

# Keysight Technologies

## 11867A RF Limiter

Operating and  
Service Guide



NOTICE: This document contains references to Agilent Technologies. Agilent's former Test and Measurement business has become Keysight Technologies. For more information, go to [www.keysight.com](http://www.keysight.com).



# Notices

© Keysight Technologies 1995, 2001, 2013, 2015

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Keysight Technologies as governed by United States and international copyright laws.

## Manual Part Number

11867-90005

## Edition

February 2015

Supersedes: October 2013

Keysight Technologies  
1400 Fountaingrove Parkway  
Santa Rosa, CA 95403

## 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, Keysight 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. Keysight shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Keysight 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 shall control.**

## Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

## Restricted Rights Legend

If software is for use in the performance of a U.S. Government prime contract or sub-contract, Software is delivered and

licensed as “Commercial computer software” as defined in DFAR 252.227-7014 (June 1995), or as a “commercial item” as defined in FAR 2.101(a) or as “Restricted computer software” as defined in FAR 52.227-19 (June 1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Keysight Technologies’ standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will receive no greater than Restricted Rights as defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June 1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.

## Safety Notices

### CAUTION

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.

---

# 11867A RF Limiter

## General Information

To obtain optimum performance from this RF limiter, observe these simple precautions:

- Make connections carefully to avoid misalignment and connector damage, which will result in inaccurate measurements.
- Keep the connectors free of dirt and any particles.
- When you clean the connectors, try using compressed air first. Do not use abrasives. With a clean foam swab, apply only isopropyl alcohol.
- For more information, refer to the *Connector Care for RF and Microwave Coaxial Connectors* document. It can be viewed online by searching for part number 08510-90064 at [www.keysight.com](http://www.keysight.com).

## Introduction

The 11867A RF limiter is an instrument accessory that can be used to protect input circuitry from transients and accidental overloads. This manual explains how to use the limiter, briefly describes tests that can be used to verify the specifications, and explains how to repair the limiter.

Instrument specifications are listed in **Table 1**. These specifications are performance standards or limits against which the instrument may be tested.

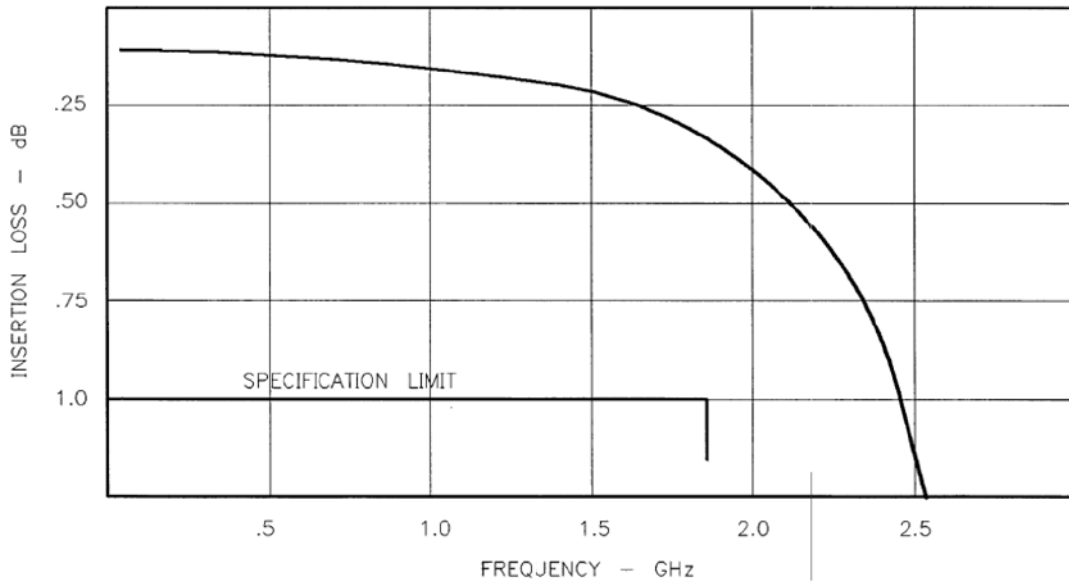
**Table 1 11867A RF Limiter Specifications**

<b>Frequency Range</b>	10 Hz to 1800 MHz
<b>Insertion Loss</b>	<1.0 dB
<b>Frequency Response<sup>a</sup></b>	< $\pm 0.25$ dB about a 0.25 dB/GHz slope
<b>Maximum Input Power Levels</b>	--
<b>Continuous</b>	10 watts average (+40 dBm); <1.3 V <sub>dc</sub> with no RF applied; 0.0 V <sub>dc</sub> with RF applied
<b>Pulse</b>	100 watts peak, pulse width $\leq 1 \mu\text{sec}$ , 0.001 duty cycle
<b>Limiting Threshold</b>	1 mW (0 dBm) gives approximately 1 dB compression
<b>Impedance</b>	50 ohm nominal
<b>Reflection Coefficient</b>	<0.13 (1.3:1 VSWR)
<b>RF Input Connector<sup>b</sup></b>	Type-N female
<b>RF Output Connector<sup>b</sup></b>	Type-N male
<b>Weight</b>	90 grams (0.2 lb)
<b>Dimensions</b>	21 mm x 60 mm (0.81 in. x 2.38 in.)

a. For operation to 2.4 GHz, see typical response shown in **Figure 1**.

b. Device is not suitable for bilateral operation. Input and output may not be interchanged.

**Figure 1** Typical Insertion Loss Versus Frequency



11867\_005\_001

### Description

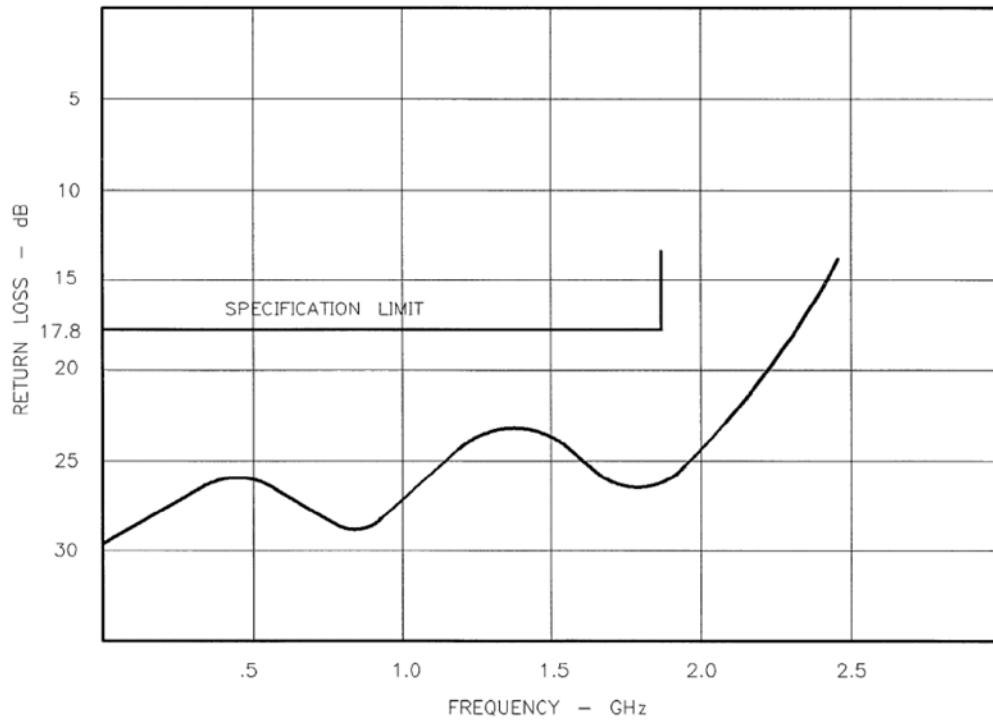
The 11867A RF limiter is a unidirectional, solid state, passive device for use from 10 Hz to 1800 MHz. It consists of four oxide-passivated silicon diodes: two PIN diodes and two Schottky-Barrier diodes. These diodes are functionally integrated in a 50 ohm transmission line as part of a low pass filter with a cutoff frequency ( $F_c$ ) of approximately 2.5 GHz. The limiter has no adjustments, and its diodes are not field replaceable.

For noise considerations, the limiter behaves as a thermal resistance shunted across the transmission line. The excess noise temperature is less than 20° Kelvin. This results in a noise figure that is essentially equal to the insertion loss below the limiting threshold. (Figure 1 shows typical insertion loss below the limiting threshold.)

The VSWR specification in Table 1 applies below the limiting threshold. (Typical VSWR into either port is shown in Figure 2.) VSWR above the threshold is unpredictable, since the limiter effects its limiting by reflecting some of the input power.

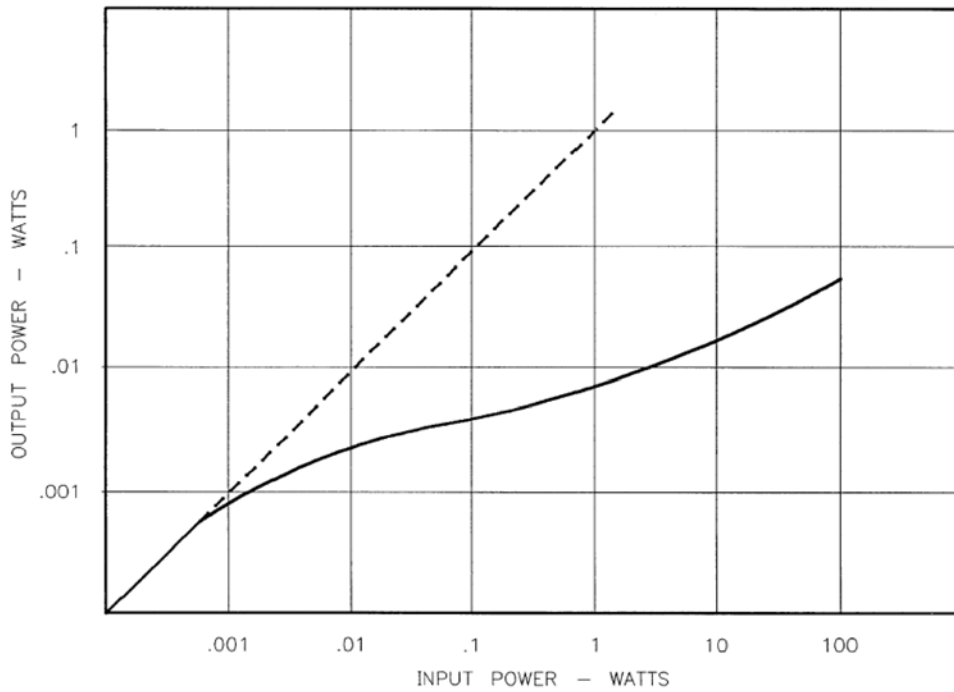
Limiting is non-linear and depends on input power and ambient temperature. The typical limiting curves shown in Figure 3 apply at an ambient temperature of 25°C.

**Figure 2** Typical Return Loss Versus Frequency



11867\_005\_002

**Figure 3** Typical Output Power Versus Input Power at 25°C



11867\_005\_003

## Installation

### Initial Inspection

Verify that the shipment is complete by referring to the contents list in the shipping container.

If the container or device appears damaged, or if the shipment is incomplete, contact Keysight Technologies — see “[Contacting Keysight](#)” on page 8. Keysight will arrange for repair or replacement of incomplete or damaged shipments without waiting for a settlement from the transportation company.

### Electrical Inspection

**VSWR** To check that the limiter meets the VSWR specification listed in [Table 1](#), use any test system that can measure return loss. Terminate the unused port with an accurate 50 ohm termination. Incident power must be less than 1 mW (the limiting threshold).

**Insertion Loss and Frequency Response** To check that the limiter meets the insertion loss and frequency response specifications listed in [Table 1](#), use any test system that can measure insertion loss. The input and output ports must be provided with a good 50 ohm match. Incident power must be less than 1 mW (the limiting threshold).

---

**CAUTION** During the test of limiting specifications, do not apply more than 10W average power to the limiter. There should be  $<1.3 V_{dc}$  with no RF applied, and  $0.0 V_{dc}$  when RF is applied.  
Permanent damage to the diodes could result from exceeding these levels.

---

**Limiting** The power limiting performance can be compared against the typical performance shown in [Figure 3](#) by using the same test system that is used to check insertion loss. Incident power should be slowly increased from below 1 mW to 10 W while the output power is observed.

### Storage Environment

The limiter should be stored in a clean, dry environment with the following environmental limitations:

- Temperature:  $-40^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$
- Humidity:  $<95\%$  relative
- Altitude:  $<7620$  meters (25,000 feet)

## Operation

### Operating Environment

The operating environment should be with the following limitations:

- Temperature:  $0^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$
- Humidity:  $<95\%$  relative
- Altitude:  $<4572$  meters (15,000 feet)



## Mating Connectors

Mating connectors used with the limiter should be Type-N connectors that are compatible with US MIL-C-39012.

## Instructions

---

**CAUTION** Do not apply more than 10 W average power or 100 W peak power to the limiter. There should be  $<1.3 V_{dc}$  with no RF applied, and  $0.0 V_{dc}$  when RF is applied. Permanent damage to the diodes could result from exceeding these levels.

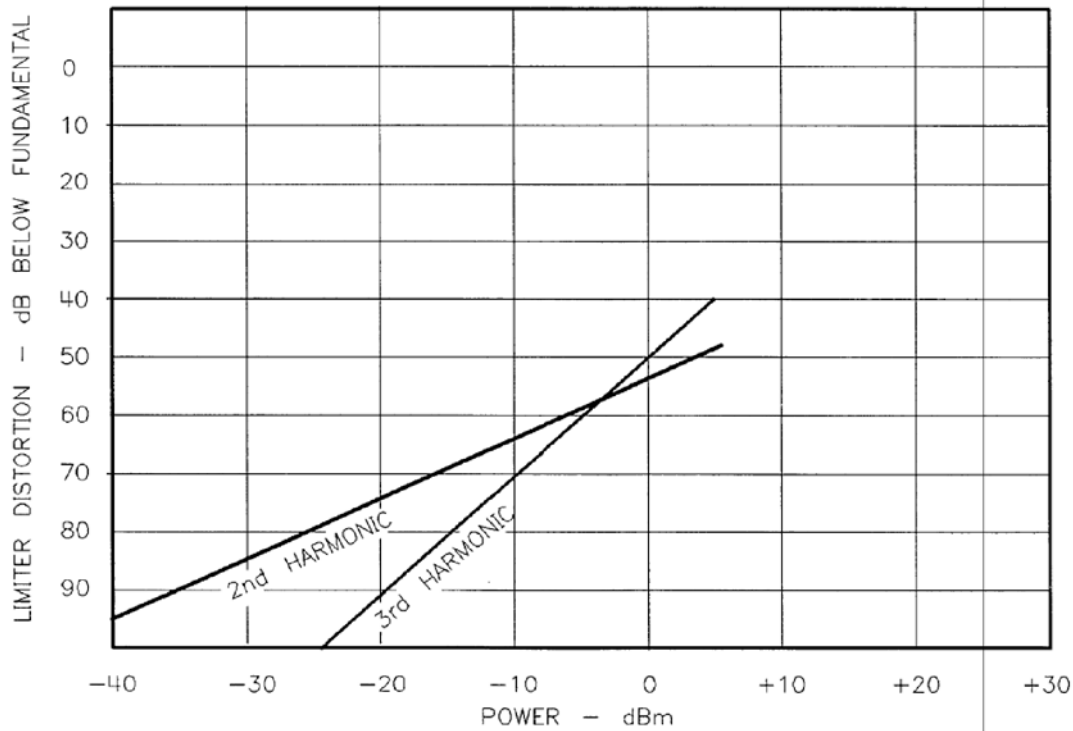
---

For reliable operation over its full frequency and power range, the limiter must be used as a unidirectional device. Incident power must be applied as shown on the label of the limiter. The limiter can be used to protect the input mixer of a spectrum analyzer, the sampler of a network analyzer, the power sensor (or thermistor mount) of a power meter, or the input circuitry of any other device that might be subjected to transients and accidental overloads.

The use of an attenuator between the limiter and the device it is protecting is recommended to minimize measurement uncertainty that is due to multiple mismatches. For example, set the input attenuator of a spectrum analyzer to at least 10 dB.

Harmonic distortion is generated by the limiter while it is limiting. If the incident signal exceeds the limiting threshold, use attenuation between the limiter and the source to reduce the signal below 1 mW. Typical harmonic distortion below the limiting threshold is shown in [Figure 4](#). The limiter will still prevent transients from damaging the device it is protecting.

**Figure 4** Typical Harmonic Distortion Versus Input Power



11867\_005\_004

## Repair

### Diodes

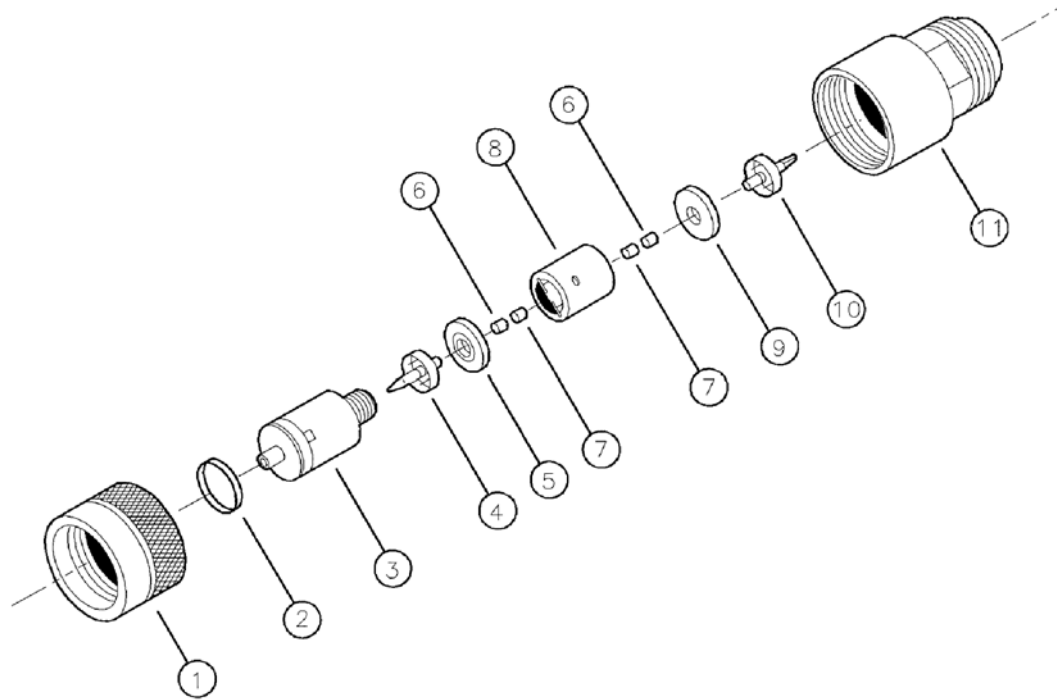
If the diodes of the limiter fail to function correctly or have been damaged, return the limiter to Keysight Technologies for repair – see “[Contacting Keysight](#)” on page 8. Do NOT attempt to remove or replace the diodes.

### Connectors

If a connector is damaged or worn, it can be disassembled, the worn or damaged parts replaced, and the connector reassembled.

To disassemble a connector, carefully remove the label, place the limiter in a vise, and remove the connector body, which has right-hand threads. Replace the worn or damaged part (see [Figure 5](#)) and reassemble the connector.

**Figure 5 11867A Illustrated Parts Breakdown**



11867\_005\_005

**Table 5 11867A Illustrated Parts Breakdown**

Item	Description	Part Number
1	Nut, RF Connector	1250-0918
2	Ring, RF Connector, Series N	1250-0016
3	Housing, Male Connector	08491-2100
4	Pin Assembly, Male	08491-4000
5	Spacer	08491-20003
6	Plug	11867-20001
7	Contact, Elastomer	8160-0729
8	Limiter Assembly (not field replaceable)	--
9	Spacer	08491-20003
10	Pin Assembly, Female	08491-4001
11	Connector, Female	08491-2101
12	Spacer, Outer Conductor (optional, not shown)	08742-0006

## Contacting Keysight

Assistance with test and measurement needs and information on finding a local Keysight office are available on the Web at:

[www.keysight.com/find/assist](http://www.keysight.com/find/assist)

---

**NOTE** In any correspondence or telephone conversation, refer to the Keysight product by its model number and full serial number. With this information, the Keysight representative can determine whether your product is still within its warranty period.

---



This information is subject to change without notice.  
© Keysight Technologies 1995, 2001, 2013, 2015  
February 2015



11867-90005

[www.keysight.com](http://www.keysight.com)