# Keysight 11667B Power Splitter

Operating and Service Manual

KEYSIGHT TECHNOLOGIES

# Notices

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## Manual Part Number

11667-90037

## Edition

Edition 2, January 23, 2019

## Printed in:

Printed in Malaysia

## Published by:

Keysight Technologies
Bayan Lepas Free Industrial Zone,
11900 Penang, Malaysia

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A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

**WARNING**

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

## Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.

| | | | |
|---|---|---|---|
|  | When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information. |  | This symbol indicates hazardous voltages. |
|  | The laser radiation symbol is marked on products that have a laser output. |  | This symbol indicates that the instrument requires alternating current (ac) input. |
|  | This symbol indicates that the power line switch is ON. |  | This symbol indicates that the power line switch is OFF or in STANDBY position. |

## Regulatory Markings

| | | | |
|---|---|---|---|
|  | The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives. |  | The CSA mark is a registered trademark of the Canadian Standards Association. |
| **ISM 1-A** | This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4). | | |

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This instrument complies with the WEEE Directive marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

### Product category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.

Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

## Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/mta
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

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# General Information

## Introduction

This manual contains operating and service information for the Keysight 11667B power splitter (shown in Figure 4). It explains the nature of the operator's check for this device and describes the one performance test required: testing the tracking between the output arms.

11667-90038 is the microfiche part number that can be used to order 10 x 15 cm (4 x 6 in) microfilm transparencies of this manual. The microfiche package includes the latest Manual Changes Supplement, and pertinent service notes.

## Specification

Performance specifications are listed in Table 1. These are performance standards or limits against which the instrument may be tested. Table 2 provides supplemental characteristics. These are not specifications, but are typical characteristics included as additional information for the user.

## Safety considerations

Do not apply more than +27 dBm RF CW power to the Keysight 11667B, or damage to the power splitter may occur.

## Instruments covered by manual

The contents of this manual apply directly to all instruments, unless a yellow Manual Changes supplement is included with the manual. An instrument manufactured after the printing of this manual may have features that do not appear in this manual. In that case, a Manual Changes supplement documenting the differences will be provided with the manual.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current as possible, Keysight recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to its print date and part number, both of which appear on front page. Changes may be keyed to specific serial numbers, in which case the relevant serial numbers will be noted on the first page of the supplement Complimentary copies of the supplement are available from your local Keysight office.

**Table 1** Specifications

| Description | Frequency (GHz) | |
|---|---|---|
| | DC to 18 | DC to 26.5 |
| Input SWR | 1.22 | 1.29 |
| Equivalent output SWR (Leveling or ratio measurement) | 1.22 | 1.22 |
| Output tracking (between output arms) | 0.25 dB | 0.40 dB |
| Frequency range: DC to 26.5 GHz<br>Maximum input power: +27 dBm (0.5W)<br>Connectors: precision 3.5mm female on all ports<br>Dimensions: 47 mm wide x 40 mm high x I0 mm deep (1.85 in x 1.57 in x 0.39 in)<br>Shipping weight: 0.14 kg (4.94 oz.) | | |

**Table 2** Supplement characteristics

| Description | Frequency (GHz) | |
|---|---|---|
| | DC to 18 | DC to 26.5 |
| Phase tracking (between output arms), typically | ≤1.5° | ≤2.5° |

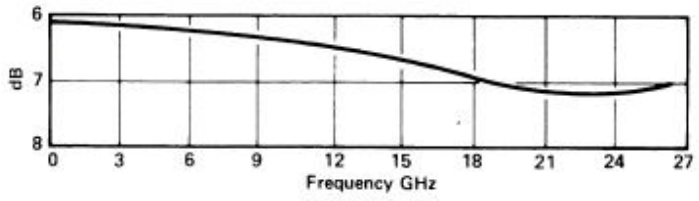



**Figure 1** Typical insertion loss

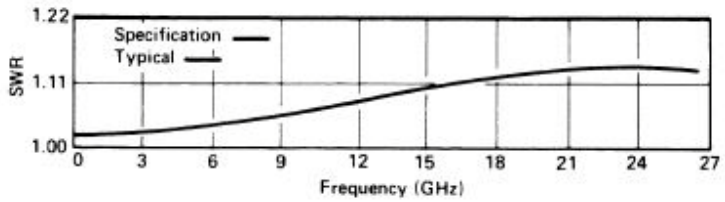



**Figure 2** Leveling or ratio measurement source match

## Description

The Keysight 11667B is a two-resistor power splitter used in network measurement systems where one output arm is used for leveling or to supply a reference signal for ratio measurements.

When the Keysight 11667B is used 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 3). 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.

When the source power level is varied (e.g., when measuring gain compression), ratioing is required to maintain calibration. This is not necessary when using the Keysight 11667B, because the ratio between the signals in the two arms is unaffected variations in power level appear in both arms equally and simultaneously.

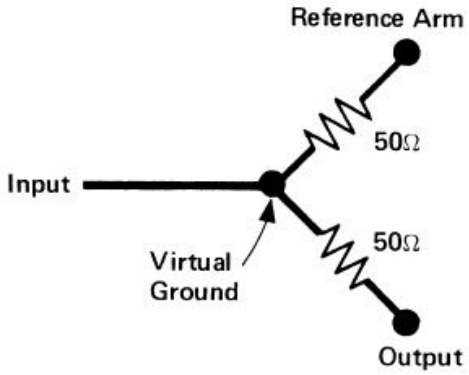



**Figure 3** Keysight 11667B schematic

# Installation

## Initial inspection

If the shipping container or cushioning material is damaged it should be kept until the contents of the shipment have been checked both mechanically and electrically. Procedures for checking electrical performance are given in this manual under PERFORMANCE TESTS. If the instrument does not pass these electrical tests, or shipping contents are incomplete, or there is mechanical damage or defect, notify your nearest Keysight office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as Keysight. Keep the shipping materials for the carrier's inspection. Keysight will arrange for repair or replacement without waiting for claim settlement

## Preparation for use

Figure 5 shows a typical measurement configuration using the Keysight 11667B.

## Mating connectors

The mating connector for a precision 3.5mm female connector is a precision 3.5mm male connector.

**CAUTION** **An SMA connector will mate with a precision 3.5mm connector, but it should ONLY be done with the following considerations:**

1. Important structural dimensional differences exist between these two types of connectors:
   - **a** Precision 3.5mm connectors are air dielectric devices. Only air exists between the center and outer conductors. The male or female center conductor is supported solely by a plastic "bead" deep within the connector body. SMA connectors employ a plastic dielectric to support the entire length of the center conductor.
   - **b** The diameters of both the center and the outer conductors differ between SMA and precision 3.5 mm connectors. When an SMA connector is mated with a precision 3.5 mm connector, the connection will exhibit a discontinuity mismatch (SWR) of typically 1.10 (return loss = 26.5 dB) at 20 GHz. The mating of SMA and precision 3.5mm connectors should be done only when such a high connector mismatch can be tolerated.
2. Because SMA connectors are not precision mechanical devices, and are especially susceptible to mechanical wear (causing them to degrade so that they are out of specification), they are potentially damaging to any precision 3.5mm connectors with which they are mated.

   A worn or out-of-spec SMA connector can permanently damage its mate ON THE VERY FIRST CONNECTION. Therefore, BEFORE making any connections, ensure that you have inspected both connectors visually, and that you have checked the mating plane dimensions with an appropriate connector gauge. BOTH connectors must be within specifications or permanent damage may result.

   Pay special attention to the SMA male pin. A male pin that is too long may smash or break the delicate fingers on the precision 3.5 mm female connector. Carefully align the two connectors. With the male contact precisely concentric with the female, push them straight together. Do not overtighten or rotate either center connector. Turn only the outer nut of the male connector and use a torque wrench (8 in-lb, 90 N-cm) for the final connection.

   Refer to Table 4 for a list of precision 3.5mm adapters available from Keysight.

A precision 3.5mm(m) to precision 3.5mm(m) adapter (Keysight part no. 1250-1864), or a precision airline, can be used to extend the life of the 11667B precision 3.5mm connectors.

## Operating environment

The operating environment should be within the following limits:

| | |
|---|---|
| Temperature | 0° to +55°C (+32° to +131°F) |
| Humidity | up to 95% relative |
| Altitude | up to 4.572 metres (15,000 feet) |

## Storage and shipment environment

The instrument may be stored or shipped in environments within the following limits:

| | |
|---|---|
| Temperature | -40° to +75°C (-40° to +16°F) |
| Humidity | up to 95% |
| Altitude | up to 7,620 metres (25.000 feet) |

Protection should be provided from temperature extremes, which can cause condensation within the instrument.

## Original packaging

Containers and materials identical to those used in factory packaging are available through Keysight offices. If the instrument is being returned to Keysight for servicing, attach a tag indicating the type of service required, return address, model number and full serial number. Ensure that the container is marked FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

## Other packaging

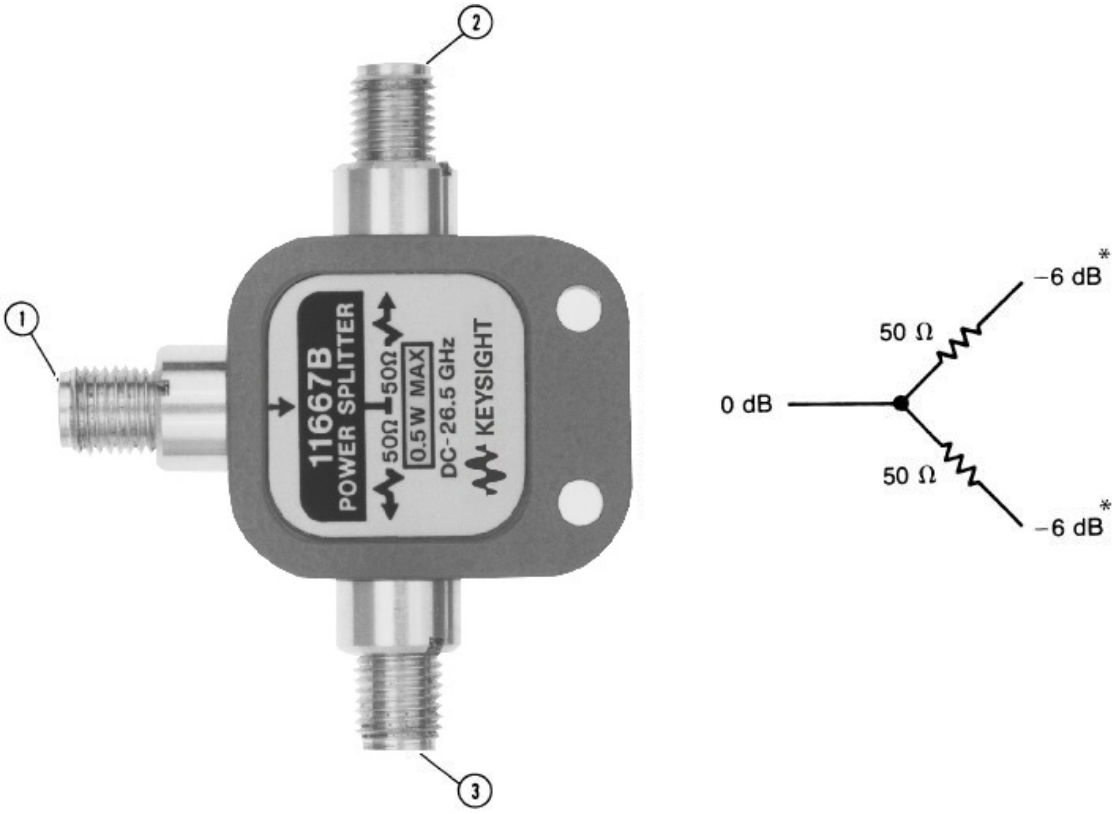
The following general instructions should be used for repackaging with commercially available materials:

1. Wrap the instrument in heavy paper or plastic. If shipping to a Keysight office or service center, attach a tag indicating the type of service required, return address model number and full serial 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 (a 3 to 4 inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container.
4. Seal the shipping container securely.
5. Mark the shipping container FRAGILE to assure careful handling.

# Operation

## Features

Features of the Keysight 11667B are shown in Figure 4.




**1.** INPUT PORT for incoming signal.

**2. 3**. OUTPUT PORTS used as exit ports for outgoing signal. Output signal is 6 dB down in power from input signal. Either port may be used as test or reference port since power is equal in both ports.

*Typically in 50Ω system at DC. Loss typically increases 0.05 dB/GHz.

**Figure 4** Instrument features

## Operator's check

The operator's check consists of performing a measurement as shown in Figure 5. Successful measurement of a known component verifies operation.

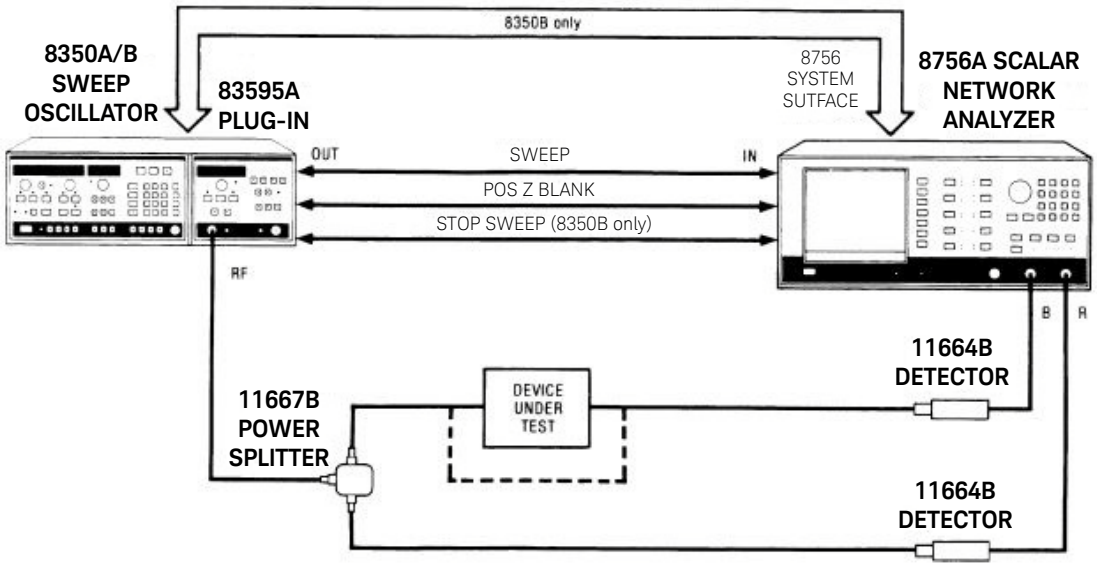



**Figure 5** Typical measurement procedure

### Insertion loss or gain

This sequence lists the steps for a typical insertion loss or gain measurement.

**Table 3** Insertion loss or gain

| Calibration | Measurement |
|---|---|
| **MEAS PWR B or MEAS RATIO B/R,** | Connect test device. |
| **DISPLAY MEAS.** | **CURSOR,** |
| Connect B Input detector to splitter, | Position Cursor, |
| Set Start/Stop Frequencies, | Read magnitude and frequency. |
| Set Power Level. | |
| **DISPLAY-MEM,** | |
| **DISPLAY M-MEAS.** | |

Calibration sets a zero dB reference with the detector connected. After connecting the test device, a negative measured value indicates insertion loss; a positive value indicates gain.

# Performance Tests

Performance testing the Keysight 11667B consists only of testing the tracking between the output arms (refer to Output Tracking Test).

Phase information is required to measure the SWR of the Keysight 11667B. The only instrument that is practical for making this measurement to 26.5 GHz is the Keysight 8510 network analyzer. For further information, refer to the Keysight 8510 Operating Manual.

SWR is usually performance tested using a scalar network analyzer such as the Keysight 8756A To measure the SWR of the Keysight 11667B with an Keysight 8756A, an Keysight 85021B bridge would be required. Both the bridge and the Keysight 11667B have female precision 3.5mm connectors. Therefore, a precision 3.5 mm male-to-male adapter would be required to connect the power splitter to the bridge.

If the adapter is connected to the bridge, and a calibration is performed at the end of the adapter, the directivity of the bridge is degraded, and the measurement uncertainty is unacceptable.

If a calibration is performed at the precision 3.5 mm female port of the bridge, and the adapter is connected to the power splitter, the SWR of the adapter masks the SWR of the power splitter.

Phase information is required to calibrate out the effects of the adapter. The Keysight 8510 can be calibrated in either female or male precision 3.5 mm, and using internal error correction, it has an effective directivity greater than 40 dB. Therefore, to accurately measure the SWR of the Keysight 11667B, refer to the Keysight 8510 network analyzer Operating Manual.

# Output Tracking Test

## Specification

DC to 18 GHz: 0.25 dB

DC to 26.5 GHz: 0.40 dB

## Description

One output arm of the Keysight 11667B is terminated in 50 ohms. A measurement is taken on the other arm and stored in the Keysight 8756A. The load and detector are then reversed, and a display minus memory reading is taken on the Keysight 8756A. The flatness of the Keysight 11667B (including the Keysight 11664B detector) is displayed as peak-to-peak variation on the Keysight 8756A CRT.

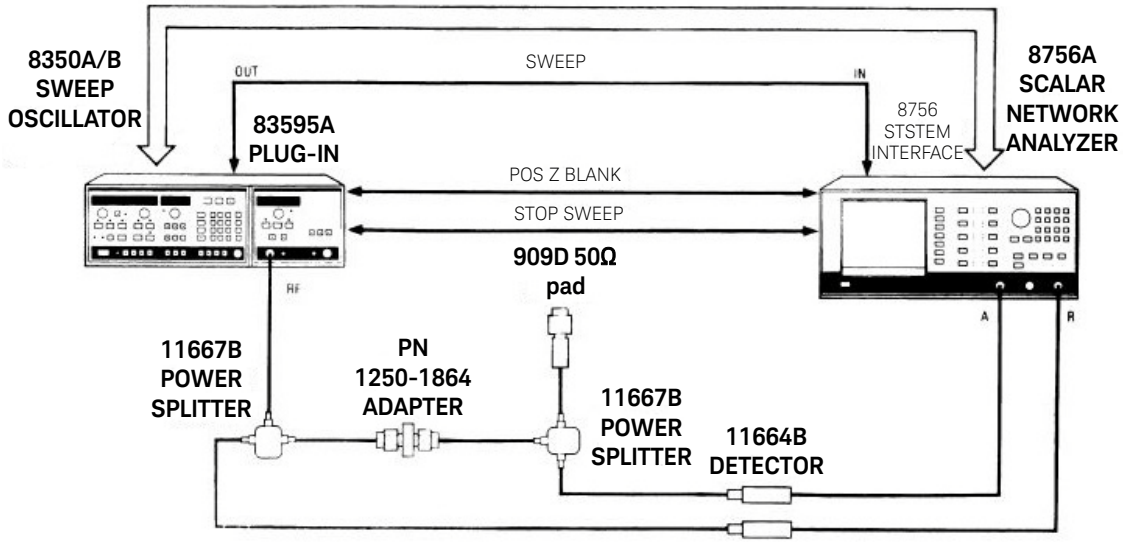



**Figure 6** Output tracking test setup

**NOTE** An Keysight 8350B is used in this performance test. A modified Keysight 8350A has the same capabilities as an Keysight 8350B, but an unmodified Keysight 8350A DOES NOT. If an unmodified Keysight 8350A is being used, DO NOT connect the 8756 SYSTEM INTERFACE or the Stop Sweep. Because the 8756 SYSTEM INTERFACE cannot be used, pressing [PRESET] on the Keysight 8756A will NOT cause the Keysight 8350A to preset. The operator must press [PRESET] on BOTH the Keysight 8756A AND the Keysight 8350A. In addition, operator must press [MOD] on the Keysight 8350A to turn square wave modulation on, and must set the sweep time to >200 ms.

## Equipment

| | |
|---|---|
| Power splitter (one plus test device) | 11667B |
| Sweep oscillator | 8350B |
| RF plug-In | 83595A |
| Network analyzer | 8756A |
| Detector (2 required) | 11664B |
| 50 ohm load (precision 3.5mm[m]) | 909D |
| Adapter (precision 3.5mm[m] to precision 3.5 mm[m]) | 1250-1864 |

## Procedure

1. Connect equipment as show in Figure 6. Press [PRESET] on the Keysight 8756A to preset both the Keysight 8756A and the Keysight 8350B (this will also turn the Keysight 8350B [MOD] on, and set the sweep rate to 200 ms). Allow 30 minutes warm-up.
2. On the Keysight 8756A, press [SHIFT] [DISPLAY] to store the trace in memory.
3. Reverse the output port connections.
4. On the Keysight 8756A, press [DISPLAY] until the M-MEM LED is on.
5. Frequency tracking is the peak to peak variation of the CRT trace.

## Adjustment

The Keysight 11667B power splitter requires no electrical or mechanical adjustments.

# Service

## Troubleshooting

The circuit elements of the Keysight 11667B are split into to identical channels. A malfunction will usually occur in only one channel and can be confirmed by reversing connections to the splitter.

Because the power splitter works to dc, an ohmmeter can be used to check the inner conductor connections. The resistance from either output center conductor to the input center conductor should be 50 ohms ±2 ohms.

## Ordering information

The Keysight 11667B has no field replaceable parts.

Table 4 lists the precision 3.5mm adapters available from Keysight.

**Table 4** Precision 3.5mm adapters available from Keysight

| Description | Part number |
|---|---|
| Precision 3.5mm(m) to N(M) | 1250-1743 |
| Precision 3.5mm(m) to N(f) | 1250-1750 |
| Precision 3.5 mm(f) to N(m) | 1250-1744 |
| Precision 3.5 mm(f) to N(f) | 1250-1745 |
| Precision 3.5mm(m) to Precision 7mm | 1250-1746 |
| Precision 3.5mm(f) to Precision 7mm | 1257-1747 |
| Precision 3.5mm(m) to Precision 3.5mm(m) | 1250-1864 |
| Precision 3.5mm(f) to Precision 3.5m(f) | 1250-1865 |
| Precision 3.5mm(m) to Precision 3.5 mm(f) | 1250-1866 |

Edition 2, January 23, 2019

Printed in Malaysia

11667-90037
www.keysight.com