

# Keysight 8497K Attenuator

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	<p>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.</p> <p>ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001.</p> <p>Cet appareil ISM est conforme a la norme NMB-001 du Canada.</p> <p>ISM GRP.1 Class A indicates that this is an Industrial Scientific and Medical Group 1 Class A product.</p>	<p><b>ICES/NMB-001</b></p> <p>ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001.</p> <p>Cet appareil ISM est conforme a la norme NMB-001 du Canada.</p>	
	<p>This symbol is a South Korean Class A EMC Declaration. This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home.</p>		
	<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>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.</p>		

## Waste Electrical and Electronic Equipment (WEEE) Directive

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/adapters](http://www.keysight.com/find/adapters)  
(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

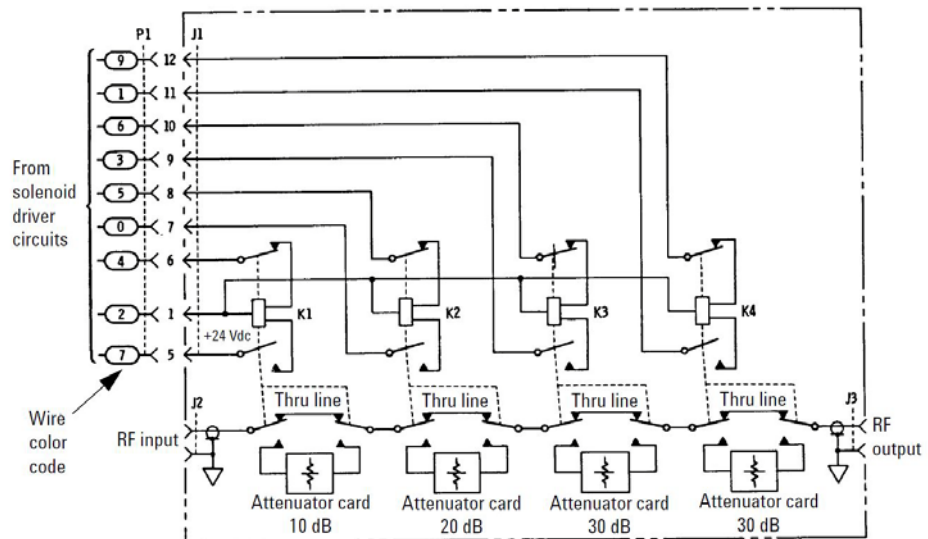
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This manual contains operating instructions for the Keysight 8497K programmable step attenuator. Included in the manual is information required to install and test these attenuators.

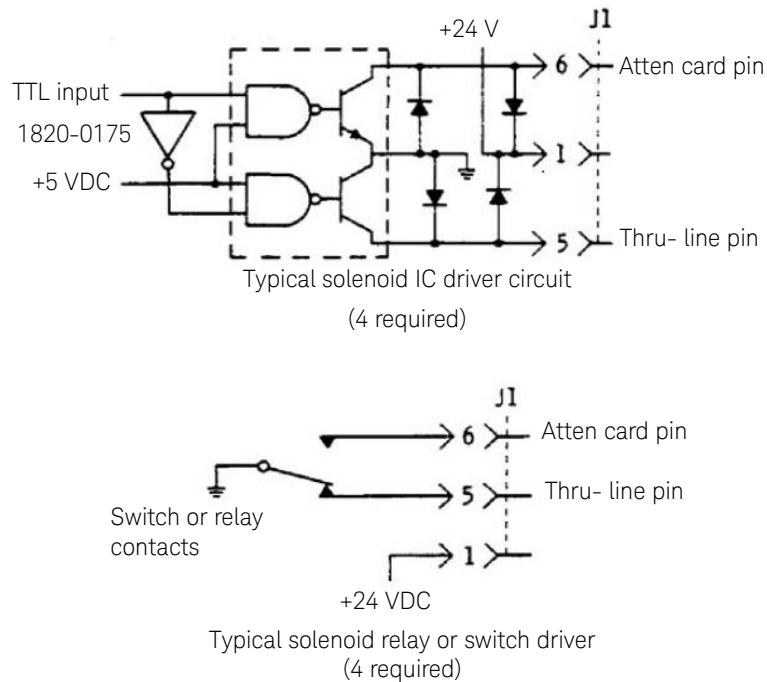
## Product Overview

The 8497K is a 50-ohm, dc to 26.5 GHz, 0 dB to 90 dB (in 10 dB steps), coaxial attenuator with APC 3.5 connectors. The attenuator is made up of four attenuation sections 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. The edge line controls are flexed by solenoid plungers (see Figure 1-1).

Each solenoid requires a drive of 20 V to 30 V. The switching current is approximately 125 mA at 24 Vdc per section. The solenoid switching time is less than 20 milliseconds including settling time. Once switched, the solenoid plungers are held in place by permanent magnets and the solenoid plungers automatically disconnect the selected coil drive and connect the opposite coil drive (see Figure 1-1 and Figure 1-2).



**Figure 1-1** 8497K programmable four-section attenuator schematic diagram



**Figure 1-2** Typical solenoid coil driver circuit

### 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

# Specifications

## Frequency range and attenuation

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

Frequency range	Attenuation
DC to 26.5 GHz	0 dB to 90 dB in 10 dB steps

## Attenuation accuracy

dB referenced from 0-dB setting<sup>[1]</sup>.

**Table 1-2** Attenuation accuracy

Frequency range	Attenuation setting (dB)								
	10	20	30	40	50	60	70	80	90
DC to 6.0 GHz	0.3	0.5	0.6	0.7	0.8	1.0	1.1	1.1	1.2
6.0 to 12.4 GHz	0.4	0.5	0.7	0.9	1.0	1.3	1.5	1.6	1.7
12.4 to 18.0 GHz	0.5	0.6	0.8	1.1	1.2	1.4	1.7	1.8	2.1
18.0 to 26.5 GHz	0.7	0.8	1.0	1.5	1.6	1.9	2.3	2.5	2.8

## Maximum SWR

Characteristic impedance, 50 ohms

[1] Typical step-to-step accuracy is 0.6 dB to 18.0 GHz, +0.9 dB to 26.5 GHz.

**Table 1-3** Maximum SWR

Frequency range (GHz)	Maximum SWR
DC to 6.0	1.25
6.0 to 12.4	1.45
12.4 to 18.0	1.60
18.0 to 26.5	1.80

Insertion loss

(0 dB position, f is frequency in GHz):  
(0.4 + 0.09 f) dB

Attenuation temperature coefficient

Less than 0.0001 dB/dB/°C.

Power sensitivity

<0.001 dB W

RF power handling capability

1 W average, 100 W peak with maximum pulse width of 10 microseconds.

Operating life

5 million cycles per section.

Attenuation repeatability

±0.03 dB, typical at 18.0 GHz  
±0.05 dB, typical at 26.5 GHz  
(5 million cycles per section)

## Switching speed

Maximum 20 milliseconds including settling time.

**Table 1-4** Switching speed

	Coil voltage	Switching current <sup>[a]</sup>	Nominal coil impedance
Solenoids	24 V (20 V to 30 V)	125 mA (24 V)	190 $\Omega$ (65 mH)

[a] Current per section: approximately 8 milliseconds duration before internal contacts open the coil circuit.

## Solenoid cable connectors

Refer to [Figure 1-2](#).

**Table 1-5** Solenoid cable connectors

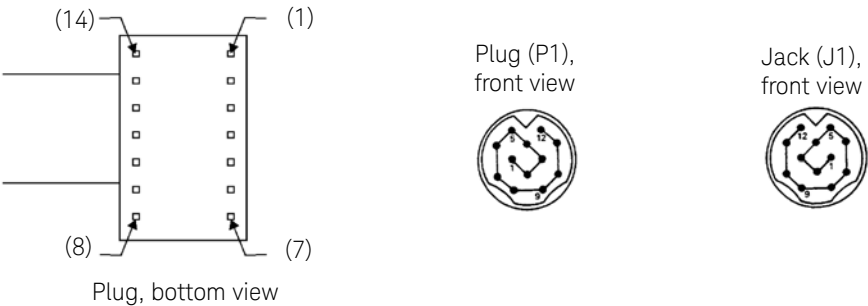
Section	Section 1		Section 2		Section 3		Section 4		Power V+
Solenoid Coil	Thru- line	Atten card	Thru- line	Atten card	Thru- line	Atten card	Thru- line	Atten card	
Cable wire color code <sup>[a]</sup>	PUR	YEL	BLK	GRN	ORN	BLU	BRN	WHT	RED
Connector plug pin number <sup>[b]</sup>	5	6	7	8	9	10	11	12	1
Attenuation	0 dB	10 dB	0 dB	20 dB	0 dB	30 dB	0 dB	30 dB	-
Option 016									
Flat pack plug pin number <sup>[c]</sup>	13	2	11	5	3	9	4	10	6

[a] Five-foot cable and mating plug assembly provided.

[b] Pin 1 (red wire) is common for all coils. Pins 2, 3, and 4 are not used.

[c] Pin 6 is common for all coils. Pins 1, 7, 8, 12, and 14 are not used.





**Figure 1-3** Solenoid cable pin configuration

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This chapter contains the environmental tests on the Keysight 8497K programmable step attenuator that fully comply with Keysight Technologies' product operating environmental specifications. The physical dimensions are illustrated in the later section.

# Environmental Specifications

The Keysight 8497K Attenuator is designed to fully comply with Keysight Technologies' product operating environmental specifications as shown in [Table 2-1](#).

**Table 2-1** Environmental specifications

Characteristic	Value
<b>Temperature</b>	
– Operating	0 °C to +55 °C
– Storage	–40 °C to +75 °C
<b>Humidity</b>	
– Operating	<95% relative / –0 relative at 40 °C
– Storage	<95% at 40 °C
<b>Altitude</b>	
– Operating	<4600 m (15000 ft)
– Storage	<15300 m (50000 ft)
<b>Shock</b>	
– Operating	10 Gs, six ms, on six sides, three blows
– Non-operating	500 Gs, 1.8 ms, in six directions
<b>Vibration</b>	
– Operating	5 Gs, 34 Hz to 2000 Hz
<b>EMC</b>	Radiated interference is within the requirements of MIL-STD-461, RE02

## Physical Dimensions

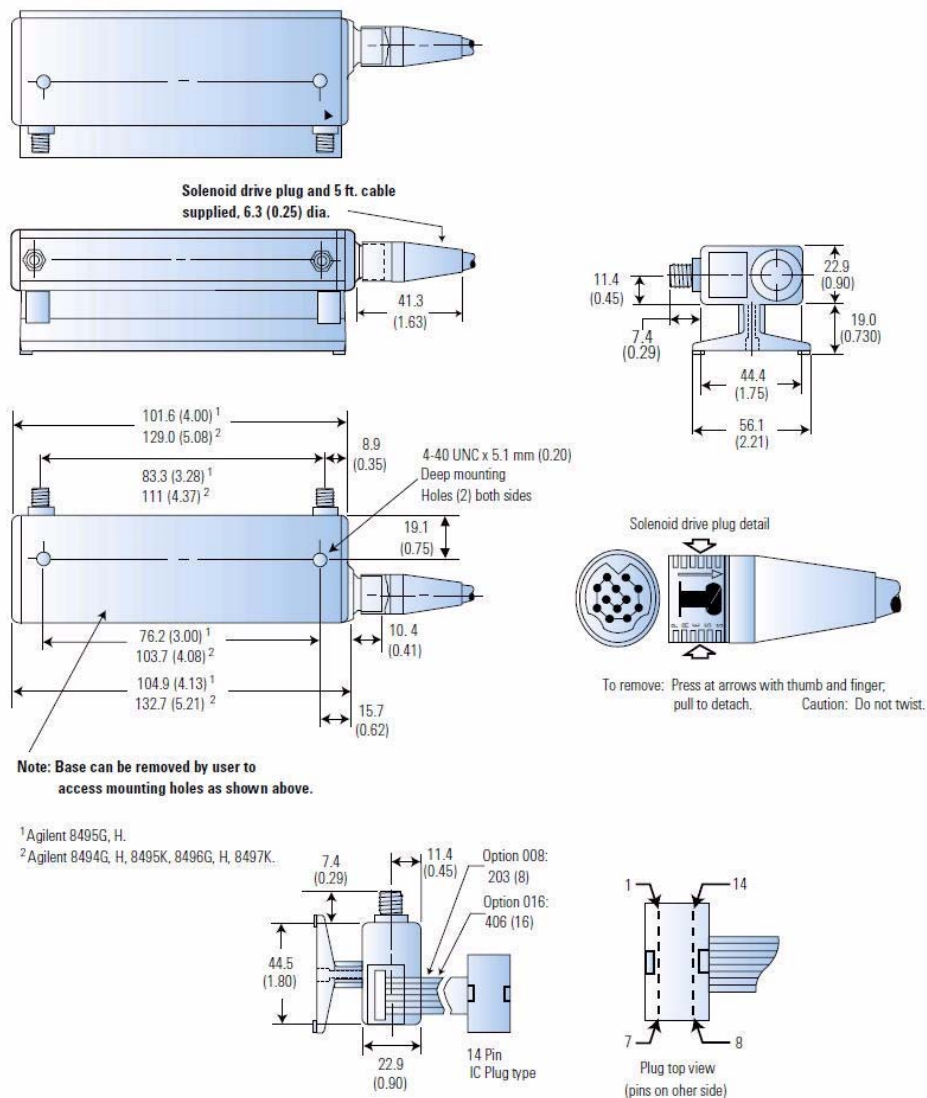
Table 2-2 shows the physical dimensions of the 8497K Attenuator.

**Table 2-2**      Physical dimensions

Connectors	Net weight	Dimension
APC 3.5 female (SMA compatible)	16 oz 454 g	Per Figure 2-1

Attenuators are warranted only when they are operated within their specifications, especially power handling capability.

## 2 Environmental Specifications & Physical Dimensions



**Figure 2-1** Dimensions of Keysight 8497K attenuator

# 3 Operating Guides

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This chapter describes the installation of the Keysight 8497K programmable step attenuator. The operating instruction quick-check procedure is included for verification test prior to usage.

## Installation

### Initial inspection

- 1** Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been 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 28 or “**Performance tests**” on page 29.
- 2** If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, contact the nearest Keysight Technologies Sales and Service office. Refer to the Service and Support information in the front matter 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 materials or their equivalents. Keysight Technologies can provide packaging materials identical to the original materials. Refer to Service and Support information in the front matter 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.

### Mating connectors

The APC 3.5 connector is a 3.5 mm air line connector that will mate with the SMA type connectors. The SWR performance of this hybrid connection is similar to a mated pair of SMA connectors when used within the frequency range of the SMA connector.

#### Option

The attenuators are configured with the APC 3.5 female connectors and are designated as Option 004 for ordering purposes.



**CAUTION**

When installing the attenuator, make sure that the connectors do not support weight or bear torque. The preferred procedure is to set all equipment in position before connecting the attenuator.

---

## Installation instructions

The solenoid drive cable connector plug is connected by aligning the plug (P1) with the jack (J1) on the attenuator, and then pushing the plug over the jack. The plug is removed by grasping the ribbed sides of the plug and squeezing them together while pulling back until the plug clears the jack.

## 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.

---

**CAUTION**

Do not ground both solenoid drive pins of the programmable attenuator at the same time. This causes rapid cycling of the solenoid and could reduce the operating life of the attenuator. The rapid cycling may produce a buzzing sound from the attenuator.

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### Operating information

Either RF connector may be used as the input or output connector. Connect the solenoid drive cable of the programmable attenuator to the solenoid drive connector (J1). By applying the proper voltage and grounds to the proper pins of J1, the attenuator will either increase or decrease the amount of attenuation as selected. (see [Figure 3-1](#))

The table below shows the switching arrangement to increase the amount of attenuation from 0 to 90 dB in 10 dB steps. To ensure specified performance, it is recommended that the attenuator sections that are shown in the table below to be used. Also, when changing attenuation, it is good practice to insert the required sections before deletion of the unneeded sections. With the attenuator set for 0 dB attenuation, only the insertion loss (residual attenuation) remains.

Table 3-1      Switching order

Attenuation (dB)	Attenuator sections			
	1 10 dB	2 20 dB	3 30 dB	4 30 dB
10	x			
20		x		
30				x
40	x			x
50		x		x
60			x	x
70	x		x	x
80		x	x	x
90	x	x	x	x

## Operator's check

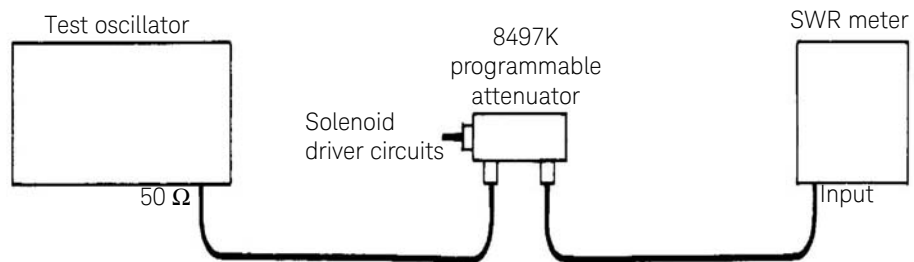
The Operator's Check is supplied to allow the operator to make a quick check of the instrument prior to use or if a failure is suspected.

### Description

The attenuator is driven from a 50-ohm 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 3-1** Operator's check setup

### Procedure

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

**Table 3-2** Attenuator and SWR settings

SWR meter range (dB)	Attenuation		Meter Indication (dB)	
	8495D/K	Minimum	Actual	Maximum
2	0	-	Set to 0.5	-
6	10	1.35	-	1.65
12	20	0.25	-	0.75
16	30	1.20	-	1.80
22 <sup>[a]</sup>	40	0.15	-	0.85
26 <sup>[a]</sup>	50	1.10	-	1.90
32 <sup>[a]</sup>	60	0.00	-	1.00
36 <sup>[a]</sup>	70	0.95	-	2.05
42 <sup>[a]</sup>	80	-0.05	-	1.10
46 <sup>[a]</sup>	90	0.90	-	2.10

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

Performance tests

The Keysight 8497K Attenuator 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 8497K Attenuator does not have internal adjustments and should not be opened.

### **Repair**

The Keysight 8497K Attenuator is 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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