

# **Operating and Service Manual**

**Agilent Technologies  
11652A Transmission/Reflection Kit**

**Agilent Technologies  
8721A  
Directional Bridge**

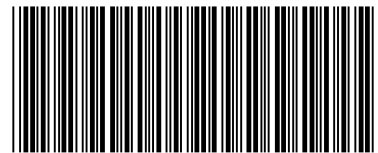


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11652-90002

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**OPERATING AND SERVICE MANUAL**

**HP 11652A  
TRANSMISSION/  
REFLECTION KIT**

**HP 8721A  
DIRECTIONAL  
BRIDGE**



**HEWLETT  
PACKARD**

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**HP 11652A  
TRANSMISSION/REFLECTION KIT**

**HP 8721A  
DIRECTIONAL BRIDGE**

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MANUAL PART NO. 11652-90002

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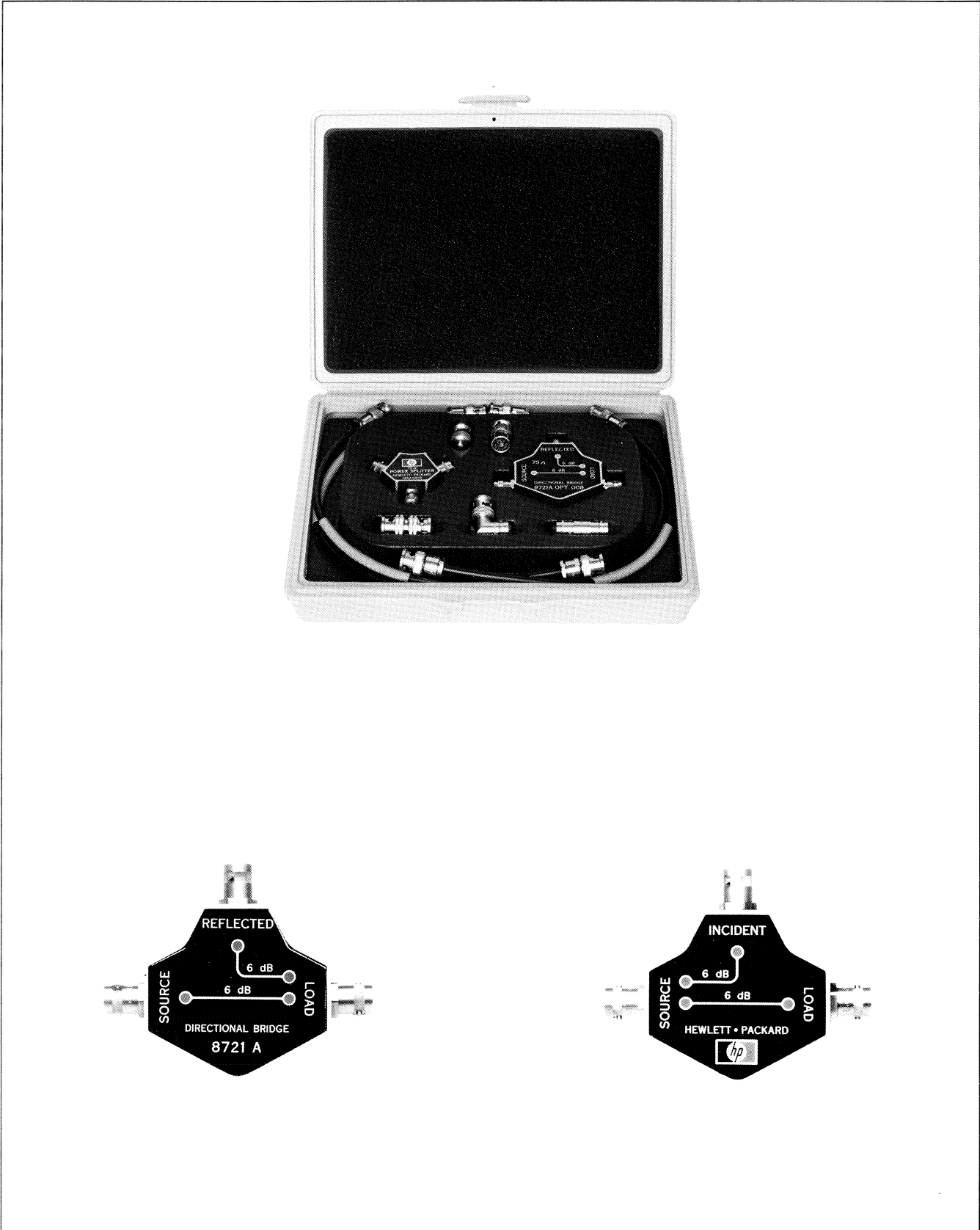


Figure 1. HP 11652A Transmission/Reflection Kit and HP 8721A Directional Bridge

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

Qty.	HP Part Number	Description
1	1250-0076	Conn Angle
1	1250-0080	Conn-RF Adptr
1	1250-0216	Conn-RF BNC
1	1250-0929	Conn-BNC Short
1	8721A	Directional Bridge
1	11652-60001	Precision Termination
2	11652-60002	Cable Assy, 1 ft.
1	11652-60003	Cable Assy, 2 ft.
1	11652-60004	Cable Assy, 3 ft. 1 in.
1	11652-60009	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 HP 11652A or HP 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:

1. 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.
2. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.
3. 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.
4. Seal the shipping carton securely.
5. 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.

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 (Reflection Measurements)\*:** <1.063 (30 dB return loss) 0.1 to 110 MHz.

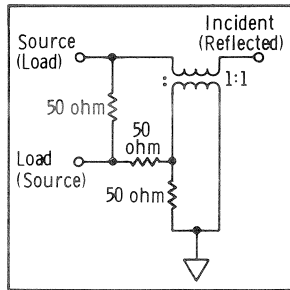
**Directivity:** >40 dB (>30 dB, 0.1 – 1.0 MHz)

**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*

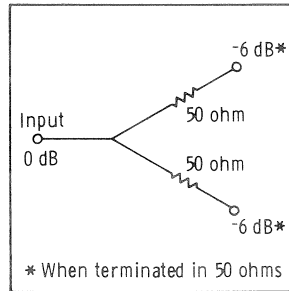
**Power Splitter (11652-60009)**

**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



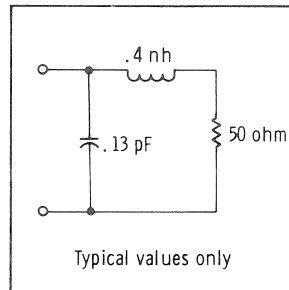
*Circuit Equivalent of Power Splitter*

**Precision Termination (11652-60001)**

**Impedance:** 50 ohm nominal

**VSWR:** 1.014 (>43 dB return loss)

**Connector:** BNC male



*Circuit Equivalent of Precision Termination*

\*NOTE: Load Port VSWR (Power Monitoring) is not specified.

# OPERATION

## REFLECTION MEASUREMENTS WITH THE HP 8721A

The HP 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 ( $E_{\text{REFLECTED}}/E_{\text{INCIDENT}}$ ), complex impedance, VSWR, and return loss ( $-20 \text{ Log reflection coefficient}$ ).

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.

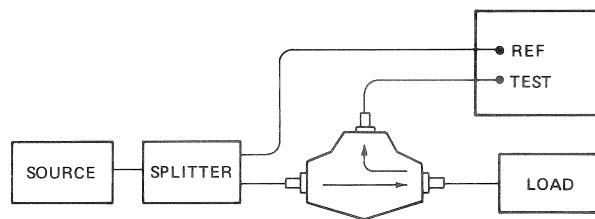


Figure 2. Reflection Measurements with the HP 8721A

## POWER MONITORING WITH THE HP 8721A

Power monitoring can also be accomplished by the HP 8721A Directional Bridge. The HP 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.

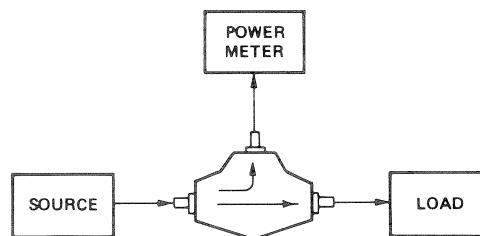


Figure 3. Power Monitoring with the HP 8721A

## HP 11652A KIT MEASUREMENTS WITH THE HP 8407A

### 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).

### Transmission Measurements

When making transmission measurements, keep the following points in mind (Refer also to AN 121-1 "Network Analysis with the HP 8407A 0.1 – 110 MHz."):

- The HP 11652A is used as shown in Figure 4 when making a transmission measurement.
- 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.
- The cable lengths specified are necessary in order to ensure matched electrical lengths between channels.
- The general procedure for making a transmission measurement is the following:

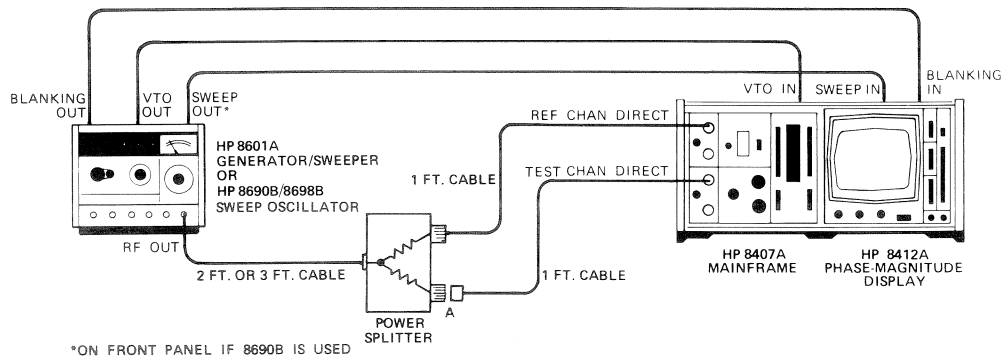


Figure 4. Basic Setup for Transmission Measurements

### Procedure

1. Set up 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 Measurements

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 ( $E_{\text{REFLECTED}}$ )

When making reflection measurements keep the following points in mind (Refer also to AN121-1 "Network Analysis with the HP 8407A 0.1 – 110 MHz."):

- The HP 11652A is used as shown in Figure 5 when measuring complex impedance, reflection coefficient or return loss (VSWR).
- 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  $E_{\text{REFLECTED}}/E_{\text{INCIDENT}}$  which is defined as reflection coefficient.
- The cable lengths specified are necessary to ensure proper phase matching of the two channels.
- The general procedure for making a reflection measurement is the following:

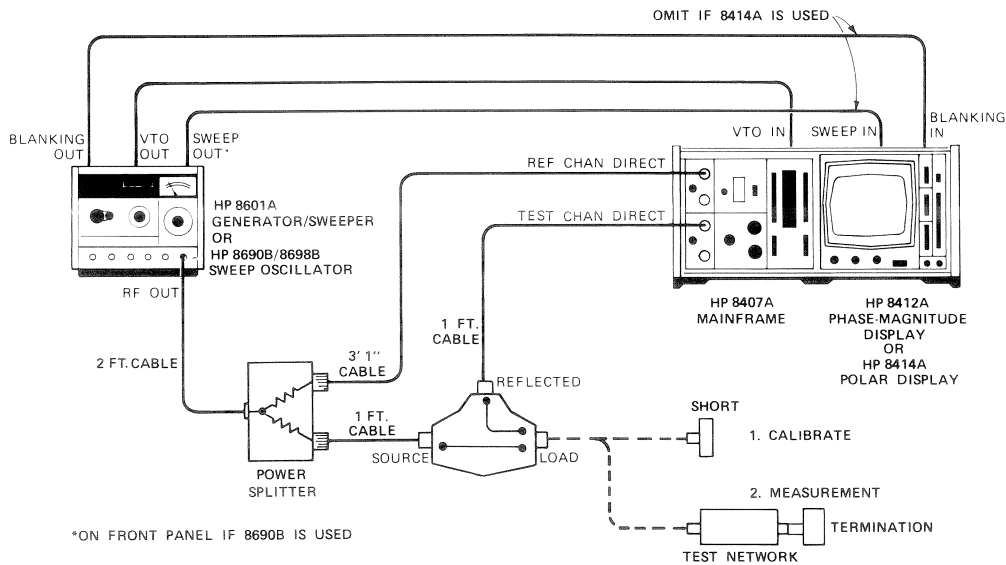


Figure 5. Basic Setup for Reflection Measurements

## Procedure

1. Set up 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 Measurement Procedure

1. Set up the equipment as shown in Figure 6.
2. 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.)
3. Insert the test device at point A in Figure 6 and make the measurement.

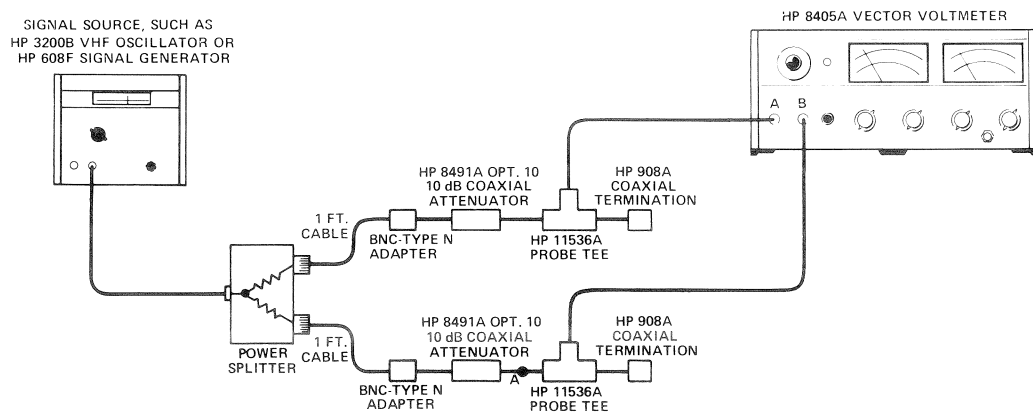


Figure 6. Setup for Making Transmission Measurements with HP 8405A

## Reflection Measurement Procedure

1. 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.
2. 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).
3. Replace the short (or open) with the terminated network and read return loss in dB, degrees.

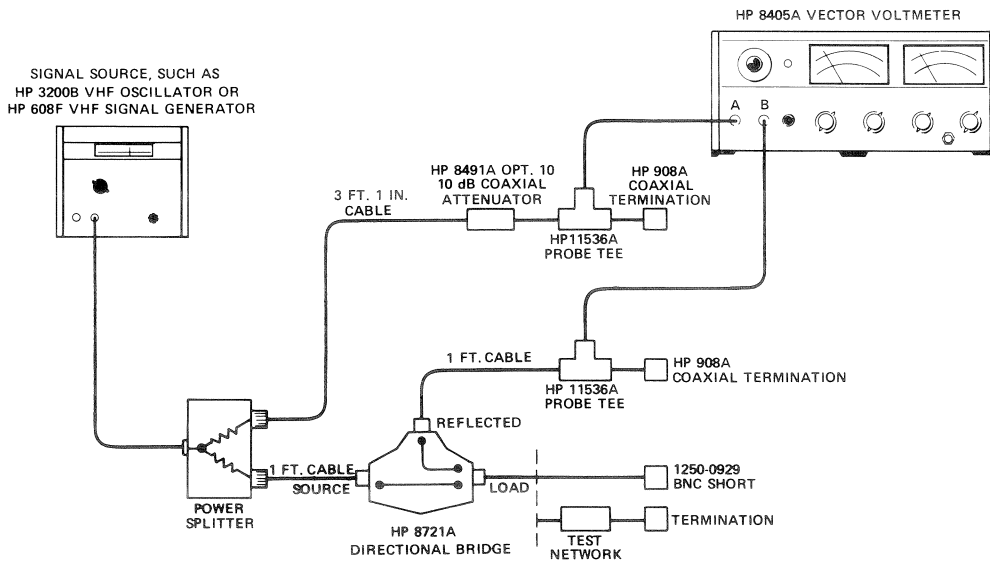


Figure 7. Setup for Making Reflection Measurements with HP 8405A

## 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 HP 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.

# Contacting Agilent

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