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# HP 8511B Frequency Converter Test Set

Operating and Service  
Manual

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HP part number: 08511-90073  
Printed in USA  
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Revision 1.0

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## Notice

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Santa Rosa Systems Division  
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## What You'll Find in This Manual...

- Chapter 1** • General Information
- Chapter 2** • Specifications
- Chapter 3** • Installation
- Chapter 4** • Operations
- Chapter 5** • Performance Tests
- Chapter 6** • Test Set Troubleshooting
- Chapter 7** • Replacement Procedures
- Chapter 8** • Replaceable Parts

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## 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 system product is warranted against defects in materials and workmanship for a period corresponding to the individual warranty periods of its component products. Instruments are warranted for a period of one year. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products that prove to be defective.

Warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within HP service travel areas. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses. In all other areas, products must be returned to a service facility designated by HP.

For products returned to HP for warranty service, 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.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

**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**

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For assistance, call your local Hewlett-Packard Sales and Service Office (refer to “Service and Support” on page viii).

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## Service and Support

Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your customer engineer through your local HP Service Center. You can find a list of HP Service Centers on the web at <http://www.hp.com/go/tmdir>.

If you do not have access to the Internet, one of these HP centers can direct you to your nearest HP representative:

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<b>United States:</b>	Hewlett-Packard Company Test and Measurement Call Center PO Box 4026 Englewood, CO 80155-4026 (800) 452 4844 (toll-free in US)
<b>Canada:</b>	Hewlett-Packard Canada Ltd. 5150 Spectrum Way Mississauga, Ontario L4W 5G1 (905) 206 4725
<b>Europe:</b>	Hewlett-Packard European Marketing Centre Postbox 999 1180 AZ Amstelveen The Netherlands (31 20) 547 9900
<b>Japan:</b>	Hewlett-Packard Ltd. Measurement Assistance Center 9-1, Takakura-Cho, Hachioji-Shi Tokyo 192, Japan (81) 426 56 7832 (81) 426 56 7840 (FAX)
<b>Latin America:</b>	Hewlett-Packard Latin American Region Headquarters 5200 Blue Lagoon Drive, 9th Floor Miami, Florida 33126, U.S.A. (305) 267 4245, (305) 267-4220 (305) 267 4288 (FAX)
<b>Australia/New Zealand:</b>	Hewlett-Packard Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130 Australia 1 800 629 485 (Australia) 0800 738 378 (New Zealand) (61 3) 9210 5489 (FAX)
<b>Asia-Pacific:</b>	Hewlett-Packard Asia Pacific Ltd. 17-21/F Shell Tower, Times Square 1 Matheson Street, Causeway Bay Hong Kong (852) 2599 7777 (852) 2506 9285 (FAX)

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## Safety and Regulatory Information

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. This product has been designed and tested in accordance with international standards.

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### WARNING

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

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### CAUTION

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The **CAUTION** notice 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** notice until the indicated conditions are fully understood and met.

## Instrument Markings



When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.



This symbol indicates hazardous voltages.



The laser radiation symbol is marked on products that have a laser output.



This symbol indicates that the instrument requires alternating current (ac) input.



The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.



The CSA mark is a registered trademark of the Canadian Standards Association.

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1SM1-A

This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).



This symbol indicates that the power line switch is ON.



This symbol indicates that the power line switch is OFF or in STANDBY position.

---

## **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 in this manual. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.



# DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

**Manufacturer's Name:** Hewlett-Packard Co.

**Manufacturer's Address:** 1400 Fountaingrove Parkway  
Santa Rosa, CA 95403-1799  
USA

Declares that the products:

**Product Name:** Frequency Converter

**Model Number:** HP 8511A, HP 8511B

**Product Options:** This declaration covers all options of the above products.

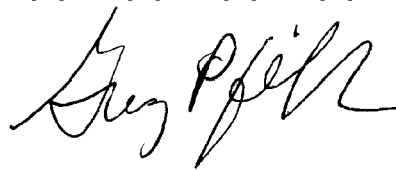
Conform to the following product specifications:

**Safety:** IEC 61010-1:1990 / EN 61010-1:1993  
CAN/CSA-C22.2 No. 1010.1-92

**EMC:** CISPR 11:1990/EN 55011:1991 Group 1, Class A  
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD  
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz  
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

## Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 30 Nov. 1998

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

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## Typeface Conventions

- *Italics*
  - Used to emphasize important information:  
Use this software *only* with the HP xxxxxX system.
  - Used for the title of a publication:  
Refer to the *HP xxxxxX System-Level User's Guide*.
  - Used to indicate a variable:  
Type `LOAD BIN filename`.
- **Instrument Display**
  - Used to show on-screen prompts and messages that you will see on the display of an instrument:  
The HP xxxxxX will display the message `CAL1 SAVED`.
- **[Keycap]**
  - Used for labeled keys on the front panel of an instrument or on a computer keyboard:  
Press `[Return]`.
- **{Softkey}**
  - Used for simulated keys that appear on an instrument display:  
Press `{Prior Menu}`.
- **User Entry**
  - Used to indicate text that you will enter using the computer keyboard; text shown in this typeface must be typed *exactly* as printed:  
Type `LOAD PARMFILE`
  - Used for examples of programming code:  
`#endif // ifndef NO_CLASS`
- **Path Name**
  - Used for a subdirectory name or file path:  
Edit the file `usr/local/bin/sample.txt`
- **Computer Display**
  - Used to show messages, prompts, and window labels that appear on a computer monitor:  
The `Edit Parameters` window will appear on the screen.
  - Used for menus, lists, dialog boxes, and button boxes on a computer monitor from which you make selections using the mouse or keyboard:  
Double-click `EXIT` to quit the program.

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# 1

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## General Information

### Introduction

This manual for the HP 8511B frequency converter test set is used in conjunction with the HP 8510 network analyzer manual set. These manuals provide the information needed to properly configure your system and make measurements.

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### NOTE

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The HP 8511B manual *may* be inserted into the HP 8510 test sets and accessories binder that was provided with your HP 8510 manual set.

The HP 8511B Operating portion consists of:

- General Information
- Specifications
- Installation
- Operation
- Performance Tests

The HP 8511B Service portion consists of:

- Troubleshooting
- Replacement procedures
- Replaceable parts

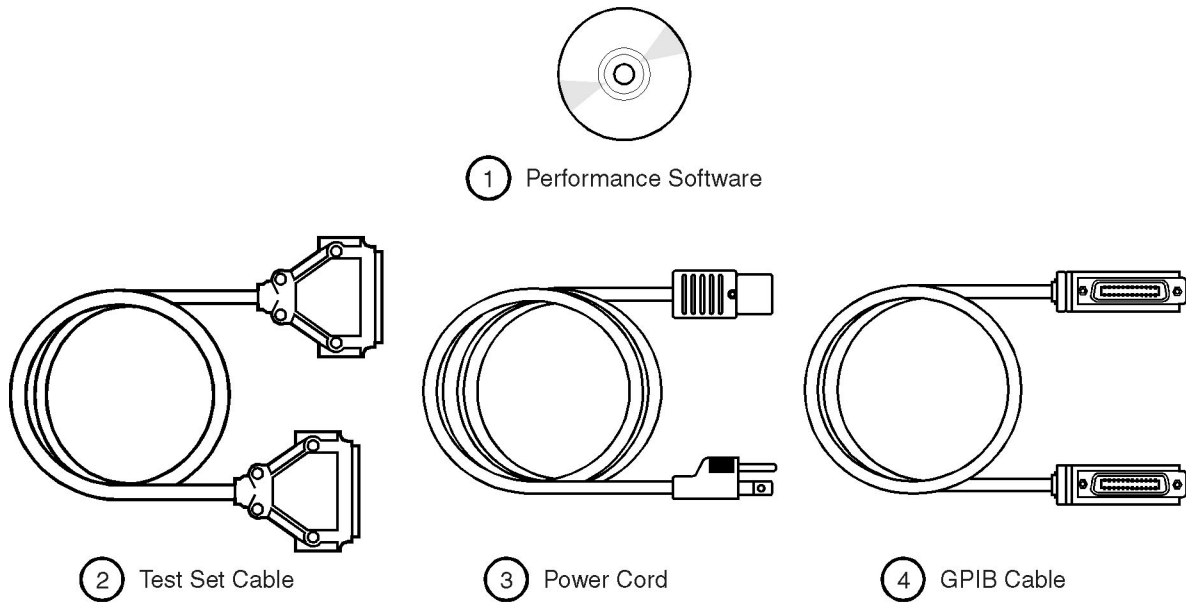
**First.** Read the chapters titled “General Information” and “Installation.” These chapters include information on site preparation, unpacking and inspecting your instrument for damage, safety considerations, and configuring your test set to the HP 8510.

**Second.** Read the chapters of the *HP 85056 Calibration Kit Manual*, that pertain to the care, cleaning, gaging, and connection of precision 2.4 mm devices. This information will help you make good connections and care for your precision devices, and to maintain the performance of your test set and network analyzer system.

**Third.** Read the chapter titled “Operation.” This chapter will acquaint you with the front and rear panel features of your test set. Also included is information on controlling multiple test sets, using the anti-rotation clamps, and connecting devices to the test set.



**HP 8511B Test Set**



accessories\_supplied.cdr

**Figure 1-1 HP 8511B Test Set with Accessories Supplied**



## Verifying the HP 8511B

The HP 8511B has been designed to operate specifically with the HP 8510 network analyzer.

- To install the instrument, turn to Chapter 3, “Installation”.
- To verify that the instrument meets its published specifications, use the HP 8511A,B and Antenna Measurement System Performance Verification Software (HP part number 08511-60024).
- To troubleshoot the test set, refer to the troubleshooting information in the *HP 8510 On-Site Service Manual*. This will determine if the test set is at fault. Then refer to Chapter 6, “Test Set Troubleshooting” for more information.

## Measurement Accuracy

Any precision measurement is no better than the calibration of the network analyzer. As a general rule, the shorter the time between a calibration and the measurement of a device under test (DUT), the more precise the measurement will be, within the limitations of your system. For this reason, Hewlett-Packard recommends that for precision measurements you recalibrate your system every few hours, or at a minimum, reverify your system calibration.

The frequency of your required calibration will depend on the temperature stability of the location of the network analyzer.

## **Instrument Compatibility**

The HP 8511B is compatible with all HP 8510 network analyzers. HP 836XX-series sources must have a frequency range that extends to 50 GHz to take full advantage of the frequency range of the HP 8511B. If your network analyzer and/or source do not fulfill the required conditions, it will be necessary to upgrade your system. Please consult your Hewlett-Packard representative for more information.

## **Description and Characteristics of the Instrument**

The HP 8511B four channel frequency converter test set is designed to operate with all HP 8510 network analyzers. The test set provides a convenient means of customizing a test configuration for a variety of applications within the frequency range of 45 MHz to 50 GHz. In addition to configurations for measuring reflection and transmission parameters of one-port or two-port devices, you can build configurations to characterize antenna parameters, radar cross sections and frequency translation devices. Figure 1-2 on page 1-7 shows one possible measurement set-up.

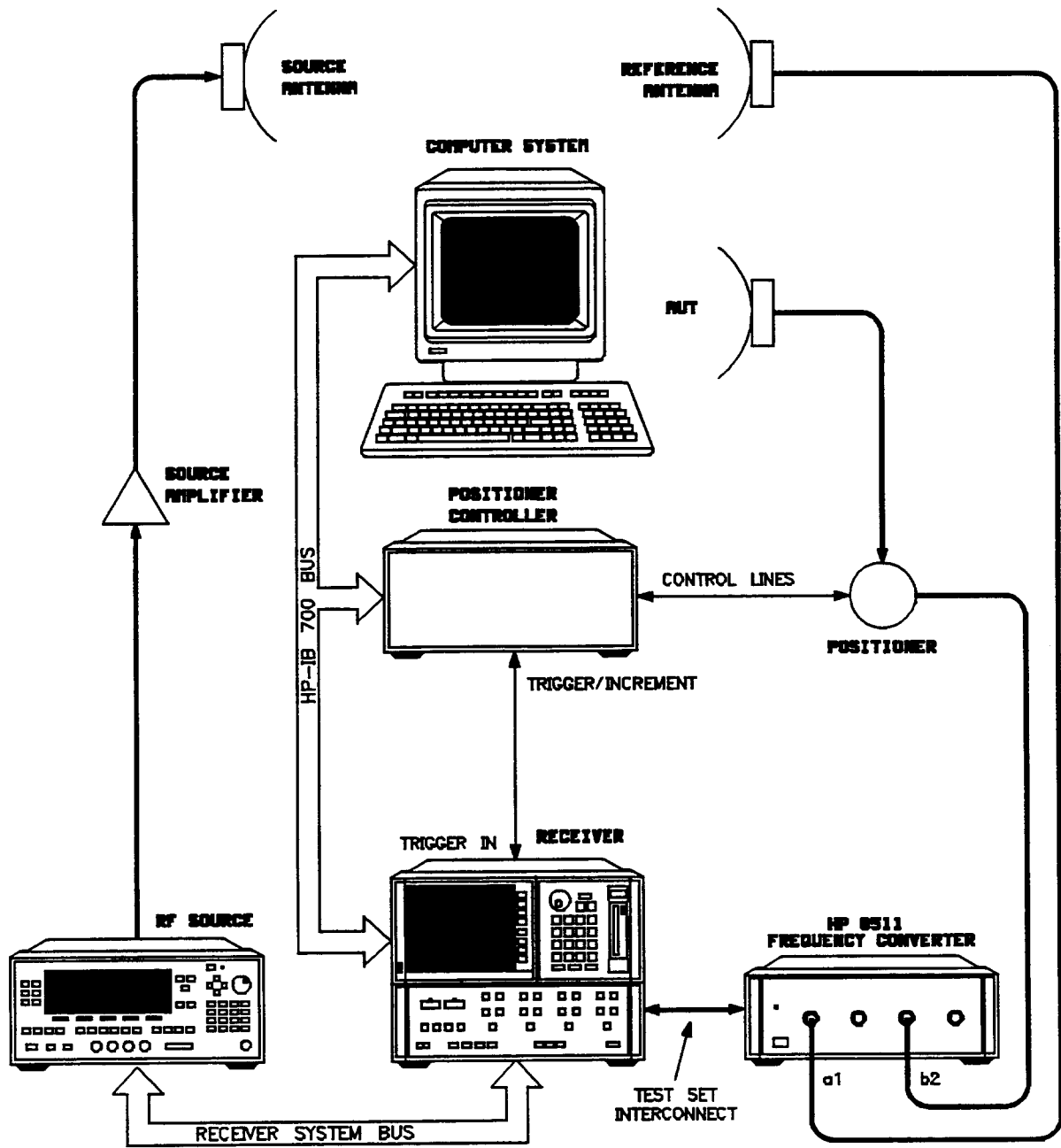


Figure 1-2 Measurement Setup

## Software and Hardware Requirements

### Computer Requirements

The computer requirements to successfully install and operate the performance verification software are as follows:

- 100% IBM-PC compatible computer.
- Pentium 133 or better.
- Windows 95<sup>®</sup>, Windows 98<sup>®</sup> or Windows NT<sup>®</sup> 4.0 installed.
- GPIB interface card and cable, or Hewlett-Packard GPIB card and cable.
- HP BASIC for Windows, version 6.32 or later installed.
- A CD-ROM drive.
- HP 8511A/B and Antenna Measurement System Performance Verification Software.
- Internet Explorer<sup>®</sup> 4.0 or higher or Netscape<sup>®</sup> 4.0 or higher.

## Options

### **Option 001**

Option 001 adds IF switching capability to allow up to four test sets to be connected to the HP 8510 at the same time. The test set in use is selected from the HP 8510 network analyzer. The 20 MHz IF signal is transmitted from the standard test set through the option 001 test set(s) to the HP 8510. IF switching is performed automatically by the option 001 test set(s), without reconnections. For more information, refer to “Controlling Multiple Test Sets” on page 4-6.

### **Option 908**

Option 908 supplies the parts required to rack mount the test set with handles removed. Refer to Chapter 3, “Installation” for additional information.

### **Option 910**

Option 910 provides a duplicate manual at the time of purchase.

### **Option 913**

Option 913 supplies the parts required to rack mount the test set with handles attached. Refer to Chapter 3, “Installation” for additional information.

## Service and Support Products

A variety of service and support products are available. These products cover repair, calibration, and verification. Consult your local Hewlett-Packard customer engineer for details.

The instrument includes a one year on-site service warranty. In the event of failure, Hewlett-Packard will provide service for the system. Note that system installation is not included.

### **Option W30**

Option W30 supplies a three year customer return repair coverage, which adds to the product warranty to provide a total of three years of customer return to Hewlett-Packard repair service.

### **Option W31**

Option W31 supplies a three year on-site repair coverage, which adds to the product warranty to provide a total of three years of next day on-site repair service.

### **Option 1BN**

Option 1BN adds a MIL-STD 45662A Certificate of Calibration to the instrument. This option must be ordered when the instrument is ordered.

### **Option 1BP**

Option 1BP adds a MIL-STD 45662A Certificate of Calibration and the corresponding calibration data to the instrument. This option must be ordered when the instrument is ordered.



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## Accessories

### Accessories Supplied

The accessories supplied with the test set, including part numbers, are listed in the “Installation” and “Replaceable Parts” chapters of this manual.

### Accessories Available

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#### NOTE

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Additional HP 8510 system accessory information is located in the HP 8510 manual set.

### Calibration and Verification Kits

Hewlett-Packard offers several calibration and verification kits suitable for use with 2.4 mm interfaces, they are listed below.

#### HP 85056A 2.4 mm Calibration Kit

Contains:

- open and short circuits
- fixed and sliding loads (2)
- 2.4 mm to 2.4 mm adapters
- 2.4 mm connector tools and gauges.

#### HP 85057B 2.4 mm Verification Kit

Contains:

- precision airline
- mismatched airline
- 20 and 40 dB attenuators
- NIST (National Institute of Standards and Technology) traceable data and uncertainties.

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## Operating and Safety Precautions

### Electrostatic Discharge Information

Electrostatic discharge (ESD) can damage or destroy electronic components. All work on electronic assemblies should be performed at a static-safe work station. Figure 1-3 shows an example of a static-safe work station using ESD protection. When used properly, this provides a significant level of ESD protection.

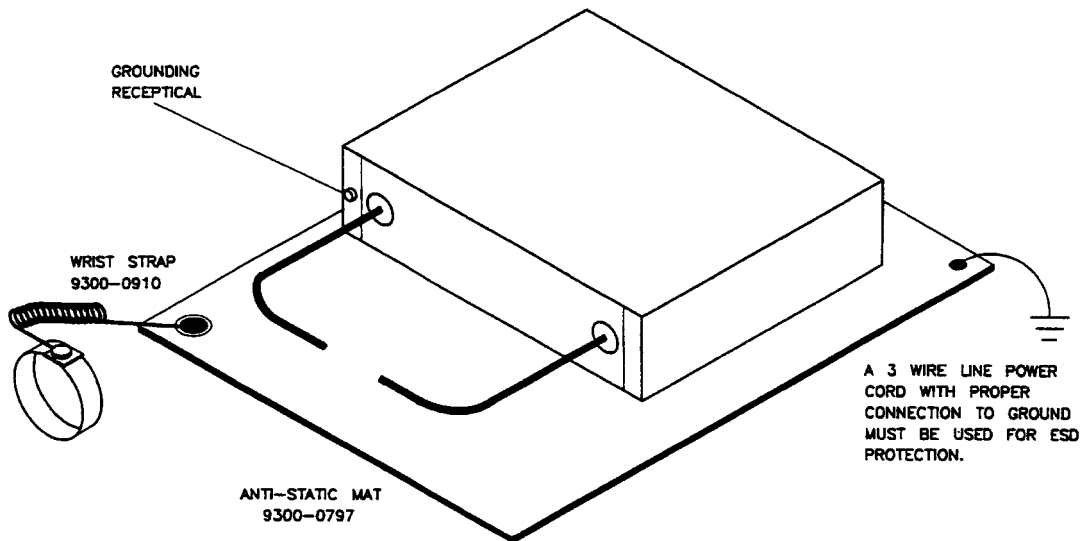
To ensure user safety, the static-safe accessories must provide at least 1 M $\Omega$  of isolation from ground. Refer to Table 1-1 on page 1-13 for information on ordering static-safe accessories.

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### WARNING

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These techniques for a static-safe work station should not be used when working on circuitry with a voltage potential greater than 500 volts.



*Figure 1-3 Example of a Static-safe Work Station*

## Reducing ESD Damage

The following suggestions may help reduce the ESD damage that occurs during testing and servicing operations.

- Before connecting any coaxial cable to an instrument connector for the first time each day, momentarily ground the center and outer conductors of the cable.
- Personnel should be grounded with a resistor-isolated wrist-strap before touching the center pin of any connector and before removing any assembly from the unit.
- Be sure that all instruments are properly earth-grounded to prevent a buildup of static charge.

Table 1-1 lists static-safe accessories that can be obtained from Hewlett-Packard using the HP part numbers shown.

**Table 1-1** *Static-Safe Accessories*

HP Part Number	Description
9300-0797	Set includes: 3M static control mat 0.6 m X 1.2 m (2 ft X 4 ft) and 4.6 cm (15 ft) ground wire. (The wrist-strap and wrist-strap cord are not included. They must be ordered separately.)
9300-0980	Wrist-strap cord 1.5 m (5 ft).
9300-0910	Wrist-strap, color black, stainless steel, without cord, has four adjustable links and a 7 mm post-type connection.
9300-1169	ESD heel-strap (reusable 6 to 12 months).

## Operating Power Level

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

**Table 1-2** *Maximum Operating Power Level*

Maximum Operating Power Level	Test Port
+13 dBm	a <sub>1</sub> , a <sub>2</sub> , b <sub>1</sub> , b <sub>2</sub>

- Do *not* exceed +15 dBm source RF input level into the test set and under no circumstances ever apply a dc level to the source RF input of the test set.
- Do *not* torque anything to the test port connector with greater than 90 N-cm (8 in.-lb.) of torque. The wrench supplied with your accessory kit is calibrated to 90 N-cm (8 in.-lb.).
- Do *not* torque anything to the source RF input on the back of your test set, with greater than 90 N-cm. (8 in.-lb.) of torque.

## **Service**

The voltages in this test set warrant normal caution for operator safety. Nevertheless, service should be performed only by qualified personnel. Service strategy, troubleshooting procedures, replaceable parts and similar information for the HP 8511B test set is in this manual or the *HP 8510 On-Site Service Manual*.

## **Specifications**

The specifications of the test set with an HP 8510 network analyzer are listed in Chapter 2, “Specifications”.

## **Characteristics**

The performance parameters listed in Chapter 2, “Specifications” as characteristics are typical or nominal, but are non-warranted characteristics of the HP 8510/8511B system.

## **Recommended Equipment**

Additional equipment and accessories required for use with the test set are listed in tables in Chapter 2, “Specifications”. The tables note which items are required to verify the performance of the test set, and which are required to operate it. Other equipment may be substituted if its specifications meet or exceed the specifications listed in the critical specifications column.

---

## Miscellaneous

### **Adjustments**

The HP 8511B had no adjustments. Specifically, no attempt should be made to adjust the samplers.

# 2

## Specifications

### Specifications and Characteristics

#### Introduction

Specifications and characteristics differ as defined in the Table 2-1 and Table 2-2 on page 2-2. Both are based on certain operating conditions. Those conditions are defined in “Specification Assumptions” on page 2-5. Specifications describe the warranted performance of the instrument. To verify the specifications follow the *HP 8511A/B and Antenna Measurement System Performance Verification Software* assembly documentation. Characteristics provide information useful in applying the instrument by giving typical but *non-warranted* performance parameters.

**Table 2-1 HP 8510/8511B Specifications**

Parameter	0.045 to 8 GHz	8 to 20 GHz	20 to 40 GHz	40 to 50 GHz
<b>Frequency Response Tracking</b>				
Magnitude (ripple) <sup>1</sup>	1.5 dB	1.5 dB	1.5 dB	1.5 dB
Phase (ripple)	75 degrees	75 degrees	75 degrees	75 degrees
Magnitude slope <sup>2</sup>	0.055 dB/GHz	0.055 dB/GHz	0.055 dB/GHz	0.055 dB/GHz
<b>Crosstalk<sup>3</sup></b>				
	-85 dB	-85 dB	-75 dB	-70 dB
<b>High Level Noise<sup>4</sup></b>				
Magnitude (ratio)	0.006 dB rms	0.009 dB rms	0.040 dB rms	0.060 dB rms
Phase (ratio)	0.08 degrees rms	0.145 degrees rms	0.245 degrees rms	0.400 degrees rms
<b>Low Level Noise<sup>5</sup></b>				
	-100 dBm	-102 dBm	-102 dBm	-102 dBm
<b>Conversion Gain<sup>6</sup></b>				
	1 dB to -4 dB	1 dB to -4 dB	-3 dB to -13 dB	-5 dB to -15 dB
<b>Compression (0.1 dB point)<sup>7</sup></b>				
	-10 dBm	-10 dBm	-15 dBm	-20 dBm
<b>Input Port<sup>8</sup></b>				
Impedance Match (return loss) (all 4 ports)	≥17 dB	≥15 dB	≥9 dB	≥7 dB

1. Deviation from a least-squares-straight-line fit, excluding noise and slope. Ratio measurement of any two ports.
2. Slope of least-squares-straight-line fit over full frequency range.
3. Uncorrected port to port crosstalk with averaging factor of 1024.
4. Trace noise, sweep to sweep variation.
5. Low level noise measured with 50 ohm load at port, and calculated as the mean value of a 101 point trace with IF averaging set at one. Low level noise varies with averaging factory: 10 log (average factor).
6. See Figure on page 2-2.
7. Do not exceed -5 dBm input to sampler for proper phase lock operation.
8. Tested with sampler in non-conducting state. When diodes are turned on by the LO pulse, they present a short circuit across the sampler input port. This may affect the measured data.

**Table 2-2 HP 8510/HP 8511B Characteristics<sup>1</sup>**

Parameter	0.045 to 8 GHz	8 to 20 GHz	20 to 40 GHz	40 to 50 GHz
<b>Dynamic Range<sup>2</sup></b>	110 dB	112 dB	107 dB	102 dB
all inputs	(-10 to -120 dBm)	(-10 to -122 dBm)	(-15 to -122 dBm)	(-20 to -122 dBm)
<b>Accuracy Enhanced Crosstalk<sup>3</sup></b>				
-115 dB	-115 dB	-113 dB	-110 dB	-105 dB
<b>Typical Drift (typical)</b>	Magnitude 0.001 X V °C, linear			
Phase (0.01 + 0.01 f (GHz) X V °C, degrees)				

**Input Ports**

Connector type: precision 2.4 mm female

Impedance: 50 ohms nominal

Damage level: +13 dBm (20 mW) CWRF input<sup>4</sup>

Port input power for phase lock:

Frequency	Minimum	Maximum
0.045 to 8 GHz	-41 dBm	-5 dBm
8 to 20 GHz	-39 dBm	-5 dBm
20 to 26.5 GHz	-32 dBm	-5 dBm
40 to 50 GHz	-30 dBm	-5 dBm

1. The performance parameters listed are characteristic of the HP 8511B. They are typical or nominal figures and are not field verifiable.
2. Determined by 0.1 dB compression level and system low level peak noise. Low level peak noise measured with 50 ohm load at port and 1024 averaging factor. Noise floor varies with averaging factor. (10 log averaging factor.) Low level noise is calculated from low level noise +10.4 dB.
3. Effective crosstalk with isolation, calibration, excludes noise.
4. Do not exceed -5 dBm input to the sampler for the proper phase lock operation.

## Dynamic Accuracy

Figure 2-1 and Figure 2-2 illustrate a worst case magnitude and phase uncertainty due to IF residuals and detector inaccuracies. This data excludes uncertainty due to noise, frequency response, directivity, port matches and connector repeatability.

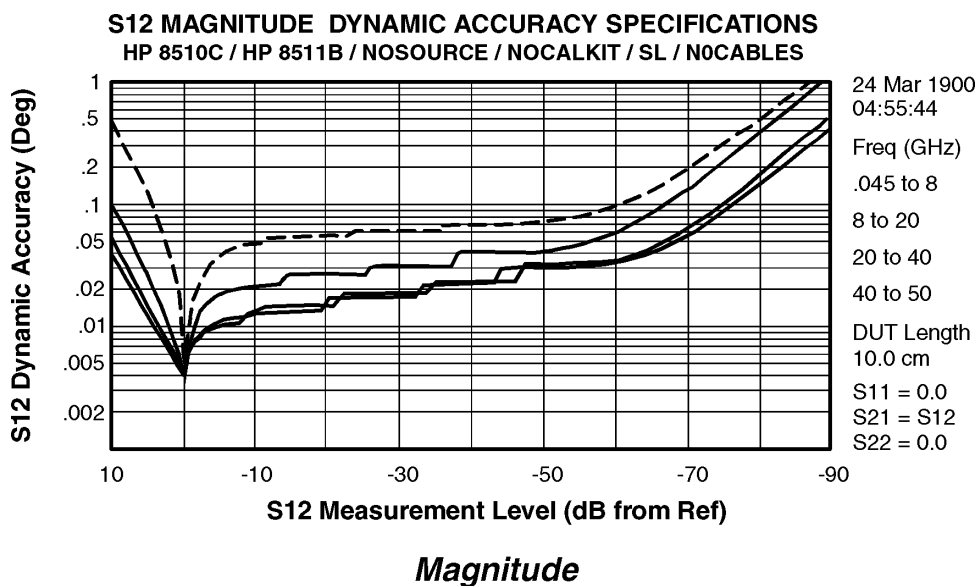


Figure 2-1 Worst Case Dynamic Accuracy (Magnitude)

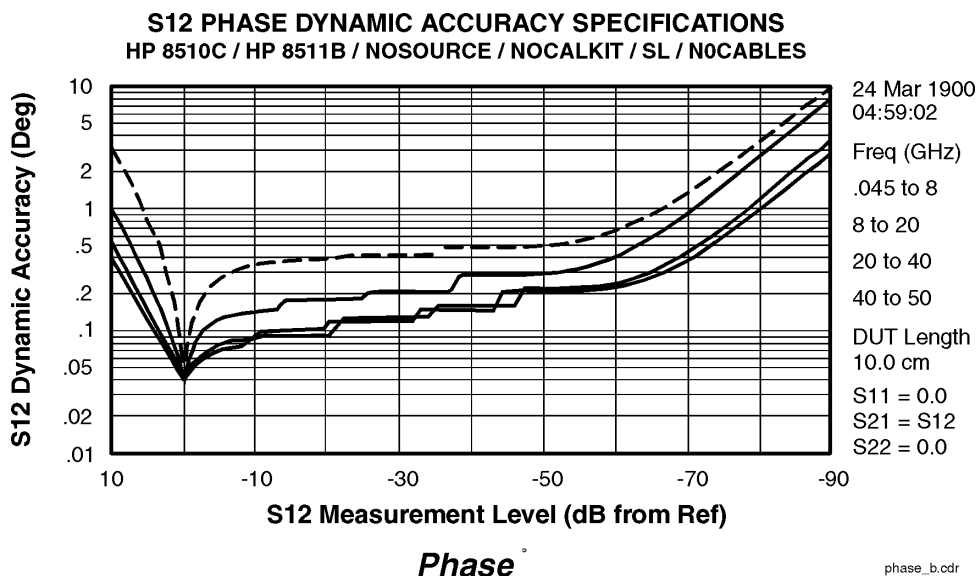


Figure 2-2 Worst Case Dynamic Accuracy (Phase)\*

\* Phase detector accuracy is better than 0.02 degrees, useful for measurements where only phase changes.



**Table 2-3 HP 8510/HP 8511B Characteristics (continued)****Source of System Dynamic Accuracy Errors:**

The factors affecting dynamic accuracy listed below are primarily a function of the IF detector. However, compression is primarily a function of the sampler/mixer circuitry. In order to measure these values, some of the system cables must be disconnected to gain access to the individual instruments.

IF Amplifier Gain Accuracy	IF Amplifier Power Range (dBm) <sup>1</sup>	Maximum Gain Error (dB)
	-10 to -34	0
	-34 to -46	0.005
	-46 to -58	0.010
	-58 to -70	0.015
	≤ 70	0.025

**Detector Circularity Error:** 0.003 dB peak

**IF Residuals:** -140 dBm<sup>1</sup>

**IF Linearity:** 0.003 dB

**Incremental Phase Accuracy (Phase versus Phase) at Measurement Reference:**

0.001 degrees/degree, not to exceed 0.02 degrees peak.

**Operating Temperature:** 0 °C to 55 °C

**Power:** 110, 120, 220 or 240 10% Vac; 47 to 66 Hz line frequency

**Dimensions:** 460 mm x 133 mm x 609 mm (18.1 x 5.25 x 24 inches)

**Weight:** 13 kg (29 lb) net; 17 kg (38 lb) shipping

1. Measured at the IF input to the HP 8510, not at the test set test ports.

---

## Specification Assumptions

The specifications of the HP 8511B require that the following operating conditions are met:

- All system instruments have reached stable operating temperature.
- RF source: HP 83651A. When used with another recommended source, the performance specifications may differ from those for the HP 8510/8511/83651A configuration. The performance test software will display and print the limits for the chosen configuration.
- Performance verification temperature: 23 ± 3 °C.
- RF source power levels as follows:

---

Test	Power at Input Level (dBm)		
	0.045 to 20 GHz	20 to 40 GHz	40 to 50 GHz
Compression, Crosstalk	-10	-15	-20
Conversion Gain, Tracking, High Level Noise	-15	-20	-25

---

## Recommended Test Equipment

Table 2-4 lists the test equipment that is required when trouble shooting, operating, and performance testing the HP 8511B

**Table 2-4 Recommended Test Equipment**

Item	Critical Specifications	Recommended Model (or Part Number)	Use <sup>1</sup>
Network analyzer	no substitute	HP 8510A,B,C	O,P,T
Multimeter	range: 0 to 50 V	HP 3456A	T
Oscilloscope	50 MHz bandwidth	HP 1740A	T
Semi-rigid cables			T,P
Power splitter	45 MHz to 50 GHz	HP 11667C	P,T
Power meter		HP 436A, HP 437A, HP438A	P
Power sensor	no substitute	HP 8487A	P
2.4 mm coax cables (2)	no substitute	08511-20031	P,T
2.4 mm (f) to 2.4 mm (m) adapter	no substitute	1250-2186	P
20 dB fixed attenuator	no substitute	HP 33340D opt. 020 <sup>2</sup>	P
RF cable	2.4 (m) semi-rigid 2-in long	08511-20031A	P,T
6 dB fixed attenuator (2)	no substitute	HP 33340D opt. 006	P
2.4 mm 50 ohm load (m)	no substitute	HP 85148A	P
2.4 mm 50 ohm load (f)	no substitute	HP 85138B	P

1. O = Operation; P = Performance test; T = Troubleshooting

2. Supplied in the HP 8511B Service Kit (HP part number 08511-60016)

# 3

---

## Installation

### Introduction

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

### Initial Inspection

Inspect the shipping container (including cushioning material) and its contents for completeness and damage. If the shipping container is damaged or defective, keep the shipping materials and notify both the carrier and the nearest Hewlett-Packard office. The HP office will arrange for repair or replacement of the test set without waiting for settlement of the claim. If any of the following accessories are not received with the test set, notify your nearest HP office and the missing parts will be sent to you.

---

### CAUTION

Assemblies in the test set are very sensitive to damage by static electricity. They may or may not continue to function if subjected to an electrostatic discharge (ESD). Their reliability will however, be impaired.

Always use an anti-static wrist strap when calibrating or verifying the test set or using the test set to measure devices. Never touch the test port center conductors. For more information on ESD, refer to “Electrostatic Discharge Information” on page 1-12 of this manual.

---

**Table 3-1** *Contents of the HP 8511B Shipping Container*

Item	Part Number
Power Cord	8120-1348
Test set cable assembly	08510-60102
GPIB cable	8120-3445
Performance test software (CD-ROM) assembly	08511-60024
<i>HP 8511B Operating and Service Manual</i>	08511-90073

## **Environmental Considerations**

### **Operation and Storage**

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

The HP 8511B may be stored in temperatures from -40 °C to +75 °C, with relative humidity up to 90% at +65 °C (maximum dry bulb temperature) and at altitudes up to 15,240 meters (50,000 feet).

### **Preparation for Use**

#### **Positioning the Test Set**

Typically the HP 8511B is placed under the HP 8510 network analyzer or the source whether it is rack-mounted or used on a bench. To install the flanges to rack mount the instrument (with or without handles) in a standard 19 inch rack refer to “Installing the Test Set in a System Rack” on page 3-3.

## Installing the Test Set in a System Rack

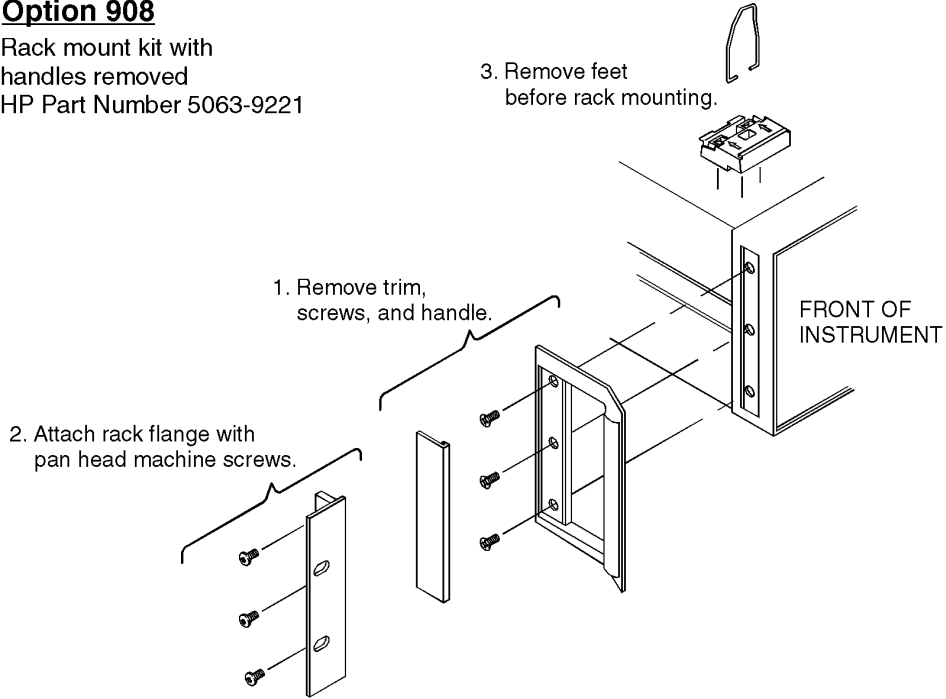
The recommended system rack is the HP 85043C. Instructions for rack-mounting the HP 8511B test set in a system configuration with the HP 8510 are provided in the “Installation” chapter of the *HP 8510 On-Site Service Manual* and in the *HP 85043C System Rack Manual* (HP part number 85043-90022).

To install the flanges to rack mount the instrument (with or without handles) in a standard 19 inch rack, refer to Figure 3-1 on page 3-4.

Installation  
Installing the Test Set in a System Rack

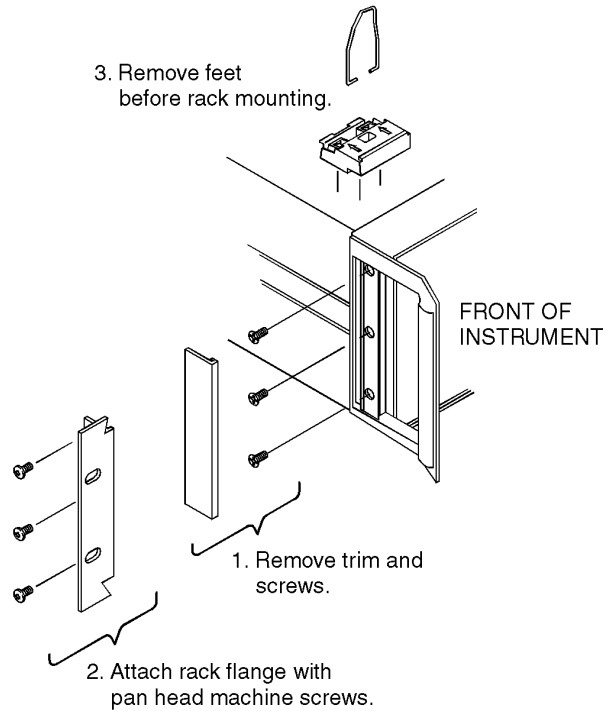
**Option 908**

Rack mount kit with handles removed  
HP Part Number 5063-9221



**Option 913**

Rack mount kit for instruments with previously attached front handles  
HP Part Number 5063-9234



rackmount.cdr

**Figure 3-1 Attaching Rack-Mounting Hardware**

## **Installing the Test Set on a Bench**

When installing the test set for use on a bench, place it on a grounded anti-static work surface to lessen the chance of ESD damage. The antistatic surface should extend far enough in front of the test set to provide effective protection for the test ports and cable ends. Refer to “Operating and Safety Precautions” on page 1-12. A grounding receptacle is provided on the test set as an alternate grounding point for your anti-static wrist-strap.



## Connecting the Test Set

### Mating Connectors

**INPUT PORTS**  $a_1$ ,  $b_1$ ,  $b_2$  and  $a_2$  are precision 2.4 mm female connectors and mate with precision 2.4 mm male connectors.

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

The 8510 **SYSTEM BUS** connector is a female GPIB type connector and mates with the corresponding male connectors of the GPIB cables.

### Power and Control Connections

The following connections, with the exception of line power, are illustrated in Figure 3-2 on page 3-7. That figure also shows the connections required for the RF source.

1. Connect the line cord between an electrical outlet and the line module to supply power to the frequency converter.
2. Connect the test set IF interconnect cable from the **J11 TEST SET INTERCONNECT** connector on the rear panel of the HP 8511B to the **J1 TEST SET INTERCONNECT** connector on the rear panel of the HP 85102 IF detector.
3. Connect the system bus cable from the HP 8511B **J12 HP 8510 SYSTEM BUS** connector to the HP 8510 **INTERCONNECT** connector of the HP 85101 display/processor. The test set IF interconnect cable and the system bus cable transmit control signals between the test set and the network analyzer.

### Signal Path Connections

The IF signals from the test set are transmitted to the HP 85102 IF detector by the supplied test set IF interconnect cable. Longer IF interconnect cables are available (see “Cables” on page 1-10) of this manual.

RF signals are typically transmitted from the source to the DUT (device under test) or signal separation devices by 3.5 mm flexible or semi-rigid cables.

## Connecting the Test Set

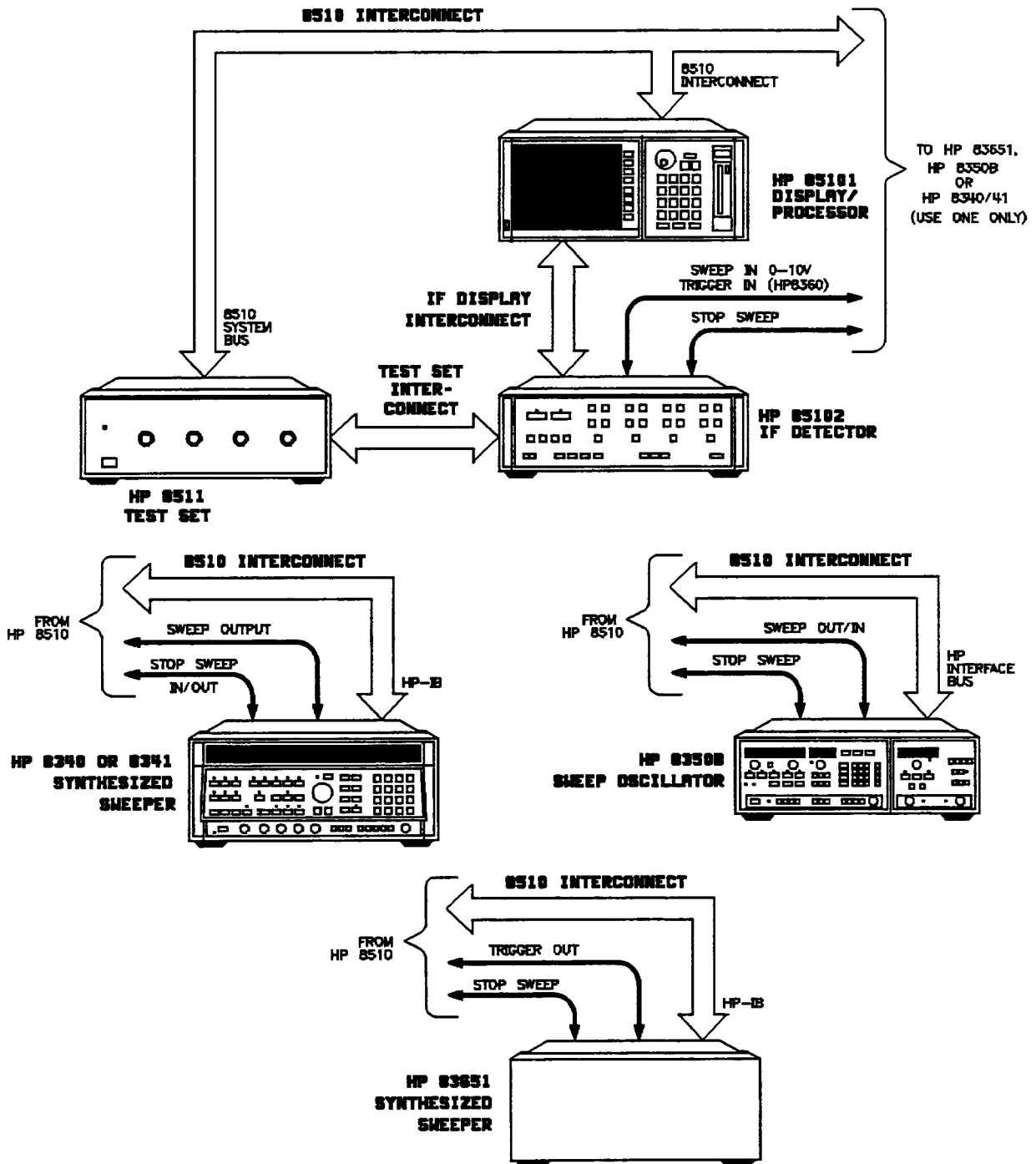


Figure 3-2 Connecting the Test Set in a System Configuration

## Packaging

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

If original packaging material is *not* available:

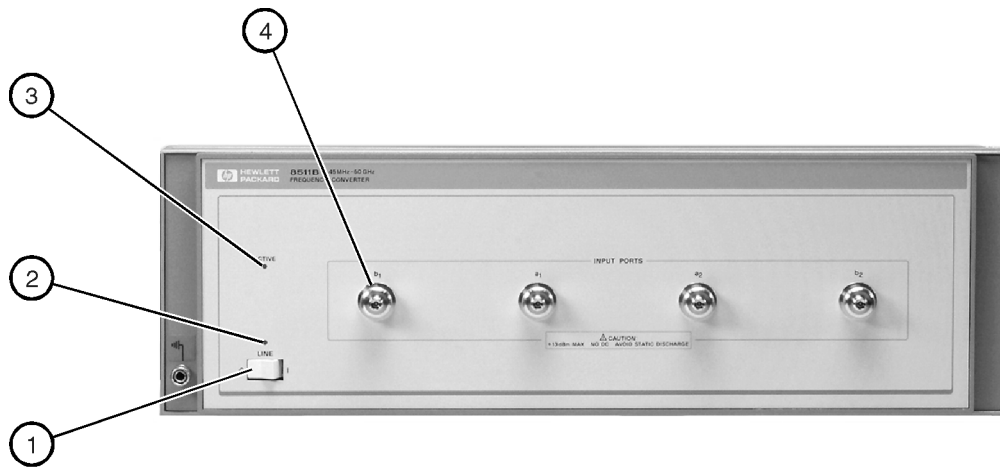
1. Wrap the test set in heavy paper or anti-static plastic.
2. Use sufficient shock absorbing material on all sides of the test set to provide a thick, firm cushion and prevent movement.
3. Seal the shipping container securely and mark it FRAGILE.
4. If shipping to an HP office or service center, complete and attach a service tag (provided in the HP 8510 manual set).

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

## Introduction

This chapter illustrates the features and functions of the front and rear panels of the HP 8511B (see Figure 4-1 and Figure 4-2 on page 4-2. This chapter also describes the multiple test set option (option 001). It explains the setup and use of one or more test sets in a system.

## Front Panel Features



fp\_features.cdr

**Figure 4-1** Front Panel Features of the Test Set

1. **Line Switch.** This switch turns the test set on and off. When the side of the switch labeled 0 is depressed, the test set is off; 1 is on.
2. **Line LED.** This LED goes on and off with the test set line switch.
3. **Active LED.** This LED lights about two seconds after power is turned on following a successful conclusion of self-test. If the test set is used with other test sets (option 001) and is not addressed by the HP 8510, this light remains off.
4. **Input Ports  $b_1$ ,  $a_1$ ,  $a_2$ , and  $b_2$ .** These input ports transmit RF energy to the samplers within the instrument. Port  $a_1$  or  $a_2$  must be used for system phaselock. These ports are precision 2.4 mm connectors and all connections must be torqued to *no more* than 90 N-cm (8 in-lb).

## Rear Panel Features



rp\_features.cdr

**Figure 4-2** Rear Panel Features of the Test Set

1. **Line Module.** This assembly houses the line cord connector, line fuse and line voltage selector. Pull out the right side of the line module cover to replace or change the fuse, or to change the voltage selection. The voltage selector drum must be removed to rotate it to a different voltage setting. Recommended fuse values are printed on the rear panel.
2. **J10 Test Set Interconnect.** This connector is used only in test sets with option 001. It allows connecting another test set to the option 001 test set. Up to four test sets can be serially connected to the analyzer. The HP 8510 system automatically selects the IF output from the chosen test set for processing and display. Refer to “Controlling Multiple Test Sets” on page 4-6 for more information.
3. **J11 Test Set Interconnect.** This connector transmits the IF signal from the test set to the HP 85102 IF detector. It also transmits control signals bidirectionally.
4. **HP 8510 System Bus Address Switch.** This five-pole binary-weighted switch sets the system bus address of the test set. The binary weight of each pole is indicated on the rear panel, as well as the on and off positions. Decimal 20 (off-off-on-off-on, from left to right) is the default setting (see Figure 6-4 on page 6-6).
5. **J12 8510 System Bus Connector.** This connector is used for GPIB communications with the HP 85101 display/processor.

## Operator's Check

The purpose of this check is to confirm that the HP 8511B functions properly as part of an HP 8510 system.

**Table 4-1 Necessary Equipment**

Description	Model or HP Part Number
Network analyzer system	HP 8510,B,C
Semi-rigid cables (2)	08511-20025 <sup>1</sup> 08511-20031 <sup>1</sup>
Power splitter	HP 1167C <sup>1</sup>

1. Supplied with the HP 8511B service kit (HP part number 08511-60016).

### NOTE

This procedure must be performed with a properly configured and operational HP 8510 system.

### Procedure

Plug in and turn on the frequency converter. The line LED should light immediately and the active LED should light in about two seconds. Those indications mean that the instrument has passed its self-test. In case of difficulty, refer to Chapter 6, "Test Set Troubleshooting" or contact your local HP Service office.

Turn on the source, then the test set and *then* the HP 8510.

On the HP 85102:

1. Press [RECALL], [MORE], [FACTORY PRESET] to preset the HP 8510C, or [PRESET] for the HP 8510B.

HP 8360 series systems:

- Press STIMULUS, [MENU], [STEP] and then use the entry keys to set the sweep time to 200 ms. In narrow band systems, the power level in the frequency band generated should match the level shown in Figure 4-4 on page 4-5 for a given frequency.
2. Reduce the source power by pressing STIMULUS, [MENU], POWER, [MENU], [POWER SOURCE 1], [-10], [x1].

### NOTE

All of the observed traces should decrease from -15.5 dB at 45 MHz to -35.5 dB at 50.0 GHz. Refer to Figure 4-4 on page 4-5.

### a1 and b1 Test

- Loosely connect the RF source cable to the power splitter as shown in Figure 4-3 below. Connect the other end of the RF source cable to the output of the source. Rotate the semi-rigid cables to the required position for connection to ports a1 and b1. Tighten all connections.

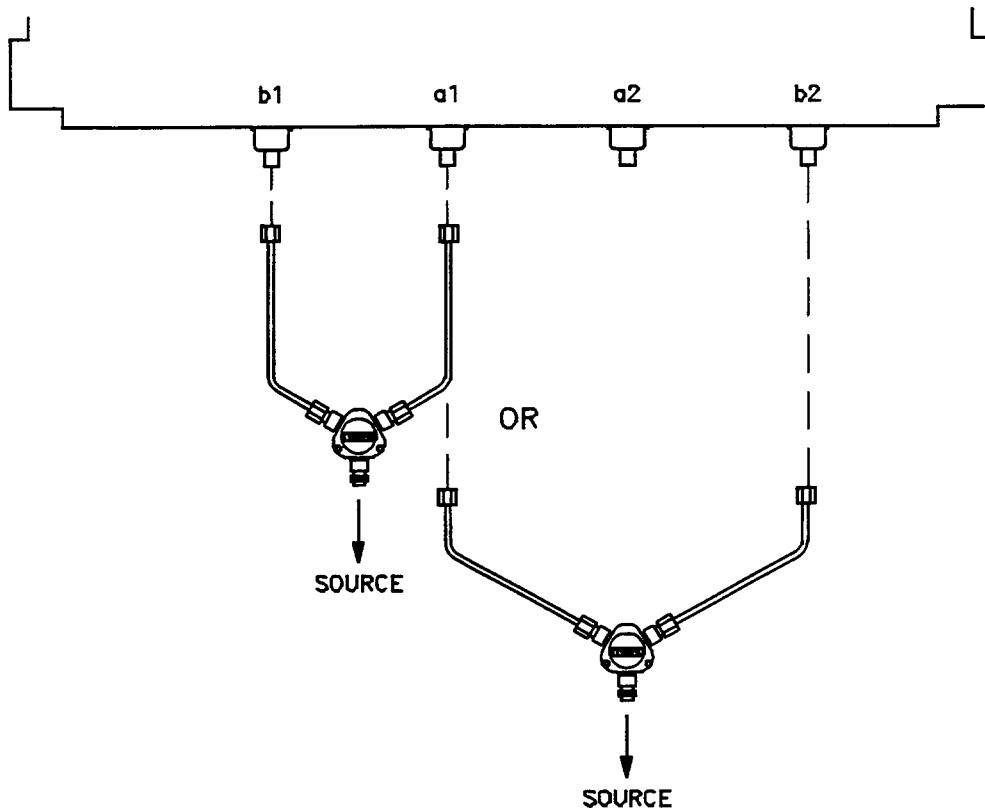


Figure 4-3 Hardware Configuration for Operator's Check

- Press PARAMETER, [MENU], [User 1 a1] to observe the a1 power level trace.

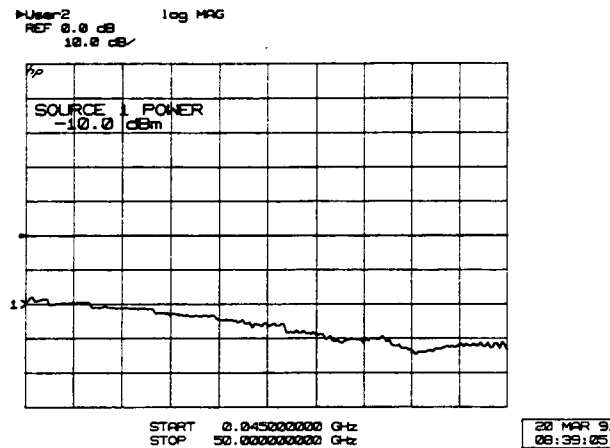


Figure 4-4 Typical Operator's Check CRT Trace

- Press [User 4 b1] to observe the b1 power level trace.

## a2 and b2 Test

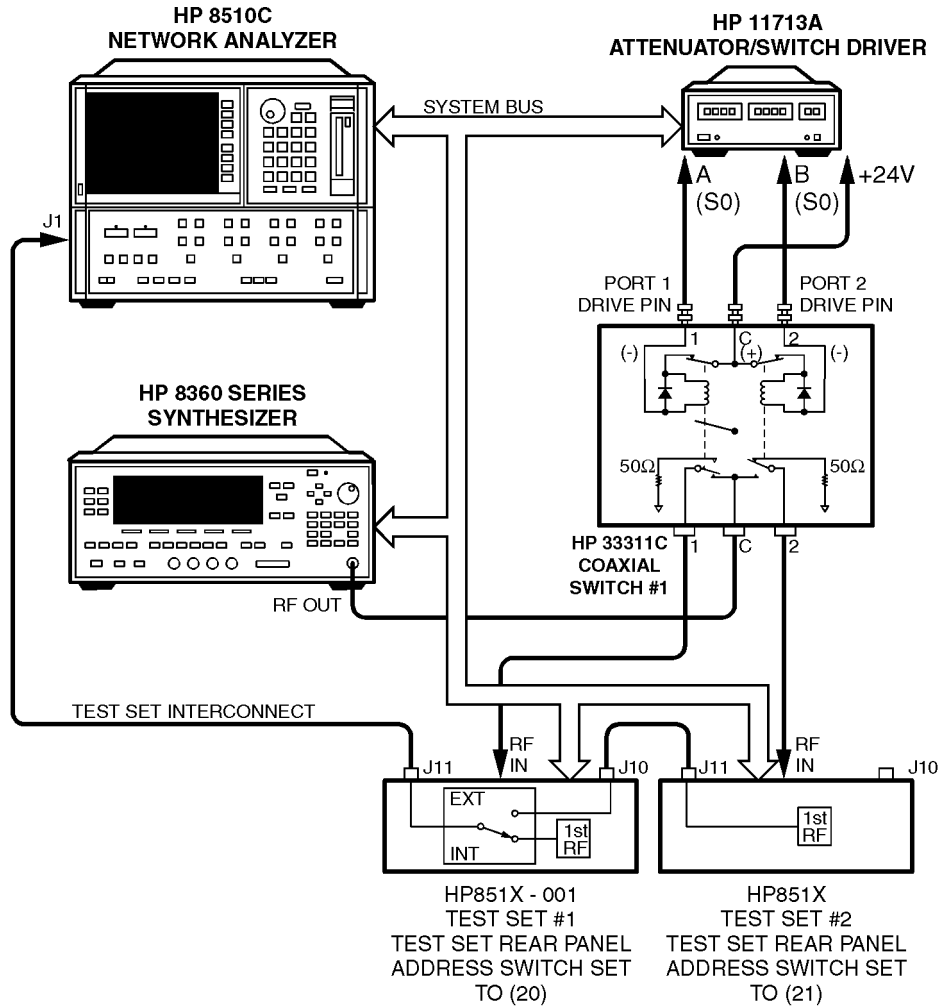
- Reconnect the semi-rigid cables (as in step 3 of "a1 and b1 Test") to ports a2 and b2. Disregard the running error message "Caution: NO IF FOUND".
- Press [User 3 a2], [REDEFINE PARAMETER], [PHASE LOCK], [a2], [REDEFINE DONE] to observe the a2 power level trace.
- Press [User 2 b2], [REDEFINE PARAMETER], [PHASE LOCK], [a2], [REDEFINE DONE] to see the b2 trace.
- If any of the traces are not within the limits noted above, check all of the connections and repeat the above procedure. If symptoms persist, refer to the "Service and Equipment Overview" chapter in the *HP 8510C On-Site Service Manual*.



## Controlling Multiple Test Sets

Option 001 for the HP 851X-series test sets will allow an HP 8510 to alternately control up to four test sets. While a measurement is proceeding on test set number 1 (equipped with option 001), a test device can be connected to test set number 2, which does *not* need to be equipped with option 001. When the measurement on test set number 1 is complete, the HP 8510 can control test set number 2.

In a standard test set, the 20 MHz IF and control signals are applied directly to the J11 TEST SET INTERCONNECT, which connects to the HP 8510. Option 001 adds a set of IF switches, control switches, and the J10 TEST SET INTERCONNECT connector. This allows the selection of 20 MHz test set IF signals. As shown in Figure 4-5 on page 4-7 test set number 1 can apply its IF to the HP 8510, or it can switch to pass the IF from test set number 2 through the J10 TEST SET INTERCONNECT to the HP 8510.



**NOTE:**

1. Not all system connections are shown.
2. In dual source configurations, the second can be multiplexed in a similar manner. If only one dual source test set is used, the second source can be directly connected to the appropriate test set.

tsrfif2.cdr

**Figure 4-5 RF and IF Switching with Two Test Sets**

**Table 4-2 HP 33311C Coaxial Switch Positions with Two Test Sets**

New ADDRESS of Test Set	Test Set Selected	HP 33311C Coaxial Switch Port Selected
20	1	Port 1
21	2	Port 2

## Installation

Set each test set rear panel address switch to the address listed in Table 4-2 on page 4-7 if using a two test set configuration, and Table 4-3 on page 4-11 if configuring more than two test sets. Use the supplied test set interconnect cable to connect test set number 2, J11, to test set number 1, J10. You may continue this test set “daisy chain” to include up to four test sets if the total length of all test set interconnect cables does not exceed 13 meters (about 40 feet). The last test set in the chain does not require option 001.

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

---

## Operation

### Initialization at Power-Up

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

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

### Selecting a Test Set

#### Test Set IF Switching

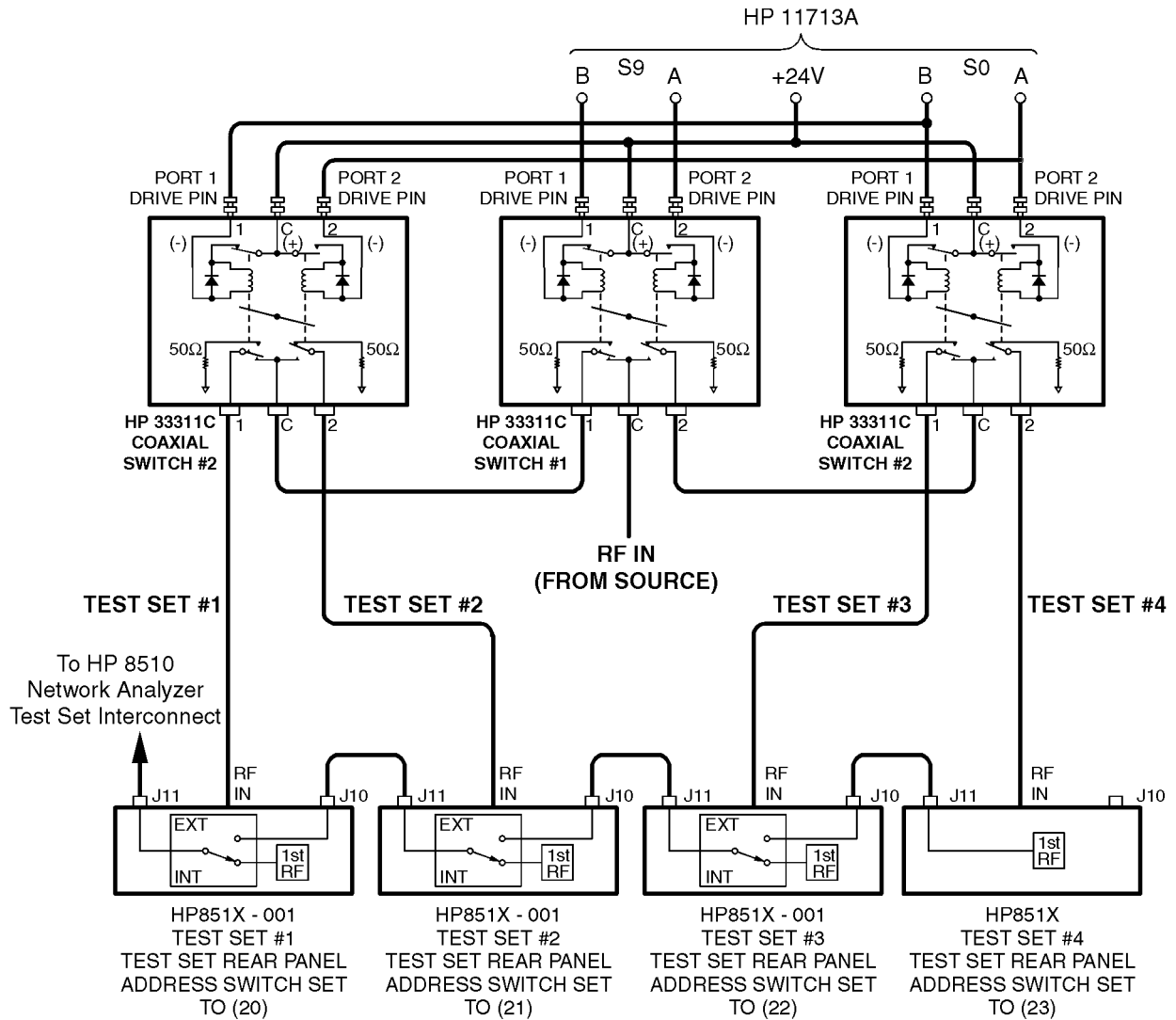
The active test set is selected by the built-in capability of the analyzer to generate an addressed command to the test set. Each time the HP 8510 [ADDRESS of TEST SET] function is changed (see [LOCAL] menu), the analyzer switches the previously addressed test set IF to external and the newly addressed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

## **Test Set Address**

The address of the active test set can be changed manually from the analyzer front panel by selecting the [ADDRESS of TEST SET] function, then entering the address of the test set and pressing [x1], or it can be changed under program control using the analyzer's GPIB ADDRESS command. The GPIB address of a particular test set is set by the address switches on the test sets rear panel (see Figure 6-4 on page 6-6).

## **RF Switch Driver Commands**

A related feature of the analyzer is that when the HP 8510 [ADDRESS of TEST SET] function is changed, a code sequence is automatically issued over the HP 8510 system bus to the device at the [ADDRESS of RF SWITCH]. In the recommended configuration, this device is an HP 11713A attenuator/switch driver which in turn controls one or more coaxial switches. As shown in Figure 4-5 on page 4-7 and Figure 4-6 on page 4-11, these switches are used to select which of the test sets receives the RF output of the network analyzer source. The exact command issued depends upon the new value of the [ADDRESS of TEST SET] function, also shown in Figure 4-5 on page 4-7 and Figure 4-6 on page 4-11.



**NOTE:**

1. Not all system connections are shown.
2. In dual source configurations, the second can be multiplexed in a similar manner. If only one dual source test set is used, the second source can be directly connected to the appropriate test set.

tsrif.cdr

**Figure 4-6 RF and IF Switching with Four Test Sets**

**Table 4-3 HP 33311C Coaxial Switch Positions with Four Test Sets**

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

## Measurement Calibration

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

---

### NOTE

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

It may be convenient to store a hardware state file and an instrument state file for each combination of test set and cal set. You may also store your hardware state file on a disk for future use. To change the configuration, simply recall the appropriate hardware state file, which sets the address of test set and issues the RF switch command, and then the appropriate instrument state file which recalls the cal set.

---

## Operational Checks

To check operation of a multiple test set configuration:

1. Connect a device with a known response at test set number 1.
2. Press HP 8510 [LOCAL], {TEST SET}, "ADDRESS of TEST SET" is displayed.
3. Enter the address of test set number 1 (this would be 20).
4. Press [x1]. The test set number 1 measurement should appear.
5. Press [DISPLAY], {DATA and MEMORIES}, {DATA →},{MEMORY 1} to store the trace for later comparison.
6. Press HP 8510 [LOCAL], {TEST SET}, "ADDRESS of TEST SET" to select test set number 2.
7. Switch back to test set number 1.
8. Observe any difference in the response between the stored trace and the result after switching back and forth between the test sets. Repeat for each of the test sets. Any difference in the data believed due to the option 001 IF switch or RF switching must be investigated. Refer to Chapter 6, "Test Set Troubleshooting" for more information.

## Performance Verification

Standard system performance verification procedures are used to verify the operation of the option 001 test set as test set number 1. To verify the performance of a test set other than an HP 8511 in the chain, select it as the active test set and proceed as usual. Refer to the *HP 8510 On-Site Service Manual* for the performance verification procedure.

# 5

---

---

## Performance Tests

The HP 8511B ships with the HP 8511A/B and Antenna Measurement System Performance Verification Software assembly (HP part number 08511-60024). This assembly includes performance verification software with on-line help and an installation and getting started manual (HP part number 5962-0493).

Follow the *HP 8511A/B and Antenna Measurement System Performance Verification Software* assembly documentation to install the software and to verify the performance of your test set.



## Port Return Loss

### Test Procedure (optional)

---

**NOTE**

---

An HP 8517B test set is required to perform this test.

1. Disconnect the HP 8511B from the GPIB, the test set IF interconnect and the RF source signal. Leave it connected to the line power.
2. Place the HP 8517B test set on top of the HP 8511B. Connect the HP 8517B test set in the system by connecting the GPIB, the test set IF interconnect, the RF source power, and the line power to it.
3. Turn on the HP 8511B and treat it like a device under test. You will use the HP 8517B test set to make S11 measurements of each port on the HP 8511B.
4. Perform the calibration at the end of the cable and take care to avoid overly sharp cable bends (defined in the cable manual). Then measure the return loss of each port on the HP 8511B.

**Introduction**

The troubleshooting strategy for the HP 8511B frequency converter test set is a systematic sequence of procedures. This troubleshooting information is used after system-level troubleshooting has pin-pointed the test set as the problem instrument. Use the troubleshooting flowchart Figure 6-2 on page 6-4 to identify the faulty assembly. The troubleshooting flowchart is keyed to numbered, individual troubleshooting procedures. As you progress through the flowchart, perform the numbered procedure associated with each block. Block diagrams are provided at the end of this chapter to assist in understanding the operation of the test set.

**Theory of Operation**

The RF section of a HP 8511B frequency converter test set consists of a voltage-tuned oscillator (VTO), a four-way power splitter and four samplers. The frequency converter operates within the frequency range of 45 MHz to 50 GHz. Two reference (a1 and a2), and two test (b1 and b2) channels accept RF input by way of the front panel bulkhead connectors.

The VTO/driver produces a harmonic that is 20 MHz away from the RF source frequency. The samplers use either the fundamental or a harmonic of the LO with the reference and test RF signals to develop a 20 MHz IF. The IF signals are then routed to the HP 85102 by way of the rear panel connector on the test set.

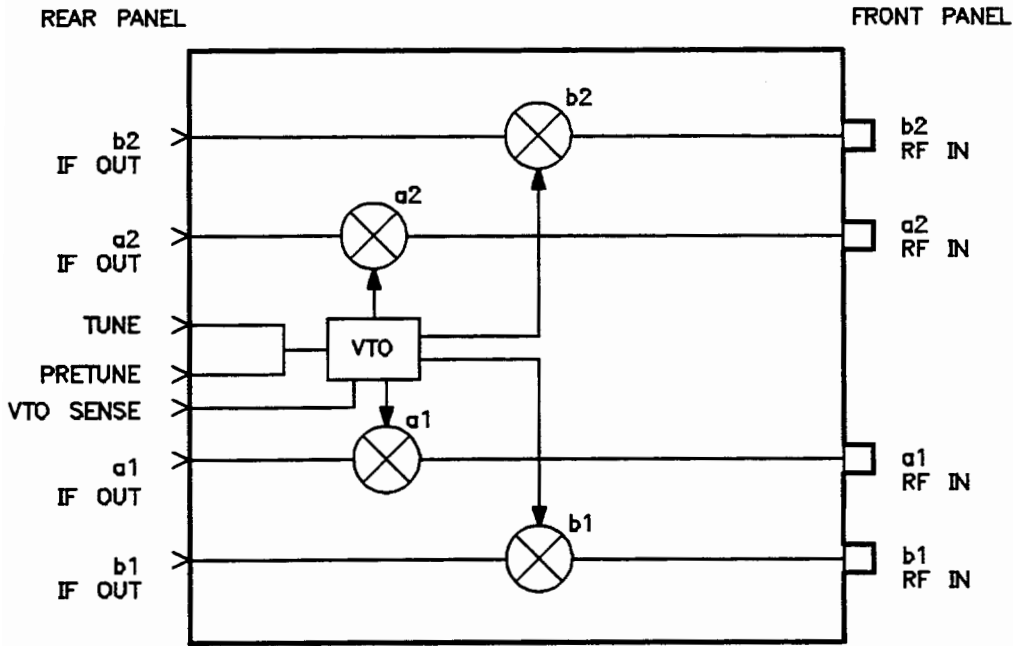
The LO, generated by the VTO/driver, is phase locked to the source. The phase lock loop includes the following:

- A3 VTO summing amplifier board
- A14 VTO/driver
- A12 a1 reference sampler assembly
- A13 a2 reference sampler assembly and the HP 8510 network analyzer

A microprocessor on the A4 GPIB board controls the samplers, which may be switched either on or off, depending on the parameter being measured. The default condition is for all four samplers to be on. This insures that the test set will be usable in the event of a failure of the A4 GPIB board or a failure in the communication between the test set and the HP 8510 display/processor.

The HP 85102 IF detector controls the VTO/driver via the VTO summing amplifier board. A control voltage is input to the VTO to tune to the correct LO frequency.

The VTO summing amplifier board has an output called LENDRA (Low = END of RANGE) that is sent to the HP 85102 IF detector over the test set interconnect cable. This indicates to the HP 85101 display processor whether or not the VTO is outside of its normal operating frequency range. Should the VTO exceed its normal operating range, the network analyzer will respond by displaying the running error message, **VTO OVER-RANGE**. This message will not be seen in the HP 8510C. It has been replaced by **PRETUNE FAILED**.



**Figure 6-1** *Simplified RF Block Diagram*

Electrostatic discharge (ESD) can damage or destroy electronic components. All work on electronic assemblies should be performed at a static-safe workstation. Refer to “Operating and Safety Precautions” on page 1-12 for more information on preventing ESD.

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

## Equipment Needed but Not Supplied

*Table 6-1 Needed Equipment*

Equipment	HP Part Number
1 point Posidriv screwdriver	8710-0899
2 point Posidriv screwdriver	8710-0900
Service adapter	85105-60210
5/16 in torque wrench	8710-1655
Oscilloscope	HP 1740A

## Troubleshooting Sequence

Use this flowchart and the following procedures to determine the faulty assembly.

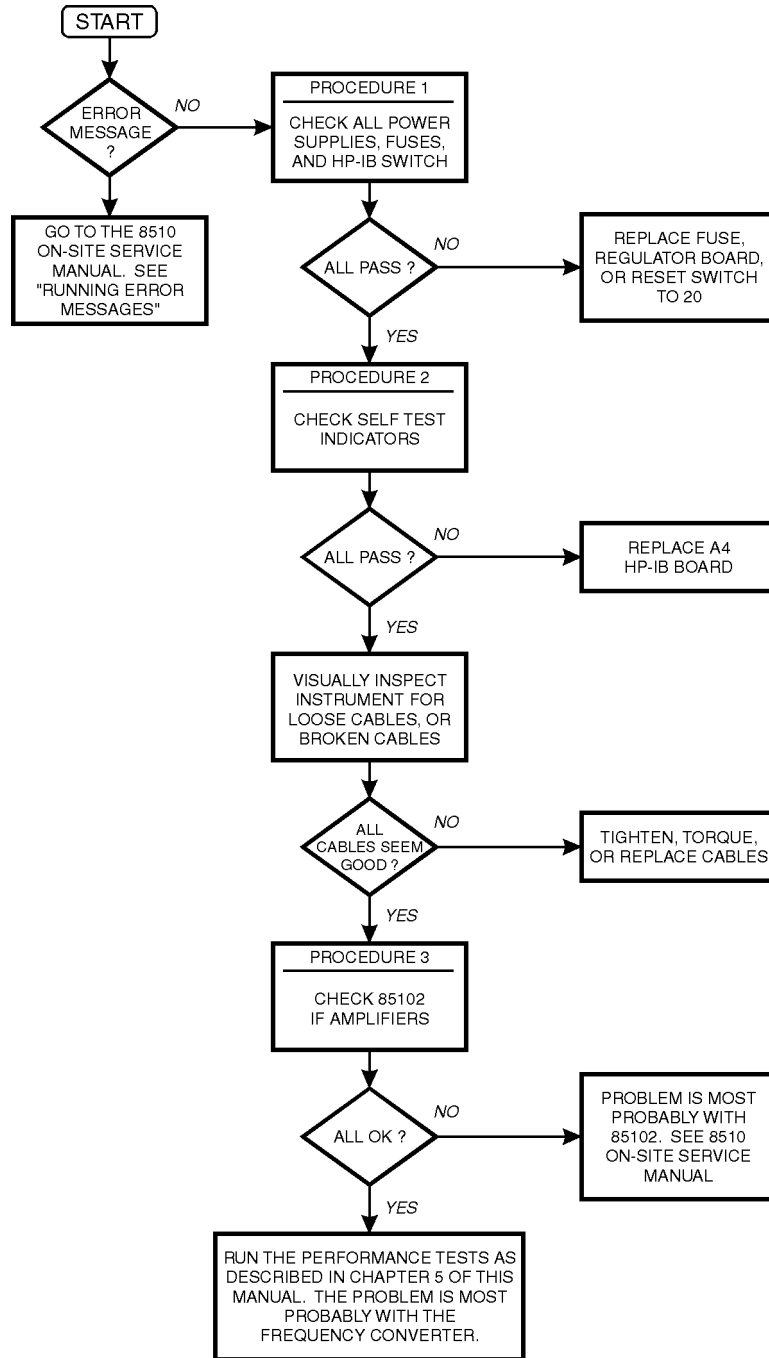


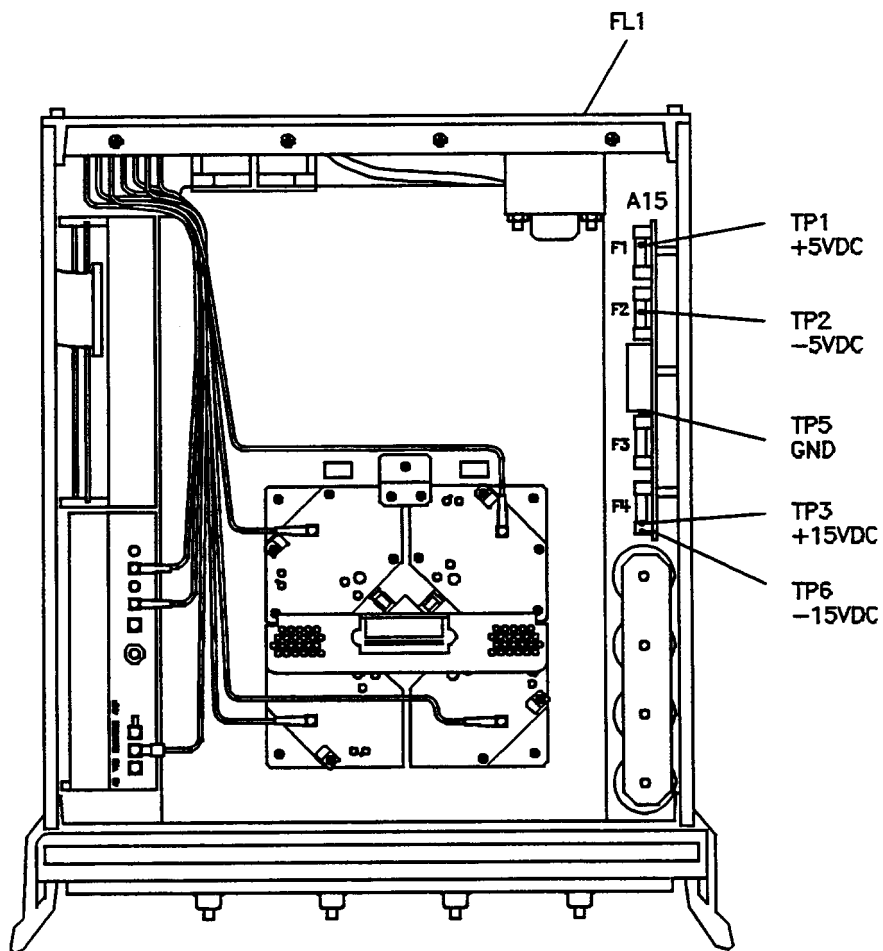
Figure 6-2 Troubleshooting Flowchart

---

## Troubleshooting Procedures

### Procedure 1

#### A15 Regulator



*Figure 6-3 Power Supply Fuses and Test Points*

## A15 Primary Regulator Board Assembly

Use a digital voltmeter to check the voltages and an oscilloscope to check the ripple in Table 6-2.

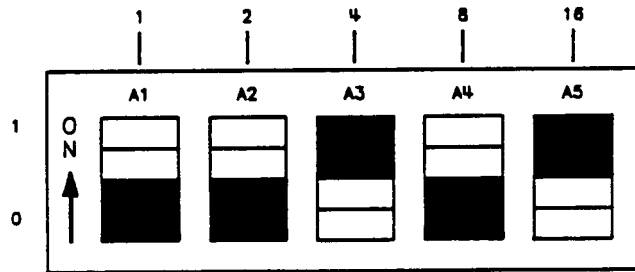
*Table 6-2 Power Supply Voltages*

Nominal Voltage	Test Point	Voltage Range	Maximum Ripple
+5.05 Vdc	A15TP1	+4.75 to +5.25	2 mV
-5.20 Vdc	A15PT2	-4.90 to -5.50	2 mV
+14.85 Vdc	A15TP3	+14.10 to +15.60	2 mV
-14.85 Vdc	A15TP6	-14.10 to -15.60	2 mV

## GPIB Address Switch

### GPIB Address Switch

Set the switch as indicated in Figure 6-4 (the dark side of the figure indicates where the switch is depressed). The GPIB address switch is on the instrument rear panel. It is easy to access but need not be changed unless the error message **SYSTEM BUS ADDRESS ERROR** is displayed on the HP 8510 screen. Decimal twenty, binary 00101 (off, off, on, off, on) is the default setting.



*Figure 6-4 Instrument GPIB Switch Setting*

## Fuses

The locations of the fuses used in the test set are illustrated in Figure 6-3 on page 6-5. The values of these fuses and their part numbers may be found in Chapter 8, “Replaceable Parts”.

### **Replacement of the Line Module Fuse**

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

### **Selection of Operating Voltage**

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

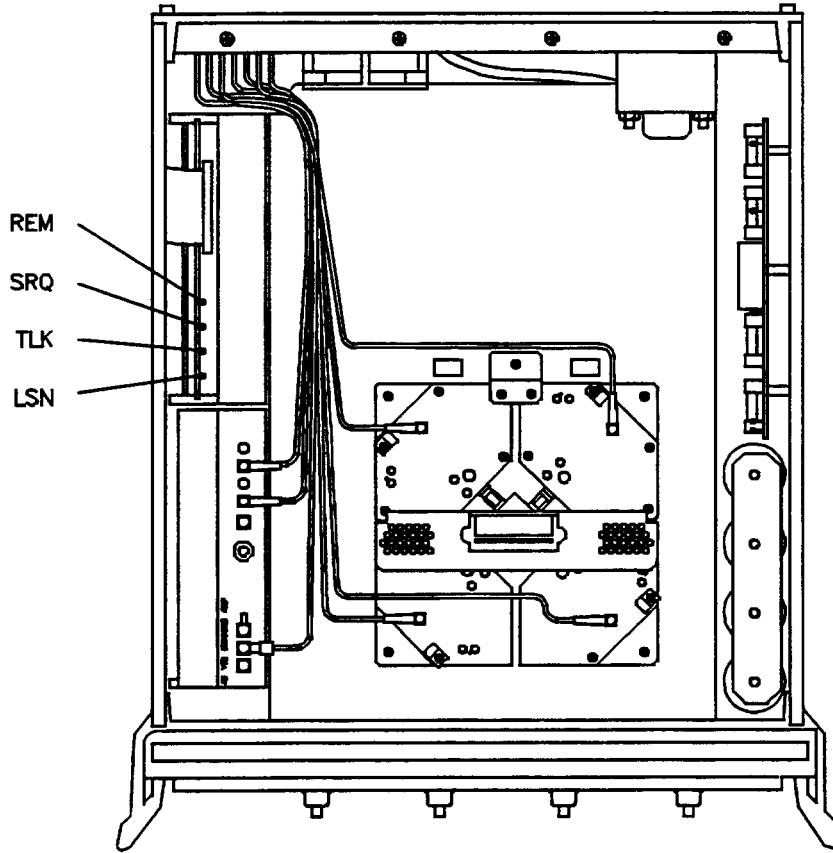
## **Procedure 2**

### **Self-Test Indicators**

If the ACTIVE LED on the front panel of the instrument fails to light within five seconds of power on or lights immediately, the instrument has not passed its self-test. To determine what part of the self-test has failed, note which LEDs on the A4 board are lit, see Figure 6-5.



Test Set Troubleshooting  
Troubleshooting Procedures



*Figure 6-5 Location of Self-Test Indicators*

**Table 6-3 Self-Test Failure Indications**

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

### **If the Self-Test Fails to Run**

If the portion of memory which contains the self-test programming is faulty, the self-test will not run properly. The following conditions indicate that the GPIB board is most probably faulty.

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

## Procedure 3

### HP 85102 IF Amplifier Test

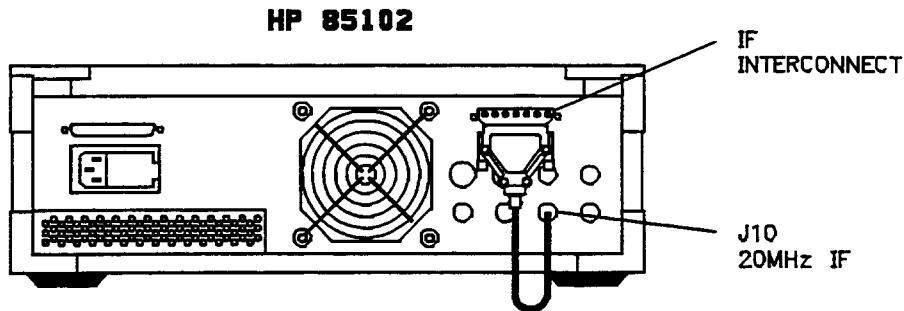


Figure 6-6 Service Adapter Connections

#### Using the Service Adapter

The service adapter (part number 85102-60210) substitutes for a test set, by connecting the 20 MHz IF signal from the HP 85102 back into the amplifier of the HP 85102. This is done to determine if a fault is in the test set or the HP 85102.

1. Connect the service adapter as shown in Figure 6-6.
2. Press [RECALL], {MORE}, {FACTORY PRESET}, [MARKER], STIMULUS, [MENU], [STEP], PARAMETER, [MENU]. Examine each user parameter by pressing the corresponding softkey to observe the unratiod power level of the user1 through user4 channels. The traces should be flat lines, quite close to each other, as indicated by the marker value (typically about  $-28.5$  dB).

#### Service Adapter Conclusions

**If all the channels look good.** The HP 85102 is working properly. The problem is most probably with the source or the test set.

**If one or more channels look bad.** The problem is most probably with the HP 85102. Refer to the *HP 8510 On-Site Service Manual* for information on troubleshooting the HP 85102.

*Figure 6-7 HP 8511B RF Block Diagram*

Test Set Troubleshooting  
**Troubleshooting Procedures**

BACK OF FOLD OUT

*Figure 6-8 HP 8511B Control Block Diagram*

Test Set Troubleshooting  
**Troubleshooting Procedures**

BACK OF FOLD OUT

***Figure 6-9 HP 8511B Motherboard Wiring List (1 of 2)***



Test Set Troubleshooting  
**Troubleshooting Procedures**

BACK OF FOLD OUT

*Figure 6-10 HP 8511B Motherboard Wiring List (2 of 2)*

# 7

## Replacement Procedures

### Introduction

This chapter consists of the following replacement procedures:

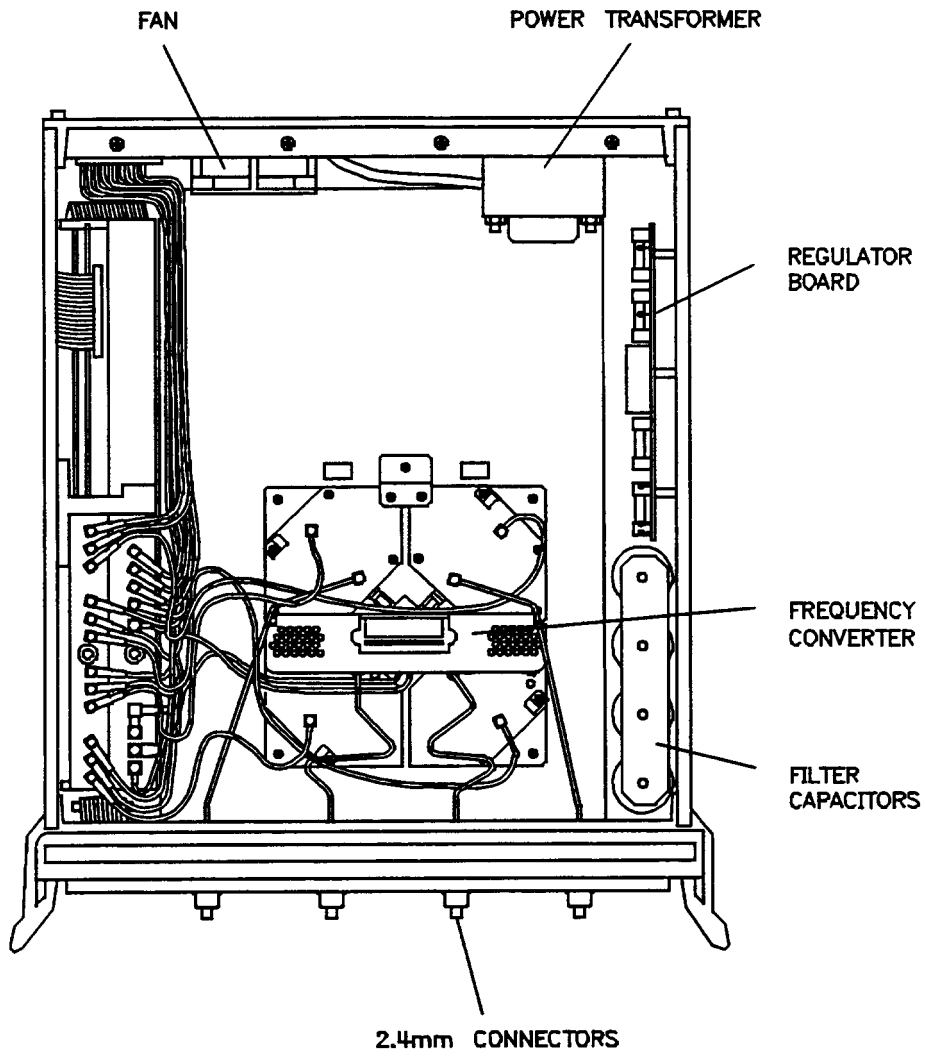
- (1) Frequency converter
- (2) Regulator board assembly
- (3) Filter capacitors
- (4) 2.4 mm RF connectors
- (5) B1 fan
- (6) T1 power transformer

### Equipment Needed But Not Supplied

Table 7-1 lists all the equipment needed to replace the assemblies documented in the following procedures. Use Figure 7-1 on page 7-2 to locate the assemblies in the HP 8511B test set.

**Table 7-1** *Equipment Needed to Replace Test Set Major Assemblies*

Tools	Used For	HP Part Number
2 point pozidriv screwdriver	all components	8710-0900
1 point pozidriv screwdriver	all components	8710-0899
5/16-inch torque wrench, 90 N-cm (8 in-lb)	all components	8710-1765
2.4 mm gauge kit	port connectors	HP 85056A calibration kit
Anti-static mat	all components	9300-0797
Wrist strap	all components	9300-0910
Clip lead	C1 - C4 capacitors	any supplier
Wire cutters	B1 fan	any supplier
T-10 TORX screwdriver	all components	8710-1623
T-15 Torts screwdriver	all components	8710-1622
9/16-inch nut driver	connector repair	8720-0008
1/2-inch torque wrench, 280 N-cm (25 in-lb)	connector repair	8710-1581
100 ohm 20 watt resistor	C1 - C4 capacitor removal	0819-0019
5/16 open-end wrench	fan replacement	any supplier
1/2-inch open-end wrench	RF input connector	any supplier



*Figure 7-1 Assembly Location Diagram*

## Preliminary Precautions

---

**CAUTION**

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ESD can damage or destroy electronic components. They may or may not continue to function if subjected to an electrostatic discharge. Their reliability will, however, be impaired. All work on electronic assemblies should be performed at a static-safe workstation. Refer to “Operating and Safety Precautions” on page 1-12 for more information.

1. To prevent electrostatic damage, ground the work area and yourself.
2. Turn the HP 8511B test set off.
3. Disconnect the power cord.
4. Remove the top and side covers, trim strips and the handles.
5. Torque the 2.4 mm connections to 90 N-cm (8 in-lb).
6. Exercise caution when handling semi-rigid coax cables. They are easily bent.
7. To install a part, reverse the appropriate procedure.

---

**NOTE**

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To install a new part in the following procedures, reverse the steps.

## **(1) Replacing the Frequency Converter**

---

**WARNING**

---

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

The frequency converter consists of a voltage-tuned oscillator (VTO) assembly and four samplers.

1. Remove the semi-rigid cable attached to each of the four samplers.
2. Remove the two in-line attenuators from the samplers.
3. Remove the six flexible cables from the frequency converter by gently pulling on the gold connector.
4. Remove the four frequency converter mounting plate screws and the bracket screw that fastens the frequency converter to the chassis.
5. Unplug the ribbon cable near the front panel.
6. Unplug the four harnessed (multi-colored) wire and socket assemblies.
7. Lift the frequency converter out of the test set.
8. Remove the frequency converter bracket by removing the two pozidriv screws.

## **(2) Replacing the Regulator Board Assembly**

1. Unplug the transformer socket from the regulator board.
2. Remove the three mounting screws from the top edge of the regulator board.
3. Remove the regulator board. (You may have to partially back out one of the transformer mounting screws for clearance.)

## **(3) Replacing the Filter Capacitors**

1. Set the test set upright and pull the metal and plastic cover off the capacitors.
2. Turn the test set over and remove the bottom cover.
3. To discharge the capacitors attach one end of an insulated clip lead to the chassis of the instrument and the other end of the clip lead to a 100 $\Omega$  20 watt resistor. Use the resistor to discharge each capacitor terminal (large pozidriv screw on the bottom side of the test set). Each capacitor has two

terminals. Discharge all capacitor terminals. It takes approximately six seconds to discharge each capacitor.

4. To remove a capacitor, remove the corresponding pair of screws and pull the capacitor out of the test set.

#### (4) Repairing a 2.4 mm RF Connector

Refer to Figure 7-2 and the following text to repair a 2.4 mm connector. Refer to the “Replaceable Parts” section of this manual for replacement part numbers.

##### Disassembly

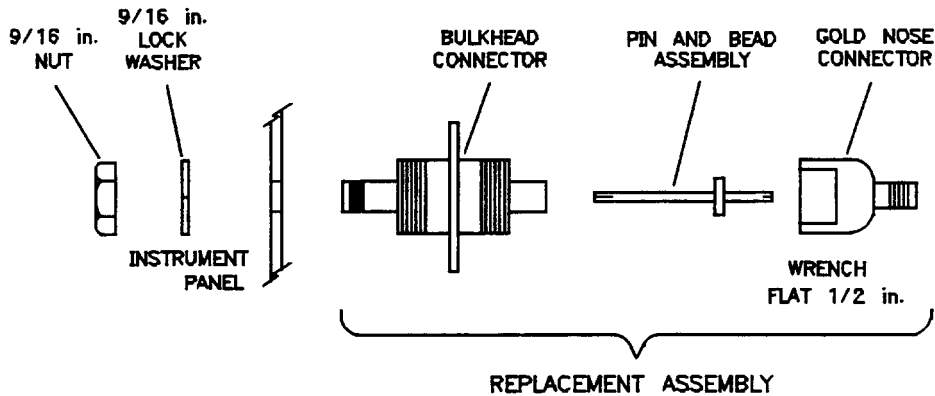


Figure 7-2 Exploded Diagram of a 2.4 mm Connector

1. Remove any attached cables from the connector to be replaced.
2. From inside the test set, use a 9/16-inch nut driver to loosen the nut and remove the connector.

##### Assembly

3. Assemble the bulkhead connector, lock washer and nut.
4. Using the 9/16-inch nut-driver, tighten the nut to 506 N-cm (45 in-lb).
5. Attach the assembly to the bulkhead connector. Torque to 281 N-cm (25 in-lb).
6. Clean the mating surfaces with alcohol and lint-free swabs.
7. Check the pin depth of the gold nose connector. The pin depth specification is 0.0000 to +0.0030 inch.
8. Reconnect the cables disconnected in step 1.



## (5) Replacing the B1 Fan

---

**WARNING**

---

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

To replace the fan (B1), you must remove the transformer (T1) so that the ends of the fan wires can be unsoldered from the line module FL1. See Figure 8-5 on page 8-7 for a detailed view of the fan and transformer hardware.

1. Turn the test set on its right side.
2. Unplug the transformer connector at J2 on the A15 regulator board.
3. Using a large pozidriv screwdriver, remove the four screws and washers that hold the transformer onto the rear panel.
4. Using a large pozidriv screwdriver, remove the screw that holds the transformer angle bracket to the main deck. The transformer wires soldered to the line module are short, so do not pull the transformer out too far.
5. Carefully remove the transformer from the test set and put it on the bench close to the test set.
6. Strip the heat shrink tubing off of the two fan wires and unsolder the wires from the line module. Cut any cable ties holding the fan wires to nearby cables.
7. Using a small pozidriv screwdriver, remove the screw and lockwasher that secure the green/yellow fan ground wire to the top of the rear panel frame.
8. Using a small pozidriv screwdriver, remove the four screws that hold the fan to the rear panel and remove the fan.

## (6) T1 Power Transformer

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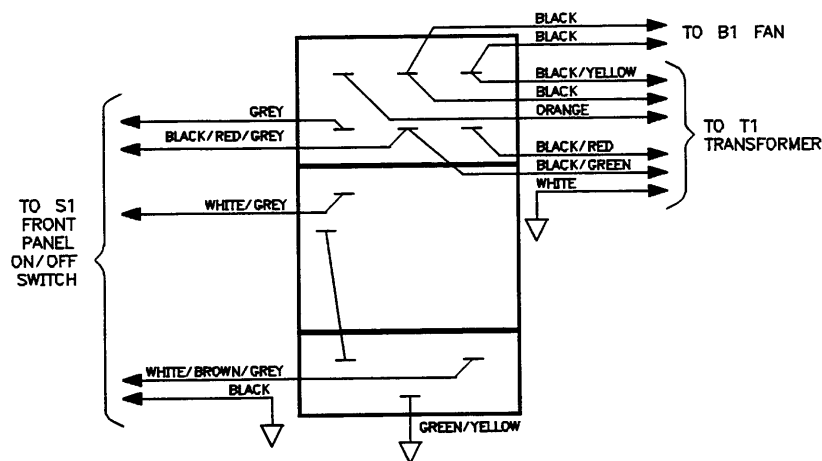
### WARNING

---

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

1. Turn the test set on its right side.
2. Unplug the transformer connector at J2 on the A15 regulator board.
3. Using a large pozidriv screwdriver, remove the four screws and washers that hold the transformer onto the rear panel.
4. Using a large pozidriv screwdriver, remove the screw that holds the transformer angle bracket to the main deck. The transformer wires soldered to the line module are short, so do not pull the transformer out too far.
5. Carefully remove the transformer from the test set and put it on the bench close to the test set.
6. Strip the heat shrink tubing off the transformer wires soldered to the line module, and unsolder the wires.
7. Unsolder the transformer ground wire connected to the chassis side rail.
8. Remove the transformer.

When you replace the transformer, refer to Figure 7-3 for the location of the wires connected to the line module.



linemod

Figure 7-3 Wire Connections to the Line Module FL1

# 8

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## Replaceable Parts

### Introduction

This chapter contains information for ordering parts. The “Replaceable Parts List” section describes how to order assemblies which are available on an exchange basis.

### Replaceable Parts List

Each part is listed both in the figures and the tables by reference designators. Quantity refers to the total number of the part in the instrument. The description is a brief written description of the part and may be used for ordering purposes.

### Reference Designations

- A = assembly
- B = fan
- C = capacitor
- W = cable, wire
- T = transformer

### Ordering Information

To order a listed part, quote the HP part number, quantity required, and send the order to the nearest Hewlett-Packard office.

To order a part that is not listed, include the instrument model number, complete serial number, description and function of the part, and quantity required. Send the order to the nearest Hewlett-Packard office.

### To Order Parts ... Fast!

Call:

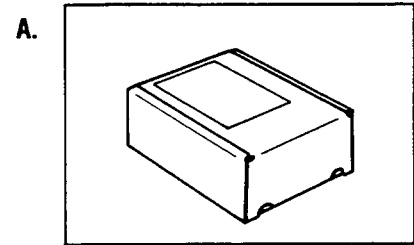
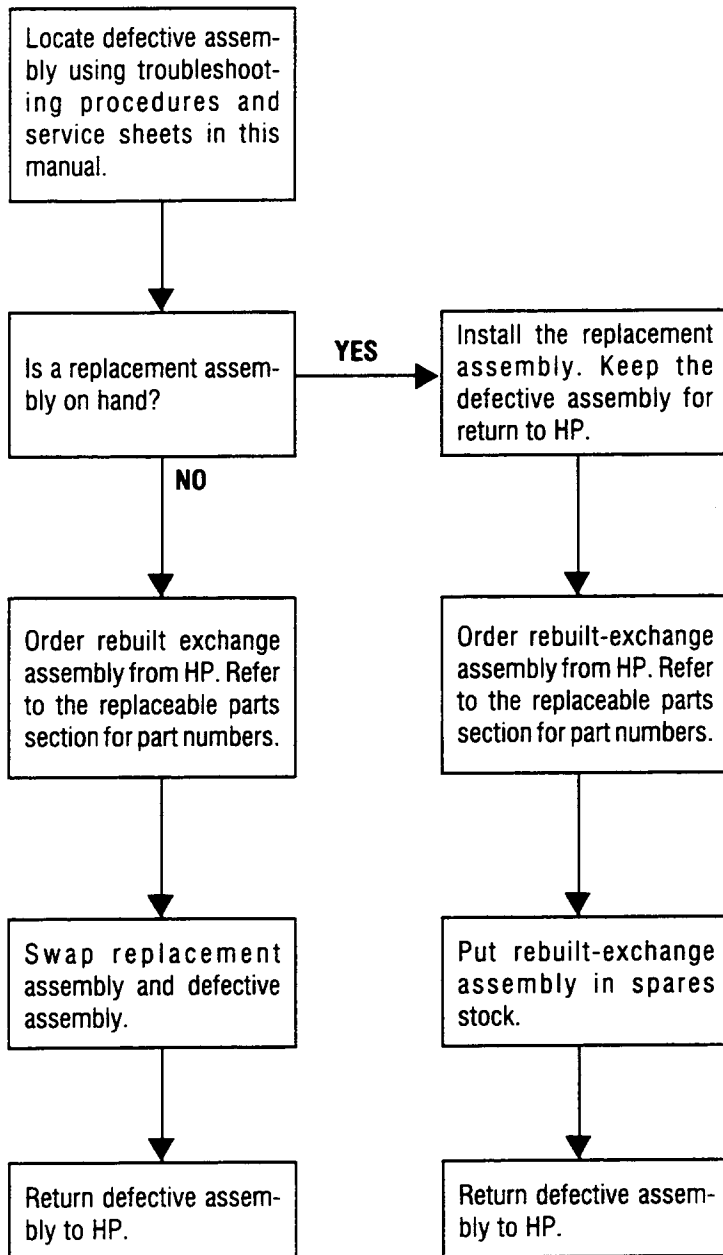
- (800) 227-8164
- Monday through Friday, 6 am to 5 pm (Pacific Standard Time)

The parts specialists have on-line access to replacement parts. There is a charge for hotline one day delivery, but four day delivery time is standard. After hours and holidays, call (415) 968-2347. This service applies to the United States only. Outside the United States, contact your nearest HP office.

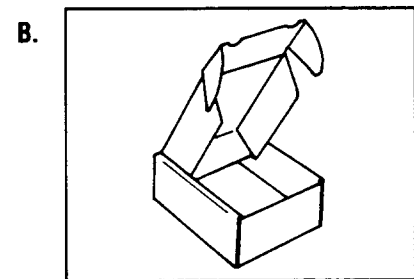
## **Exchange Assemblies Available**

The assemblies below are replaceable on a rebuilt exchange basis at a cost saving. They are not field-repairable. Defective assemblies must be returned for credit to realize the cost savings. Thus, assemblies required for spare parts stock should be ordered by the new assembly part number which is included in the replaceable parts list of this section. See the parts list for the orderable part numbers, and Figure 8-1 on page 8-3 for the Rebuilt-Exchange flow-chart.

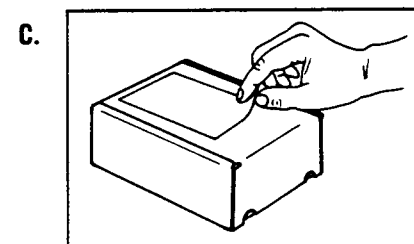
- A2 = IF multiplexer board assembly (option 001 only)
- A3 = VTO summing amplifier board assembly
- A4 = GPIB board assembly
- A10, A11, A12, A13 plus A14 = sampler assembly (inputs b1, b2, a1, a2 and A14 VTO driver)
- A15 = regulator board assembly



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



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.



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.

Figure 8-1 Low Cost Rebuilt-Exchange Procedure

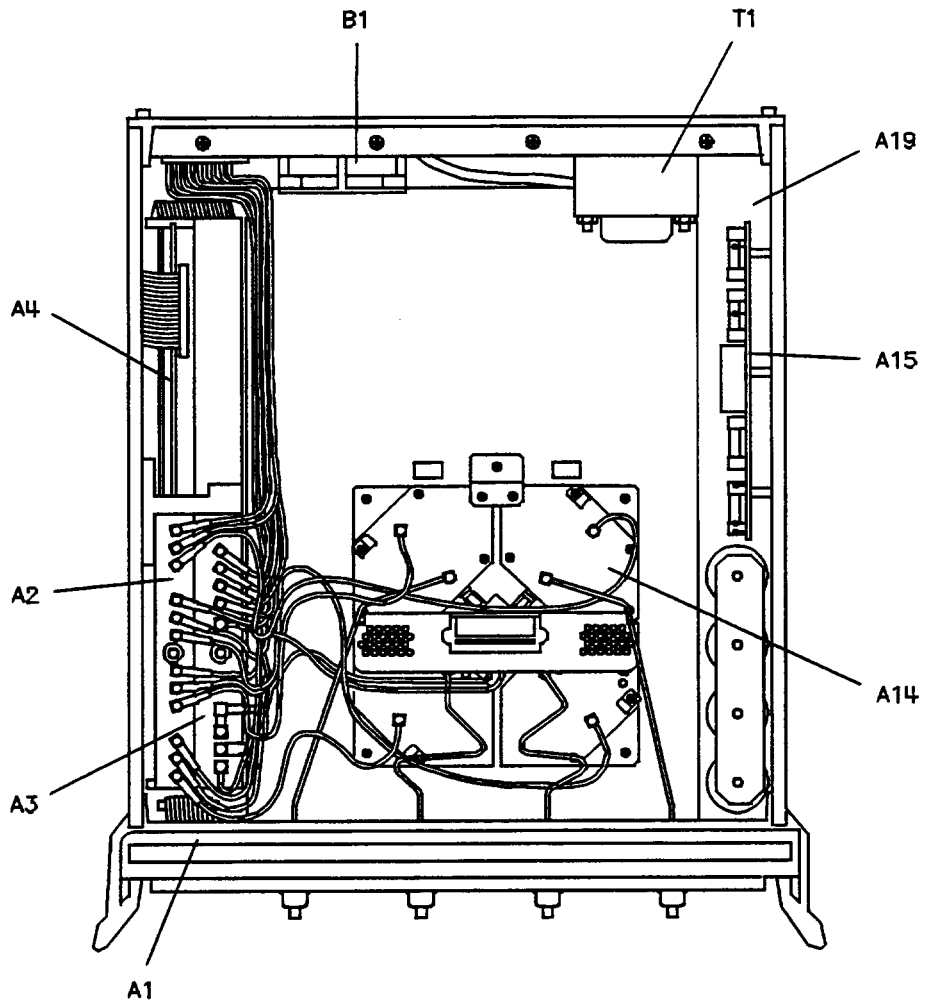
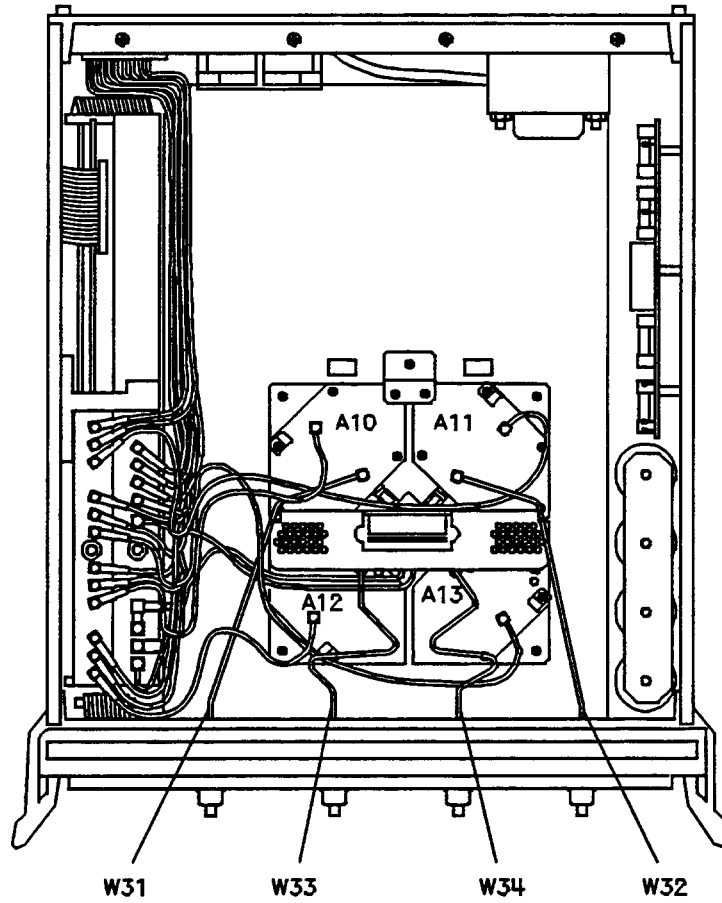


Figure 8-2 Major Assemblies



*Figure 8-3 Semi-Rigid Cables*

Replaceable Parts

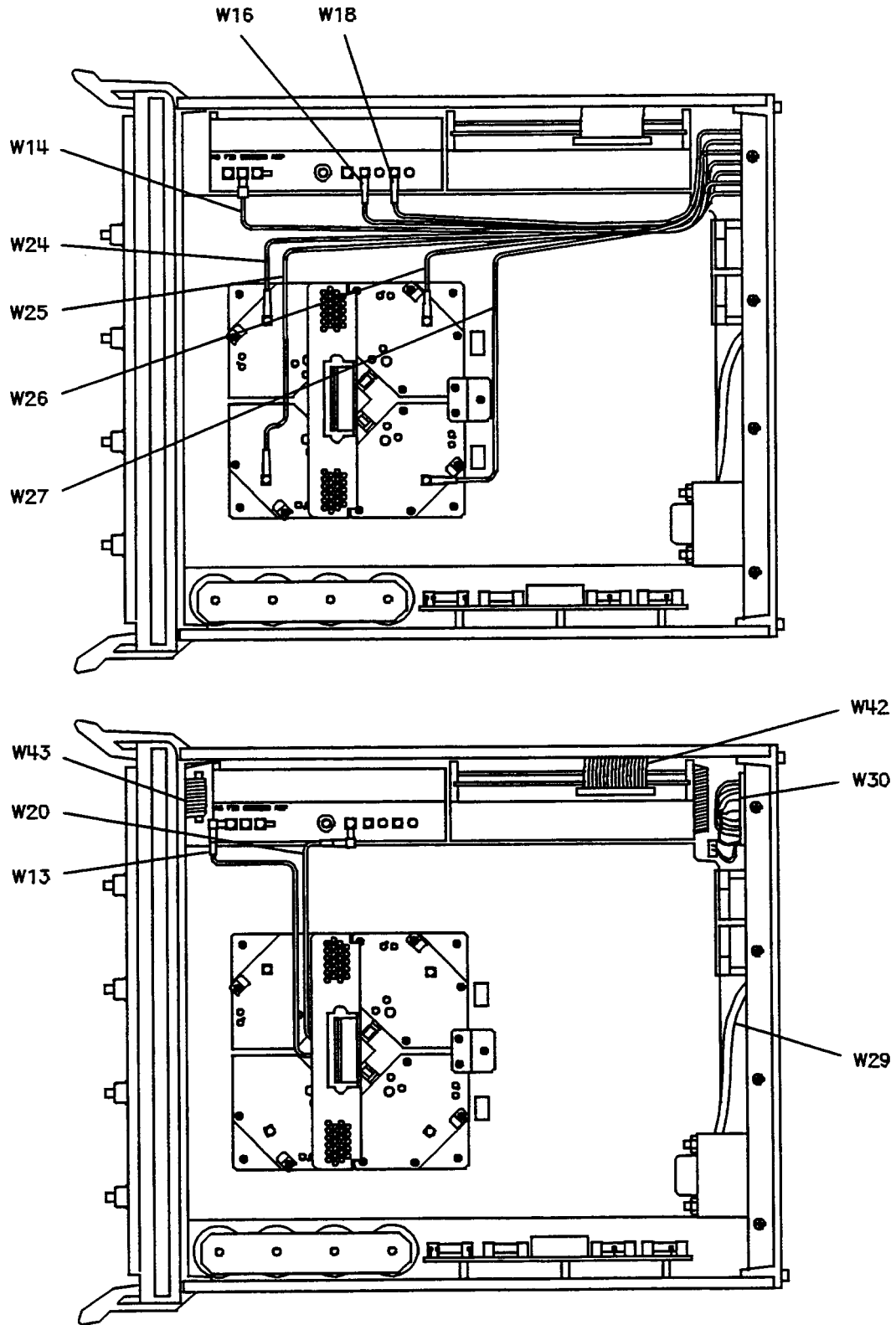
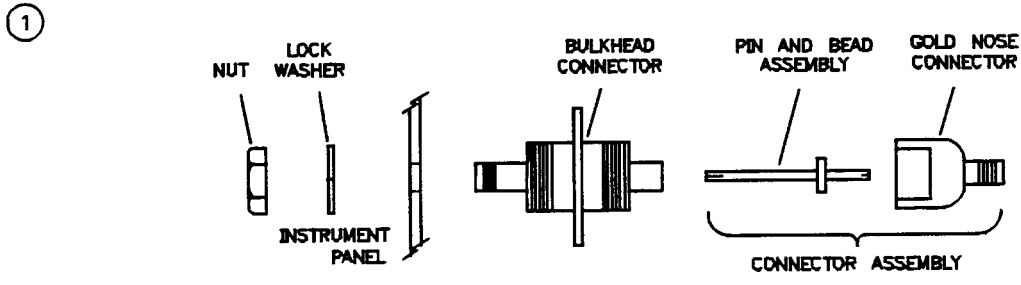
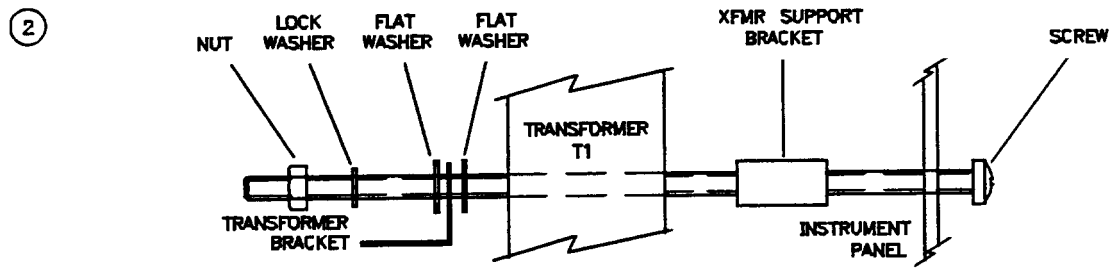


Figure 8-4 Flexible RF Cables

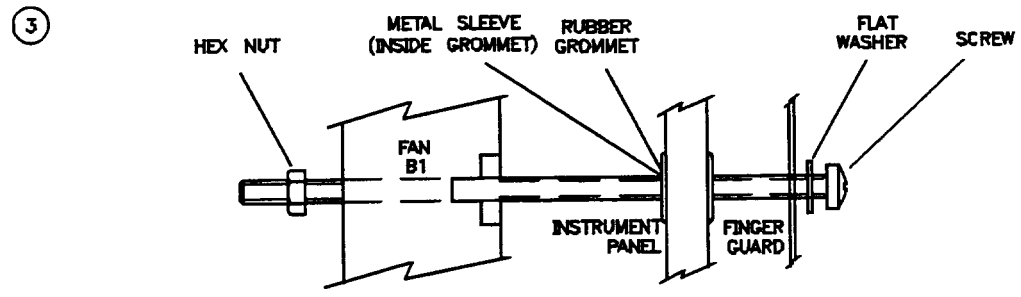




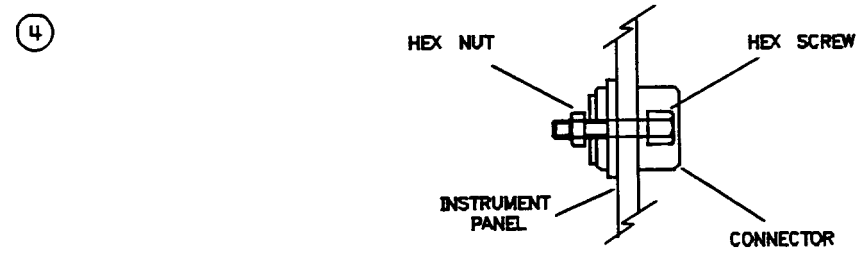
**2.4MM TEST PORT CONNECTOR HARDWARE STACK-UP**



**TRANSFORMER HARDWARE STACK-UP**



**FAN HARDWARE STACK-UP**



**CABLE CONNECTORS HARDWARE STACK-UP**

Figure 8-5 Detailed Views of Rear Panel Miscellaneous Parts

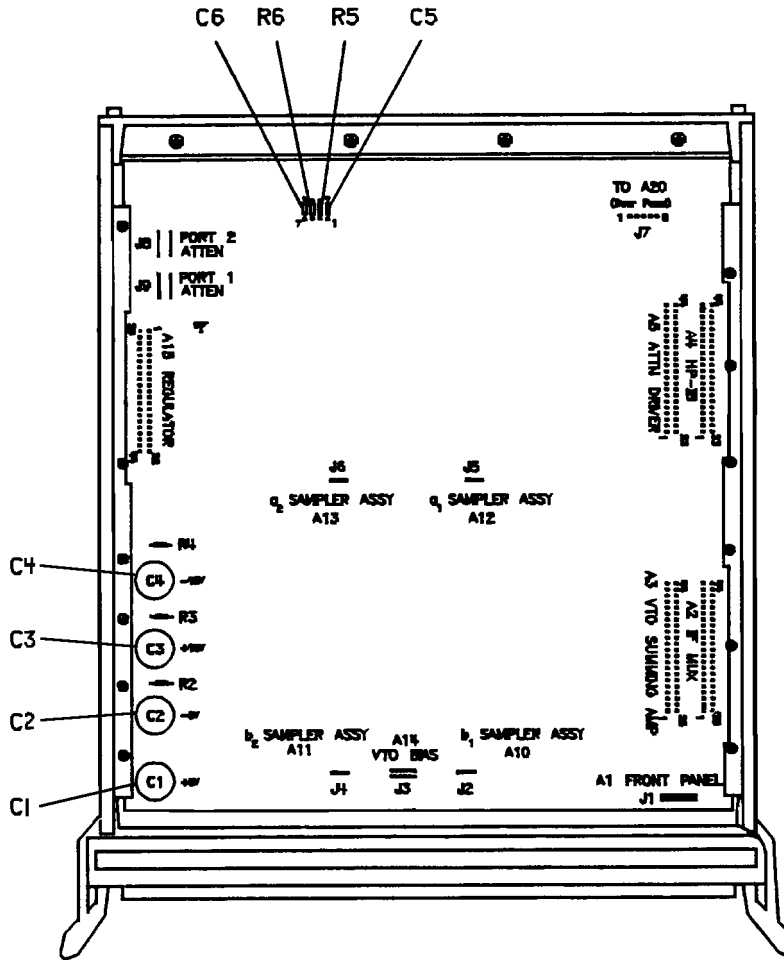


Figure 8-6 Miscellaneous Motherboard Parts

## Replaceable Parts Lists

**Table 8-1 HP 8511B Replaceable Parts**

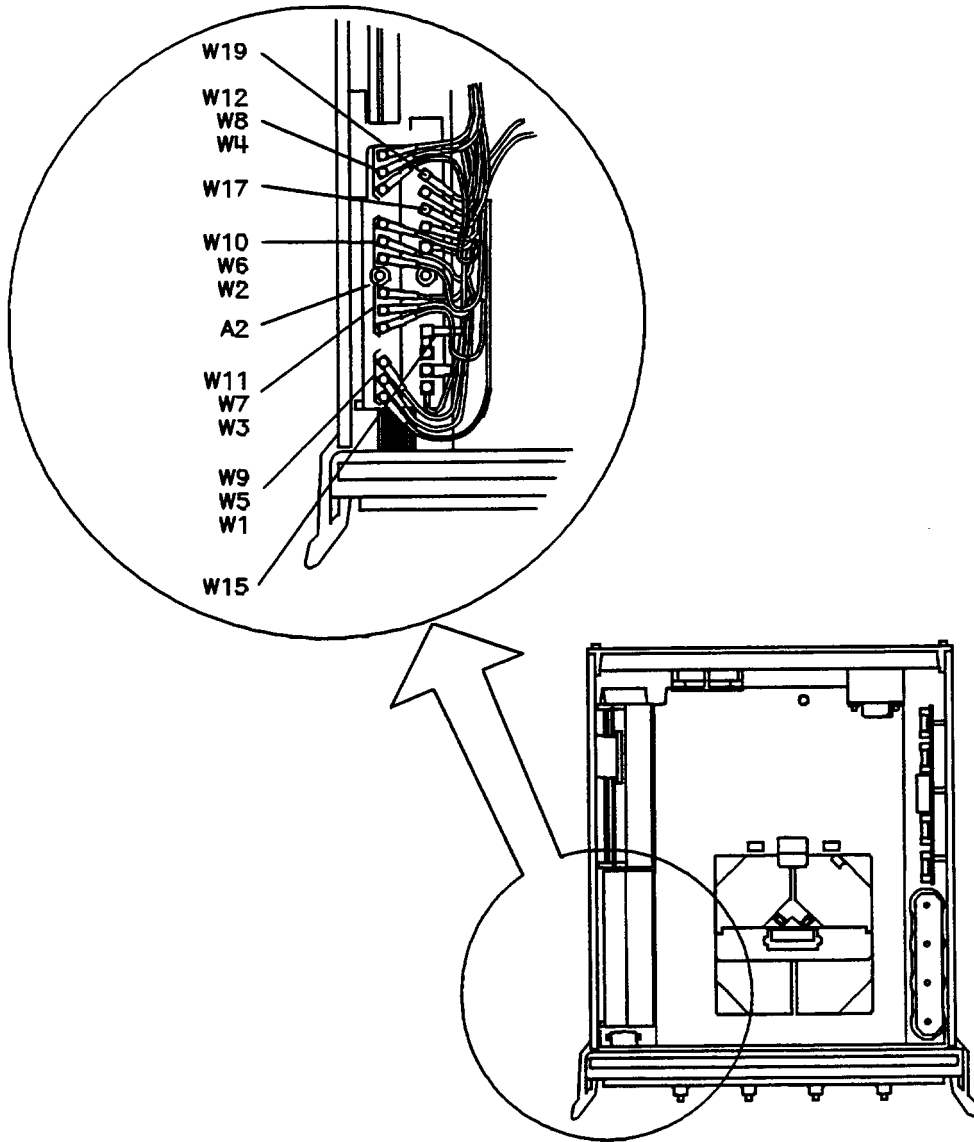
Reference Designation	HP Part Number	Qty	Description
<b>Major Assemblies:</b>			
A1	08511-60011	1	Assembly, front panel
A3	08517-60002	1	VTO summing amplifier board assembly
A3	08517-69002	1	VTO summing amplifier board assembly (rebuilt)
A4		1	GPIB board assembly
A4		1	GPIB board assembly (rebuilt)
A10, A11, A12, A13, A14	5086-7501	1	Sampler assembly + VTO driver
A10, A11, A12, A13, A14	5086-6501	1	Sampler assembly + VTO driver (rebuilt)
A15	08513-60007	1	Regulator board assembly
A19	08513-60001	1	Motherboard assembly
A20		1	GPIB interface board assembly
A20		1	GPIB interface board assembly (rebuilt)
T1	9100-4616	1	Transformer power
<b>Cable Assemblies:</b>			
W13	08513-60133	1	Cable assembly A3J1 to A14J1
W14	08513-60134	1	Cable assembly A3J2 to J11A7
W16	08513-60136	1	Cable assembly A3J5 to J11A5
W18	08513-60138	1	Cable assembly A3J7 to J11A6
W20	08513-60140	1	Cable assembly A3J4 to J14J2
W24	08513-60144	1	Cable assembly A12J3 to J11A1
W25	08513-60145	1	Cable assembly A13J3 to J11A4
W26	08513-60146	1	Cable assembly A10J3 to J11A2
W27	08513-60147	1	Cable assembly A11J3 to J11A3
W29		1	Cable assembly line switch
W30		1	Cable assembly J10 to J11
W31	08511-20021	1	Cable assembly A10 to front panel
W32	08511-20024	1	Cable assembly A11 to front panel
W33	08511-20022	1	Cable assembly A12 to front panel
W34	08511-20023	1	Cable assembly A13 to front panel

**Table 8-1 HP 8511B Replaceable Parts (Continued)**

Reference Designation	HP Part Number	Qty	Description
W42		1	Cable assembly A4 to A20
W43		1	Cable assembly A1 to A19
	08510-60102	1	Test set cable assembly
	08511-60021	1	Cable SMA/SMB 150C
	08511-60022	1	Cable SMA/SMB 150C
	8120-1348	1	Cable 03 C 03 F 03 M (power cord)
	8120-3445	1	Cable 24 C 24 F 24 F (GPIB)
<b>Fuses:</b>			
	2110-0043	2	1.5 A fuse (rear panel and regulator board)
	2110-0001	1	1 A fuse (regulator board)
	2110-0002	1	1.5 A fuse (regulator board)
<b>Miscellaneous Parts:</b>			
C1, C2, C3, C4	0180-2671	4	Capacitor 0.012F 30 Vdc AL (motherboard)
U19	08517-80005	1	EPROM
	08511-90073	1	HP 8511B Operating and Service Manual
	08510-90360	1	Quick Reference Connector Care Card
	08511-60024	1	HP 8511A/B and Antenna Measurement System Performance Verification Software Assembly
	08512-20005	1	RFI gasket
	08513-00001	1	Deck
	08513-00005	1	Mounting bracket LH
	08513-00006	1	Mounting bracket RH
	08513-00015	1	Plate, support cap
	08513-00017	1	Bracket CONV assembly
	08513-00018	1	Insulator brace
	08513-00037	1	Bracket enclosure
	08513-00040	1	Cover (test set top)
	08513-00041	1	Cover (side PERF)
	08513-20013	1	Brace (deck)
	08513-20015	1	Mounting bar
	08513-60156	1	ENC assembly doubler
	08513-65002	1	INTMD board assembly
	08517-60005	1	Rear panel assembly

**Table 8-1 HP 8511B Replaceable Parts (Continued)**

Reference Designation	HP Part Number	Qty	Description
	0955-0207	1	Attenuator 5 dB 2 W SMA
	1250-1251	1	Adapter F SMA to F SMA
	1252-4694	1	CAP PROT 50 pin F
	1252-4695	1	CAP PROT 50 pin M
	1252-5007	1	CAP PROT 24 pin F
	1400-0054	1	CLP CA .07 D .37 W
	1400-0650	2	CLP CA .25 D .75 W
	1400-0757	1	CLP CA .25 D 1.0 W
	1400-1209	1	CLP CA .69 D 1.0 W
	1401-0050	3	CAP PROT .125 ID
	1401-0245	5	CAO CIBD .240 ID
	5021-5804	1	Frame FM rear
	5021-5837	4	Corner strut
	5021-8403	1	FR front 132.6 H
	5040-6988	1	Front frame cover
	5041-8801	4	Foot FM .5 M
	5041-8821	2	Rear panel standoff
	5062-3747	1	Cover (bottom)
	5062-3757	1	Cover (side)5062-3989
	5062-3989	1	Front handle kit
	5062-7243	4	Connector assembly (bulkhead)
	5962-0476	1	Certificate of Calibration
	85120-00041	2	Cover (blank)



*Figure 8-7 Parts Unique to Option 001*

**Table 8-2 Replaceable Parts for HP 8511B Option 001**

Reference Designation	HP Part Number	Qty	Description
	08510-60106	1	Cable assembly IF test
	08510-60102	1	Test set cable assembly
A2	08513-60004	1	IF multiplexer board assembly (new)
A2	08513-69004	1	IF multiplexer board assembly (rebuilt)
W1	08513-60121	1	Cable assembly A12J3 to A2J1
W2	08513-60122	1	Cable assembly A13J3 to A2J7
W3	08513-60123	1	Cable assembly A10J3 to A2J4
W4	08513-60124	1	Cable assembly A11J3 to A2J10
W5	08513-60125	1	Cable SMB/MSC 635W
W6	08513-60126	1	Cable SMB/MSC 533W
W7	08513-60127	1	Cable SMB.MSC 737W
W8	08513-60128	1	Cable assembly A2J11-J11A3
W9	08513-60129	1	Cable SMB/MSC 711W
W10	08513-60130	1	Cable SMB/MSC 456W
W11	08513-60131	1	Cable SMB/MSC 762W
W12	08513-60132	1	Cable SMB/MSC 457W
W15	08513-60135	1	Cable SMB/MSC 610W
W17	08513-60137	1	Cable SMB/MSC 4836W
W19	08513-60139	1	Cable SMB/MSC 457W