Operating and Service Manual

Agilent Technologies
11667C Power Splitter

Serial Numbers

This manual applies directly to Agilent 11667C power splitters with a serial number of 00101 and above.

For additional information concerning serial numbers, refer to INSTRUMENTS COVERED BY MANUAL in the General Information Section of this manual.

Agilent Technologies

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Hewlett-Packard to Agilent Technologies Transition

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. To reduce potential confusion, the only change to product numbers and names has been in the company name prefix: the product number/name was HP 11612A, and now the current name/number is now Agilent 11612A.

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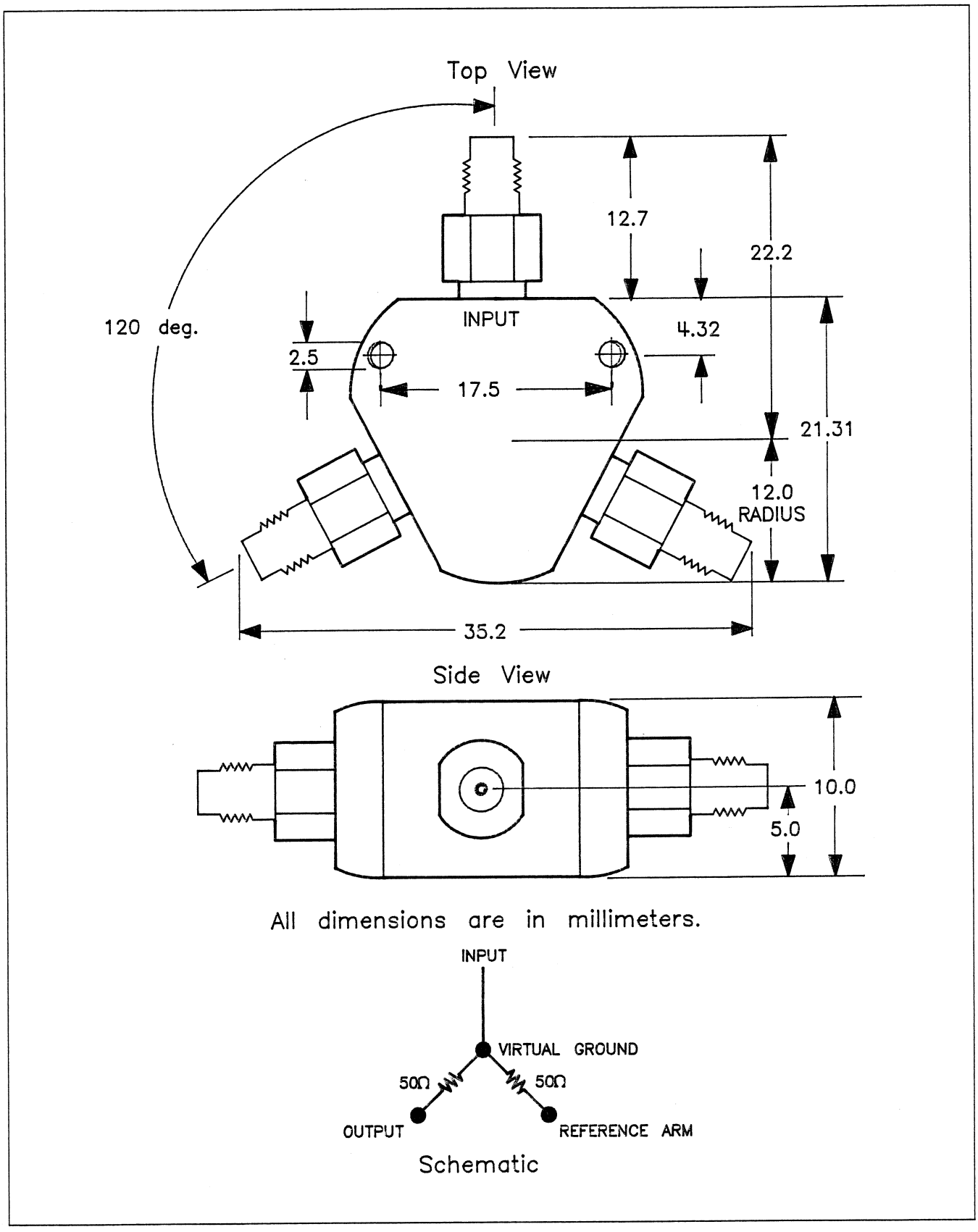

Figure 1-1. HP 11667C Schematic and Dimensions

Section 1. General Information

INTRODUCTION

This manual contains operating and service information for the HP 11667C power splitter. The front cover of this manual shows the HP 11667C.

On the title page of this manual is a microfiche part number. Use this number to order microfilm transparencies of this manual. The microfiche package includes the latest manual changes supplement and relevant service notes.

SPECIFICATIONS

Table 1-1 lists performance specifications. The instrument is tested against these performance standards. Table 1-2 provides supplemental (non-warranted) characteristics of the HP 11667C. These are also denoted as *typical*, *nominal*, or *approximate*.

INSTRUMENTS COVERED BY MANUAL

Each HP 11667C has a unique serial number. The content of this manual applies directly to power splitters with serial number 00101 and above.

An HP 11667C manufactured after the printing of this manual may be different from those documented in this manual. The manual for that instrument is supplied with a manual changes supplement that documents the differences.

In addition to change information, the supplement may contain information that applies to all instruments, regardless of serial number. To keep this manual as current as possible, periodically request the latest manual changes supplement. The supplement for this manual is keyed to it's print date and part number, which appear on the title page. Copies of the supplement are available from Hewlett-Packard.

Table 1-1. HP 11667C Specifications

Frequency Range: DC to 50 GHz.

Maximum Input Power: +27 dBm.

Connectors: 2.4 mm female on all ports.

ELECTRICAL SPECIFICATIONS

Description	Frequency			
	DC to 18 GHz	**DC to 26.5 GHz**	**DC to 40 GHz**	**DC to 50 GHz**
Input Return Loss (SWR):	20 dB (1.22)	16 dB (1.38)	14 dB (1.50)	12 dB (1.65)
Equivalent Output SWR (leveling or ratio measurements):	1.29	1.29	1.50	1.65
Output Tracking (between output arms):	0.30 dB	0.35 dB	0.40 dB	0.40 dB

MECHANICAL SPECIFICATIONS

Pin Depth:	0.000 to 0.076 mm (0.000 to 0.003 in)[1]
Dimensions:	35.2 mm H x 35.2 mm W x 10 mm D (1.4 x 1.4 x 0.4 in).
Weight:	Net 0.06 kg (0.13 lb). Shipping 0.14 kg (0.3 lb).

1. Allowable recession of the end of the female center pin behind the outer conductor mating plane.

Table 1-2. HP 11667C Supplemental Characteristics

Description	DC to 18 GHz	DC to 26.5 GHz	DC to 40 GHz	DC to 50 GHz
Phase Tracking (between output arms), typically:	2.0°	2.5°	3.0°	3.0°
Insertion Loss, typically:	6.0 dB	7.0 dB	8.0 dB	8.5 dB

DESCRIPTION

The HP 11667C is a two-resistor power splitter used in network analysis where one output arm is used for leveling or to supply a reference signal for ratio measurements.

In a network analyzer system, the node at the fork of the power splitter is held constant by the leveling action of the network analyzer reference channel (see Figure 1-1). Because a virtual ground is present at the node, the resistance in each output arm is 50 ohms, giving a 50 ohm matched output impedance.

The ratio between the two power splitter arms is not affected by source power level variation. Variations in power level appear in both arms equally and simultaneously.

EQUIPMENT AVAILABLE

The power splitter's 2.4 mm connectors are compatible with all other 2.4 mm connectors. Hewlett-Packard also produces adapters from 2.4 mm to other coaxial connector types. Refer to *2.4 mm ADAPTERS and CALIBRATION ACCESSORIES*, HP Part Number 11900-90003, for a list of these products and their specifications.

Section 2. Installation

INITIAL INSPECTION

If the shipping container or cushioning material is damaged, do not discard them until the power splitter has been checked mechanically and electrically.

Inspect the power splitter for mechanical damage.

Electrically test the power splitter. Refer to *Performance Tests*, in this manual.

Notify your nearest Hewlett-Packard office if there is mechanical damage or defect, or if the power splitter does not pass electrical tests. Notify the carrier if the shipping container is damaged or 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.

PREPARATION FOR USE

CAUTION

Maximum input power to the HP 11667C is +27 dBm. Exceeding this limit will damage the resistor network and void the warranty.

Mating Connectors

The accuracy and repeatability of each measurement depends on the proper care and use of the 2.4 mm connectors. Visually inspect and clean connectors before every connection. Measure mechanical tolerances (pin depth) with a precision gage prior to the connector's first use, and periodically thereafter. Torque connections to 8 in-lb (90 N-cm). Information concerning the proper maintenance, inspection, and gaging of connectors is provided in the Hewlett-Packard *Microwave Connector Care* manual, HP Part Number 08510-90064.

Environment

Operate the power splitter only in environments within the limits listed. Storage and shipment environments must meet the conditions shown.

	Operating	Storage and Shipment
Temperature:	0° to +55°C (+32° to +131°F)	−40° to +75°C (−40° to +167°F)
Humidity:	Up to 95% relative	Up to 95% relative
Altitude:	Up to 4,572 metres (15,000 feet)	Up to 7,620 metres (25,000 feet)

Returning The Power Splitter For Service

If you return the instrument to Hewlett-Packard, follow the *Packaging* instructions in this manual. Attach a tag to the instrument indicating the model and serial number, type of service required, return address, and technical contact person with complete phone number.

Packaging

Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If you choose to package the instrument with commercially available materials, follow these instructions:

1. Place the power splitter completely inside an anti-static bag.
2. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.
3. Use a 7 to 10 cm (3 to 4 in) layer of shock-absorbing material around all sides of the instrument to provide a firm cushion and prevent movement inside the container.
4. Seal the shipping container securely.
5. Mark the shipping container **FRAGILE**.

Section 3. Operation

OPERATOR'S CHECK

The operator's check is a quick evaluation of the power splitter's operation. Perform this procedure to verify that the power splitter is functioning.

1. Visually inspect the input port and both output ports for defect or damage. Mating defective or unclean connectors will degrade the measurement and damage the mating connector.

2. Perform the *Output Tracking* test from 0.01 to 40 GHz (or over the frequency range you will be using.) Refer to *Performance Tests* for this procedure.

If the power splitter fails either check, refer to *Troubleshooting* in the *Service* section or contact Hewlett-Packard for repair or replacement.

Section 4. Performance Tests

INPUT RETURN LOSS

Specifications

Refer to Table 1-1, HP 11667C Specifications. Specifications apply at 25° ± 5°C.

Description

Input return loss is a measurement of the input port match of the power splitter. The reflected RF signal is measured at the input port with both output ports terminated in 50 ohms.

Two test setups are required to measure the input return loss of the HP 11667C. The test system for 0.01 to 40 GHz uses the HP 85027D directional bridge. The second, for 40 to 50 GHz, uses a waveguide system.

To ensure that the power splitter meets the input return loss specifications, the measured values must be greater than or equal to the specifications plus the measurement uncertainty. The *Performance Test Record*, Table 4-1, lists the input return loss specifications and the approximate measurement uncertainty for the HP 11667C power splitter.

Equipment

For 0.01 to 40 GHz

Scalar Network Analyzer	HP 8757A
Sweep Oscillator	HP 8350B
RF Plug-in	HP 83597A
Directional Bridge	HP 85027D
Open PSC-2.4 (f)	HP 85141B*
Short PSC-2.4 (f)	HP 85140B*
Termination 50 ohm (m) (2 required)	HP 85138A

Additional Equipment Required for 40 to 50 GHz

RF Plug-in	HP 83550A
Millimeter-Wave Source Module	HP 83555A
Directional Coupler	HP Q752C
Detector	HP 85025D
Adapter Waveguide to 2.4 mm (f)	HP Q281A
Adapter Waveguide to 2.4 mm (m)	HP Q281B

*Included with the HP 85027D.

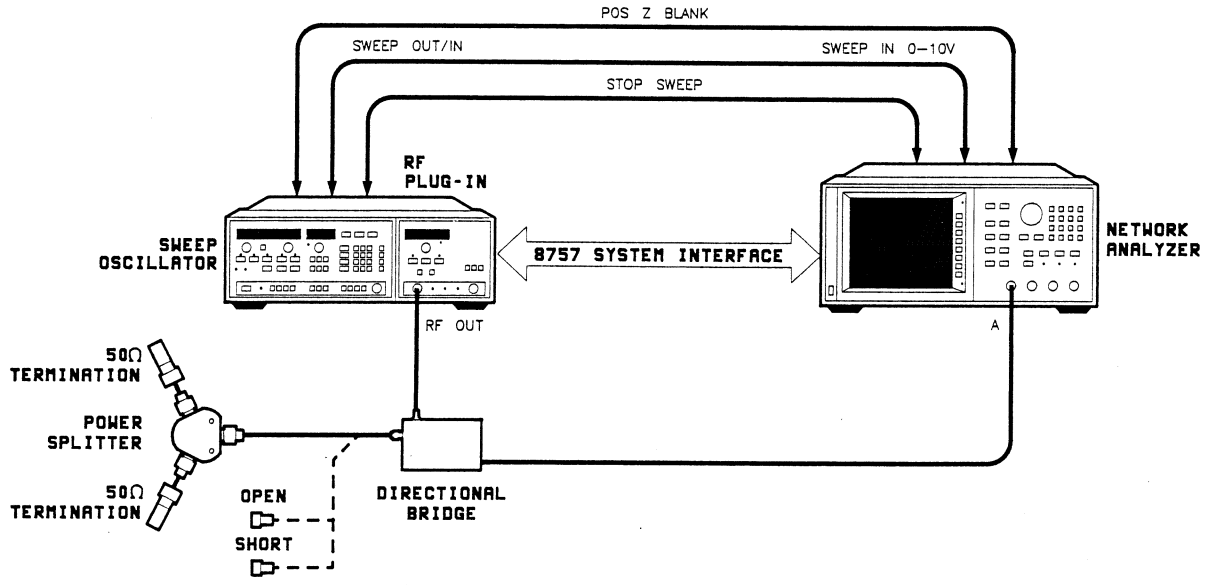

Figure 4-1. Input Return Loss Test Setup 0.01 to 40 GHz

Procedure – 0.01 to 40 GHz

1. Connect the equipment as shown in Figure 4-1, with no connection to the bridge test port. Allow 30 minutes warm-up.

2. On the analyzer, press **[PRESET]**. Both the source and analyzer will reset.

3. Set up the analyzer. Press ***[CHAN 2 OFF]*** **[REF]** ***[REF POSN]***. Use the step keys to move the reference position to center screen.

   Press **[SCALE]** ***[AUTO SCALE]***.

4. Calibrate the analyzer. Press **[CAL]** ***[SHORT/OPEN]*** and connect the short to the bridge test port.

   Press ***[STORE SHORT]***. Remove the short and replace with the open.

   Press ***[STORE OPEN]*** and remove the open. The CRT will display:
   SHORT/OPEN CAL SAVED IN CH 1 MEM.

   Press **[DISPLAY]** ***[MEAS-MEM]*** to normalize the measurement.

5. Connect a 50 ohm termination to each of the power splitter output ports, then connect the power splitter to be tested to the test port of the bridge.

6. Press **[CURSOR]**. Turn the analyzer's front panel knob to read the worst case return loss (highest value) between each frequency range listed in the performance specifications.

   Enter the measured value on the *Performance Test Record*.

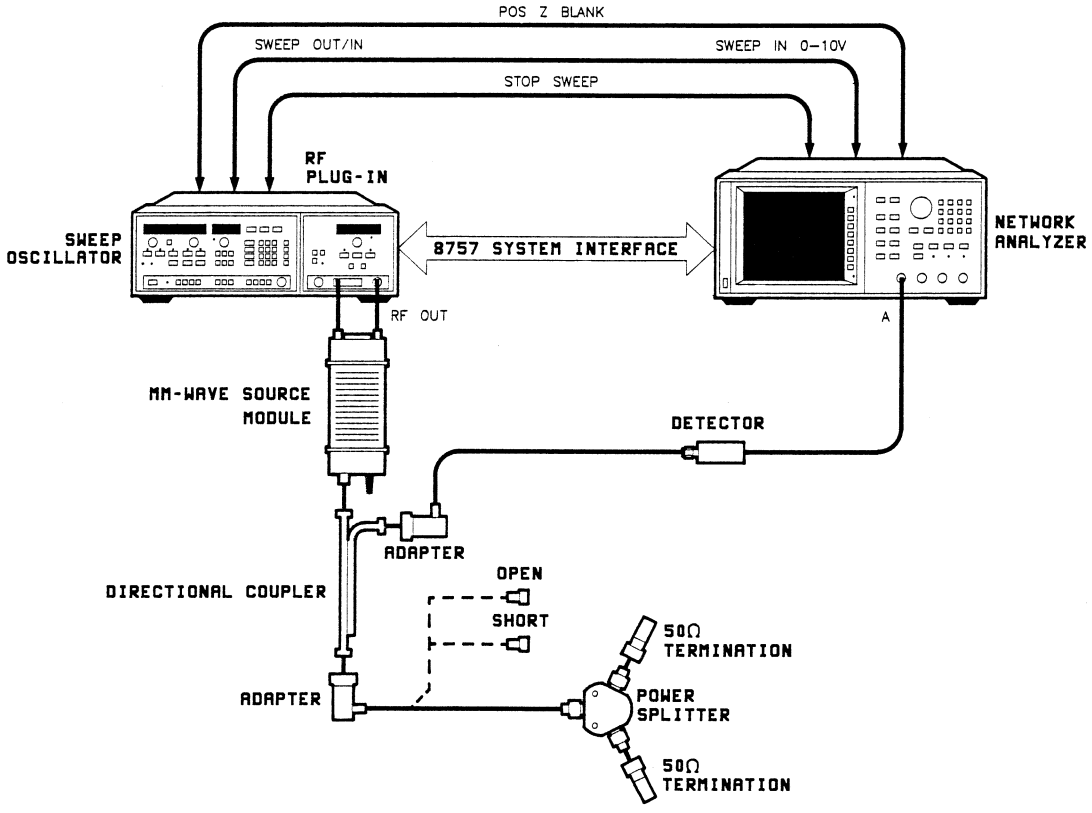

Figure 4-2. Input Return Loss Test Setup 40 to 50 GHz

Procedure – 40 to 50 GHz

1. Set up the equipment as shown in Figure 4-2 with nothing connected to the adapted output of the coupler. Allow 30 minutes warm-up.

2. Set up the analyzer. Press **[PRESET]** ***[CHAN 2 OFF]*** **[REF]** ***[REF POSN]***. Set the reference position to center screen if it is not already there.

   Press **[SCALE]** ***[AUTO SCALE]***.

3. Calibrate the analyzer. Press **[CAL]** ***[SHORT/OPEN]*** and connect the short to the adapted output of the coupler.

   Press ***[STORE SHORT]***. Remove the short and replace it with the open.

   Select ***[STORE OPEN]*** and remove the open. The CRT will display:
   SHORT/OPEN CAL SAVED IN CH 1 MEM.

   Press **[DISPLAY]** ***[MEAS-MEM]***.

4. Connect a 50 ohm termination to each of the power splitter output ports, then connect the power splitter to be tested to the adapted output of the coupler.

5. Press **[CURSOR]**. Turn the analyzer's front panel knob to read the worst case return loss (highest value) between 40 and 50 GHz.

   Enter the measured value on the *Performance Test Record*.

IF THE INSTRUMENT FAILS THIS TEST

If the instrument fails this test, refer to *Troubleshooting*.

OUTPUT TRACKING

Specifications

Refer to Table 1-1, HP 11667C Specifications. Specifications apply at 25° ±5°C.

Description

Output tracking compares the frequency response of one output port to the other output port. A swept measurement is stored from the first output port and compared to the measurement of the other output port. Output tracking is measured as the maximum peak-to-peak variation.

Two tests are required to cover the frequency range of the power splitter. The first tests from 0.01 to 40 GHz. The second tests from 40 to 50 GHz.

Equipment

For 0.01 to 40 GHz

Scalar Network Analyzer	HP 8757A
Sweep Oscillator	HP 8350B
RF Plug-in	HP 83597A
Detector	HP 85025D
Termination 50 ohm (m)	HP 85138A

Additional Equipment Required For 40 to 50 GHz

RF Plug-in	HP 83550A
Millimeter-Wave Source Module	HP 83555A
Adapter Waveguide to 2.4 mm (m)	HP Q281B

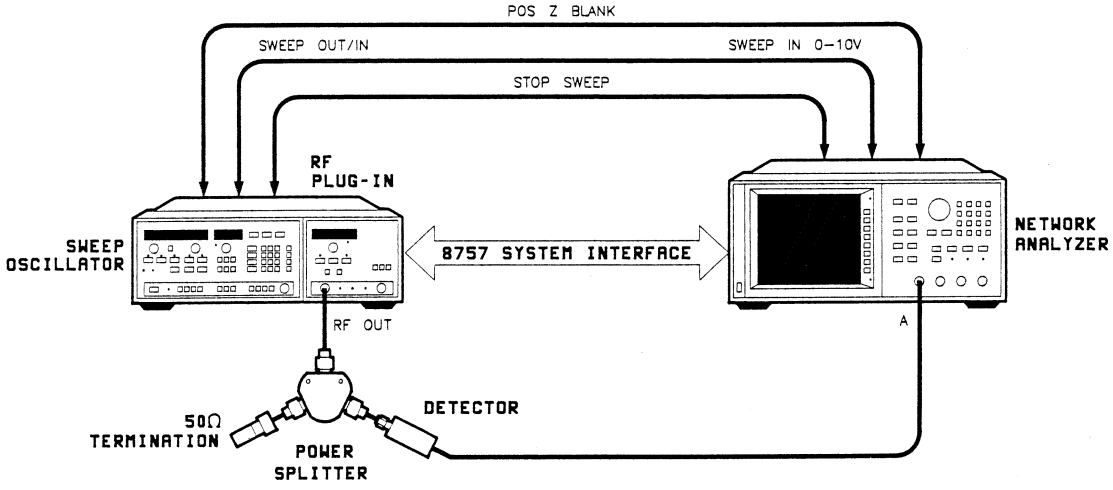

Figure 4-3. Output Tracking Test Setup .01 to 40 GHz

Procedure — 0.01 to 40 GHz

1. Connect the equipment as shown in Figure 4-3. Allow 30 minutes warm-up.
2. On the analyzer, press **[PRESET]**. Both the source and analyzer will reset.
3. Set up the analyzer. Press ***[CHAN 2 OFF]*** **[REF]** ***[REF POSN]***. Use the step keys to set the reference at center screen, if it is not already there.

   Press **[SCALE]** ***[AUTO SCALE]***.
4. Press **[DISPLAY]** ***[MEAS→MEM] [MEAS-MEM]***. The displayed trace will be a flat line.
5. Reverse the connections to the output ports of the power splitter. Press **[CURSOR]**. Turn the analyzer's front panel knob to read the worst case output tracking (greatest deviation + or − from the reference line) between the frequency ranges specified.

   Enter the measured values on the *Performance Test Record*.

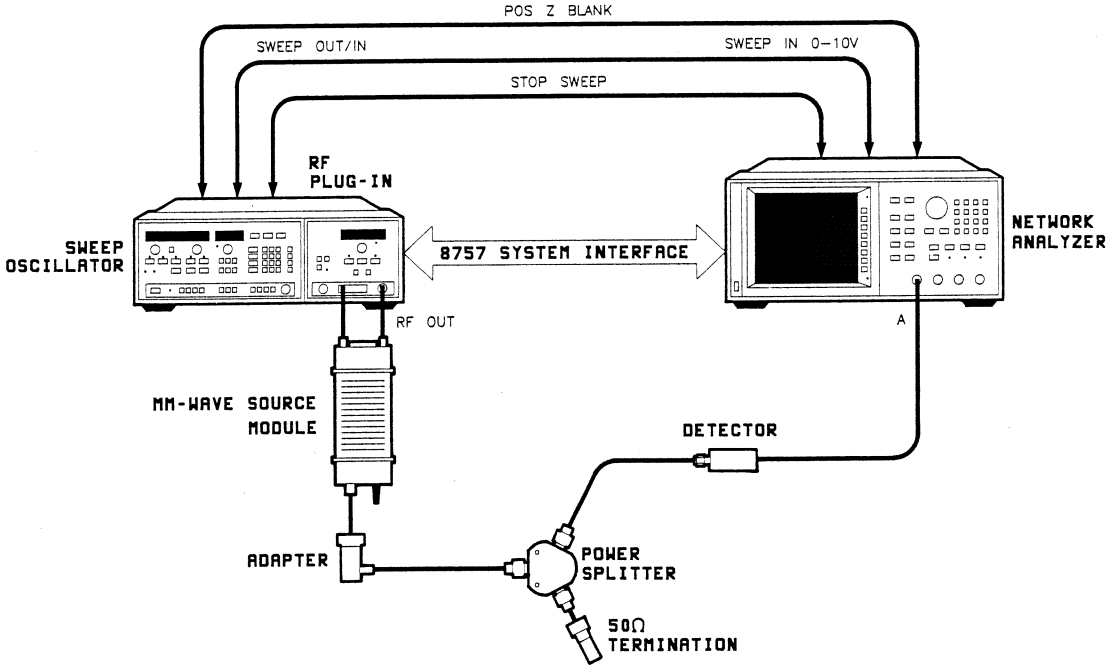

Figure 4-4. Output Tracking Test Setup 40 to 50 GHz

Procedure – 40 to 50 GHz

1. Set up equipment as shown in Figure 4-4. Allow 30 minutes warm-up.
2. On the analyzer, press **[PRESET]**. Both the source and analyzer will reset.
3. On the source, press **[START] [4] [0] [GHZ]**.
4. Set up the analyzer. Press ***[CHAN 2 OFF]*** **[REF]** ***[REF POSN]***. Set reference at center screen, if it is not already there.

   Press **[SCALE]** and select ***[AUTO SCALE]***.
5. Press **[DISPLAY]** ***[MEAS→MEM] [MEAS-MEM]***. The displayed trace will be flat.
6. Reverse the connections to the output ports of the power splitter. Press **[CURSOR]**. Turn the analyzer's front panel knob to read the worst case output tracking (greatest deviation + or – from the reference line) between 40 and 50 GHz.

   Enter the measured values on the *Performance Test Record*.

IF THE INSTRUMENT FAILS THIS TEST

If the instrument fails this test, refer to *Troubleshooting*.

SOURCE MATCH (EQUIVALENT OUTPUT SWR)

A performance test for source match is not included in this manual. Complex vector network analysis is required to accurately measure this characteristic. Source match specification is guaranteed by virtue of its simple design if the power splitter passes the other performance tests in this section, and the output port connectors are in good condition.

Table 4-1. Performance Test Record

HP 11667C POWER SPLITTER PERFORMANCE TEST RECORD

Serial No._____ Date_____ Tested By_____

INPUT RETURN LOSS

Frequency Range	Minimum	Approximate Measurement Uncertainty	Actual
DC to 18 GHz	20 dB	±2.5 dB	_____dB
DC to 26.5 GHz	18 dB	±2.5 dB	_____dB
DC to 40 GHz	16 dB	±2.5 dB	_____dB
DC to 50 GHz	14 dB	±2.5 dB	_____dB

OUTPUT TRACKING

Frequency Range	Specification	Actual
DC to 18 GHz	0.30 dB	
DC to 26.5 GHz	0.35 dB	_____dB
DC to 40 GHz	0.40 dB	_____dB
DC to 50 GHz	0.40 dB	_____dB

PIN DEPTH

Connector Type	Minimum Recession	Maximum Recession	Measured Recession
PSC-2.4	0.000 in 0.000 mm	0.003 in 0.076 mm	_____

Section 5. Adjustments

The HP 11667C has no electrical or mechanical adjustments.

Section 6. Service

TROUBLESHOOTING

Troubleshooting information is provided for problem isolation. Only the connectors are replaceable.

If the power splitter marginally fails *Output Tracking* and meets all other specifications including the DC resistance measurement described in this section:

1. Make certain all measurement equipment is calibrated and correctly configured.
2. Inspect all connections for good electrical contact.
3. Inspect the output connectors for damage. Not all connector damage is visible. If no other problems are found, replacing the output connectors will probably resolve the failure. See *Replaceable Parts* for the connector repair kit. Each kit replaces one connector.
4. If both output connectors have been replaced and the power splitter still fails *Output Tracking*, there is an internal failure. The power splitter must be replaced.

If the power splitter has catastrophically failed either performance test:

1. Make certain all measurement equipment is calibrated and correctly configured.
2. Inspect all connections for good electrical contact.
3. Measure the DC resistance between the center conductors of the input port and each output port.

CAUTION

Gently make contact between ohmmeter leads and center conductors. Do not force the leads into the center conductors. The larger leads will damage the smaller center conductors.

The measured value between the input port and either output port should be 50 ohms $\pm$0.4 ohms. A value higher than this indicates the power splitter has probably been submitted to excessive power or ESD (electrostatic discharge). The power splitter must be replaced.

4. Inspect all connectors for damage. See *Replaceable Parts* for the connector repair kit. Each kit replaces one connector.

Section 7. Replaceable Parts

ORDERING PARTS

Only the connectors on the power splitter are replaceable. All three connectors are identical. Each connector repair kit replaces **one** connector. To order, contact Hewlett-Packard with this information:

1. HP Part Number: 11667-60001
2. CD (Check Digit): 1
3. Description: Connector Repair Kit
4. Quantity Desired

To replace the connector, follow the instructions included with the kit.

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
(tel) 1 800 452 4844

Latin America
(tel) (305) 269 7500
(fax) (305) 269 7599

Canada
(tel) 1 877 894 4414
(fax) (905) 282-6495

Europe
(tel) (+31) 20 547 2323
(fax) (+31) 20 547 2390

New Zealand
(tel) 0 800 738 378
(fax) (+64) 4 495 8950

Japan
(tel) (+81) 426 56 7832
(fax) (+81) 426 56 7840

Australia
(tel) 1 800 629 485
(fax) (+61) 3 9210 5947

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Malaysia	1-800-828-848	1-800-801664
Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
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