

**TRANSMISSION/  
REFLECTION  
KIT**

**11652A**

**DIRECTIONAL  
BRIDGE**

**8721A**

PROPERTY OF  
CAL CENTER, INC.  
DO NOT SHIP

JUNE 1980



**HEWLETT  
PACKARD**

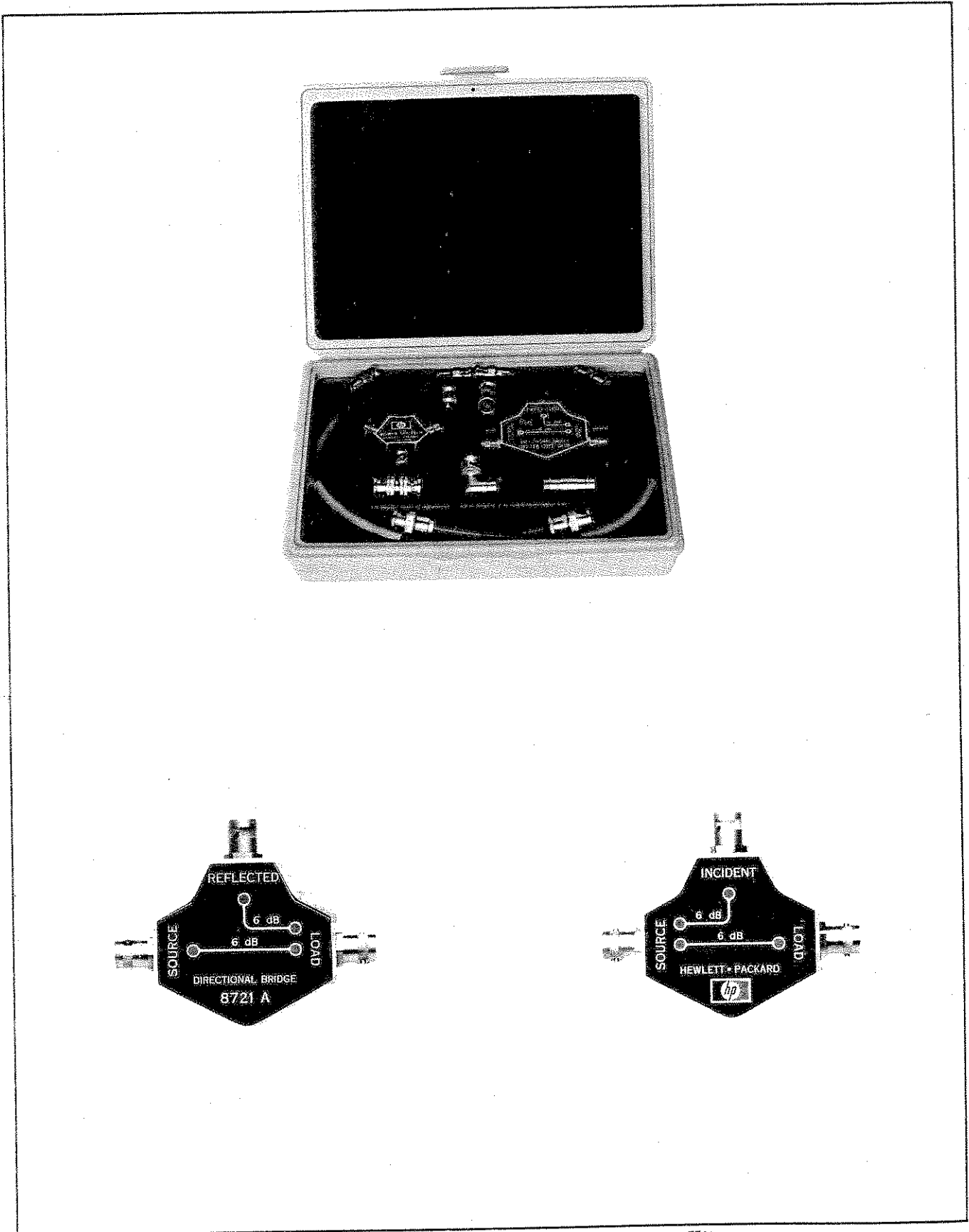


Figure 1. HP 11652A Transmission/Reflection Kit and HP 8721A Directional Bridge

Table 1. Contents of HP 11652A Transmission/Reflection Kit

Item Number	Qty.	HP Part No.	CD	Description
1	1	1250-0076	2	Conn Angle
2	1	1250-0080	8	Conn-RF Adptr
3	1	1250-0216	2	Conn-RF BNC
4	1	1250-0929	4	Conn-BNC Short
5	1	8721A		Directional Bridge
6	1	11652-60001	4	Precision Termination
7	2	11652-60002	5	Cable Assy, 1 ft.
8	1	11652-60003	6	Cable Assy, 2 ft.
9	1	11652-60004	7	Cable Assy, 3 ft. 1 in.
10	1	11652-60009	2	Power Splitter

## INTRODUCTION

The HP Model 11652A Transmission/Reflection Kit (see Figure 1) is used when characterizing 50-ohm RF networks from 0.1 to 110 MHz. Swept measurements may be made when the HP 11652A is used with the HP 8407A Network Analyzer (see Figures 4 and 5). Single frequency measurements may be made when using the HP 11652A with the HP 8405A Vector Voltmeter (see Figures 6 and 7).

The HP Model 8721A Directional Bridge, which is available separately or as part of the HP Model 11652A Transmission/Reflection Kit, is principally used to make reflection measurements. The HP 8721A is also very useful for power monitoring and closed-loop leveling applications.

## INITIAL INSPECTION

### Mechanical Check

If damage to the shipping carton is evident, ask that the carrier's agent be present when the instrument is unpacked. Inspect the parts for mechanical damage, such as scratches or dents. Also, check the cushioning material for signs of severe stress.

### Electrical Check

The electrical performance should be verified as soon as possible after receipt. Refer to the paragraph on MAINTENANCE.

## Claim for Damage

If any unit is mechanically damaged or fails to meet specifications upon receipt, notify the carrier and your nearest Hewlett-Packard office immediately (a list of regional offices is at the rear of this operating note). Retain the shipping carton and the padding for the carrier's inspection. The HP office will arrange for repair or replacement without waiting for the claim against the carrier to be settled.

## REPACKAGING FOR SHIPMENT

### Using Original Packaging

The same containers and materials used in factory packaging can be obtained through the HP offices near you (a list of regional offices is at the rear of this operating note).

If the Model 11652A or Model 8721A is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, and model or part number. Also mark the container FRAGILE to assure careful handling.

### Using Other Packaging

If it is desired to return a component without its case, the following general instructions should be used for repackaging with commercially-available materials:

a. Wrap the component in heavy paper or plastic. (If shipping to a Hewlett-Packard office attach a tag indicating the type of service required, return address, and model or part number.

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use enough shock-absorbing material (three to four inch layer) around all sides of the fixture to provide a firm cushion and prevent movement inside the container.

d. Seal the shipping carton securely.

e. Mark the shipping carton FRAGILE to assure careful handling.

### TRANSMISSION/REFLECTION KIT CONTENTS

Refer to Table 1 for a list of the components furnished in the HP Model 11652A Transmission/Reflection Kit.

### SPECIFICATIONS

Refer to Table 2 for the specifications and circuit representations of the components in the HP 11652A Kit.

### OPERATION

#### Reflection Measurements with the HP 8721A

The HP Model 8721A Directional Bridge (functionally similar to a directional coupler) is a valuable device in reflection measurements and power monitoring.

By measuring the reflected voltage and comparing this to the voltage incident upon a device under test, you can characterize the test device for its complex reflection coefficient ( $\bar{E}_{\text{REFLECTED}}/\bar{E}_{\text{INCIDENT}}$ ), complex impedance, VSWR, and return loss (-20 Log reflection coefficient).

To find the ratio of two voltages, measure the voltages present at a prescribed test channel and compare it to a reference voltage. To make a reflection measurement, use an instrument such as the HP 8405A Vector Voltmeter and connect the directional bridge as shown in Figure 2.

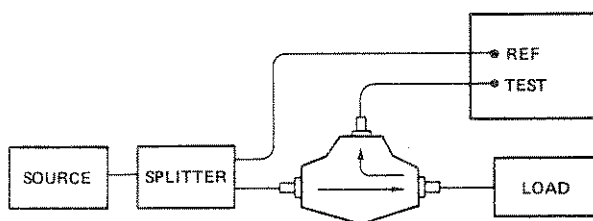


Figure 2. Reflection Measurements with the HP 8721A

#### Power Monitoring with the HP 8721A

Power monitoring can also be accomplished by the HP 8721A Directional Bridge. The 8721A can monitor the power being produced by a source while loaded and also monitor the power being delivered to a remote load. To use the directional bridge for this purpose, insert the bridge as shown in Figure 3. Since there is a 6 dB drop below the source power level in both arms of the bridge, the power meter measures the power delivered to the load.

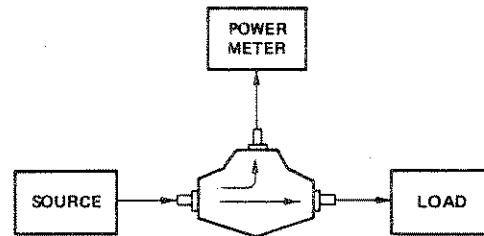


Figure 3. Power Monitoring with the HP 8721A

#### HP 11652A Kit Measurements with the HP 8407A

**Transmission.** (Refer also to AN 121-1 "Network Analysis with the HP 8407A 0.1 - 110 MHz.")

a. The HP 11652A is used as shown in Figure 4 when making a transmission measurement.

b. Power entering the power splitter is divided into two channels, reference and test. The HP 8407A measures the ratio of the test channel to the reference channel and measures the phase difference between the two channels.

c. The cable lengths specified are necessary in order to ensure matched electrical lengths between channels.

d. The general procedure for making a transmission measurement is the following (refer also to AN 121-1 "Network Analysis with the HP 8407A 0.1 - 110 MHz"):

1. Setup the equipment as shown in Figure 4.
2. Establish a 0 dB, zero degree reference level on the HP 8407A.
3. Insert the test network at point A and make the measurement.

**Reflection.** (Refer also to AN 121-1 "Network Analysis with the HP 8407A 0.1 - 110 MHz.")

a. The HP 11652A is used as shown in Figure 5 when measuring complex impedance, reflection coefficient or return loss (VSWR).

Table 2. Specifications

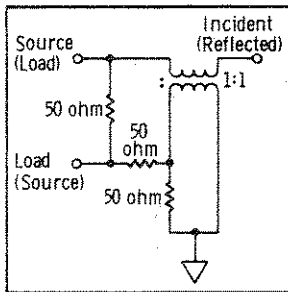
**COMPLETE KIT:**

**Plastic Case Dimensions:**  
 10 in. by 7-1/2 in. by 2-3/8 in.  
**Net Weight:** 2 lb, 3 oz.

**COMPONENTS:**

**Directional Bridge (HP 8721A)**

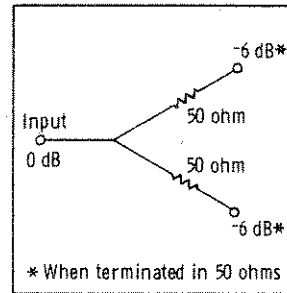
**Impedance:** 50 ohm nominal  
**Load Port VSWR:** <1.063 (30 dB return loss)  
**Directivity:** >40 dB (>30 dB, 0.1 - 1.0 MHz)  
**Coupling:** 6 dB nominal.  $\pm 0.6$  dB frequency variation when used with HP 8407A Network Analyzer.  
**Transmission:** 6 dB nominal insertion loss.  $\pm 0.2$  dB frequency variation when used with HP 8407A Network Analyzer.  
**Maximum input power:** +20 dBm  
**Connectors:** BNC female



*Circuit Equivalent of Directional Bridge*

**Power Splitter (11652-60009)**

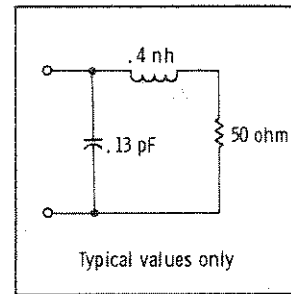
**Impedance:** 50 ohm nominal  
**Input VSWR:** 1.02 (>40 dB return loss)  
**Output VSWR:** 1.02 (>40 dB return loss), when used with the HP 8407A or HP 8405A  
**Connectors:** BNC female



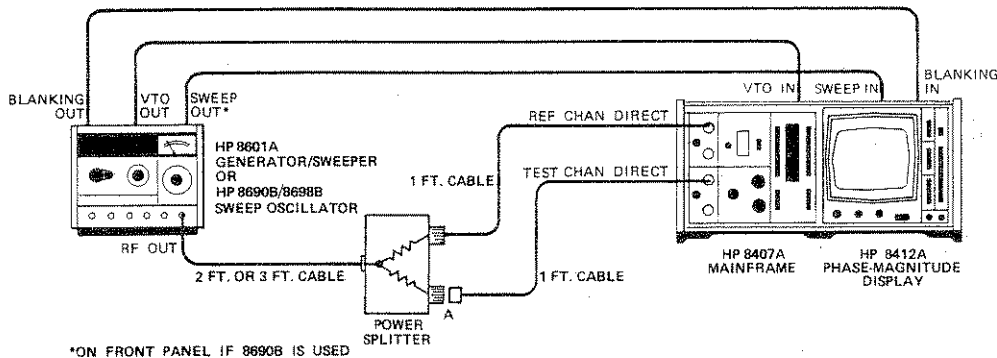
*Circuit Equivalent of Power Splitter*

**Precision Termination (11652-60001)**

**Impedance:** 50 ohm nominal  
**VSWR:** 1.014 (>43 dB return loss)  
**Connector:** BNC male



*Circuit Equivalent of Precision Termination*



\*ON FRONT PANEL IF 8690B IS USED

b. Power from the sweeper is again divided into a reference and a test channel. This time, however, the signal entering the test channel is the reflected voltage from the input to a network, not the transmitted voltage. The HP 8407A takes the ratio of  $E_{REFLECTED}/E_{INCIDENT}$ , which is defined as reflection coefficient.

c. The cable lengths specified are necessary to ensure proper phase matching of the two channels.

d. The general procedure for making a reflection measurement is the following (refer also to AN 121-1 "Network Analysis with the HP 8407A 0.1 - 110 MHz"):

1. Setup the equipment as shown in Figure 5.
2. Place a short circuit (or open circuit) at the LOAD port of the directional bridge. Establish a 0 dB, 180 degree (or 0 dB, zero degree) reference level on the HP 8407A Phase-Magnitude Display or the HP 8414A Polar Display.
3. Replace the short with the terminated network and make the measurement.

### HP 11652A Kit Measurements with the HP 8405A Vector Voltmeter, 0.1 to 110 MHz

The HP 11652A can be used with the HP 8405A Vector Voltmeter to make CW transmission and reflection measurements. The procedure is outlined below. (Refer also to the HP 8405A Operating and Service Manual.)

### Transmission

- a. Setup the equipment as shown in Figure 6.
- b. Establish a 0 dB, zero degree reference level with the CHANNEL switch set to B. (Set the amplitude with the oscillator attenuator and the phase with the HP 8405A PHASE ZERO.)
- c. Insert the test device at point A in Figure 6 and make the measurement.

### Reflection

- a. Setup the equipment as shown in Figure 7. Be sure to use the cable lengths specified (from the HP 11652A) in order to ensure proper phase matching between channels A and B.
- b. Place a short circuit at the LOAD port of the directional bridge. Establish a 0 dB, 180 degree reference level with the CHANNEL switch set to B. (Use the oscillator output attenuator to set the amplitude and the HP 8405A PHASE ZERO to set the phase).
- c. Replace the short (or open) with the terminated network and read return loss in dB, degrees.

### PRECAUTIONS

Do not misplace the cables supplied with the kit. They have been carefully chosen for proper electrical length and are triple-shielded for isolation. Be sure to use proper lengths of cable during setup (refer to Figures 4 through 7).

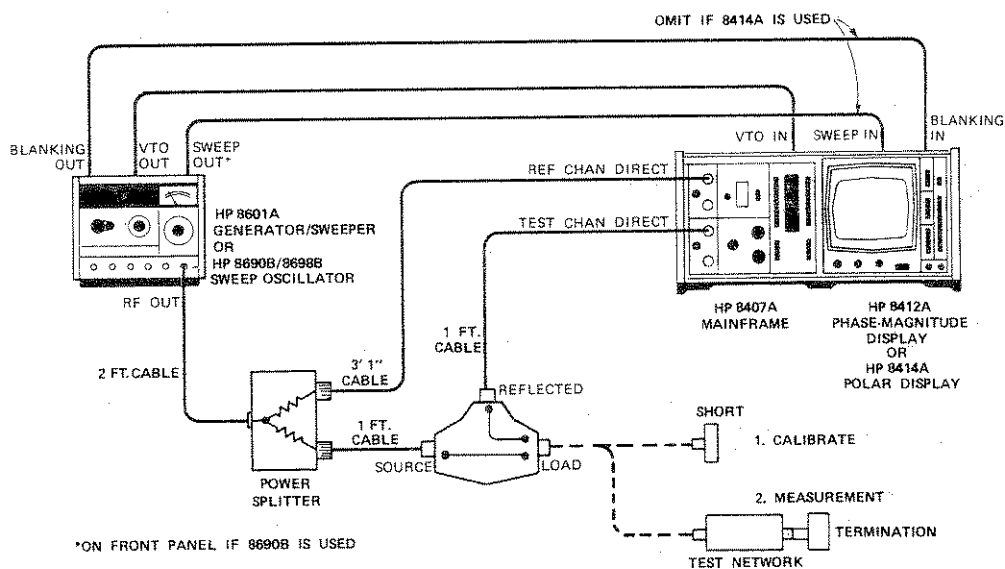


Figure 5. Basic Setup for Reflection Measurements

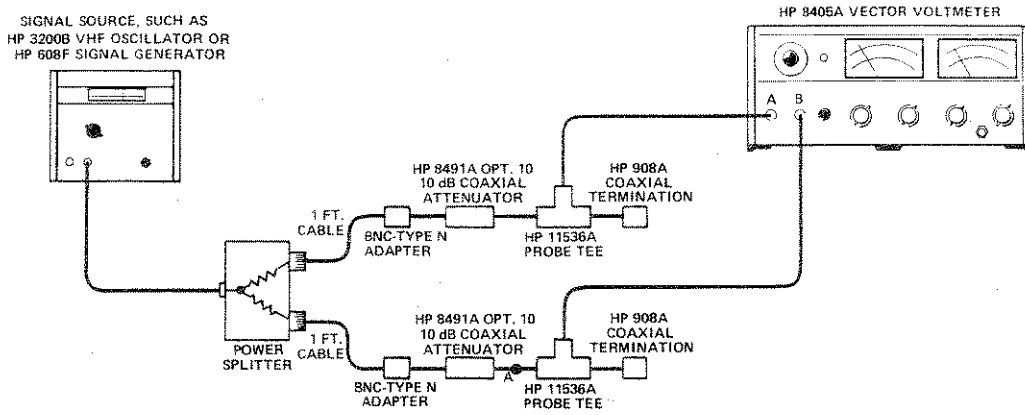


Figure 6. Setup for Making Transmission Measurements with HP 8405A

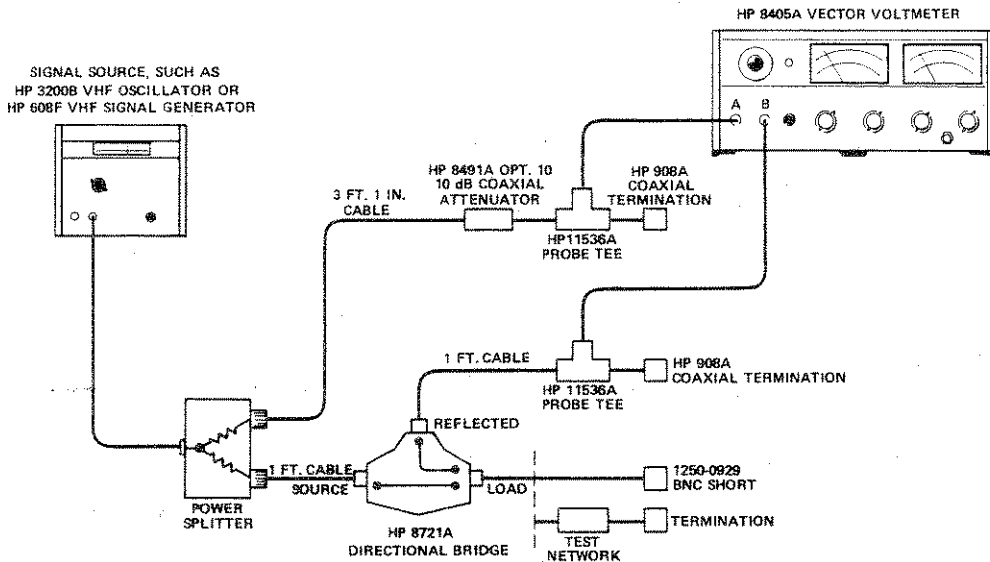


Figure 7. Setup for Making Reflection Measurements with HP 8405A

Be sure the HP 8721A Directional Bridge is being used as a reverse coupler, not as a forward coupler during a reflection measurement (see Figure 5). This ensures that only the reflected signal will enter the test channel ( $E_{REFLECTED}$ ).

**MAINTENANCE**

Specifications for the Directional Bridge, Power Splitter, and Precision Termination are given in Table 2. However, the individual specifications for these components are of such a tolerance that the ambiguities encountered in the directivity, port VSWR, and Input/Output VSWR measurement setups impair the checking of each of the

component's specifications. Verification of the individual specifications can be accomplished by using an 8507B Automatic Network Analyzer with an Accuracy Improved Measurement (AIM) Program. This system will remove the vector mismatch uncertainties from the measurements.

**REPLACEABLE PARTS**

The HP 8721A Directional Bridge, the Power Splitter and the Precision Termination are not field repairable. If any of them do not meet the specifications in Table 2, return the component to the HP Service Center nearest you.

## CERTIFICATION

*The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.*

## WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

## HEWLETT-PACKARD SALES AND SERVICE OFFICES

To obtain servicing information and order replacement parts, contact the nearest Hewlett-Packard Sales and Service Office in HP Catalog, or contact the nearest regional office.

### IN THE UNITED STATES:

#### CALIFORNIA

3939 Lankershim Blvd.  
North Hollywood 91604

#### GEORGIA

P.O. Box 28234  
450 Interstate North  
Atlanta 30328

#### ILLINOIS

5500 Howard Street  
Skokie 60076

#### NEW JERSEY

W. 120 Century Road  
Paramus 07652

### IN CANADA:

#### QUEBEC

Hewlett-Packard (Canada) Ltd.  
275 Hymus Blvd.  
Pointe Claire

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#### SWITZERLAND

HEWPAK, S.A.  
1217 Meyrin  
Geneva

### IN AFRICA, ASIA, AND AUSTRALIA:

Hewlett-Packard Export Marketing  
3200 Hillview Ave.  
Palo Alto, California 94304

### IN CENTRAL AND SOUTH AMERICA:

Hewlett-Packard Inter-Americas  
3200 Hillview Ave.  
Palo Alto, California 94304



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