

# Keysight 8494/95/96A/B Attenuators



Operating and  
Service Manual

# Notices

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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.

## Environmental Conditions

The table below shows the general environmental requirements for this instrument.

Environmental condition	Requirement
Temperature	Operating condition: - 0 °C to +55 °C Storage condition: - -40 °C to +75 °C
Humidity	<95% relative
Altitude	Operating condition: - <4600 m (15000 ft) Storage condition: - <7600 m (25000 ft)
Shock	Operating condition: - 10 Gs, 6 ms, on six sides, three blows Non-operating condition: - 500 Gs, 1.8 ms, in six directions
Vibration	5 Gs, 34 Hz to 2000 Hz
EMC	Radiated interference is within the requirements of MIL-STD-461, RE02

## Regulatory Markings

	<p>This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.</p>		<p>This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.</p>
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## Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) 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](http://www.keysight.com/find/mta)  
(product-specific information and support, software and documentation updates)
- [www.keysight.com/find/assist](http://www.keysight.com/find/assist)  
(worldwide contact information for repair and service)

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# 1 Introduction

Product Overview **12**

This chapter provides an overview of the Keysight 8494/95/96A/B Attenuators.

## Product Overview

The Keysight 8494A/B, 8495A/B, and 8496A/B are 50- $\Omega$  coaxial step attenuators.

For the 8494A/B, the attenuation can be varied in 1 dB steps, or 10 dB steps for the 8495A/B and 8496A/B. The attenuation shown on the control knob is the additional attenuation added in the signal path over the insertion loss of the attenuator in the 0 dB position.

- The Keysight 8494A/B instruments are four-section attenuators with a range of 0 dB to 11 dB in 1 dB steps.
- The 8495A/B is a three-section attenuator with a range of 0 dB to 70 dB in 10 dB steps.
- The 8496A/B is a four-section attenuator with a range of 0 dB to 110 dB in 10 dB steps.

The attenuator sections are connected in cascade. Each section consists of a precision, thin-film attenuator card, a lossless thru-line, and a ganged pair of edge-line transmission lines. The edge-lines are flexed to make contact with either the attenuator card or the thru-line. The edge-line contacts are gold-plated leaf springs which ensure long life and high repeatability. Low-torque cams flex the edge lines. [Table 4-1](#) on [page 24](#) shows the switching arrangements.

### CAUTION

Do not exceed the RF power rating of 1 W average or 100 W peak with a maximum pulse width of 10  $\mu$ s. Do not connect an attenuator RF input or output connector to greater than  $\pm 7$  Vdc. If the attenuator must be connected to a device with a potential greater than  $\pm 7$  Vdc, use a blocking capacitor.

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## 2 Installation

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This chapter provides you important information on how to check and prepare your instrument for operation.

## Initial Inspection

- 1** Unpack and inspect the shipping container and its contents thoroughly to ensure that nothing was damaged during shipment. If the shipping container or cushioning material is damaged, the contents should be checked both mechanically and electrically.

  - Check for mechanical damage such as scratches or dents.
  - Procedures for checking electrical performance are given under “**Operator’s check**” on page 25.
- 2** If the contents are damaged or defective, contact your nearest Keysight Technologies Service and Support Office. Refer to “**Sales and Technical Support**” on page 4 of this manual. Keysight Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier’s inspection.
- 3** If you are returning the instrument under warranty or for service, repackaging the instrument requires original shipping containers and material or their equivalents. Keysight Technologies can provide packaging materials identical to the original materials. Refer to “**Sales and Technical Support**” on page 4 of this manual for the Keysight Technologies nearest to you. Attach a tag indicating the type of service required, return address, model number, and serial number. Mark the container **FRAGILE** to insure careful handling. In any correspondence, refer to the instrument by model number and serial number.

## Instrument Options

Each instrument is specified with an option number which denotes the configuration of the input and output connectors.

**Table 2-1** Instrument options

Option	Connector description
001	Both connectors Type-N female
002	Both connectors SMA female
003 <sup>[a]</sup>	Both connectors APC-7

[a] Option 003 is not available with the 8494A, 8495A, and 8496A.

## Mating Connectors

Mating RF connectors used with the Option 001 must be Type-N male connectors, which comply with U.S. military standard MIL-C-39012.

For Option 002, male SMA connectors must be used.

For Option 003, APC- 7 mating connectors must be used.

### CAUTION

When installing the instrument, make sure that the connectors do not support weight or bear torque. The preferred procedure is to set up all equipment in position before connecting the instrument. Either connector may be used as the input or output connector.

## Installation Instructions

The attenuators may be installed with or without the base. The base is removed by unscrewing the two fillister head screws from the bottom of the base. The attenuator may be mounted without the base by inserting two 4-40 screws into the screw holes in the bottom of the attenuator. Removing the base and mounting the attenuator does not affect the performance of the attenuator.



# 3 Specifications

Specifications 18

This chapter provides the specifications of the 8494/95/96A/B attenuators.

## Specifications

### Frequency range and attenuation

**Table 3-1** Frequency range and attenuation

Specification	8494A	8494B	8495A	8495B	8496A	8496B
Frequency range	dc to 4 GHz	dc to 18 GHz	dc to 4 GHz	dc to 18 GHz	dc to 4 GHz	dc to 18 GHz
Attenuation	0 dB to 11 dB	0 dB to 11 dB	0 dB to 70 dB	0 dB to 70 dB	0 dB to 110 dB	0 dB to 110 dB
Step	1 dB	1 dB	10 dB	10 dB	10 dB	10 dB

### Attenuation accuracy

(±dB): (Referenced from 0 dB)

**Table 3-2** Attenuation accuracy

8494A/B	8495A/B 8496A/B	8494A		8494B		8495A		8495B		8496A		8496B	
		Attenuation selection (dB)	dc to 4 GHz	dc to 12.4 GHz	12.4 to 18 GHz	dc to 4 GHz	dc to 12.4 GHz	12.4 to 18 GHz	dc to 4 GHz	dc to 12.4 GHz	12.4 to 18 GHz	dc to 4 GHz	dc to 12.4 GHz
1	10	0.2	0.3	0.7	0.2	0.5	0.6	0.2	0.5	0.6	0.2	0.5	0.6
2	20	0.2	0.3	0.7	0.4	0.7	0.8	0.4	0.7	0.8	0.4	0.7	0.8
3	30	0.3	0.4	0.7	0.5	0.9	1.2	0.5	0.9	1.2	0.5	0.9	1.2
4	40	0.3	0.4	0.7	0.7	1.2	1.6	0.7	1.2	1.6	0.7	1.2	1.6
5	50	0.3	0.5	0.7	0.8	1.5	2.0	0.8	1.5	2.0	0.8	1.5	2.0
6	60	0.3	0.5	0.8	1.0	1.8	2.4	1.0	1.8	2.4	1.0	1.8	2.4
7	70	0.4	0.6	0.8	1.2	2.1	2.8	1.2	2.1	2.8	1.2	2.1	2.8
8	80	0.4	0.6	0.8	–	–	–	1.3	2.4	3.2	1.3	2.4	3.2
9	90	0.4	0.6	0.8	–	–	–	1.5	2.7	3.6	1.5	2.7	3.6
10	100	0.4	0.6	0.9	–	–	–	1.6	3.0	4.0	1.6	3.0	4.0
11	110	0.5	0.7	0.9	–	–	–	1.8	3.3	4.4	1.8	3.3	4.4

## Maximum SWR

**Table 3-3** Maximum SWR

Instrument	Frequency range (GHz)	Maximum SWR
8495A	dc to 4	1.35
8495B	dc to 8	1.35
	8 to 12.4	1.5
	12.4 to 18	1.7
8494A, 8496A	dc to 4	1.5
8494B, 8496B	dc to 8	1.5
	8 to 12.4	1.6
	12.4 to 18	1.9

## Maximum residual attenuation

**Table 3-4** Maximum residual attenuation

Instrument	Maximum residual attenuation
8494A, 8494B	0.6 dB + 0.09 dB/GHz
8495A, 8495B	0.4 dB + 0.07 dB/GHz
8496A, 8496B	0.6 dB + 0.09 dB/GHz

## Attenuation repeatability

±0.03 dB max (5 million cycles per section).

### 3 Specifications

#### RF power handling capability

1 W average, 100 W peak with maximum pulse width of 10 microseconds (all models).

#### Operating life

5 million cycles per section.

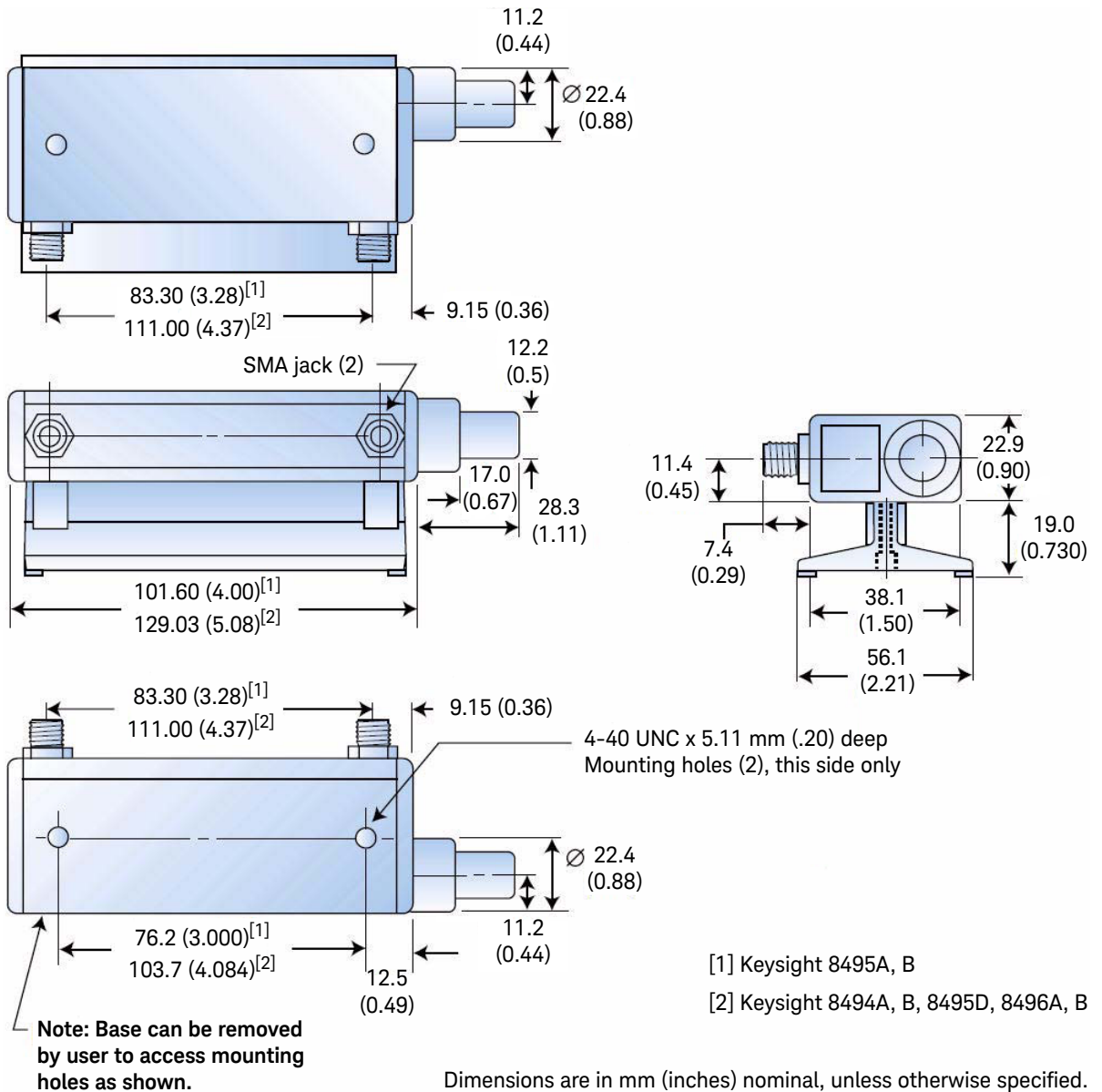
#### Physical specifications

**Table 3-5** Physical specifications

Instrument	Dimensions <sup>[a]</sup>	Weight <sup>[b]</sup>
8494A/B	Per <a href="#">Figure 3-1</a>	15 oz (425 g)
8495A/B	Per <a href="#">Figure 3-1</a>	11 oz (312 g)
8496A/B	Per <a href="#">Figure 3-1</a>	15 oz (425 g)

[a] Dimensions are for general information only. If dimensions are required for building special enclosures, contact your Keysight field engineer.

[b] Weight and width of the instrument vary with the option selected due to the type of connectors.



**Figure 3-1** Dimensions of Keysight 8494/95/96A/B Attenuators

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# 4 Operating Guide

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This chapter provides simple quick-check instructions to verify the attenuators' functionality prior to usage. It also provides information on service and maintenance of the attenuators.

## Operating Instructions

**CAUTION**

Do not apply RF power greater than 1 W average, or 100 W peak with a maximum pulse width of 10 microseconds. If these limits are exceeded, the attenuators may be damaged.

After the instrument is connected, the attenuation may be selected. Turn counterclockwise to increase attenuation or clockwise to decrease attenuation. Either connector may be used as the input or output. Table 8 lists the attenuator switching order.

**Table 4-1** Attenuator switching order

8494A/B attenuator sections					8495A/B attenuator sections				8496A/B attenuator sections					
Atten (dB)	1 dB	2 dB	3 dB	4 dB	Atten (dB)	10 dB	20 dB	30 dB	40 dB	Atten (dB)	10 dB	20 dB	30 dB	40 dB
0					0					0				
1	x				10	x				10	x			
2		x			20		x			20		x		
3	x	x			30	x	x			30	x	x		
4				x	40			x		40				x
5	x		x		50	x		x		50	x		x	
6		x	x		60		x	x		60		x	x	
7	x	x	x		70	x	x	x		70	x	x	x	
8			x	x						80			x	x
9	x		x	x						90	x		x	x
10		x	x	x						100		x	x	x
11	x	x	x	x						110	x	x	x	x



**CAUTION**

Do not attempt to force the switch between 0 and the highest value position as there is a stop between these switch positions.

## Operator's check

The operator's check allows the operator to make a quick check of the instrument prior to use or if a failure is suspected.

**Description**

The attenuator is driven from a 50- $\Omega$  signal source at 1 kHz. The output level from the attenuator is detected by a narrow-bandwidth voltmeter. The attenuator and detector range switches are stepped together and the variations in level noted. This verifies that each attenuator section is being properly switched and checks the low-frequency accuracy of the attenuator.

**NOTE**

The SWR meter used in this check is calibrated for a square-law detector. Therefore, the range changes and errors (read in dB) are twice that indicated by the meter.

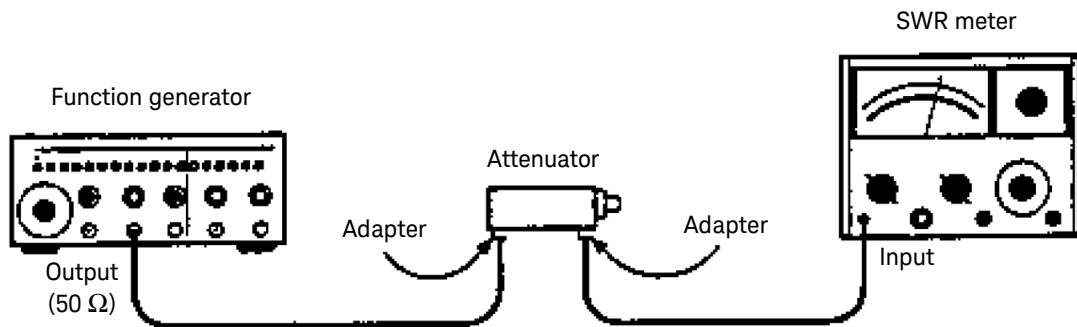


Figure 4-1 Operator's check setup

### Procedure

- 1 Connect equipment as shown in Figure 2 on page 23 with the attenuator set to 0 dB attenuation.
- 2 Set the test oscillator to 0.3 Vrms at 1 kHz.
- 3 Set the SWR meter range to 2 dB (expanded) [or for the 8494A/B to 10 dB (expanded)] and adjust its bandwidth to the center of the adjustment range. Fine-tune the oscillator frequency to obtain maximum meter indication.
- 4 Set the attenuator and the SWR meter range switch as listed in [Table 4-2](#) and verify that the SWR meter indicates within the limits shown.

**Table 4-2** Attenuator and SWR settings

SWR meter range (dB)		Attenuation (dB)			Meter indication (dB)					
					Minimum		Actual		Maximum	
8494A/B	8495A/B 8496A/B	8494A/B	8495A/B	8496A/B	8494A/B	8495A/B 8496A/B	8494A/B	8495A/B 8496A/B	8494A/B	8495A/B 8496A/B
10	2	0	0	0	–	–	Set to 0.0	Set to 0.5	–	–
10	6	1	10	10	0.40	1.40	–	–	0.60	1.60
10	12	2	20	20	0.90	0.30	–	–	1.10	0.70
10	16	3	30	30	1.35	1.25	–	–	1.65	1.75
10 <sup>[a]</sup>	22	4	40	40	1.85	0.15	–	–	2.15	0.85
12	26	5	50	50	0.35	1.10	–	–	0.65	1.90
12	32	6	60	60	0.85	0.00	–	–	1.15	1.00
12	36 <sup>[a]</sup>	7	70	70	1.30	0.90	–	–	1.70	2.10
12 <sup>[a]</sup>	42 <sup>[a]</sup>	8	–	80	1.80	-0.15	–	–	2.20	1.15
14	46 <sup>[a]</sup>	9	–	90	0.30	0.75	–	–	0.70	2.25
14	52 <sup>[a]</sup>	10	–	100	0.80	-0.30	–	–	1.20	1.30
14	56 <sup>[a]</sup>	11	–	110	1.75	0.60	–	–	1.75	2.40

[a] Adjust range by 2 dB, if needed, to obtain an on-scale indication.

## Performance Tests

The Keysight 8494/95/96A/B Attenuators can be tested to the accuracy of the specifications with a network analyzer or equivalent equipment of suitable accuracy. If a network analyzer is available, test instrument using the procedure in the analyzer's operating manual.

## Service Instructions

### Adjustment

The Keysight 8494/95/96A/B Attenuators do not have internal adjustments and should not be opened.

### Repair

The Keysight 8494/95/96A/B Attenuators are not recommended for repair as most components are not easily removed.

### Maintenance

The connectors, particularly the connector faces, must be kept clean. For instruction on connecting and care of your connectors, refer to the *Microwave Connector Care Quick Reference Card (08510-90360)*.

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This information is subject to change without notice. Always refer to the English version at the Keysight website for the latest revision.

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