

Agilent 8495D/K Attenuators

Operating and Service Manual



Agilent Technologies

Notices

© Agilent Technologies, Inc. 2011

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 Agilent Technologies, Inc. as governed by United States and international copyright laws.

Manual Part Number

08495-90027

Edition

Third Edition, January 2011

Printed in Malaysia

Agilent Technologies, Inc.
Phase 3 Bayan Lepas Free Industrial Zone
Bayan Lepas, Penang 11900 Malaysia

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, Agilent 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. Agilent 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 Agilent 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

U.S. Government Restricted Rights. Software and technical data rights granted to the federal government include only those rights customarily provided to end user customers. Agilent provides this customary commercial license in Software and technical data pursuant to FAR 12.211 (Technical Data) and 12.212 (Computer Software) and, for the Department of Defense, DFARS 252.227-7015 (Technical Data - Commercial Items) and DFARS 227.7202-3 (Rights in Commercial Computer Software or Computer Software Documentation).

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the likes of 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 likes of 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.

Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST, formerly NBS), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of the other International Standards Organization members.

WEEE Compliance






This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control Instrumentation" product.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Agilent office, or see www.agilent.com for more information.

Regulatory Markings

	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.
	The CSA mark is a registered trademark of the Canadian Standards Association.
ICES/NMB-001	This text indicates that this ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.
ISM 1-A	This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).
	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.

Contacting Agilent

For more information, please contact your nearest Agilent office.

Americas

Canada	(877) 894-4414
Latin America	305 269 7500
United States	(800) 829-4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	81 426 56 7832
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Thailand	1 800 226 008

Europe

Austria	0820 87 44 11
Belgium	32 (0) 2 404 93 40
Denmark	45 70 13 15 15
Finland	358 (0) 10 855 2100
France	0825 010 700
Germany	01805 24 6333
Ireland	1890 924 204
Italy	39 02 92 60 8484
Netherlands	31 (0) 20 547 2111
Spain	34 (91) 631 3300
Sweden	0200-88 22 55
Switzerland(French)	41 (21) 8113811 (Opt 2)
Switzerland(German)	0800 80 53 53 (Opt 1)
United Kingdom	44 (0) 118 9276201
Other European Countries:	www.agilent.com/find/contactus

Or, go to www.agilent.com/find/assist for more information.

This page is intentionally left blank.

Contents

1	Introduction	9
	Product Overview	10
	Supplied Accessories	12
	Specifications	15
	Frequency Range and Attenuation	15
	Attenuation Accuracy	15
	Maximum Insertion Loss	15
	Attenuation Repeatability	16
	RF Power Handling Capability	16
	Solenoid Drive	16
	Switching Speed	16
	Maximum SWR	17
	Operating Life	17
2	Environmental Specifications & Physical Dimensions	19
	Environmental Specifications	20
	Physical Dimensions	21
3	Operating Guides	25
	Installation	26
	Initial Inspection	26
	Mating Connectors	27
	Installation Instructions	27
	Operating Instructions	28
	Operating Information	28
	Operator's Check	28
	Performance Tests	31
	Service Instructions	31

This page is intentionally left blank.



1 Introduction

Product Overview	10
Supplied Accessories	12
Specifications	15
Frequency Range and Attenuation	15
Attenuation Accuracy	15
Maximum Insertion Loss	15
Attenuation Repeatability	16
RF Power Handling Capability	16
Solenoid Drive	16
Switching Speed	16
Maximum SWR	17
Operating Life	17

This manual contains operating instructions for the Agilent 8495D/K Attenuators. Included in the manual is information required to install and test these attenuators.



Product Overview

The Agilent 8495D and 8495K are 50-ohm, dc to 26.5 GHz, 0 dB to 70 dB (in 10 dB steps), coaxial attenuators with APC 3.5 connectors. Each 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. In the 8495D, the edge line controls are flexed by low-torque cams. In the 8495K, the edge line controls are flexed by solenoid plungers (see [Figure 1](#)).

[Table 1](#) on [page 12](#) shows the switching arrangement required to increase the amount of attenuation from 0 dB to 70 dB in 10 dB steps. In the 8495K, to ensure specified performance, it is recommended that the attenuator sections shown in the table below 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.

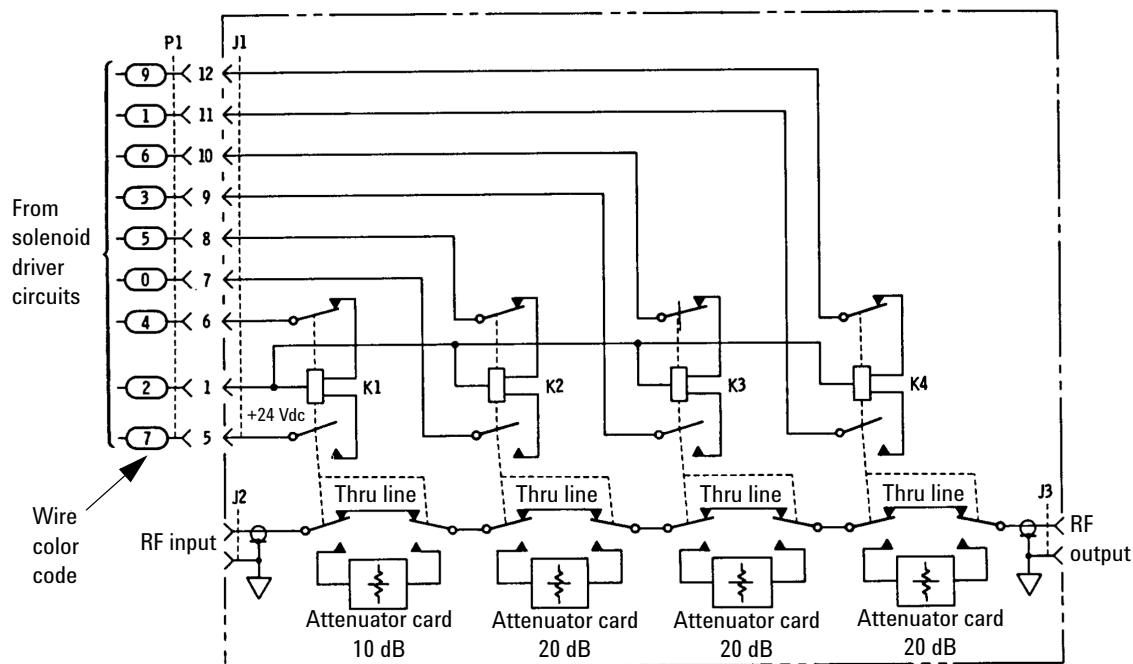


Figure 1 8495K Programmable Four-Section Attenuator Schematic Diagram

In the 8495K, each solenoid requires a drive of 20 V to 30 V. The switching current is approximately 125 mA at 24 Vdc per section for the 8495K. 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](#) on page 11 and [Figure 3](#) on page 14).

Table 1 Attenuator Switching

Attenuator Sections				
Attenuation (dB)	1 10 dB	2 20 dB	3 20 dB	4 20 dB
10	×			
20			× ^[1]	× ^[2]
30	×		× ^[1]	× ^[2]
40		×		×
50	×	×		×
60		×	×	×
70	×	×	×	×

[1] D model only

[2] K model only

CAUTION

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

Supplied Accessories

A solenoid drive cable is supplied with the 8495K. The cable is 1.5 m (5 ft) long with a mating connector plug on one end and the other end is unterminated (see [Figure 2](#) on [page 13](#)).

Solenoid Cable Connectors

Refer also to [Figure 2](#) on page 13.

Table 2 Solenoid Cable Connectors

Section	Section 1		Section 2		Section 3		Section 4		Power V+
	Thru-Line	Atten Card	Thru-Line	Atten Card	Thru-Line	Atten Card	Thru-Line	Atten Card	
Solenoid Coil									
Cable Wire Color Code ^[1]	PUR	YEL	BLK	GRN	ORN	BLU	BRN	WHT	RED
Connector Plug Pin Number ^[2]	5	6	7	8	9	10	11	12	1
8495K	0 dB	10 dB	0 dB	20 dB	0 dB	20 dB	0 dB	20 dB	–
Option 016 Flat Pack Plug Pin Number ^[3]	13	2	11	5	3	9	4	10	6

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

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

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

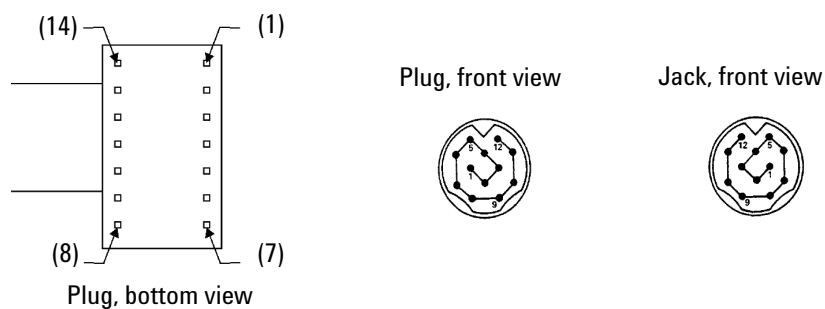


Figure 2 Solenoid Cable Pin Configuration

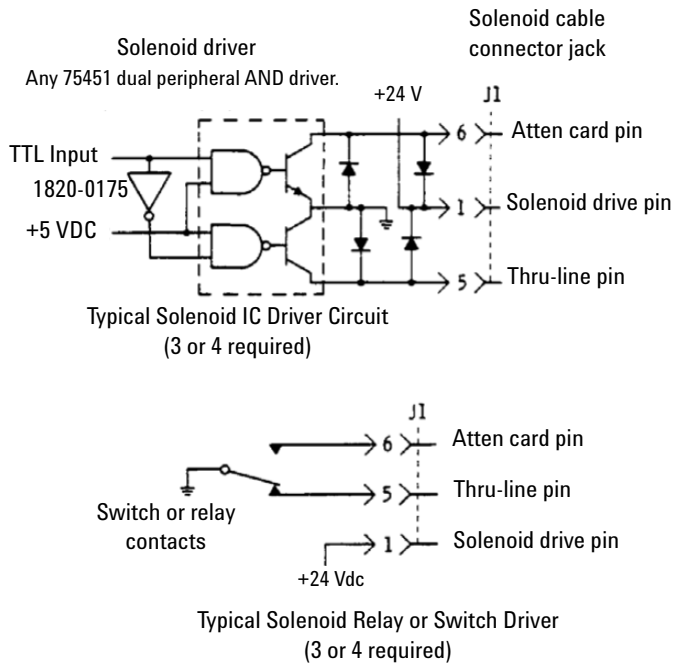


Figure 3 Typical Solenoid Coil Driver Circuit

Specifications

Frequency Range and Attenuation

Table 3 Frequency Range and Attenuation

Frequency Range	dc to 26.5 GHz
Attenuation	0 dB to 70 dB in 10 dB steps

Attenuation Accuracy

Table 4 Attenuation Accuracy

Attenuation Accuracy (\pm dB, referenced from 0 dB)				
Attenuation Selection (dB)	dc–6.0 GHz	6.0–12.4 GHz	12.4–18.0 GHz	18.0–26.5 GHz
10	0.3	0.4	0.5	0.7
20	0.5	0.5	0.6	0.8
30	0.6	0.7	0.8	1.0
40	0.7	0.9	1.1	1.5
50	0.8	1.0	1.2	1.6
60	1.0	1.3	1.4	1.9
70	1.1	1.5	1.7	2.3

Maximum Insertion Loss

$$(0.4 + 0.09 f) \text{ dB}$$

where “f” is the frequency in GHz.

Attenuation Repeatability

±0.03 dB max to 18 GHz
±0.05 dB max to 26.5 GHz
(5 million cycles per section)

RF Power Handling Capability

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

Solenoid Drive

For Agilent 8495K only.

Table 5 Solenoid Drive

Solenoid Drive	Coil Voltage	Switching Current
8495K	20 Vdc to 30 Vdc	125 mA at 24 V (approx.)

Switching Speed

Maximum 20 milliseconds including settling time.

Maximum SWR

Table 6 Maximum SWR

Instrument	Frequency Range (GHz)	Maximum SWR
8495D, 8495K	dc to 6.0	1.25
	6.0 to 12.4	1.45
	12.4 to 18.0	1.9
	18.0 to 26.5	2.2

Operating Life

5 million cycles per section.

This page is intentionally left blank.



2 Environmental Specifications & Physical Dimensions

Environmental Specifications 20

Physical Dimensions 21

This chapter contains the environmental tests on the Agilent 8495D/K Attenuators that fully comply with Agilent Technologies' product operating environmental specifications. The physical dimensions are illustrated in the later section.



Environmental Specifications

The Agilent 8495D/K Attenuators are designed to fully comply with Agilent Technologies' product operating environmental specifications as shown in [Table 7](#).

Table 7 Environmental Specifications

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

Physical Dimensions

Table 8 shows the physical dimensions of the Agilent 8495D/K Attenuators.

Table 8 Physical Dimensions

Instrument	Dimensions^[1]	Weight
8495D	Per Figure 4	15 oz 425 g
8495K	Per Figure 5	16 oz 454 g

[1] Dimensions are in millimeters and inches. Dimensions are for general information only. If dimensions are required for building special enclosures, contact your Agilent field engineer.

2 Environmental Specifications & Physical Dimensions

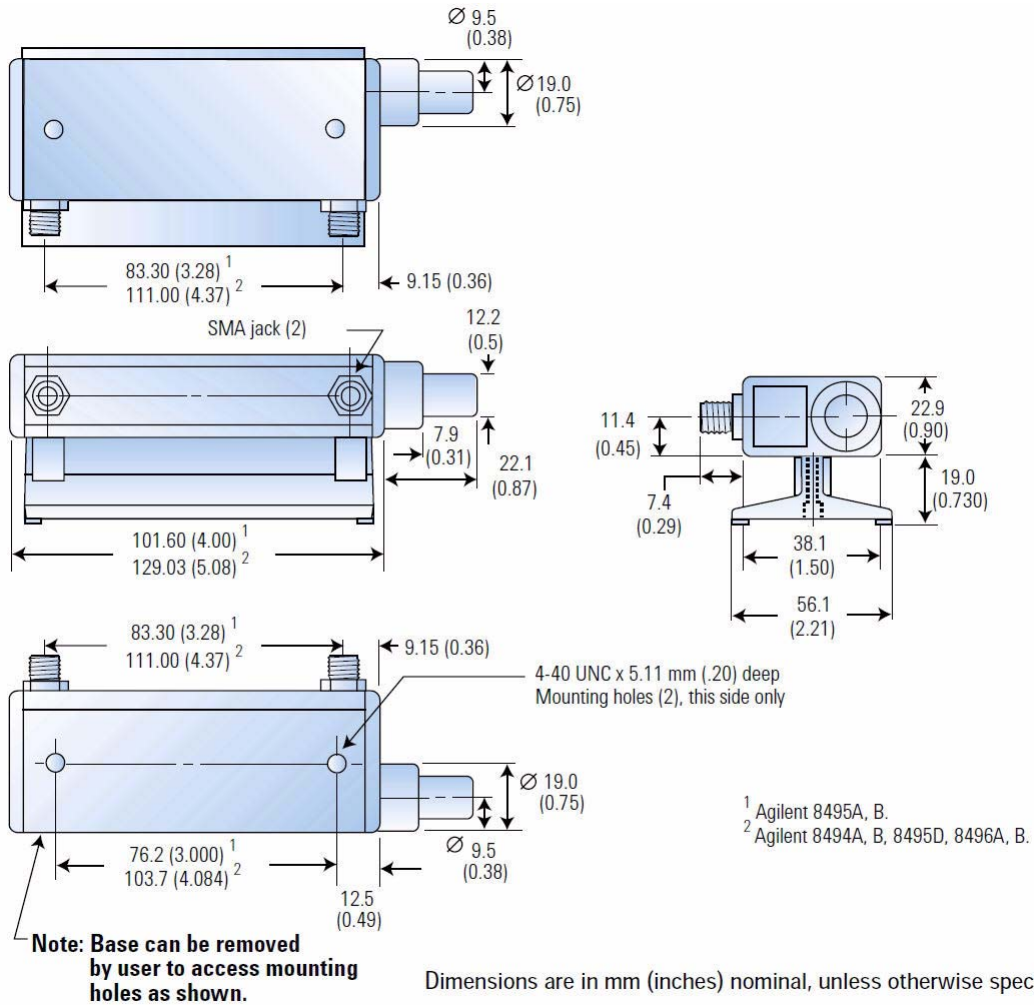


Figure 4 Dimensions of Agilent 8495D Attenuator

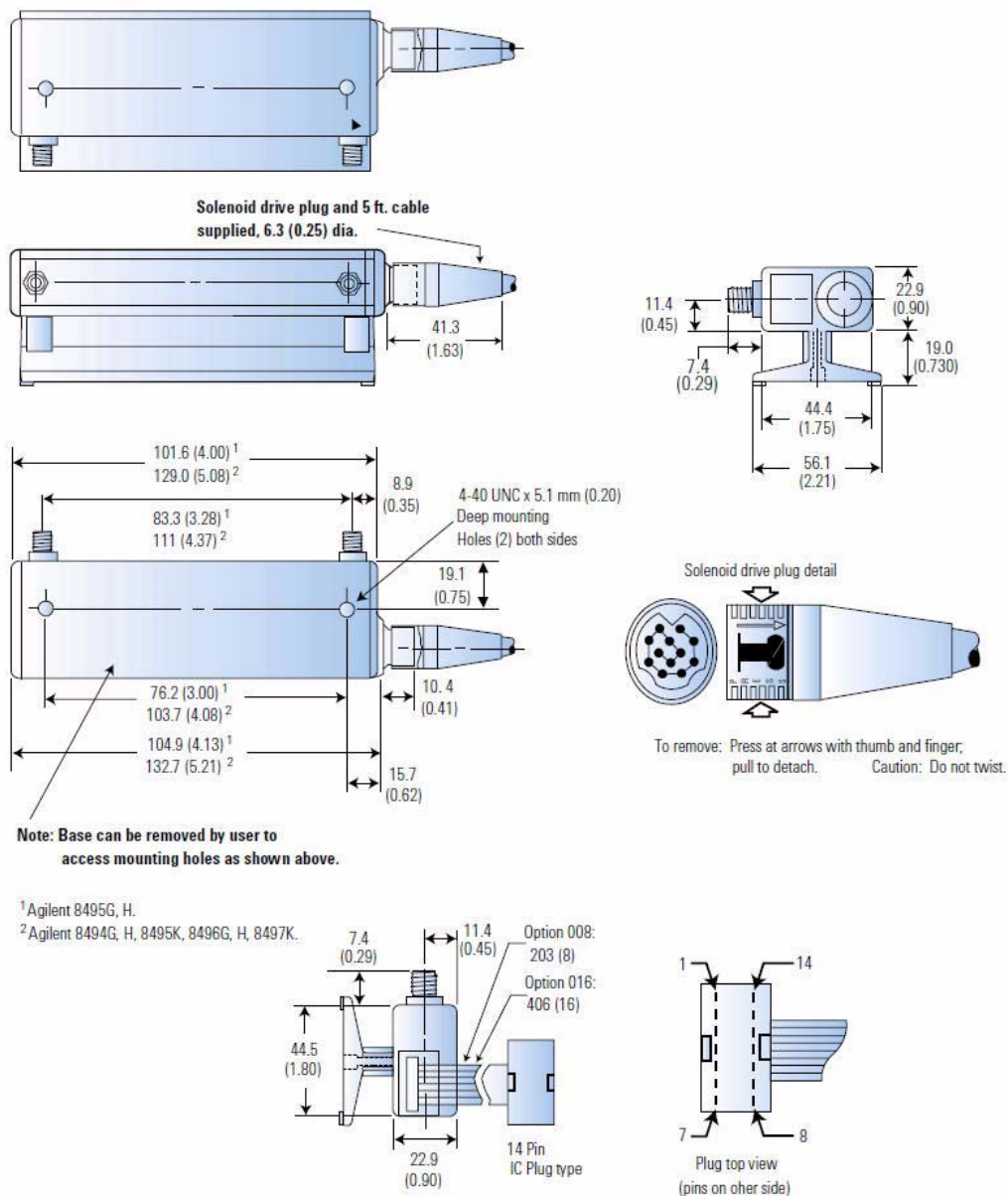
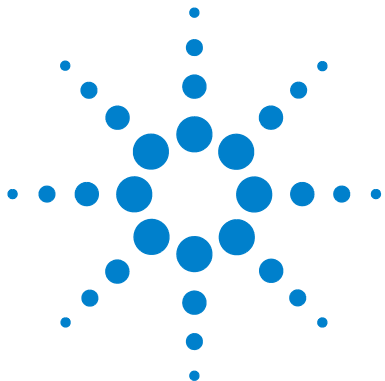


Figure 5 Dimensions of Agilent 8495K Attenuator

2 Environmental Specifications & Physical Dimensions

This page is intentionally left blank.



3 Operating Guides

Installation	26
Initial Inspection	26
Mating Connectors	27
Installation Instructions	27
Operating Instructions	28
Operating Information	28
Operator's Check	28
Performance Tests	31
Service Instructions	31

This chapter describes the installation of the Agilent 8495D/K Attenuators. 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 31.
- 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 Agilent Technologies Sales and Service office. Refer to the Service and Support information in the front matter of this manual. Agilent 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. Agilent 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 Agilent 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.

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 8495K 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

For the 8495K, 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.

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.

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.

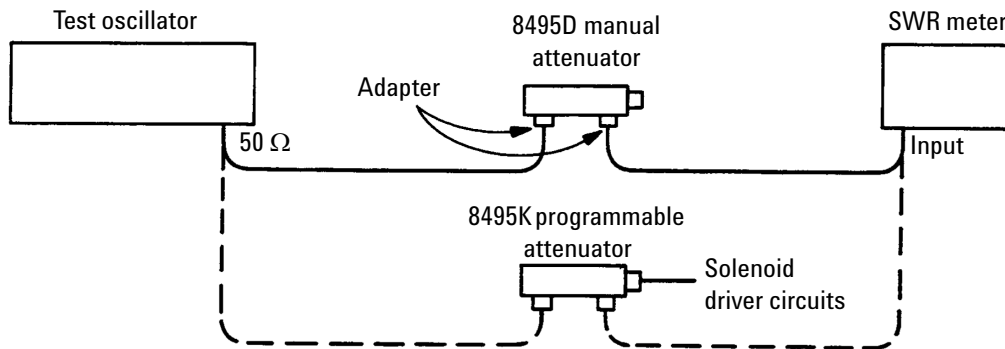


Figure 6 Operator's Check Setup

Procedure

- 1 Connect equipment as shown in [Figure 6](#) on [page 29](#) 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 9](#) and verify that the SWR meter indicates within the limits shown.

Table 9 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	1.20	–	1.80
12	20	0.15	–	0.85
16	30	1.05	–	1.95
22 ^[1]	40	–0.40	–	1.40
26 ^[1]	50	0.50	–	2.50
32 ^[1]	60	–0.60	–	1.60
36 ^[1]	70	0.35	–	2.65

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

Performance Tests

The Agilent 8495D/K 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 Agilent 8495D/K Attenuators do not have internal adjustments and should not be opened.

Repair

The Agilent 8495D/K 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 Microwave Connector Care Quick Reference Card (08510- 90360).

This page is intentionally left blank.