# Operating and Service Manual

## Agilent Technologies
## 85027E Directional Bridge

This manual applies directly to the 85027E directional bridge with the following serial number prefix:

Serial Prefix: 2722A

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

Agilent Technologies

**Manufacturing Part Number: 85027-90014**

**Printed in USA**

**Print Date: October 1987**



85027-90014

# Notice

The information contained in this document is subject to change without notice.

Agilent Technologies makes no warranty of any kind with regard to this material, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

# Hewlett-Packard to Agilent Technologies Transition

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

# Documentation Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, AGILENT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. AGILENT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. SHOULD AGILENT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT WILL CONTROL.

# Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products. For any assistance, contact Agilent Technologies.

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

### Contacting Agilent

**Online assistance:** `www.agilent.com/find/assist`

| | | | |
|---|---|---|---|
| **United States**<br>*(tel)* 1 800 452 4844 | **Latin America**<br>*(tel)* (305) 269 7500<br>*(fax)* (305) 269 7599 | **Canada**<br>*(tel)* 1 877 894 4414<br>*(fax)* (905) 282-6495 | **Europe**<br>*(tel)* (+31) 20 547 2323<br>*(fax)* (+31) 20 547 2390 |
| **New Zealand**<br>*(tel)* 0 800 738 378<br>*(fax)* (+64) 4 495 8950 | **Japan**<br>*(tel)* (+81) 426 56 7832<br>*(fax)* (+81) 426 56 7840 | **Australia**<br>*(tel)* 1 800 629 485<br>*(fax)* (+61) 3 9210 5947 | **Singapore**<br>*(tel)* 1 800 375 8100<br>*(fax)* (65) 836 0252 |
| **Malaysia**<br>*(tel)* 1 800 828 848<br>*(fax)* 1 800 801 664 | **Philippines**<br>*(tel)* (632) 8426802<br>*(tel) (PLDT subscriber only):*<br>1 800 16510170<br>*(fax)* (632) 8426809<br>*(fax) (PLDT subscriber only):*<br>1 800 16510288 | **Thailand**<br>*(tel) outside Bangkok:*<br>(088) 226 008<br>*(tel) within Bangkok:*<br>(662) 661 3999<br>*(fax)* (66) 1 661 3714 | **Hong Kong**<br>*(tel)* 800 930 871<br>*(fax)* (852) 2506 9233 |
| **Taiwan**<br>*(tel)* 0800-047-866<br>*(fax)* (886) 2 25456723 | **People's Republic of China**<br>*(tel) (preferred):*<br>800-810-0189<br>*(tel) (alternate):*<br>10800-650-0021<br>*(fax)* 10800-650-0121 | **India**<br>*(tel)* 1-600-11-2929<br>*(fax)* 000-800-650-1101 | |

# TABLE OF CONTENTS
## HP 85027E
## Directional Bridge


*Figure 1-1. HP 85027E in Accessory Case Supplied*

# Section 1. General Information

## SECTION CONTENTS



## INTRODUCTION

This manual contains the information required to install, operate, test, adjust and service the Hewlett-Packard 85027E directional bridge. This manual is divided into eight major sections. These sections, and their contents, are listed below.

## MANUAL OVERVIEW

### Section 1: General Information

Provides information on the product, specifications, accessories, the manual, and recommended test equipment. See the contents list above.

### Section 2: Installation

Section 2 tells how to inspect the shipped product to make sure it was not damaged in transit, and what to do if it was.

Section 2 gives important information on the precision 3.5 mm connectors, and the product's environmental requirements for operation, storage, and shipment.

### Section 3: Operation

Section 3 not only describes how to operate the product, but warns the user about the hazards of static electricity, excessive input voltages, and connector wear.

Section 3 also provides an operator's check, which verifies that the directional bridge and its companion scalar network analyzer are functioning properly.

### Section 4: Performance Tests

This section contains procedures that ensure the HP 85027E meets published specifications.

### Section 5: Adjustments

This section contains procedures to adjust the HP 85027E after repair, or if the instrument fails a performance test.

### Section 6: Replaceable Parts

This section contains information required to order all replaceable parts and assemblies.

### Section 7: Manual Backdating

This section is reserved for information on earlier shipment configurations, at this time there are no previous versions of this product. Therefore, Section 7 currently contains no backdating information.

### Section 8: Service

Section 8 provides theory of operation, troubleshooting procedures, and important information on the proper care of the bridge's 3.5 mm connectors.

## SAFETY CONSIDERATIONS

There are no hazardous voltages in this directional bridge.


**The CAUTION sign in this manual identifies an operating procedure or practice which, if not correctly performed, could damage or destroy the equipment. Do not proceed beyond a CAUTION sign until you fully understand and meet the conditions indicated.**

## INSTRUMENTS COVERED BY THE MANUAL

A serial number label is attached to the side of the HP 85027E (see Figure 1-2). The serial number is in two parts:

1. The first four digits followed by the letter "A", comprise the serial number prefix. This prefix differentiates between different product versions.
2. The last five digits of the serial number are unique to each instrument.

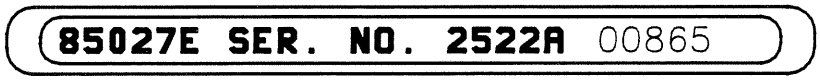



*Figure 1-2. Typical Serial Number Label*

The contents of this manual apply directly to directional bridges having the same serial number prefix as those listed on the title page of this manual, under SERIAL NUMBER.

A directional bridge manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. An unlisted serial prefix indicates that the product may be different from those documented in this manual. If this occurs, a manual change supplement is sent with the product, documenting the differences.

The manual change supplement may contain updates which apply to your manual, regardless of the serial prefix number. Such updates usually correct errors in the manual, provide manual improvements, or give recommended replacement part numbers.

To keep this manual as current as possible, periodically request the latest manual change supplement from your nearest Hewlett-Packard office. The part number and print date of the manual is shown on the manual change supplement for reference purposes. This information is also given on the title page of the manual.

## ORDERING A PRINTED OR MICROFICHE MANUAL

On the title page of this manual is a manual part number and a microfiche part number. Contact your nearest Hewlett-Packard office to order one of these documents.

Microfiche documents contain the entire manual on 10x15 cm (4x6 in) microfilm transparencies. Each microfiche contains reduced photocopies of the manual pages. Also included in the microfiche package are the latest manual change supplement.

The manual part number also appears on the back cover, in the lower left hand corner.

## PRODUCT DESCRIPTION

The HP 85027E is a microwave directional bridge that has a frequency range of 0.01 to 26.5 GHz and a 3.5 mm (male) test port input connector. The bridge makes modulated (AC) or unmodulated (DC) scalar reflection measurements with the HP 8757A scalar network analyzer, and AC measurements with the HP 8756A scalar network analyzer.

A single zero-biased Schottky diode detector in the bridge performs reflection measurements by sampling the return loss of the device under test. A detector can be added for simultaneous transmission measurements. A power splitter can be used with the bridge or detector (or both) for ratio measurements. The RF input signal is typically supplied by a sweep oscillator or a synthesized sweeper.

## EQUIPMENT REQUIRED BUT NOT SUPPLIED

The following equipment is required for use with the HP 85027E in making reflection, transmission and ratio measurements.

### Scalar Network Analyzers

**HP 8757A Scalar Network Analyzer.** This scalar network analyzer is a microprocessor based four-channel, three input (four with option 001) receiver with integral digital display. It makes scalar transmission and reflection measurements at RF and microwave frequencies over a dynamic range of −60 dBm to +16 dBm.

The HP 8757A is completely programmable through HP-IB (Hewlett-Packard Interface Bus, Hewlett-Packard's hardware, software, documentation and support for IEEE-488 and IEC 625). Additionally the HP 8757A can control a plotter, a printer, (such as the Thinkjet printer), and a swept source through the 8757 System Interface.

The HP 8757A offers both AC and DC detection. AC detection requires that the source signal be modulated by a signal at 27.8 kHz.

**NOTE:** The modulation frequency of 27.8 kHz referred to in this manual is actually 27.778 kHz. The DC detection technique modulates the input signal at 27.8 kHz within the bridge, which is on the output of the DUT (device under test).

**HP 8756A Scalar Network Analyzer.** This scalar network analyzer is a dual channel, microprocessor based receiver with its own digital display. The HP 8756A makes scalar transmission and reflection measurements at RF and microwave frequencies over a dynamic range of −50 dBm to +10 dBm. The HP 8756A is completely programmable through HP-IB, and can control a plotter or swept source through the 8756 System Interface.

When HP 8756A is used with the HP 85027E directional bridge, it is only capable of AC detection measurements.

## Swept Signal Sources

**HP 8350B.** This sweep oscillator mainframe is solid-state, fully HP-IB programmable, and can be controlled by the HP 8757A through the 8757 system interface. It has internal 27.8 kHz square-wave modulation capability. The HP 8350, when equipped with an RF plug-in, provides CW or analog-swept RF stimulus. Depending on the plug-in selected, the HP 8350 can cover the entire frequency range of 0.01 to 26.5 GHz.

**HP 8340A/B.** This synthesized sweeper is also fully HP-IB programmable and can be controlled by the HP 8757A. It does not require a plug-in as it is a complete analog sweep synthesizer. It generates synthesized output frequencies from 0.01 to 26.5 GHz at up to 1 Hz resolution in CW/Manual mode. The HP 8340 has extremely good resolution, accuracy, and phase noise performance, and can be square-wave modulated at 27.8 kHz by the HP 8757A.

## Detectors

One or more HP 85025B detectors are used with the HP 85027E bridge and the HP 8757A to make transmission measurements in AC or DC mode. Detection in the AC and DC mode is similar to that of the HP 85027E. For AC mode (only) transmission measurements, the HP 11664E detector may be used.

## Power Splitter

Ratio measurements can be made with the addition of a power splitter. The HP 11667B has a frequency range of DC to 26.5 GHz.

# ACCESSORIES

| Description | HP Part Number |
|---|---|
| 3.5 mm Connector Cleaning Kit | 92193Z |
| Connector Gage Kit (male and female gages) | 1250-1862 |

## Anti-Static Accessories

When cleaning or servicing this product, wear an anti-static wrist strap and work on an anti-static bench mat. The elastic wrist straps are available in three sizes.

| Description | | HP Part Number |
|---|---|---|
| Anti-Static Wrist Strap | Small | 9300-0969 |
| | Medium | 9300-1257 |
| | Large | 9300-0970 |
| Anti-Static Bench Mat | | 9300-0797 |

## EQUIPMENT AVAILABLE

Additional equipment available for use with the HP 85027E directional bridge and the HP 8757A scalar network analyzer is listed in Section 1 of the network analyzer's operating and service manual.

## SPECIFICATIONS

Table 1-1 contains the specifications for this directional bridge. Specifications are the performance standards, or limits, against which the product may be tested.

## SUPPLEMENTAL PERFORMANCE CHARACTERISTICS

Table 1-2 contains the supplemental performance characteristics of the directional bridge, These are not specifications, but are typical characteristics included as additional information for the user.

## RECOMMENDED TEST EQUIPMENT

Table 1-3 lists equipment that is recommended for use in performance testing the HP 85027E bridge. Other equipment may be substituted if its specifications meet or exceed the specifications listed in the Critical Specifications column.

## WARRANTY RESTRICTIONS

Performing any disassembly or repair procedure not included in Section 8 of this manual will void the warranty.

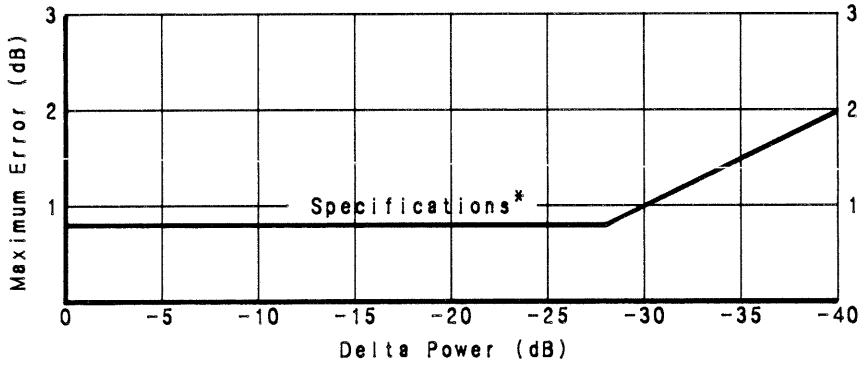
Subjecting a HP 85027E bridge to RF input power levels in excess of +23 dBm or +10 volts will likewise void the warranty.

Connector damage caused by mating with out-of-specification connectors or improper connection technique is not covered by the warranty. (See Connector Inspection in Section 8.)

*Table 1-1. Specifications*

| | |
|---|---|
| **Frequency Range**[1] | 0.01 to 26.5 GHz |
| **Connectors**<br>Input<br>Test Port | <br>3.5 mm (female)<br>3.5 mm (male) |
| **Maximum Input Power** | +23 dBm or ±10 volts |
| **Directivity**[2]<br>0.01 to 20.0 GHz<br>20.0 to 26.5 GHz | <br>≥40 dB<br>≥36 dB |
| **Test Port Match**[2]<br>0.01 to 8.4 GHz<br>8.4 to 20.0 GHz<br>20.0 to 26.5 GHz | <br>≥23 dB (≤1.15 SWR)<br>≥15 dB (≤1.43 SWR)<br>≥11 dB (≤1.43 SWR) |

**Dynamic Power Accuracy**[2]:




*Measured at 50 MHz
*Relative to +7dBm input to bridge
*25°C±5°C

1. Unless otherwise noted, all specifications apply from 0°C to +55°C.
2. +25°C ±5°C.

*Table 1-2. Supplemental Characteristics*

| Values in this table are not specifications but are typical, non-warranted performance parameters. | |
|---|---|
| **Typical Return Loss of Connector Savers (Adapters) (to 3.5 mm male or female)** | −32 dB |
| **Typical Insertion Loss** | |
| At 0.01 GHz | 6.5 dB |
| At 18 GHz | 8.5 dB |
| At 26.5 GHz | 11.0 dB |
| **Typical Input Port Match** | |
| 0.01 to 8.4 GHz | ≥20 dB (≤1.22 SWR) |
| 8.4 to 18.0 GHz | ≥15 dB (≤1.33 SWR) |
| 18.0 to 26.5 GHz | ≥9 dB (≤2.1 SWR) |
| **Typical Minimum Input Power for a 40 dB Return Loss at 18 GHz** | |
| HP 8757 | +2 dBm |
| HP 8756/55 | +7 dBm |
| **Nominal Impedance** | 50 ohms |
| **Dimensions** | 26 mm high x 124 mm wide x 118 mm deep<br>(1.0 inch x 4.9 inches x 4.4 inches) |
| **Cable Length** | 1219 mm (48 inches) |
| **Net Weight** | 0.5 kg (1.2 lb) |
| **Shipping Weight** | 2.3 kg (5 lb) |

*Table 1-3. Recommended Test Equipment*

| Type | Critical Specification | Recommended HP Model Number |
|---|---|---|
| Scalar Network Analyzer | HP 85027 AC/DC compatible | HP 8757A |
| Sweep Oscillator with RF Plug-in<br>or<br>Synthesized Sweeper | HP 8757 compatible<br>Frequency: 0.01 to 26.5 GHz<br><br>Frequency: 0.01 to 26.5 GHz | HP 8350B with<br>HP 83595<br>or<br>HP 8340 |
| Detectors (2 required) | Frequency: 0.01 to 26.5 GHz | HP 85025B |
| Power Splitter | Frequency: 0.01 to 26.5 GHz | HP 11667B |
| Power Meter | Frequency: 0.01 to 26.5 GHz | HP 436 |
| Power Sensor | Frequency: 0.01 to 26.5 GHz<br>Connector: 3.5 mm | HP 8485 |
| 50Ω Load | SWR $\leq$ 1.22:1<br>Connector: 3.5 mm | HP 909D* |
| 10 dB Step Attenuator | Frequency: DC to 26.5 GHz<br>Connector: 3.5 mm | HP 8495D<br>Option 004 |
| Directivity Verification Standards | No substitute | HP 85028E |

The equipment listed above is used for performance testing, adjustment, and troubleshooting.

*A suitable load is included in the HP 85028E Directivity Verification Standards.

# Section 2. Installation

## SECTION CONTENTS



## INTRODUCTION

This section explains:

- How to inspect the product to see if it was damaged in transit, and what to do if it was.
- Cleaning and using the bridge's precision 3.5 mm connectors.
- The product's environmental requirements during operation, storage, and shipment.
- Packaging the bridge for shipment, and how to return it to Hewlett-Packard for service or performance verification.

## INITIAL INSPECTION

If the shipping container or cushioning material is damaged, keep it until the contents of the shipment are checked for completeness, and the product is checked both mechanically and electrically.

Procedures for checking electrical performance are given in Section 4. If the product does not pass the electrical performance tests, refer to Section 8 for troubleshooting.

Notify your nearest Hewlett-Packard office if any of the following conditions exist:

- The product does not pass the performance tests and, using the troubleshooting procedures in Section 8, you cannot correct the problem.
- The product does not pass the performance tests and you wish to return it to Hewlett-Packard for repair.
- The shipping contents are incomplete. (Refer to Table 2-1).
- There is mechanical damage or defect.

Notify the carrier if the shipping container is damaged or if the cushioning material shows signs of stress. Keep all shipping materials for the carrier's inspection. Hewlett-Packard will arrange for repair or replacement without waiting for a claim settlement.

*Table 2-1. Contents of HP 85027E Directional Bridge*

| Description | HP Part Number |
|---|---|
| Directional Bridge | HP 85027E |
| 3.5 mm open/short | 85027-60004 |
| Adapter, 3.5 mm (f) to (f) | 85027-60005 |
| Adapter, 3.5 mm (f) to (m) | 85027-60006 |

## PREPARATION FOR USE

**CAUTION**

**Electrostatic discharge (ESD) can damage the highly sensitive microcircuits in the HP 85027E. ESD damage is most likely to occur as the bridges are connected or disconnected. Protect the bridges by wearing a grounding strap.**

**Never touch the center contacts of the connectors.**

**Use a work station equipped with an anti-static surface.**

### Power Requirements

**CAUTION**

**Do not apply more than +23 dBm RF power or more than ±10 volts DC to the HP 85027E. More power or voltage will damage the bridge.**

Power for the HP 85027E is supplied by the network analyzer.

## MATING CONNECTORS


**Use caution when mating an SMA female connector to the precision 3.5 mm male connectors on the HP 85027E. Push the connectors straight together with the female contact concentric with the male. DO NOT overtighten or rotate either center conductor; turn only the outer nut of the male. An out of specification connector can permanently damage its mate. For this reason, you should measure connectors with a connector gage (see section 8, "Mechanical Inspection") and use connector savers whenever possible.**

To extend the life of the 3.5 mm (m) connectors, use the precision 3.5 mm (f) to 3.5 mm (f) adapter or the 3.5 mm (f) to 3.5 mm (m) adapter. They are included with the HP 85027E as noted in Table 2-1.

## ENVIRONMENTAL REQUIREMENTS

**Humidity:** Protect this product from temperature extremes which can cause internal condensation.

**Environmental Requirements during Operation**

| | |
|---|---|
| **Temperature:** | Refer to Table 1-1, Specifications |
| **Pressure Altitude:** | Up to 4572 metres (15,000 feet). |

**Environmental Requirements during Storage and Shipment**

| | |
|---|---|
| **Temperature:** | −40°C to +75°C |
| **Pressure Altitude:** | Up to 15240 metres (50,000 feet). |

## RETURNING THE PRODUCT FOR SERVICE

If you ship the instrument to a Hewlett-Packard office or service center, please include a blue service tag (found at the end of this manual), on which you provide the following information:

1. Your company name and address. **Products cannot be returned to a post office box.**
2. A technical contact person within your company, and their complete phone number.
3. The complete model and serial number of the instrument.
4. The type of service required/failure symptoms.
5. Any other information that may expedite service.

Wrap the bridge (with service tag) in heavy paper or anti-static plastic, and place in a strong shipping container such as a double-wall carton made of 160 kg (350-pound) test material. Pack at least 2.5 cm (1 inch) of polystyrene loose fill packing material (or equivalent). Seal the shipping container securely and mark it **FRAGILE**.

When making inquiries, either by correspondence or by telephone, please refer to the instrument by model and full serial number.

# Section 3. Operation

## SECTION CONTENTS



## INTRODUCTION

This section describes how to use the HP 85027E directional bridge. This section also warns the user about the hazards of static electricity, excessive input voltages, and connector wear.

This section contains an Operators Check, which verifies that the directional bridge and its companion scalar network analyzer are functioning properly.

## OPERATING PRECAUTIONS

Electrostatic discharge (ESD), excessive input signals or mechanical shock can dramatically degrade the performance of the HP 85027E. Read the following cautions:

**CAUTION**

**Electrostatic discharge (ESD) can damage the highly sensitive microcircuits in the HP 85027E. MICROCIRCUIT DEVICES ARE DESTROYED EVERY DAY BECAUSE SIMPLE ANTI-STATIC PRECAUTIONS ARE NOT TAKEN. ESD damage is most likely to occur as the bridges are connected or disconnected. Protect the bridges by wearing a grounding strap (HP Part Number 9300-1117).**

**NEVER touch the center contacts of the connectors.**

**Use a work station equipped with an anti-static table mat (HP Part Number 9300-0797).**

**CAUTION**

**Do not apply more than +23 dBm RF power or more than ±10 volts DC to the HP 85027E. More power or voltage will damage the bridge.**

**Do not drop the HP 85027E or subject it to mechanical shock.**

## CONNECTOR WEAR

The input port and test port connectors are part of the microcircuit bridge assembly. They are not separately replaceable or field repairable, although the entire assembly can be replaced with a new or rebuilt assembly. Refer to Section 8, Service, for details. Section 6 contains information about rebuilt assemblies.

Repeated connections will cause connectors to become worn, which will cause greater measurement errors. This problem is best avoided by using an adapter, or connector saver, on the test port whenever some loss in directivity can be tolerated. Refer to Table 1-2 to see the return loss of Hewlett-Packard's connector savers.

Only precision adapters achieve accurate, repeatable measurements. Any adapter should be replaced periodically for best performance. When calibrating, use the same adapters and interconnect cables that will be used for the measurements. Additional information on the proper care, inspection, and cleaning of connectors, adapters and connector savers is in Section 8.

## Connecting the HP 85027E

**IMPORTANT**

**With highly accurate measurement devices such as the HP 8757 and 85027E, the condition of mating connectors and adapters can greatly affect measurement error. Always inspect connectors before use, clean them regularly (use the 3.5 mm connector cleaning kit HP Part Number 92193Z), and store them in a protective case (or place plastic end caps on them). Use connector savers whenever possible.**

**Refer to Section 8 for more information on connector care. Proper maintenance and use of connectors greatly improves measurement accuracy and longevity of costly connectors. Hewlett-Packard has produced a guide to the proper care of microwave connectors, and highly recommends its use. Order HP Part Number 08510-90064.**

Insert the connector of the bridge's power cable (W1) into the A, B, (C if HP 8757A, option 001) or R mating connector of the network analyzer and turn the outer sleeve clockwise to tighten it.

Connect the directional bridge input port to the RF output port of the source.

Connect the device under test to the bridge's test port. Section 3 shows typical measurement configurations. Refer to Section 8 for information on the care and use of 3.5 mm connectors.

## OPERATING INSTRUCTIONS

Because the HP 85027E has been designed specifically to operate with the HP 8757 scalar network analyzer, operating instructions have been included in Section 3 of the network analyzer's operating manual. Figure 3-2 of this manual illustrates the features of the bridge. Figure 3-4 shows a typical measurement setup with the HP 8757. When you use the bridge with the HP 8757, set the configuration switch on the bridge to the **[HP 8757]** position. If you are using the HP 8756 with the HP 85027E, set the bridge configuration switch to **[HP 8756/HP 8755]** and refer to the HP 8756's manual for the corresponding setups. Figure 3-5 shows a typical measurement setup using a power splitter.

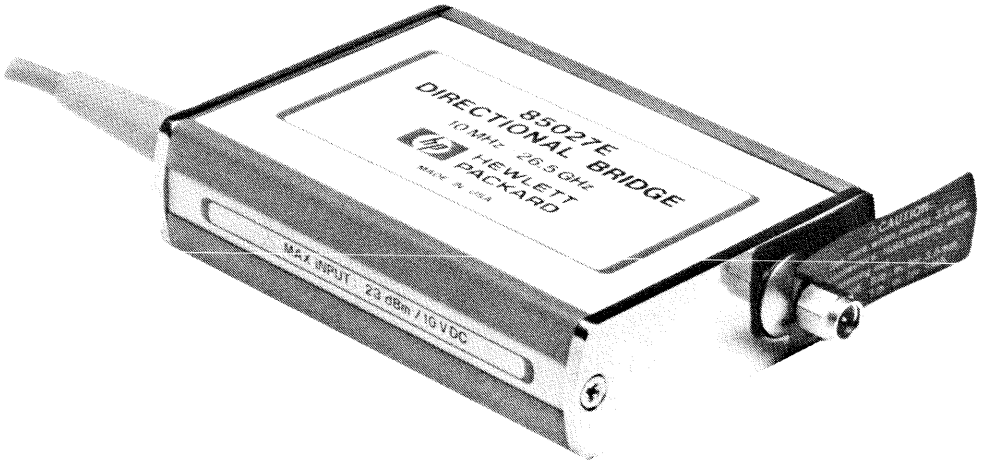
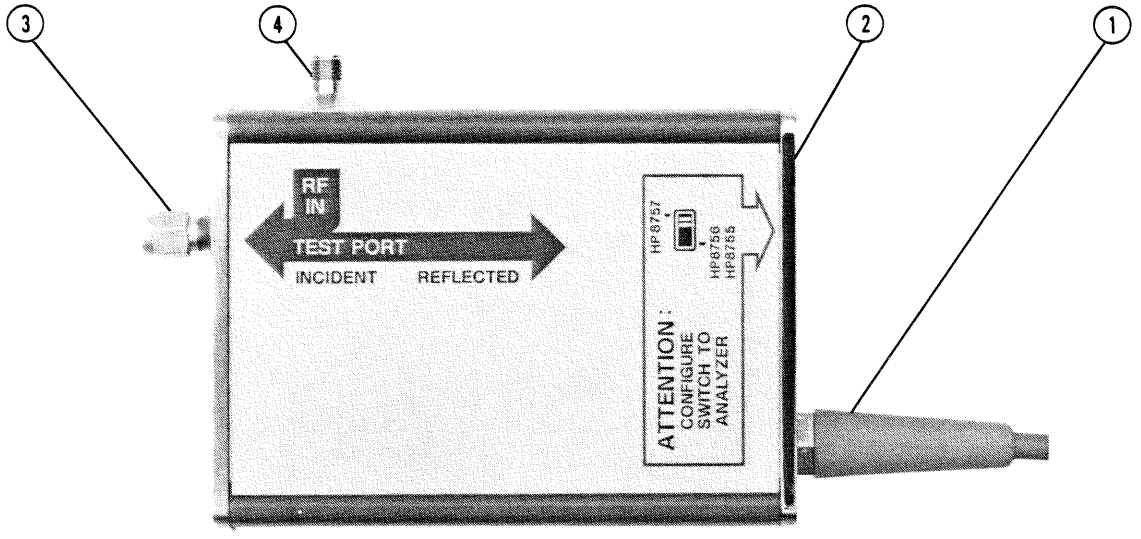



*Figure 3-1. HP 85027E*




1. **Power supply cable W1.** This cable supplies DC voltages to the bridge, performs control functions and feeds to the analyzer data on the signal reflected by the DUT.
2. **Configuration switch S1.** This switch sets the bridge for use with either the HP 8757 or HP 8756/ HP 8755.
3. **Test port connector J2** (3.5 mm – male). Connect the DUT, calibration short or open here.
4. **Input connector J1** (3.5 mm – female). Apply the RF signal here.

*Figure 3-2. HP 85027E Features*

## OPERATOR'S CHECK

Figure 3-3 illustrates the setup for the operator's check procedure. Follow this procedure to quickly check the entire measurement system. Incorrect results may be caused by any portion of the system, but if the HP 85027E is suspected use the performance tests in Section 4 to determine if the bridge is operating correctly. If the bridge fails those tests, turn to Section 8 to isolate the problem.

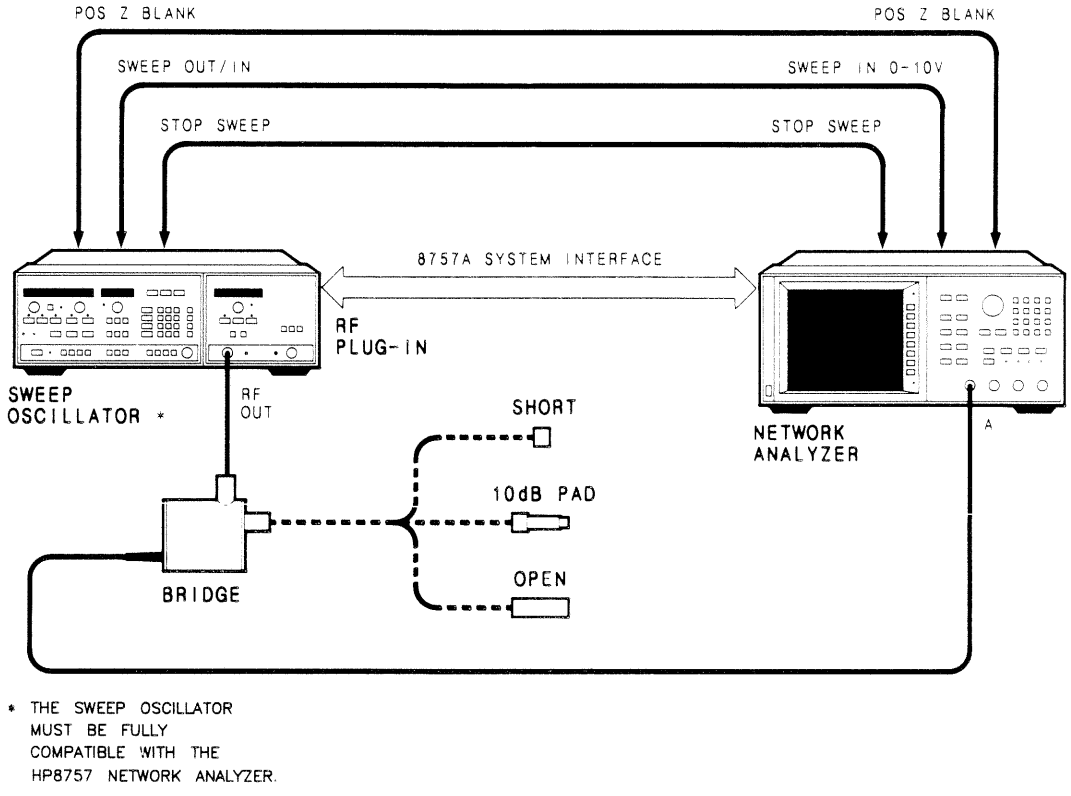



*Figure 3-3. Typical Operator's Check using HP 8757A*

### Equipment

| | |
|---|---|
| Scalar Network Analyzer | HP 8757 |
| Sweep Oscillator | HP 8350 |
| RF Plug-in | HP 83595 |
| 3.5 mm Open/Short | HP Part No. 85037-60001 |
| 10 dB Pad | HP 8493C Option 010 |

**NOTE:** If you perform this procedure with the HP 8756, set the configuration switch in step 2 to **[HP8756/8755]**, and omit step 8.

### Procedure

1. Connect the equipment as shown in Figure 3-3. Allow a 30 minute warm up period.
2. Set the HP 85027E switch (S1) to **[HP8757]**.

3. Press **[PRESET]** on the HP 8757 and turn off channel 2.

4. Set the HP 8350B to a CW frequency of 50 MHz at 0 dBm.

5. Perform a short/open calibration and then press **[DISPLAY] [MEAS-MEM]** on the HP 8757 for normalized measurements. Turn on the cursor.

6. Connect the 10 dB pad to the test port of the bridge.

7. The cursor value should now be $-20.0 \pm 2.0$ dB.

8. To check the DC performance of the bridge, perform steps 1 through 4. Then select **[MODE DC]** and perform a manual DC ZERO. Continue with steps 5 through 7. The final result should again be $-20.0 \pm 2.0$ dB.

NOTE: Figures 3-4 and 3-5 show typical measurement setups using the HP 8757 and power splitter, respectively.

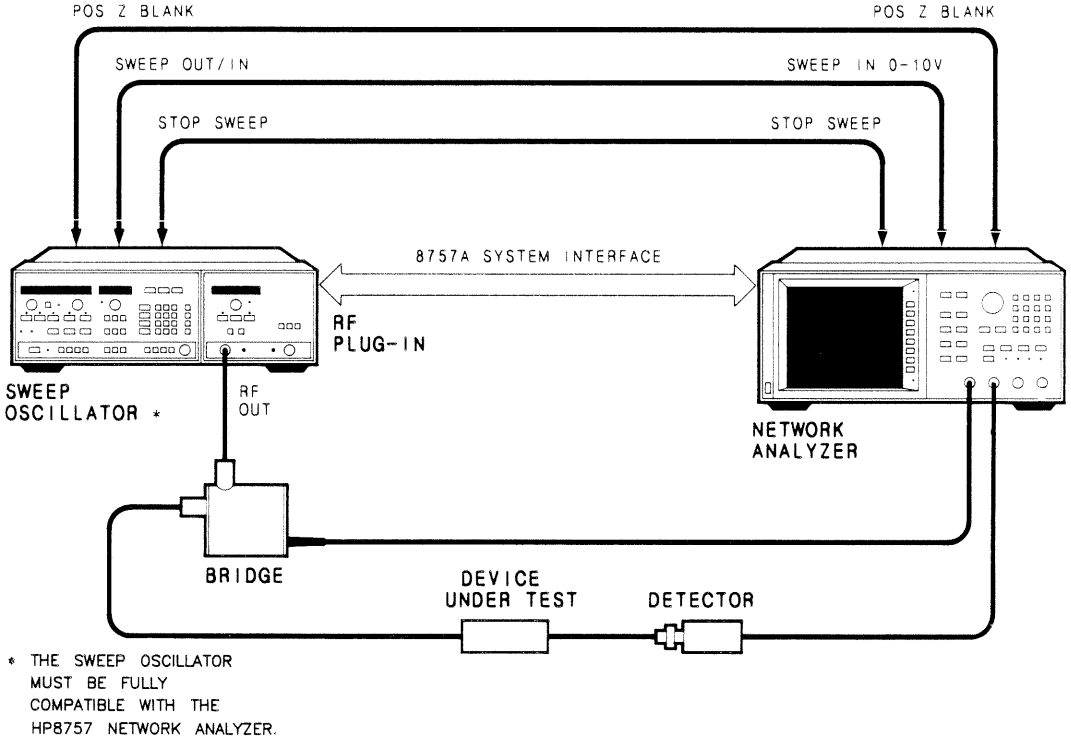



*Figure 3-4. Typical Measurement Setup using HP 8757*

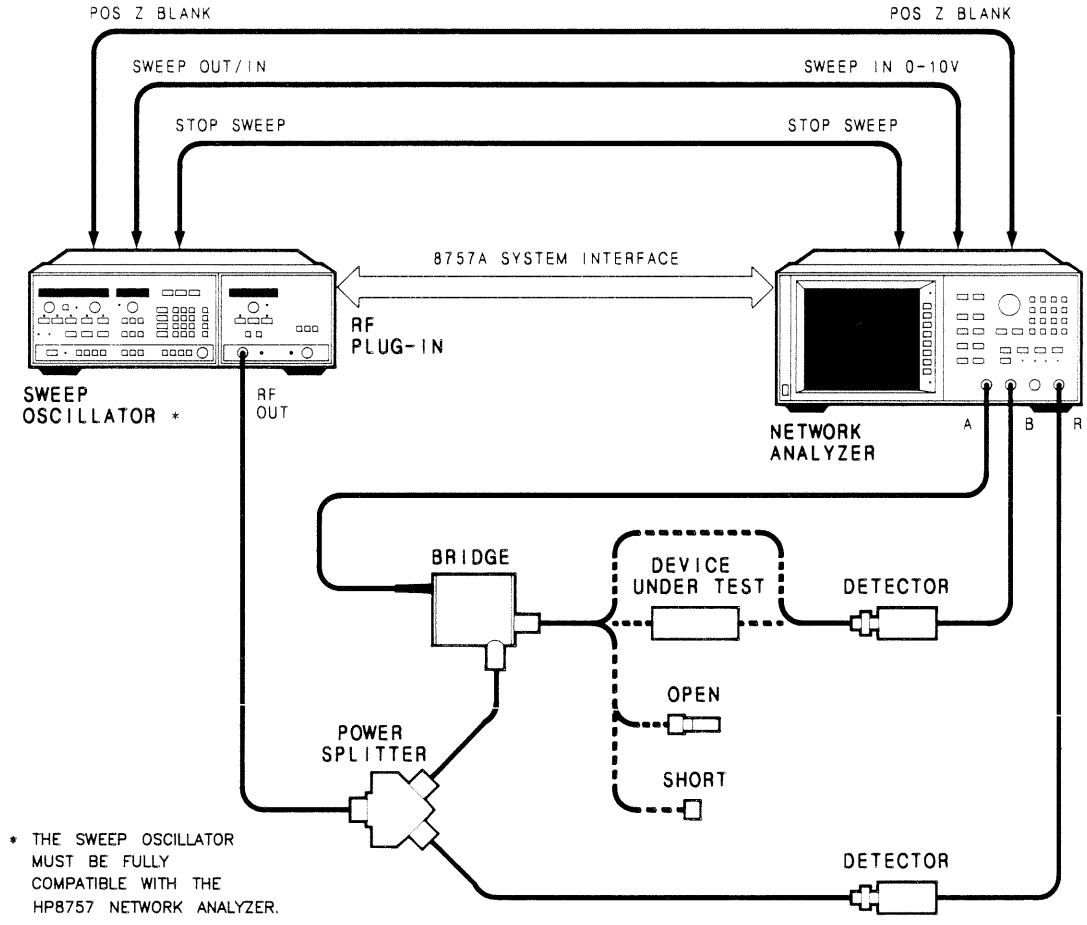



*Figure 3-5. Typical Measurement Setup using Power Splitter*

# Section 4. Performance Tests

## SECTION CONTENTS



## INTRODUCTION

The procedures in this section test the directivity, test port match and dynamic accuracy of the HP 85027E directional bridge using the specifications of Table 1-1 as the performance standards. Record the specifications and test results in the test record, located at the end of this section. Each test procedure lists the equipment required. You may substitute test equipment if the substitute equipment meets or exceeds the critical specifications of Table 1-5. Each of the tests can be performed without access to the interior of the bridge.

## EQUIPMENT REQUIRED

The equipment required to test the HP 85027E is listed in Table 1-3 in Section 1. Any equipment that satisfies the critical specifications given in the table can be substituted for the recommended model.

## PERFORMANCE TEST RECORD

Results of the performance test procedures may be tabulated on the test record card located at the end of this section. Each test record lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting, and after repairs or adjustments have been made.

## DIRECTIVITY

### Specification (at 25°c ± 5°c)

| | |
|---|---|
| 0.01 to 20.0 GHz | 40 dB |
| 20.0 to 26.5 GHz | 36 dB |

### Description

**NOTE:** Directivity can only be verified with the HP 85028E Directivity Verification Standards. The standards include the procedure for verifying the directivity of your bridge.

The HP 85028E Directivity Verification Standards use a sliding mismatch to determine directivity.

## TEST PORT MATCH

### Specifications (at 25°c ± 5°c)

| Frequency | Test Port Match |
|---|---|
| 0.01 to 8.4 GHz | ≥23 dB |
| 8.4 to 20.0 GHz | ≥15 dB |
| 20.0 to 26.5 GHz | ≥11 dB |

### Description

Using a typical reflection measurement setup, as shown in Figure 4-1 a second directional bridge is used to measure the TEST PORT of the bridge under test. The bridge under test must be biased by the HP 8757 and its RF IN PORT must be properly terminated.

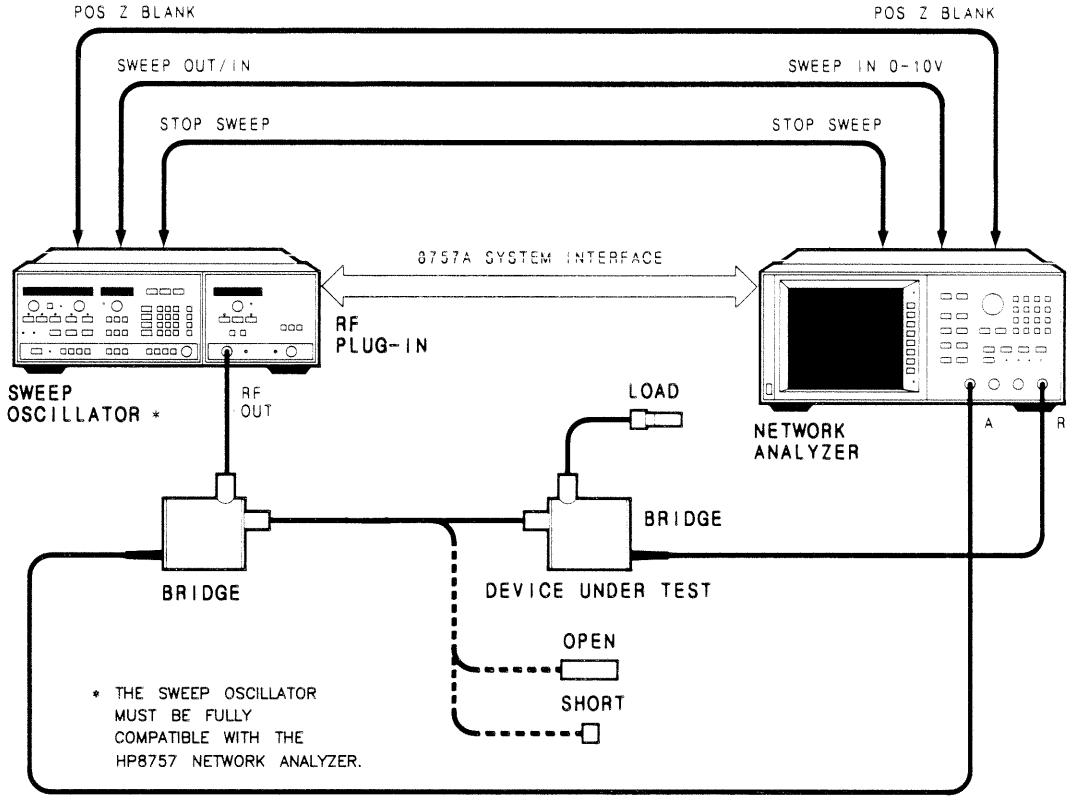



*Figure 4-1. Test Port Match Performance Test Setup*

### Equipment

| | |
|---|---|
| Sweep Oscillator | HP 8350 |
| RF Plug-in | HP 83595 |
| Scalar Network Analyzer | HP 8757 |
| Open/Short | HP Part Number 85027-60004 |
| 50Ω Load | HP 909D |
| Directional Bridge | HP 85027B |

## Procedure

1. Set up the equipment as shown in Figure 4-1, with the calibrated open connected to the test directional bridge, not the directional bridge under test.

2. Preset the analyzer. It should indicate that input A is on channel 1. Turn off channel 2. The preset command should also preset the sweep oscillator to a sweep time of 200 ms with 27.8 kHz modulation on. If this does not occur, check the sweeper-to-analyzer interconnections.

3. Set the sweep oscillator start frequency to 0.01 GHz and the stop frequency to 8.4 GHz.

4. Perform an open/short calibration and store it in memory.

5. Connect the test ports of the two directional bridges together. Connect the 50 ohm load to the input port of the directional bridge under test.

6. On the HP 8757 turn on the cursor and press the **[MAX]** softkey to find the point of minimum return loss (highest point) on the trace. Enter this value on the performance test record.

7. Repeat steps 3 through 6 for the following frequency bands:

   8.4 to 20.0 GHz
   20.0 to 26.5 GHz

8. If the test results (including uncertainties) are not within specifications, refer to the troubleshooting section of this manual.

## DYNAMIC POWER ACCURACY (AC and DC)

### Specifications

Refer to Table 1-1 in Section 1 for a chart showing dynamic power accuracy specifications. This table shows the specifications in terms of maximum error, e.g. at −10 dB the maximum error is 0.8 dB. This test procedure expresses the specification relative to a reference point, e.g. the 0.8 dB maximum error specification is expressed as ±0.4 dB, etc.

| **Nominal Power** | **Maximum Error** (relative) |
|---|---|
| 0 dB | Reference |
| −10 dB | ±0.4 dB |
| −20 dB | ±0.4 dB |
| −30 dB | ±0.5 dB |
| −40 dB | ±1.0 dB |

### Description

Using the setup illustrated in Figure 4-2 the scalar network analyzer is used to measure the dynamic power accuracy of the bridge under test.

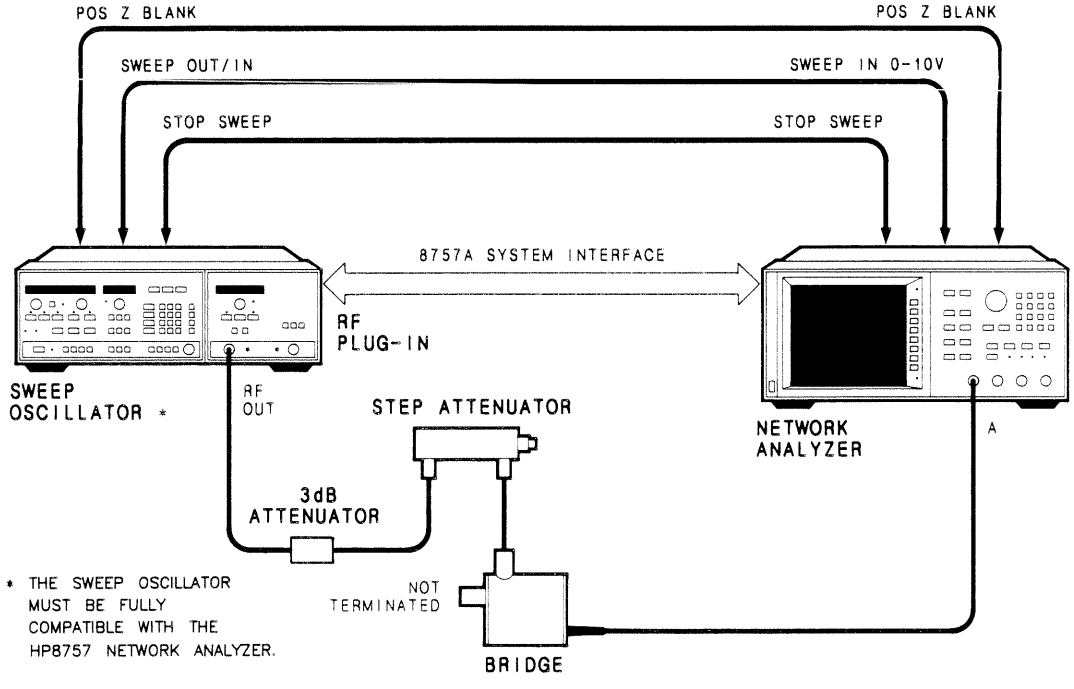



*Figure 4-2. Dynamic Power Accuracy Performance Test Setup*

## Equipment

| | |
|---|---|
| Sweep Oscillator | HP 8350 |
| RF Plug-in | HP 83595A |
| Scalar Network Analyzer | HP 8757A |
| Adapter(s) | As Needed |
| Step Attenuator | HP 8495D option 004 |
| 3 dB Attenuator | HP 8493C option 003 |

## Procedure

1. Set up the equipment as shown in Figure 4-2, preset the instruments and allow 30 minutes for warm-up.

2. Adjust the RF plug-in as required to output +10 dBm at 50 MHz CW.

3. Set the attenuator to 0 dB attenuation.

4. On the analyzer, turn on the cursor and press **[MEAS→MEM]** and **[MEAS-MEM]**. This should result in a 0 dB reading.

5. Step down the attenuator 10 dB at a time. Note the cursor readings on the appropriate lines of the test record.

6. All of the test results should be within the specifications as tabulated in column two of the test record. However there is a source of error which can adversely affect the results — attenuator inaccuracy: For example, the attenuator at a nominal setting of 10 dB may not actually attenuate 10 dB.

   To overcome this error, refer to the attenuator's calibration data and use the actual attenuation value for each setting.

7. If, after removing the source of error from the test results as noted above, the bridge still does not meet its specifications, refer to the troubleshooting information in Section 8.

8. If you are using an HP 8757A with the bridge and wish to test its DC dynamic power accuracy, return to the SYSTEM menu, select DC mode and perform a short/open calibration by pressing these keys: **[SYSTEM] [MODE] [CAL] [SHORT/OPEN] [DISPLAY]** and **[MEAS-MEM]**.

9. Perform steps 3 through 8 and enter the results in the fourth column of the test record.

*HP 85027E Test Record*

**Hewlett Packard 85027E**
**Directional Bridge**

**Serial Number:** _____ **Date:** _____

**Tested By:** _____ **Temperature** _____

**DIRECTIVITY** Refer to the test record in the HP 85028E directivity verification standards procedure.

**TEST PORT MATCH**

| Frequency Band | Specification | Test Result |
|---|---|---|
| 0.01 to 8.4 GHz | ≥23 dB | _____ |
| 8.4 to 20.0 GHz | ≥15 dB | _____ |
| 20.0 to 26.5 GHz | ≥11 dB | _____ |

**DYNAMIC POWER ACCURACY PERFORMANCE**

| Delta Power (Nominal) | AC/DC Specification | Attenuator Error (dB) | AC Test Result | DC Test Result |
|---|---|---|---|---|
| 0 dB | Reference | _____ | _____ | _____ |
| −10 dB | 0.4 dB | _____ | _____ | _____ |
| −20 dB | 0.4 dB | _____ | _____ | _____ |
| −30 dB | 0.5 dB | _____ | _____ | _____ |
| −40 dB | 1.0 dB | _____ | _____ | _____ |

# Section 5. Adjustments

## INTRODUCTION

The adjustments in this section should only be done under three circumstances:

- The internal bridge microcircuit assembly (A1) is replaced.
- The circuit board assembly (A2) is repaired or replaced.
- The directional bridge does not pass one of the performance tests.

After repairing this product you must perform the adjustments in this section to match the preamplifier to the characteristics of the microcircuit.

## ADJUSTMENT PROCEDURES

### AC Adjustment Procedure

1. Connect the equipment as shown in Figure 5-1. Turn on the analyzer, source and power meter and allow 30 minutes for warm-up.

**NOTE:** To perform the following adjustments refer to Figure 5-2 for the locations of the adjustment potentiometers.

2. Connect the power meter sensor to the calibrated 10 dB step attenuator.

**NOTE:** If your attenuator does not have calibration data, determine exactly how much the attenuation changes between the 0 dB and 30 dB settings. Do this with the source set for about +13 dBm at 50 MHz CW. Use this correction value when the procedure refers to calibrated 30 dB; for example, 29.9 dB or 30.06 dB.

3. Set the attenuator for 0 dB.

4. Preset the analyzer. Set the source to generate 50 MHz CW without modulation. Adjust the output for a reading of +6.5 dBm on the power meter.

5. Remove the printed, plastic switch configuration label from the back of the bridge (additional labels are available as HP part number 85027-80004).

6. Disconnect the power sensor from the attenuator and turn on modulation. Connect the bridge input port to the attenuator, leaving the test port open.

7. On the analyzer, turn on averaging (averaging factor = 8), and the cursor. Turn on smoothing (5%).

8. Adjust R5 (see Figure 5-2) for a cursor reading of −6 ±0.1 dBm.

**NOTE:** The ±0.1 dB margin shown in step 8 is not a specification, but simply a starting point for this adjustment. The actual specification, which is verified later in the procedure, is ±0.8 dB.

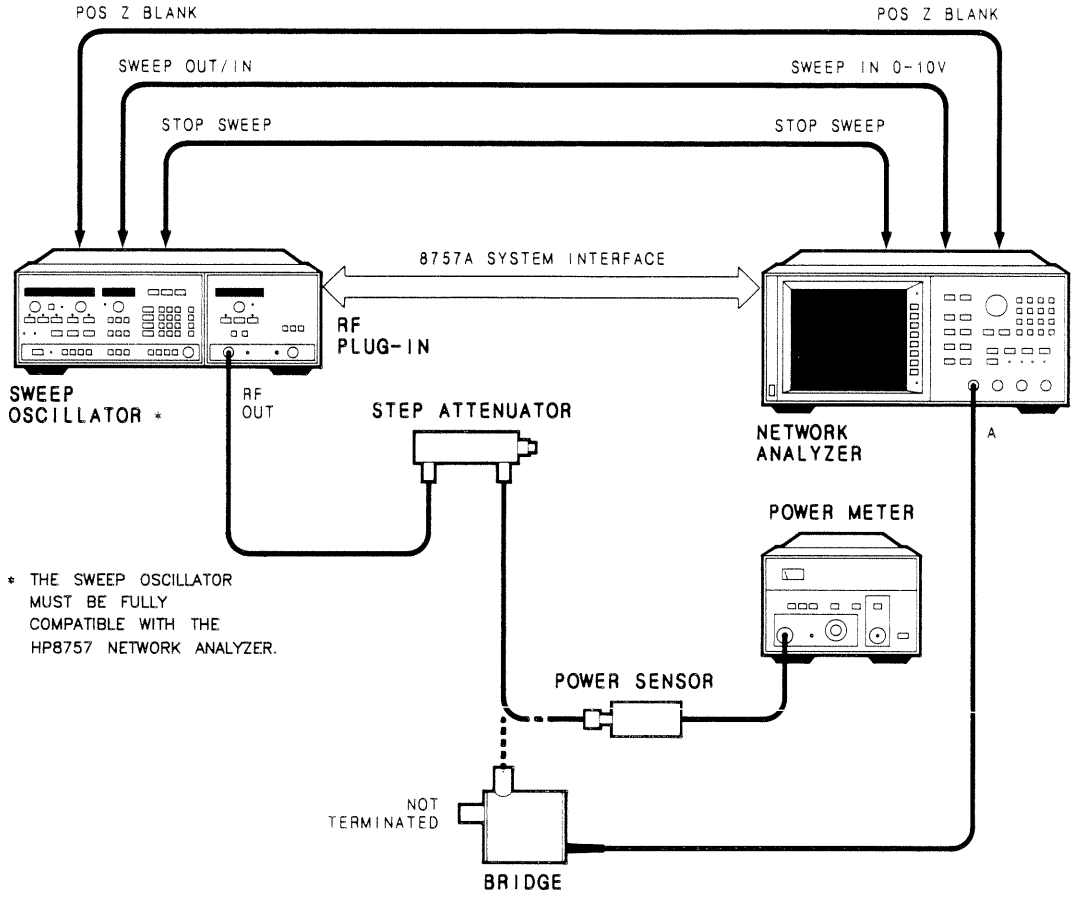



*Figure 5-1. Adjustment Test Equipment Setup*

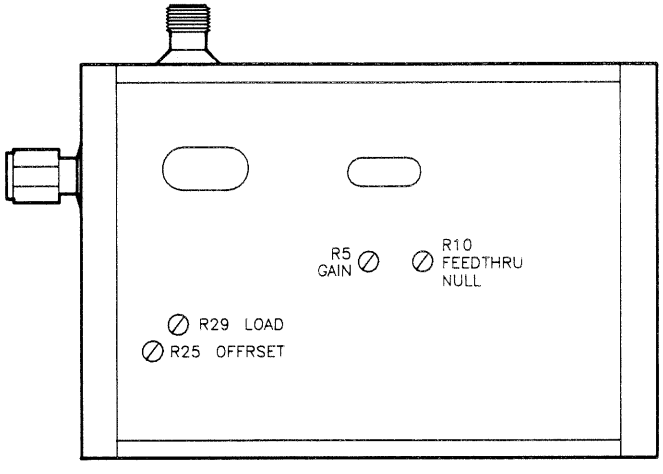



*Figure 5-2. Locations of Adjustment Potentiometers*

9. Set the attenuator to 0 dB and adjust R29 (Figure 5-2) for a cursor reading of **calibrated** −30 dB, minus 6, ±0.1 dBm (nominally −36 dBm).

10. Set the attenuator to 0 dB and adjust R29 (if required) until the cursor reads −6 ±0.1 dBm.

11. Repeat steps 8 through 10 until the change in level is equal to the **calibrated** 30 dB ±0.1 dB and, with 0 dB attenuation, the cursor indicates −6 ±0.1 dBm.

## DC Adjustment Procedure

**NOTE:** You can perform this DC procedure only with an HP 8757A analyzer.

12. Set the HP 8757A to DC mode.

13. Set the reference level to −50 dBm at mid-screen, and the scale to 5 dB/DIV.

14. On the source, turn off the RF power.

15. On the analyzer, press **[CAL] [CONFIG SYSTEM]**. If your analyzer has firmware revision 2.0 or above, press **[CAL]** and select **[MORE] [AUTOCAL]**, to turn auto calibration OFF.

16. On the bridge, use a jumper to short pad **Y** (where yellow wire terminates) to ground.

17. Adjust R25 for a minimum reading on the analyzer (it should be <-50 dBm).

18. Remove the short, and turn auto cal back ON.

## Feedthrough Null Adjustment Procedure

19. On the analyzer, press **[CAL]** and select **[DC DET ZERO] [AUTOZERO]**.

20. Adjust R10 for as high a trace as possible. Adjust slowly, because averaging and smoothing mask adjustment effects.

**NOTE:** Steps 19 and 20 must be repeated until no further change is noted.

## DC Mode RF Adjustment Check

21. Turn on the source's RF power.

22. Set the attenuator to 0dB.

23. On the analyzer, verify DC mode, averaging, smoothing, and the cursor are still on. Allow the trace to settle. Press **[DISPLAY] [MEAS→MEM] [MEAS-MEM]**. The cursor should now indicate 0.0 dB.

24. Set the attenuator to 30 dB.

25. The cursor should now indicate the calibrated −30 dB to within 0.8 dB.

26. If the value indicated is not within 0.8 dB of the calibrated −30 dB, it may be necessary to adjust R5 and R29 until the **difference** between the 0 dB and 30 dB attenuator setting is just within 0.8 dB of the calibrated 30 dB. Adjust R5 when the attenuator setting is 0 dB and R29 when at 30 dB.

27. If any adjustments are made, it will be necessary to repeat the AC adjustment procedure again, only this time using a tolerance limit of ±0.8 dB instead of the 0.1 dB indicated in steps 8 through 11. This will allow you to split the error difference between the two modes of operation.

28. Both AC and DC dynamic accuracy specifications should be within the limits given in Table 1-1.

# Section 6. Replaceable Parts

## SECTION CONTENTS



## INTRODUCTION

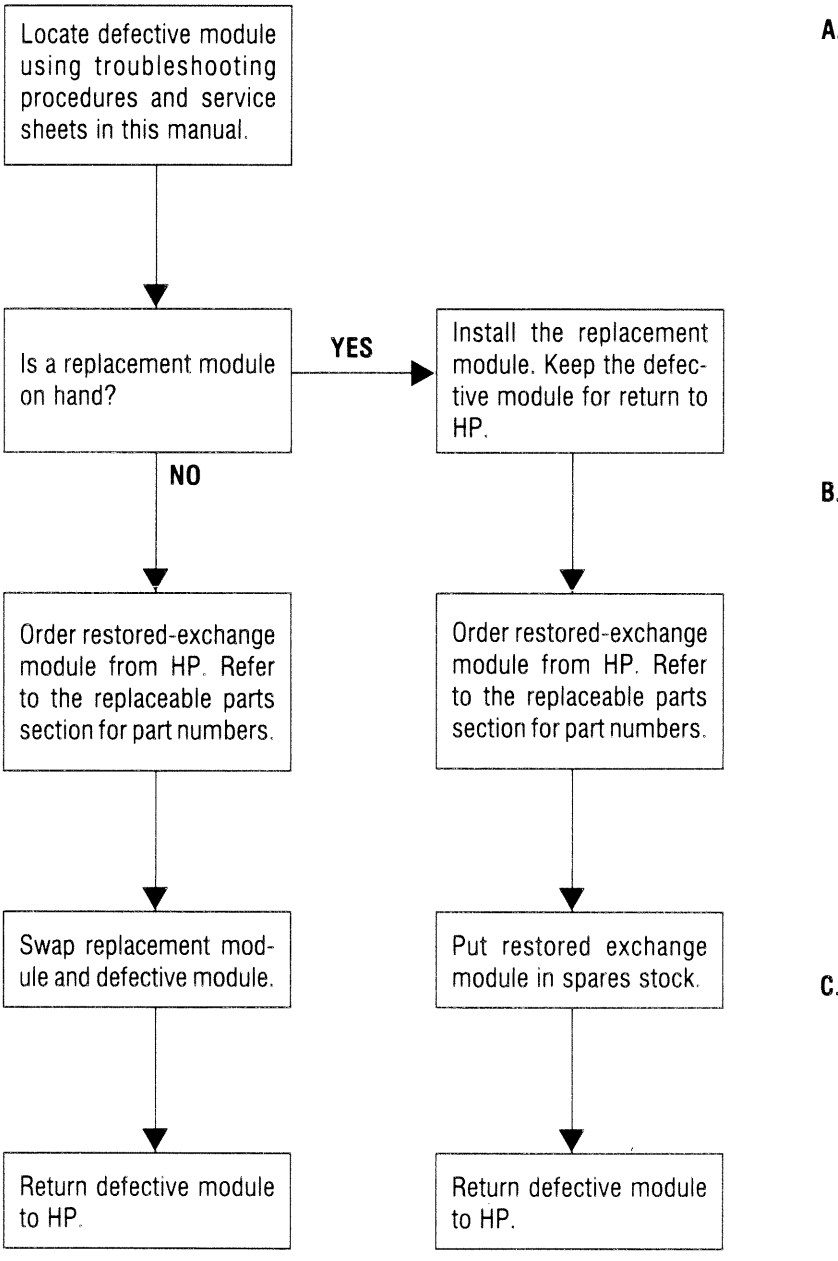
This section contains information for ordering parts. Exchange assemblies, manufacturer codes, reference designations and abbreviations are also described.

## EXCHANGE ASSEMBLIES

The bridge microcircuit may be replaced on an exchange basis, affording a considerable cost savings. This assembly includes the input and test port connectors, and the reference termination. Instructions for ordering an exchange microcircuit are given at the end of this section. Exchange, factory-repaired and tested assemblies are available only on a trade-in basis; therefore, the defective assembly must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the new assembly part number. Figure 6-1 describes the module exchange procedure.

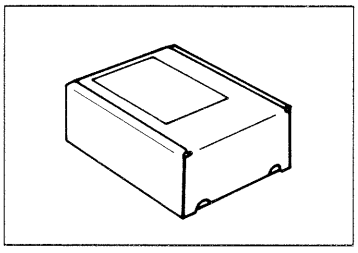
The A1 bridge microcircuit assembly exchange part number is given in Table 6-1, HP 85027E Replaceable Parts.

**The module exchange program described here is a fast, efficient, economical method of keeping your Hewlett-Packard instrument in service.**




*HP pays postage on boxes mailed in U.S.A.

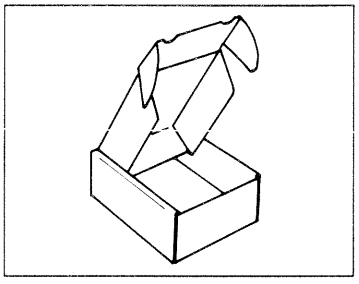
**A.**



Restored-exchange modules are shipped individually in boxes like this. In addition to the circuit module, the box contains:

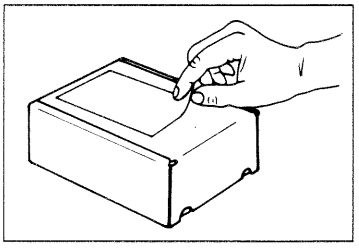
Exchange assembly failure report
Return address label

**B.**



Open box carefully - it will be used to return defective module to HP. Complete failure report. Place it and defective module 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.

*Figure 6-1. Module Exchange Procedure*

## REPLACEABLE PARTS LIST DESCRIPTION

### Organization

The replaceable parts lists are organized as follows:

- Components and assemblies of the directional bridge given in alphabetic/numerical order by reference designation.
- Components of the A2 circuit board assembly given in alphabetic/numerical order by reference designation.

### Information

The following information is given for each part:

- The Hewlett-Packard part number.
- The part number check digit (CD).
- The total quantity (Qty) used in the product.
- The description of the part.
- The five digit code of the typical manufacturer of the part.
- The manufacturer's part number for the part.

**NOTE**: The total quantity for each part is given only once, at the first appearance of the part in the list.

## ORDERING INFORMATION

To order a part listed in the replaceable parts list, indicate the Hewlett-Packard part number (with check digit to ensure efficient processing) and the quantity desired. Address the order to the nearest Hewlett-Packard office.

To order a part that is not listed in the replaceable parts list, include the instrument model and serial number, the description and function of the part and the quantity desired. Address the order to the nearest Hewlett-Packard office.

**CAUTION**

**Only the parts listed are replaceable. Any attempt to perform any disassembly or repair procedure not specifically outlined in Section 8 of this manual will void the warranty. Damaged connectors can be repaired or replaced only by Hewlett-Packard.**

*Table 6-1. HP 85027E Replaceable Parts*

| Reference Designation | HP Part Number | C D | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A1 (NEW) | 5086-7477 | 6 | 1 | BRIDGE MICROCIRCUIT ASSEMBLY (NEW) | 28480 | 5086-7477 |
| A1 (REBUILT) | 5086-6477 | 4 | | BRIDGE MICROCIRCUIT ASSEMBLY (REBUILT) | 28480 | 5086-6477 |
| A2*** | 85027-60001 | 2 | 1 | PREAMPLIFIER ASSEMBLY | 28480 | 85027-60001 |
| AT1 | P/O A1 | | 1 | TERMINATION CARTRIDGE | 28480 | P/O A1 |
| J1 | P/O A1 | | 1 | INPUT CONNECTOR | 28480 | P/O A1 |
| J2 | P/O A1 | | 1 | TEST PORT CONNECTOR | 28480 | P/O A1 |
| MP1 | 85027-00001 | 6 | 1 | DRESS COVER | 28480 | 85027-00001 |
| MP2 | 85027-20005 | 2 | 1 | CABLE COVER | 28480 | 85027-20005 |
| MP3 | 85027-20003 | 0 | 1 | EXTRUDED HOUSING | 28480 | 85027-20003 |
| MP4 | 85027-20004 | 1 | 1 | PORT COVER | 28480 | 85027-20004 |
| MP5 | 0535-0694 | 3 | 1 | NUTM-DBLHX | 28480 | 0535-0694 |
| MP6 | 85027-00002 | 7 | 1 | WRENCH, CONNECTOR SAVER | 28480 | 85027-00002 |
| MP7 | 0360-0002 | 6 | 1 | TERMINAL-SLDR LUG PL-MTG FOR-#2-SCR | 28480 | 0360-0002 |
| MP8 | 0515-1445 | 2 | 4 | SCREW-THD-RLG-M3 X 0.5 8MM-LG | 28480 | 0515-1445 |
| MP9 | 1531-0289 | 5 | 1 | MACHINED PART-SST SPACER-BRIDGE | 28480 | 1531-0289 |
| MP10 | 0515-0820 | 5 | 4 | SCREW-MACH M2 X 0.4 5MM-LG 90-DEG-FLH-HD | 28480 | 0515-0820 |
| MP11 | 0515-0912 | 6 | 4 | SCREW-MACH 3.0 X 8MM PN PD | 28480 | 0515-0912 |
| MP12* | 85027-80017 | 2 | 1 | ID LABEL 85027E (FRONT LABEL) | 28480 | 85027-80017 |
| MP13* | 85027-80012 | 7 | 1 | FOAM PAD | 28480 | 85027-80012 |
| MP14* | 85027-80015 | 0 | 1 | WOOD INSTRUMENT CASE | 28480 | 85027-80015 |
| MP15 | 2190-0584 | 0 | 4 | LOCK WASHER M3.0 | 28480 | 2190-0584 |
| MP16 | 85027-80018 | 3 | 1 | LABEL ID 85027E (SERIAL TAG) | 28480 | 85027-80018 |
| MP17 | | | | NOT ASSIGNED | | |
| MP18 | 85027-80004 | 7 | 1 | LABEL IN RF TEST (BACK LABEL) | 28480 | 85027-80004 |
| MP19 | 85027-80005 | 8 | 1 | LABEL WARNING MAXIMUM INPUT (SIDE) | 28480 | 85027-80005 |
| MP20 | | | | NOT ASSIGNED | | |
| MP21* | 85027-60005 | 6 | 1 | ADAPTER 3.5 F TO 3.5 F | 28480 | 85027-60005 |
| MP22* | 85027-60006 | 7 | 1 | ADAPTER 3.5 M TO 3.5 F | 28480 | 85027-60006 |
| MP23* | 85027-60004 | 5 | 1 | 3.5 MM OPEN/SHORT | 28480 | 85027-60004 |
| W1 | 85025-60003 | 2 | 1 | CABLE ASSY | 28480 | 85025-60003 |
| | 92193Z | | | 3.5 MM CONNECTOR CLEANING KIT | 28480 | 92193Z |

* NOT SHOWN
** SEE TABLE 6-2**

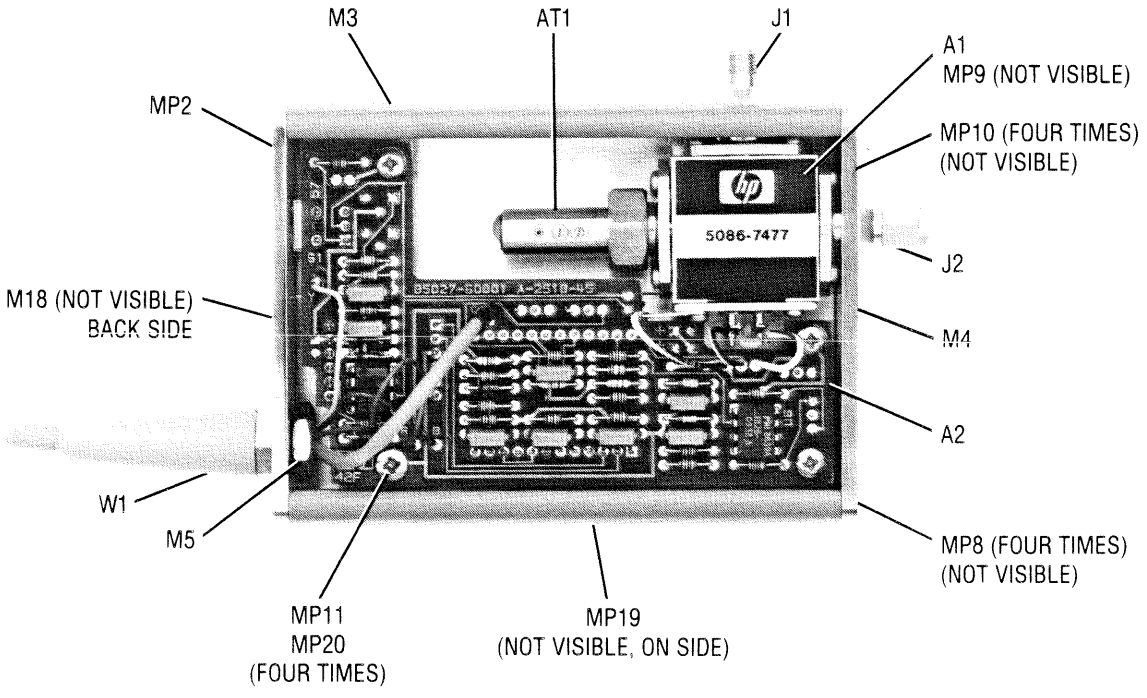



*Figure 6-2. HP 85027E Replaceable Parts Identification*

*Table 6-2. A2 Bridge Circuit Assembly Replaceable Parts*

| Reference Designation | HP Part Number | C D | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| | | | | A2 BRIDGE CIRCUIT BOARD ASSEMBLY | | |
| A2 | 85027-60001 | 2 | 1 | BRIDGE PC BOARD ASSEMBLY | 28480 | 85027-60001 |
| A2C1 | 0160-5375 | 2 | 8 | CAPACITOR-FXD .1UF +-10% 50VDC CER | 28480 | 0160-5375 |
| A2C2 | 0160-5375 | 2 | | CAPACITOR-FXD .1UF +-10% 50VDC CER | 28480 | 0160-5375 |
| A2C3 | 0160-5375 | 2 | | CAPACITOR-FXD .1UF +-10% 50VDC CER | 28480 | 0160-5375 |
| A2C4 | 0160-5375 | 2 | | CAPACITOR-FXD .1UF +-10% 50VDC CER | 28480 | 0160-5375 |
| A2C5 | 0180-2683 | 1 | 1 | CAPACITOR-FXD 4.7UF +-20% 35VDC TA | 28480 | 0180-2683 |
| A2C6 | 0160-5375 | 2 | | CAPACITOR-FXD .1UF +-10% 50VDC CER | 28480 | 0160-5375 |
| A2C7 | 0160-5375 | 2 | | CAPACITOR-FXD .1UF +-10% 50VDC CER | 28480 | 0160-5375 |
| A2C8 | 0160-5375 | 2 | | CAPACITOR-FXD .1UF +-10% 50VDC CER | 28480 | 0160-5375 |
| A2C9 | 0160-5375 | 2 | | CAPACITOR-FXD .1UF +-10% 50VDC CER | 28480 | 0160-5375 |
| A2C10 | 0180-2661 | 5 | 2 | CAPACITOR-FXD 1UF +-10% 50VDC TA | 25088 | DIROGSIA50K |
| A2C11 | 0180-2661 | 5 | | CAPACITOR-FXD 1UF +-10% 50VDC TA | 25088 | DIROGSIA50K |
| A2C12 | 0160-0573 | 2 | 1 | CAPACITOR-FXD 4700PF +-20% 100VDC CER | 28480 | 0160-0573 |
| A2CR1 | 1901-0050 | 3 | 2 | DIODE-SWITCHING 80V 200MA 2NS DO-35 | 28480 | 1901-0050 |
| A2CR2 | 1901-0050 | 3 | | DIODE-SWITCHING 80V 200MA 2NS DO-35 | 28480 | 1901-0050 |
| A2CR3 | 1901-0539 | 3 | 1 | DIODE-SM SIG SCHOTTKY | 28480 | 1901-0539 |
| A2MP1 | 85027-20001 | 8 | 1 | BD-AD/DC BRIDGE | 28480 | 85027-20001 |
| A2R1 | 0698-7212 | 9 | 7 | RESISTOR 100 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-100R-F |
| A2R2 | 0698-7279 | 8 | 1 | RESISTOR 61.9K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-6192-F |
| A2R3 | 0698-7249 | 2 | 1 | RESISTOR 3.48K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-3481-F |
| A2R4 | 0698-7284 | 5 | 1 | RESISTOR 100K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-1003-F |
| A2R5 | 2100-3091 | 1 | 2 | RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN | 32997 | 3292W-1-202 |
| A2R6 | 0698-7212 | 9 | | RESISTOR 100 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-100R-F |
| A2R7 | 0698-7212 | 9 | | RESISTOR 100 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-100R-F |
| A2R8 | 0698-7212 | 9 | | RESISTOR 100 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-100R-F |
| A2R9 | 0698-8615 | 8 | 1 | RESISTOR 75K 1% .05W F TC=0+-100 | 28480 | 0698-8615 |
| A2R10 | 2100-3097 | 7 | 1 | RESISTOR-TRMR 100K 10% C TOP-ADJ 17-TRN | 32997 | 3292W-1-104 |
| A2R11 | 0698-7212 | 9 | | RESISTOR 100 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-100R-F |
| A2R12 | 0698-7212 | 9 | | RESISTOR 100 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-100R-F |
| A2R14 | 0698-7288 | 9 | 1 | RESISTOR 147K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-1473-F |
| A2R15 | 0698-7236 | 7 | 1 | RESISTOR 1K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-1001-F |
| A2R16 | 0698-7253 | 8 | 2 | RESISTOR 5.11K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-5111-F |
| A2R17 | 0698-7212 | 9 | | RESISTOR 100 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-100R-F |
| A2R18 | 0698-7229 | 8 | 1 | RESISTOR 511 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-511R-F |
| A2R19 | 0698-7247 | 0 | 1 | RESISTOR 2.87K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-2871-F |
| A2R21 | 0698-7261 | 8 | 1 | RESISTOR 11K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-1102-F |
| A2R22 | 0698-7253 | 8 | | RESISTOR 5.11K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-5111-F |
| A2R23 | 0698-7251 | 6 | 2 | RESISTOR 4.22K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-4221-F |
| A2R24 | 0698-7251 | 6 | | RESISTOR 4.22K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-4221-F |
| A2R25 | 2100-3091 | 1 | | RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN | 32997 | 3292W-1-202 |
| A2R28 | 0698-7224 | 3 | 1 | RESISTOR 316 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-316R-F |
| A2R29 | 2100-3286 | 6 | 1 | RESISTOR-TRMR 10K 10% C TOP-ADJ 17-TRN | 32997 | 3292W-1-103 |
| A2R30 | 0698-7277 | 6 | 1 | RESISTOR 51.1K 1% .05W F TC=0+-100 | 24546 | C3-1/8-TO-5112-F |
| A2RT1 | 0837-0324 | 6 | 1 | THERMISTOR DISC 2K-OHM TC=4.4%/C-DEG | 28480 | 0837-0324 |
| A2S1 | 3101-2851 | 2 | 1 | SWITCH | 28480 | 3101-2851 |
| A2U1 | 1NB7-8045 | 6 | 1 | PREAMP HYBRID ASSEMBLY | 28480 | 1NB7-8045 |
| A2U2 | 1NB7-8039 | 8 | 1 | CLOCK HYBRID ASSEMBLY | 28480 | 1NB7-8039 |
| A2U3 | 1826-0412 | 1 | 1 | IC COMPARATOR PRCN DUAL 8-DIP-P PKG | 27014 | LM393N |
| A2U4 | 1826-0772 | 6 | 1 | IC V RGL TR-ADJ-POS 1.2/32V TO-92 PKG | 28480 | 1826-0772 |
| A2U5 | 1826-0285 | 6 | 1 | IC V RGLTR TO-92 | 04713 | MC79L05C |
| A2U6 | 1826-0932 | 0 | 1 | IC OP AMP PRCN 8-DIP-C PKG | 06665 | 0P-27FZ |
| A2VR1 | 1902-3245 | 6 | 2 | DIODE-ZNR 21.5V 5% DO-35 PD=.4W | 28480 | 1902-3245 |
| A2VR2 | 1902-3245 | 6 | | DIODE-ZNR 21.5V 5% DO-35 PD=.4W | 28480 | 1902-3245 |

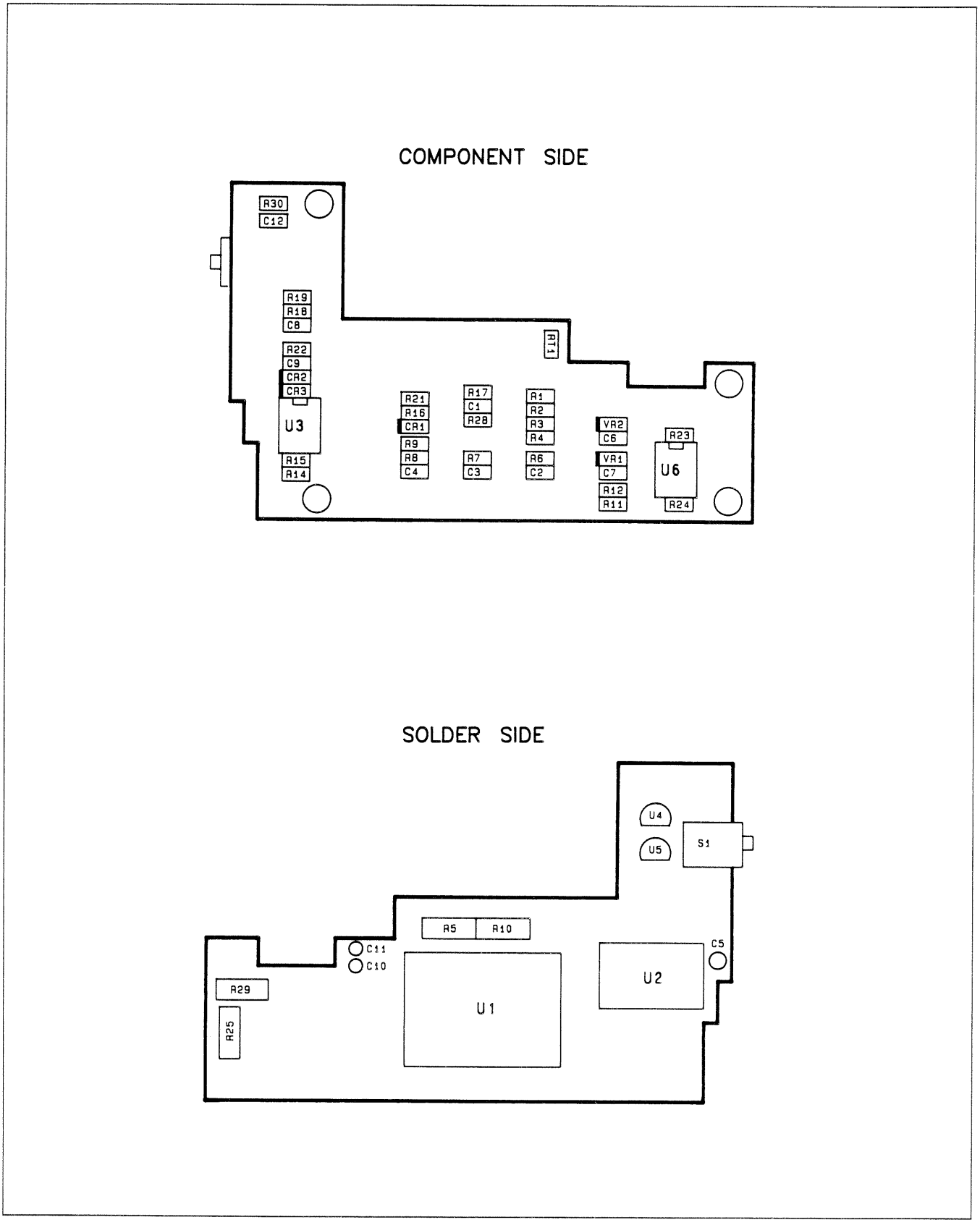



*Figure 6-3. A2 Circuit Board Component Location*

*Table 6-3. Manufacturers' Code List*

| Manufacturers Code List | | | |
|---|---|---|---|
| **Code** | **Manufacturer** | **Address** | **Zip Code** |
| 04713 | Motorola Semiconductor Products | Phoenix AZ | 85008 |
| 06383 | Panduit Corp | Tinley Park IL | 60477 |
| 06665 | Precision Monolithics Inc | Santa Clara CA | 95050 |
| 24546 | Corning Glass Works (Bradford) | Bradford PA | 16701 |
| 25088 | Siemens Corp | Iselin NJ | 08830 |
| 27014 | National Semiconductor Corp | Santa Clara CA | 95051 |
| 28480 | Hewlett-Packard Company Corporate HQ | Palo Alto CA | 94304 |
| 32997 | Bourns Inc Trimpot Prod Div | Riverside CA | 92507 |

| Reference Designators | | | |
|---|---|---|---|
| A | assembly | R | resistor |
| AT | termination assembly | TP | test point |
| C | capacitor | S | switch |
| CR | diode | U | integrated circuit |
| J | jack | VR | diode |
| L | inductor | W | cable |
| MP | miscellaneous part | | |

| Abbreviations | | | |
|---|---|---|---|
| ADJ | adjustable | RMS | root-mean-square |
| ASSY | assembly | SGL | signal |
| BD | board | SI | silicon |
| CER | ceramic | SIG | signal |
| DBLHX | double chamfered, hex | SLDR | solder |
| FXD | fixed | STR | straight |
| G | giga ($10^9$) | TA | tantalum |
| K | kilo ($10^3$ | THD | thread |
| MA | milli-amp | TML | terminal |
| MEG | mega ($10^6$) | TRMR | trimmer |
| MFR | manufacturer | TRN | turn |
| MHZ | megahertz | UF | microfarad |
| PF | picofarad | VDC | volts, direct current |
| PRCN | precision | W | watt |
| RGLTR | regulator | ZNR | zener |

# Section 7. Manual Backdating Changes

## INTRODUCTION

This manual has been written for and applies directly to instruments with serial numbers prefixed as indicated on the title page. Earlier versions of the instrument (serial prefixes lower than the one indicated on the title page) may be slightly different in design or appearance. The purpose of this section of the manual is to document these differences. With the information provided in this section, this manual can be corrected so that it applies to any earlier version or configuration of the instrument. Later versions of the instrument (serial prefixes higher than the one indicated on the title page) are documented in a yellow manual changes supplement.

Since there are no earlier versions of the HP 85027E directional bridge, there is no change information required here. If your instrument serial number is different than the one on the title page, it will be documented in a manual change supplement. Complimentary copies of this supplement can be obtained from your nearest Hewlett-Packard office. Refer to INSTRUMENTS COVERED BY MANUAL in Section 1 for more information about serial number coverage.

# Section 8. Service

## SECTION CONTENTS



## INTRODUCTION

This section contains troubleshooting and repair information. Heed the caution signs or risk damaging the bridge. You may wish to read the theory of operation with its associated diagrams as an aid to troubleshooting.

Troubleshooting the bridge begins with performing the operator's check (in Section 3) and the performance tests (in Section 4). If the bridge does not pass the performance tests, refer to the adjustments in Section 5. If the problem persists, refer to the troubleshooting procedures later in this section. Troubleshooting procedures require the use of test equipment listed in Section 1.

## THEORY OF OPERATION

The HP 85027E can detect RF or microwave signals which are either 27.8 kHz square-wave modulated (AC mode) or unmodulated (DC mode). In both detection modes, the bridge provides a 27.8 kHz square-wave signal for the analyzer to interpret and display.

In AC mode, the signal is amplitude modulated at the source. The bridge demodulates (envelope detects) this signal to produce a 27.8 kHz square wave signal whose peak-to-peak voltage corresponds to the magnitude of the signal at the bridge test port. Since only the modulated signal is detected, unmodulated broadband noise and extraneous signals are disregarded. Additionally, this technique provides nearly drift-free operation.

In DC mode, the source signal is not modulated. Instead, the bridge converts the signal into an equivalent DC voltage which it then chops at a frequency of 27.8 kHz. It amplifies the chopped signal to simulate the signal produced by AC detection, and outputs this signal to the analyzer. This technique is preferable for devices such as amplifiers with ALC circuits, or filters with very narrow bandwidths.

## TROUBLESHOOTING PROCEDURES

If a problem persists after you have performed the adjustments in Section 5, perform the troubleshooting procedures outlined below.

**CAUTION**

**The HP 85027E contains microcircuits which are highly sensitive to electrostatic discharge (ESD). Work only at a station equipped with an antistatic surface. Wear a grounded wrist strap. Do not touch the center contacts of the connectors with your fingers. Before you make a measurement, ground the leads of the digital multimeter by touching them to the grounded instrument chassis.**

### Gaining Internal Access

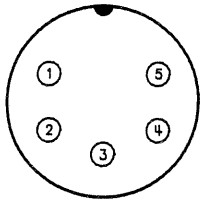
To access the interior of the directional bridge, proceed as follows:

1. Disconnect the bridge from the analyzer.
2. Remove the two screws which hold the (test) port cover (end plate) in place.
3. Remove the port cover.
4. Slide the top dress cover out of the bridge housing. The component side of the circuit board and the bridge assembly are now accessible.

### Cable Continuity Check

1. Disconnect the directional bridge from the analyzer and ground the leads of the digital multimeter (DMM) by touching them to the grounded chassis of the HP 8756 or 8757.
2. Use a DMM to check the continuity of the conductors of the power cable (W1). Measure from the connector pins to the wire connections inside the bridge housing. Table 8-1 lists W1 connector pins and the corresponding wires.
3. If there are any discontinuities, replace cable W1 by following the instructions in the power cable replacement procedure.

*Table 8-1. Conductor in Power Cable W1*




| Connector Pin | Conductor (Label) | Signal |
|---|---|---|
| 1 | White (W) | Output |
| 2 | Green (G) | Return |
| 3 | Yellow (Y) | Control |
| 4 | Blue (B) | −12.6V |
| 5 | Red (R) | +15V |

## Power Cable Replacement

1. To replace the power cable (W1), first open the bridge by following the instructions above in "Gaining Internal Access."
2. Desolder the wires connected to the power cable/circuit board assembly.
3. Remove the two screws from the cable cover end plate.
4. Remove the 1/2 inch hex nut which fastens the cable to the end plate.
5. Replace the cable and reinstall it by performing in reverse order steps 1 through 4. The pads the wires are soldered to are labeled as shown in Table 8-1.

## Input Port and Test Port Resistance Checks

1. Disconnect the directional bridge from the analyzer. Ground the leads of the DMM by touching them to the grounded chassis of the HP 8756 or 8757.
2. Measure the resistance from the center contact of input port connector J1 to the center contact of test port connector J2. The resistance should be 33 $\pm 2\Omega$.
3. Measure the resistance from the center contact of input connector J1 to signal ground (the black/white wire connected to the microcircuit housing). The resistance should be 83 $\pm 2\Omega$.
4. Measure the resistance from the center contact of test port connector J2 to signal ground. It should be 83 $\pm 2\Omega$.
5. If any of the above results are not correct, the bridge microcircuit assembly A1 is defective and must be replaced. Refer to A1 Bridge Microcircuit Assembly Replacement.

## Microcircuit Check

1. Connect the input port of the bridge at the RF output of the RF plug-in or synthesized sweeper. Do not terminate the bridge test port.
2. Set the RF output of the source to +13 dBm with the modulation on.
3. With a true RMS DMM, measure the voltage across the two output pins of the microcircuit. The bridge diode is probably good if the reading is approximately 0.07V rms.
4. If the reading in step 3 is low, expose R29 by removing the self-adhesive plastic label which explains the switch configuration. Center the load potentiometer R29 (see Figure 5-2). Measure again, if the reading remains low, the microcircuit is defective and must be replaced.

## A2 Circuit Board Assembly Replacement

1. To remove the circuit board, first open up the bridge and desolder the power cable wires (see "Gaining Internal Access" and "Power Cable Replacement").
2. At the circuit board pads, desolder the signal, signal ground and chassis ground wires from the microcircuit.
3. Remove the four screws and lock washers which fasten the A2 circuit board to the standoffs.

4. Reverse the above procedure to install the repaired or replacement board assembly.

5. Perform the adjustments in Section 5 to electrically match the A2 board to the A1 microcircuit.

6. Reassemble the remaining parts of the bridge.

## A1 Bridge Microcircuit Assembly Replacement

1. Type the serial number of the directional bridge on the rear panel label supplied with the new or replacement bridge microcircuit assembly.

2. Remove the two screws holding the (test) port cover (end plate) and remove the port cover.

3. Remove the two screws holding the cable cover (end plate). This will allow the cable and cable cover to move freely.

4. Desolder the white/black wires (signal ground and chassis ground) and the white/red wire (signal) at the microcircuit. Remove the capacitor from the microcircuit pins.

5. Remove the four screws and lock washers which fasten the A2 circuit board assembly to the standoffs.

6. Remove the A2 circuit board assembly with the cable cover and cable from the extruded housing.

7. Turn the bridge over. Remove the four screws which fasten the microcircuit assembly. Take out the microcircuit assembly. Note the stainless steel spacer under it.

8. Install the spacer over the screw holes and the bridge microcircuit assembly over the spacer. Reinstall the four microcircuit assembly screws.

9. Perform in reverse sequence steps 2 through 6.

10. Perform the adjustments is Section 5 to electrically match the microcircuit to the circuit board assembly.

11. Attach the new label to the bridge housing.

## Power Supply Check

1. Connect the power cord of the bridge (W1) to the analyzer and turn on the analyzer.

2. Refer to Figure 8-1 and check the power supply voltages of +15, −12.6, +8 and −5 volts at the four pads indicated. Since the +15V and −12.6V are supplied by the analyzer, those voltages are specified in the analyzer's manual. The +8V should be +8.3 ±0.3V; −5V should be −5 ±0.2V.

3. Refer to Figure 8-1 and check the power supplies at the various components as required.

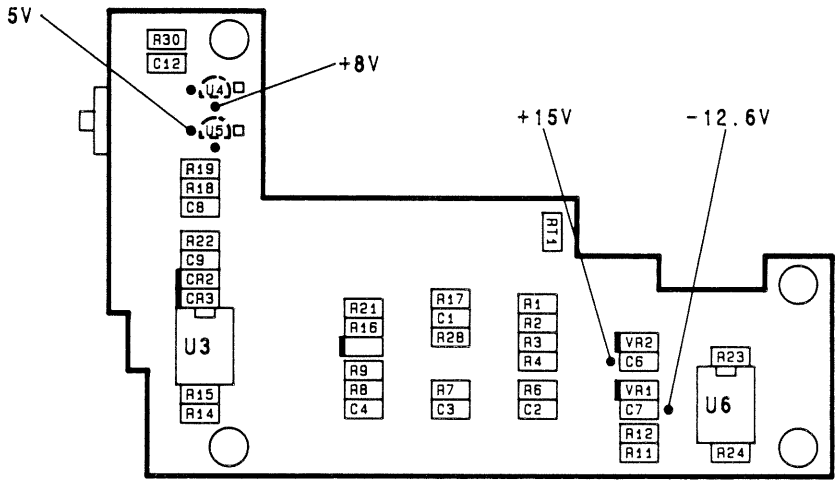



*Figure 8-1. A2 Circuit Board Power Supply Check Points*

## Signal Path Check

1. Check the output of the buffer amplifier at U6 pin 6. The voltage should be the same as that measured in step 3 of the microcircuit check. It may be offset.

2. Check the output of U1 pin 14 with the gain potentiometer (R5) centered. The voltage should be approximately 0.44V rms.

## Clock/Control Check

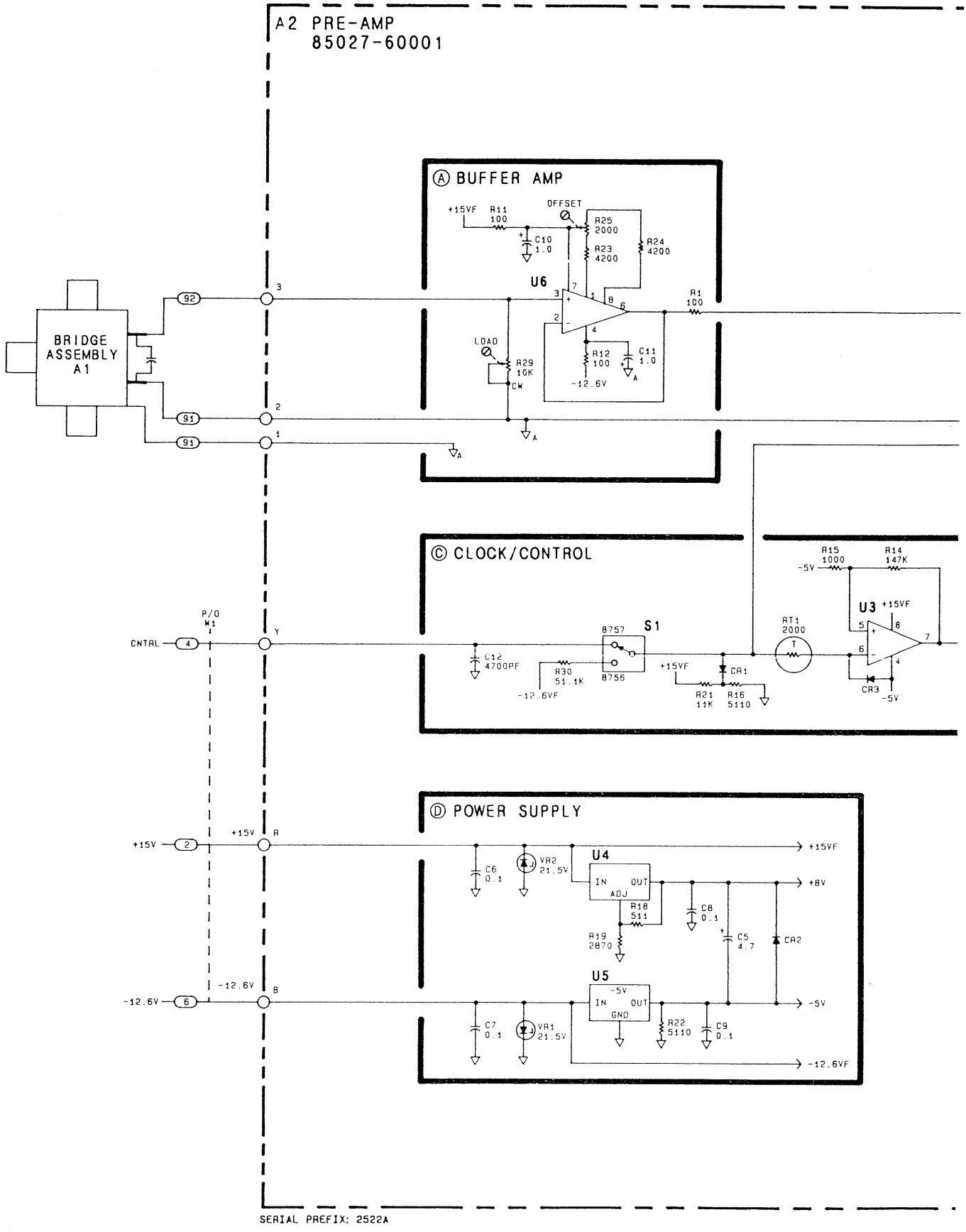
1. With the directional bridge configuration switch set at **[HP8756/HP8755]**, verify that there is no square-wave output at U2 pins 1, 2 and 4.

2. Set the directional bridge configuration switch to the **[HP8757]** position.

3. Configure the HP 8757A for DC mode.

4. Verify a square-wave output of 27.778 kHz at U1 pin 14.

5. If U1 pin 14 does not have a square-wave output, check for a square-wave of 27.778 kHz at U1 pins 2 and 3, also U2 pins 1 and 2; 55.555 kHz at U1 pin 9, also U2 pin 4.


A2 PRE-AMP
85027-60001
Ⓐ BUFFER AMP
+15VF
R11
100
OFFSET
R25
2000
R24
4200
R23
4200
C10
1.0
U6
R1
100
LOAD
R29
10K
CW
R12
100
C11
1.0
-12.6V
BRIDGE
ASSEMBLY
A1
92
91
91
3
2
1
Ⓒ CLOCK/CONTROL
R15
1000
R14
147K
-5V
U3
+15VF
RT1
2000
S1
8757
8756
C12
4700PF
R30
51.1K
-12.6VF
+15VF
CR1
R21
11K
R16
5110
CR3
-5V
P/O
W1
CNTRL
4
Y
Ⓓ POWER SUPPLY
+15V
2
+15V
R
C6
0.1
VR2
21.5V
U4
IN
OUT
ADJ
+15VF
+8V
R18
511
R19
2870
C8
0.1
C5
4.7
CR2
-12.6V
-12.6V
6
B
U5
-5V
IN
OUT
GND
-5V
C7
0.1
VR1
21.5V
R22
5110
C9
0.1
-12.6VF
SERIAL PREFIX: 2522A

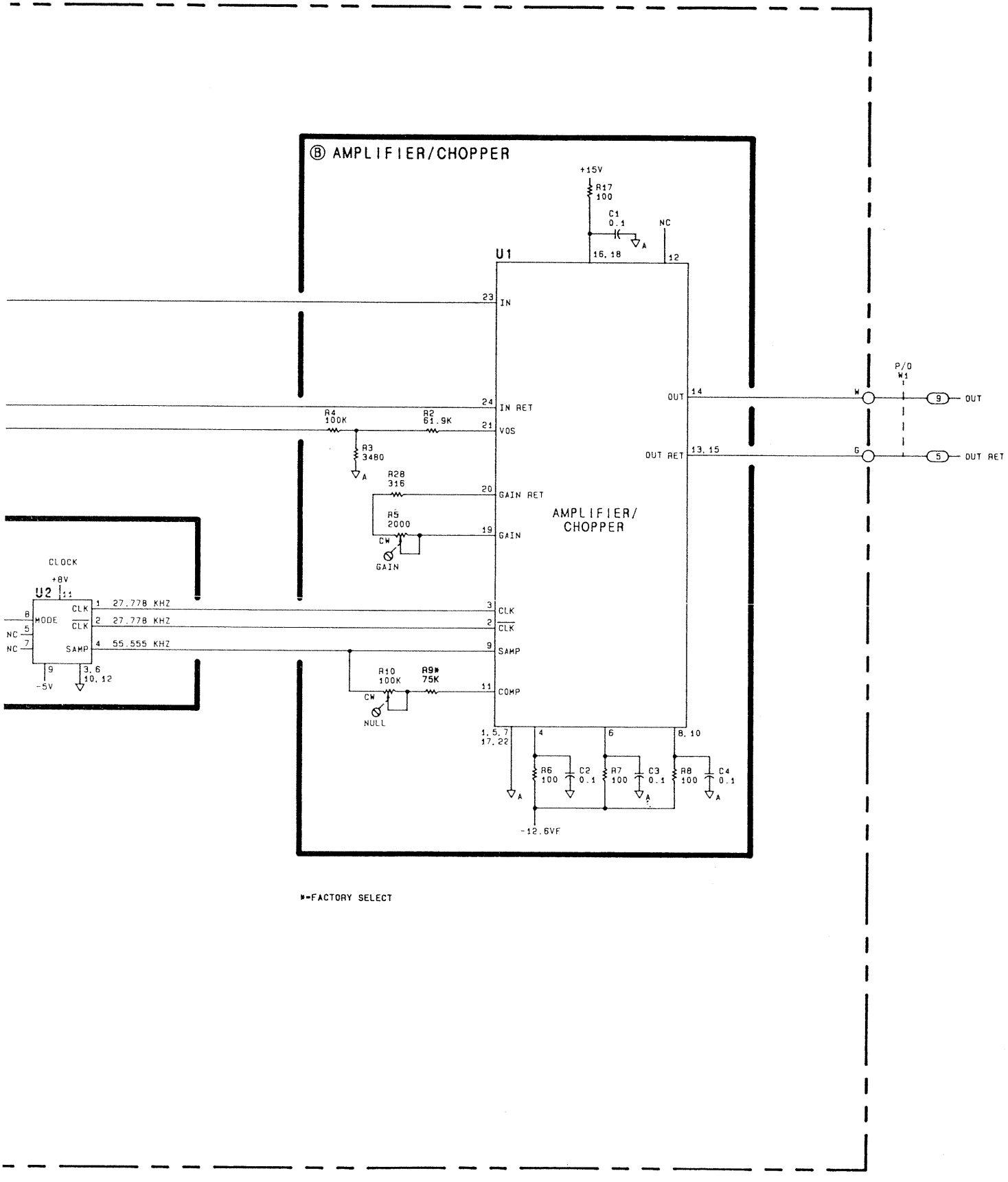



*Figure 8-2. A2 Preamplifier Schematic Diagram*

## CONNECTOR INSPECTION AND CLEANING

The condition of a system's connectors has a large effect on measurement quality. This is probably the least understood fact in the microwave industry.

Hewlett Packard recommends that you periodically inspect the connectors, visually and mechanically. Use connector savers whenever your measurement allows some loss in directivity. (Table 1-2 shows return loss of connector savers.) The part numbers of female-to-male and female-to-female connector savers are:

| | |
|---|---|
| female-to-male connector saver: | HP Part Number 85027-60006 |
| female-to-female connector saver: | HP Part Number 85027-60005 |

A bad connector can ruin a good connector instantly. Periodic checks can eliminate the expense of replacing bridges with damaged connectors. If a connector fails the visual or mechanical inspection, don't use it. Contact your local HP Sales and Service office for instructions.

### Visual Inspection

Inspect connectors with an illuminated, 4-power magnifying glass. The lighting is crucial. Normal room lighting (from desk lamps, etc) casts shadows. The shadows can hide the small defects you are trying to see. A magnifying lens with built-in lighting provides shadowless, even illumination. This type of inspection lamp is readily available from office or electrical equipment suppliers.

Examine connectors for obvious problems such as deformed or clogged threads, contamination or corrosion. look carefully at the contact surfaces. Look for burrs, scratches, rounded edges or other signs of wear or damage. Defects which you can see with the magnifying glass can degrade performance. The microcircuit and connector are not separately replaceable. To replace a damaged connector you must replace the microcircuit as well. If the connector were replaced in the field, the directional bridge would no longer meet specifications. This is why it is so important to take good care of the connectors and clean them when necessary.

### Cleaning 3.5 mm (male) Connectors

**NOTE:** If a connector looks dirty when you inspect it, clean it. If it is not dirty, don't clean it. If connectors are cleaned too often, the plastic support bead inside the connector can be damaged (by the freon). (Refer to Figure 8-3.) This would eventually affect your measurements.

Clean dirty connectors using the 3.5 mm connector cleaning kit, HP Part Number 92193Z. The kit contains; one can of compressed air, one can of liquid freon, and foam-tipped cleaning swabs.

**CAUTION**

**Always wear an anti-static wrist strap and work on an anti-static bench mat when cleaning the connectors. Furthermore, wear the grounding strap on the wrist of the hand which holds the cleaning swab. Cleaning a 3.5 mm connector requires you to touch the center conductor of the connector with a swab. The danger of introducing static electricity into the center conductor must be completely eliminated.**

1. Use the can of compressed air to blow off loose dirt.

**NOTE:** Using air from a compressor is not recommended because it may contain moisture and oil. Also, **most air nozzles charge the air with static electricity,** which could destroy your bridge.

**The small foam swabs in the kit are the ONLY recommended swabs for use with 3.5 mm connectors. Do not use cotton (fibrous) swabs.** Use trichlorotri- fluoroethane (liquid Freon) sparingly. Do not use abrasives which could damage the thin gold plating. Do not use harsh solvents that can damage the plastic dielectric supporting element.

2. Soak one of the foam swabs in liquid freon. Insert the tip of the swab between the threads and center conductor.

3. Move the swab in a circle around the center conductor. This cleans the threads and center conductor at the same time. Try to avoid getting freon on the plastic dielectric supporting element.

## Mechanical Inspection

Gauging the 3.5 mm connector: Use a precision 3.5 mm connector gauge (shown in Figure 8-4) to check the mechanical dimensions of the connector. The tolerances are tight, but must be met to ensure perfect mating between the connector surfaces. Perfect mating ensures a good electrical match and reduces the possibility of connector damage.

The recession of the center conductor is the critical dimension. The maximum allowable recession of the center conductor is 0.08 mm (0.003 inches). The minimum allowable recession of the center conductor is 0.000 (precisely flush with the mating plane).

**CAUTION**

**Any center conductor which protrudes beyond the outer conductor mating plane is out of tolerance. It will permanently damage any connector attached to it by buckling the female contact fingers. This damage and the resultant electrical interference is often noticeable as a power hole of several dB at about 22 GHz.**

Any center conductor which is recessed $>0.08$ mm ($>0.003$ inches) behind the outer conductor mating plane will cause poor electrical contact and degraded performance.

Before using the connector gauge to measure the connector, visually inspect the end of the gauge and the calibration block. Dirty or damaged gauge facings can cause dirty or damaged connectors. Figures 8-4 through 8-6 explain how to gage 3.5 mm male connectors. The part number of the gage kit is:

**3.5 mm Connector Gage Kit (male and female): HP Part Number 1250-1862**

Refer to the *Microwave Connector Care* guide, HP part number 08510-90064, for information on other connector types.

If you will be mating precision 3.5 mm connectors with SMA connectors, please refer to Figure 8-3, SMA and precision 3.5 mm connectors.

## CAUTION: SMA CONNECTORS

SMA connectors will mate with precision 3.5 mm connectors. But use caution to prevent accidental damage due to worn or out-of-specification connectors. Such connectors can destroy a precision 3.5 mm connector **even on the very first connection**. Hewlett-Packard recommends that you keep two points in mind when you mate SMA with 3.5 mm connectors.

1. SMA connectors are not precision mechanical devices. They are very susceptible to mechanical wear and are often found to be out of specification prior to first use. Thus gauging SMA connectors is the single most important step you can take to prevent damaging your equipment.

   Also take care with initial alignment: push the two connectors straight together without overtightening or rotating either center conductor. Use a torque wrench (HP part number 8710-1582) for the final connection. This torque (60 N/cm, 5 lb/in) is less than is used when mating 3.5 mm connectors together. Use connector savers for an extra margin of safety.

2. Important structural and dimensional differences exist between these two types of connectors. Thus when an SMA connector is mated to a precision 3.5 mm connector, the connection will typically exhibit a discontinuity match at about 20 GHz. Even so, the performance is better than mating two SMA connectors.

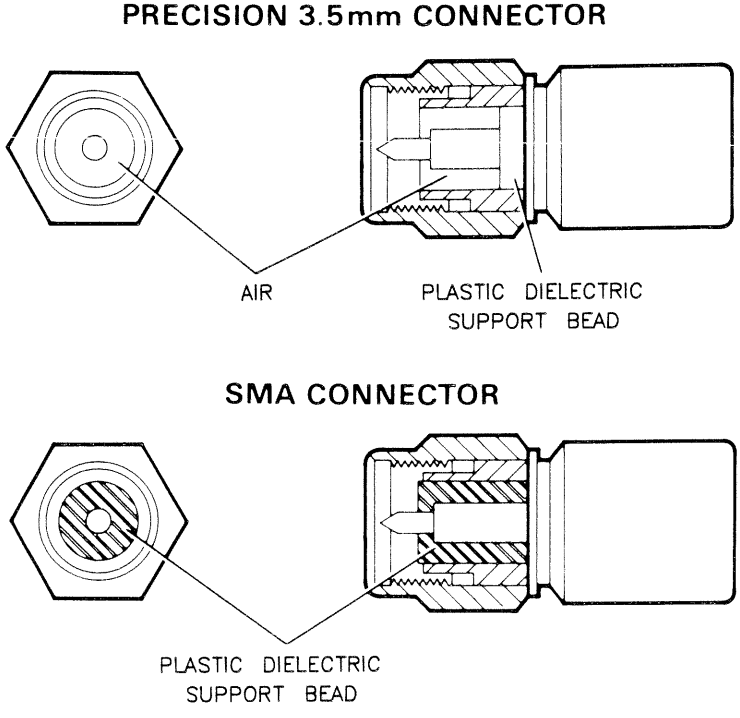



*Figure 8-3. SMA and Precision 3.5 mm Connectors*

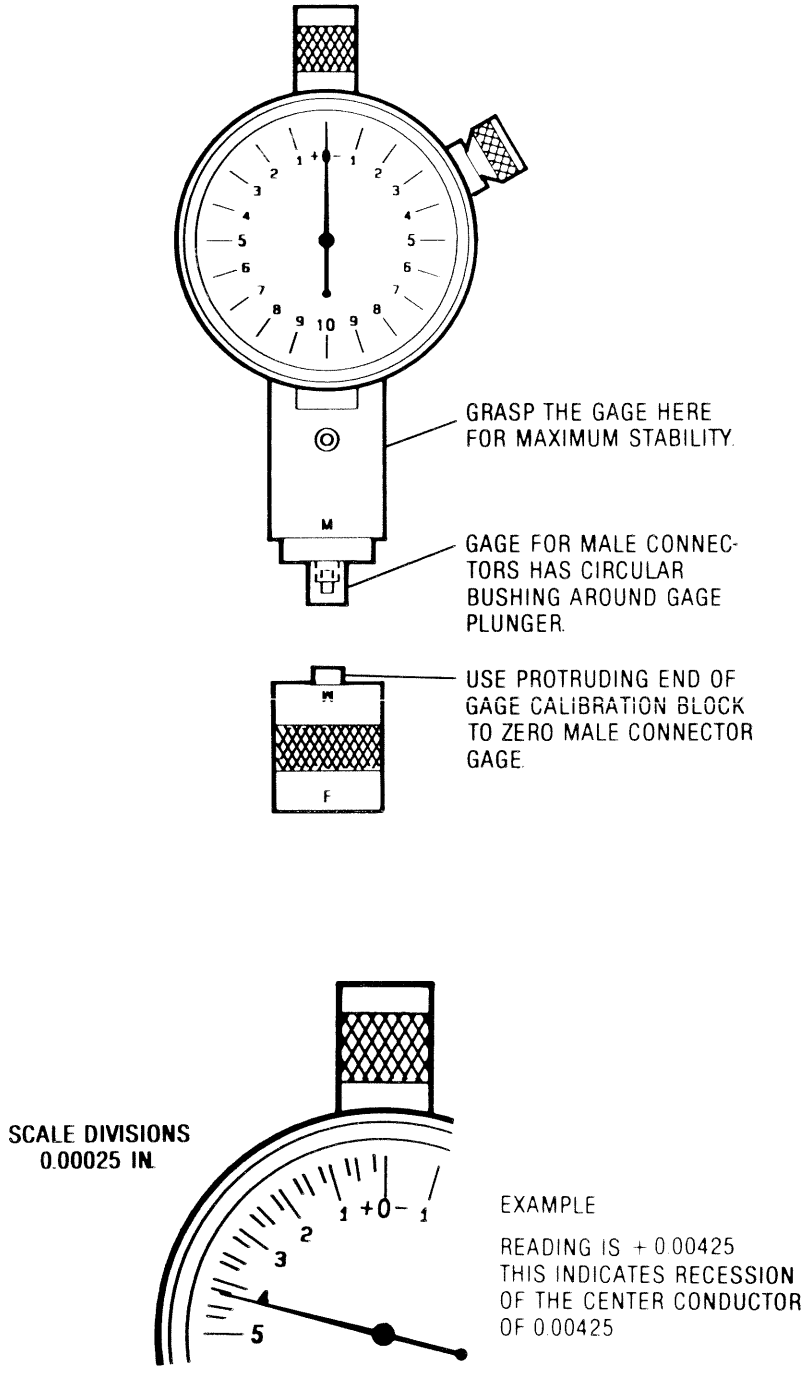



*Figure 8-4. Precision 3.5 mm (male) Connector Gage*

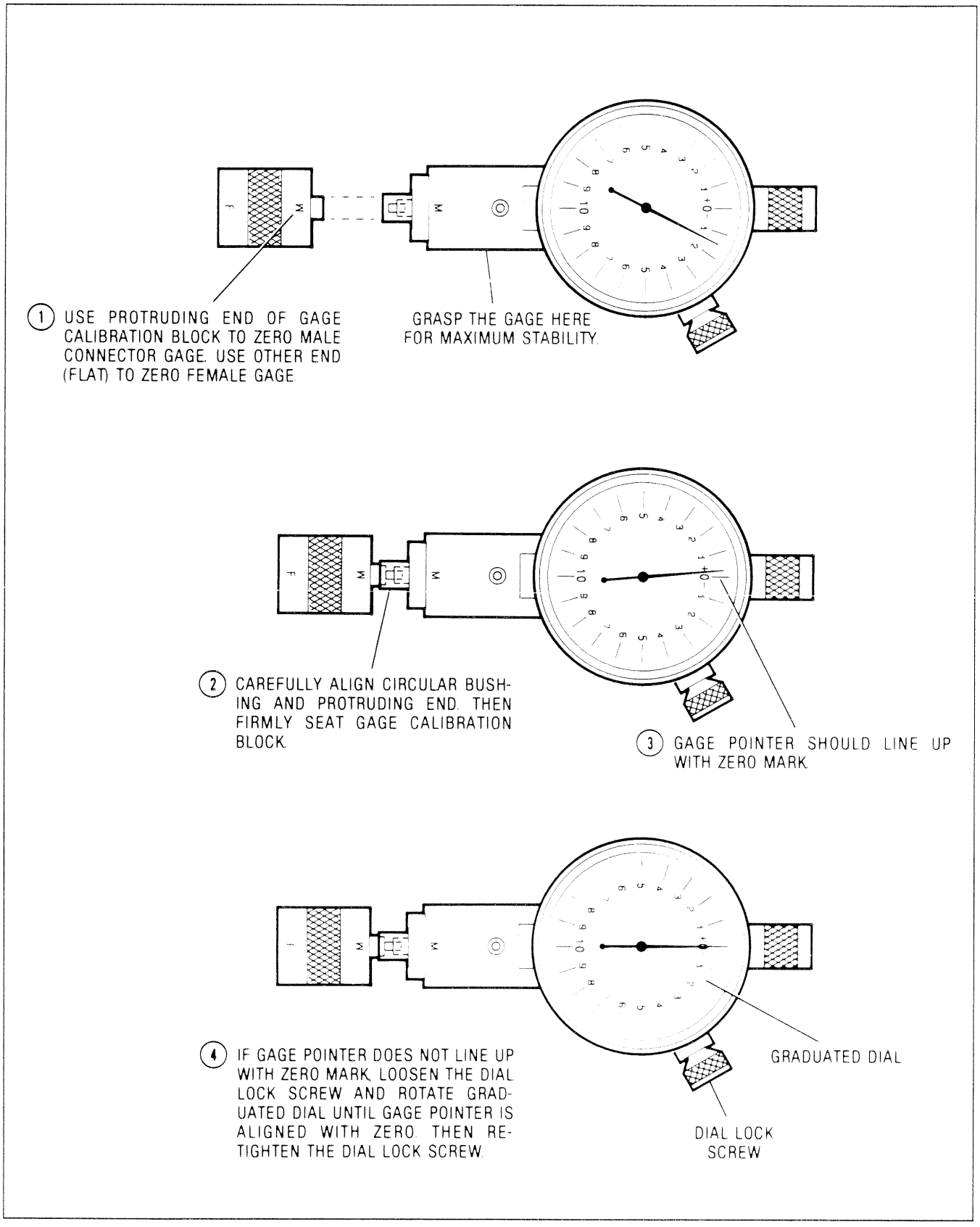



*Figure 8-5. Zeroing Precision 3.5 mm (male) Connector Gage*

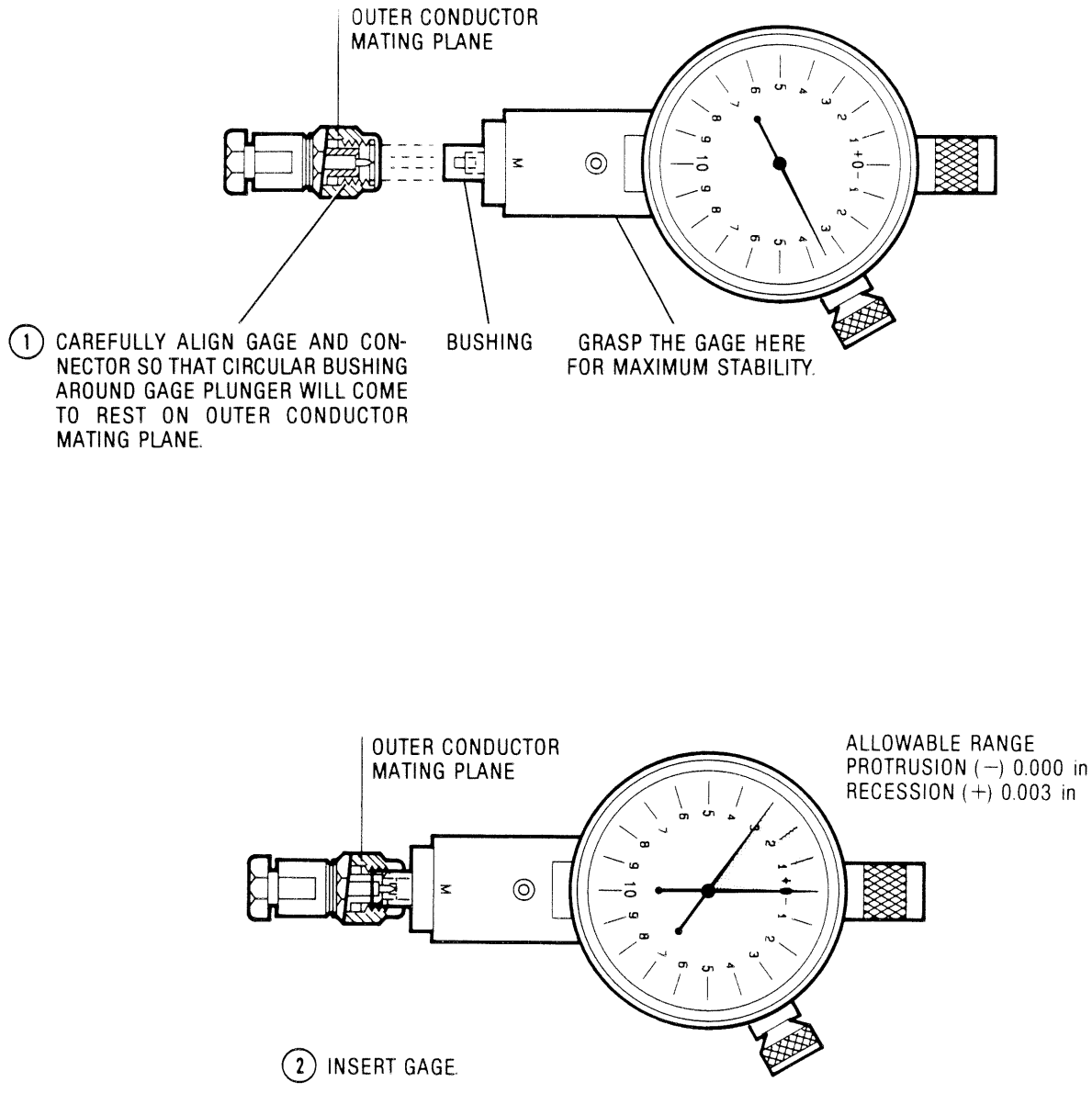



*Figure 8-6. Gaging Precision 3.5 mm (male) Connector*