristic" refers to performance that is based on design parameters, but is not actually measured.

Receiver

The HP 8510B. The HP 8510 receives the IF signal, digitizes it, and processes the digital signals.

Receiver System

All of the instruments in the system that act as the RF downconverter and IF receiver.

Return Loss

Reflection measurements determine how much RF energy bounces off of a cable connector or the input of a device. This reflected energy is measured in "return loss" units. Reflected energy travels back toward the RF source.

For example, if you send a 0 dBm signal into a cable with 14 dB of return loss, a lower-level signal (−14 dBm) will reflect off the input of the cable and travel back toward the source. A low return loss value is bad because it shows that too much power is being reflected back out of the system. This indicates a bad connection somewhere in the system.

System

The antenna measurement system. This system includes an HP 8510B receiver, HP 85310A Distributed Frequency Converter, LO source, RF source, and cables.

System Bus

The system bus is a dedicated HP-IB bus that is unique to the HP 8510 and 8530 receivers. The receiver has complete control over the instruments and peripherals connected to this bus. The bus is needed because the receiver must have immediate control of the RF and LO sources at all times, without waiting for permission from a computer. The System Bus uses two-digit addresses.

Transmitter System

All of the instruments in the system that provide the RF stimulus signal. These may be the Transmitter, Amplifier, and any other instrument that acts on the transmitters signal.

Transmitter

The RF synthesizer source that provides the RF stimulus signal.

Typical

When a specification is noted as being typical it means that most units exhibit the stated performance, but not all. For this reason, the specification is not guaranteed by Hewlett-Packard. Generally, typical specifications are provided for non-critical performance categories.

Wide Frequency Range Measurement

A measurement where the test frequency changes during the measurement. For a wide frequency range, the bandwidth of the measurement range (from start to stop frequency) is typically greater than 10% of the measurement systems's frequency range. In the case of the HP 85310A, this range would be greater than 1.5 GHz.

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