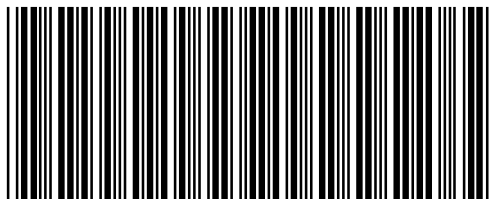

Agilent Technologies
8497K 90 dB Attenuator

**Operating and Service
Manual**



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Safety and Regulatory Information

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. This product has been designed and tested in accordance with international standards.








WARNING

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

CAUTION

The **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, 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.

Instrument Markings

	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.
	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.
1SM1-A	This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).
	This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB du Canada.
	This symbol indicates that the power line switch is ON.



This symbol indicates that the power line switch is OFF or in STANDBY position.

Safety Earth Ground

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

Before Applying Power

Verify that the product is configured to match the available main power source as described in the input power configuration instructions in this manual. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

Instrument Definition

This manual applies to the Agilent Technologies 8497K programmable step attenuator. This manual contains information necessary to operate and service the attenuator.

Instruments Covered by Manual

The attenuators covered by this manual have a two-part serial number. The first four digits and letter constitute the serial number prefix. The last five digits form the sequential suffix that is unique to each attenuator. The contents of this manual apply directly to the attenuators having the serial number prefix(es) 2544A and above.

An attenuator manufactured after the printing of this manual may have a serial number prefix that is not listed above. This unlisted serial number prefix indicates that the attenuator is different from those documented in this manual. The manual for these attenuators is supplied with a yellow Manual Changes supplement that contains change information to document the differences. Complimentary copies of the supplement are available from Agilent Technologies.

Description

The 8497K is a 50-ohm, dc to 26.5 GHz, 0 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 on page 2](#)).

Each solenoid requires a drive of 20 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](#) and [Figure 2 on page 3](#)).

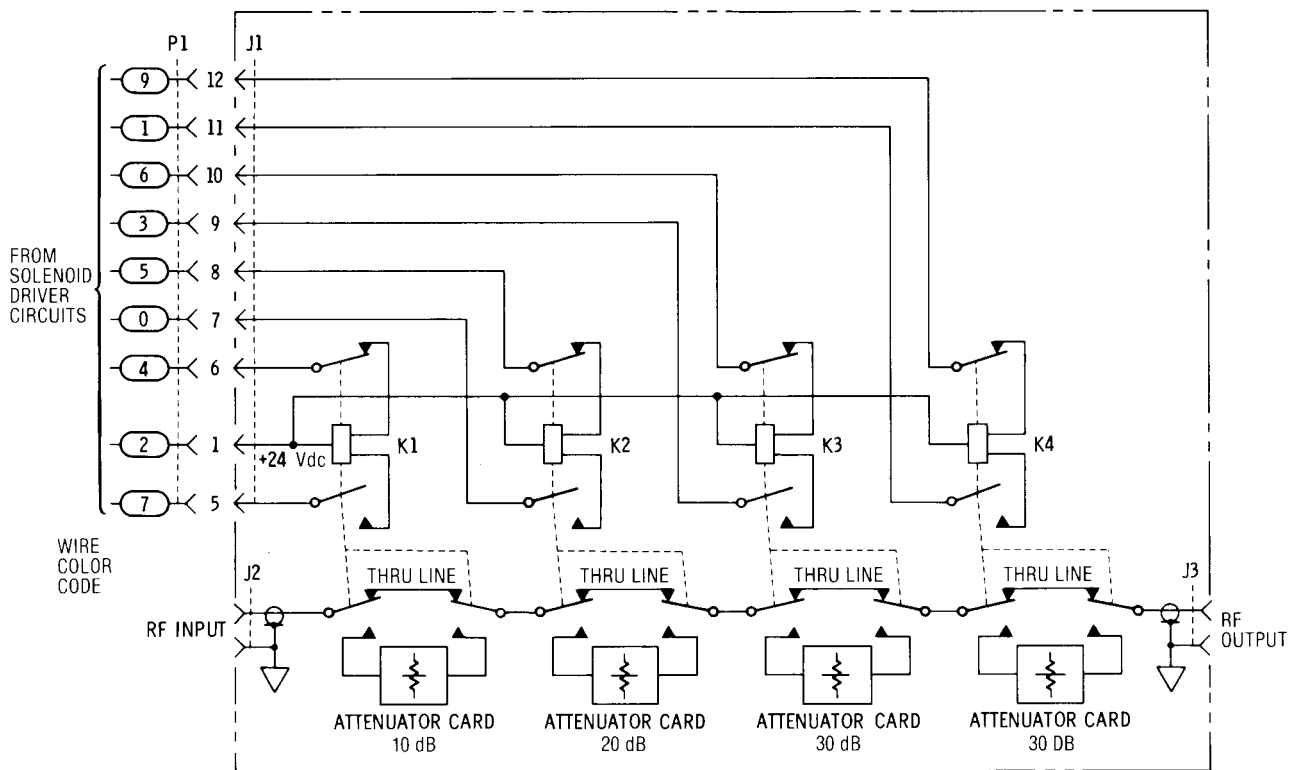
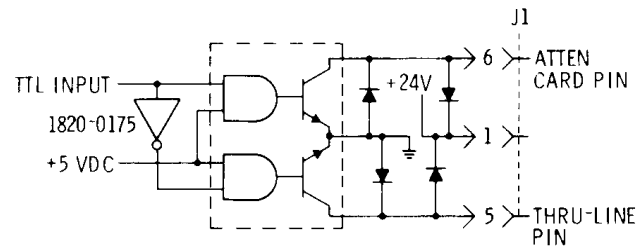
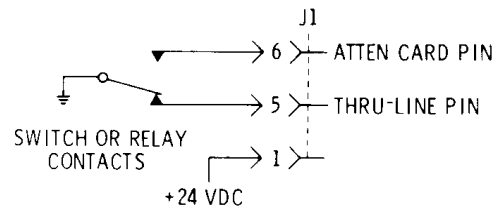


Figure 1 8497K Programmable Four-Section Attenuator Schematic Diagram



TYPICAL SOLENOID IC DRIVER CIRCUIT
(4 REQUIRED)



TYPICAL SOLENOID RELAY OR SWITCH DRIVER
(4 REQUIRED)

Figure 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 microseconds. 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.

Specifications

Electrical

Frequency Range	dc to 26.5 GHz
Dynamic Range	0 to 90 dB in 10 dB steps

Attenuation Accuracy *(dB referenced from 0-dB setting):

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

*Typical step-to-step accuracy is 0.6 dB to 18 GHz, +0.9 dB to 26.5 GHz.

Maximum SWR Characteristic impedance, 50 ohms

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 Input Power (maximum) 1 W average, 100 W peak (10 μs pulse width)

Life (minimum) 5 million cycles per section

Repeatability 0.01 dB typical, for up to 5 million cycles to 18 GHz
0.05 dB typical, for up to 5 million cycles to 26.5 GHz

EMC Radiated interference is within the requirements of MIL-STD-461, RE02.

Switching Speed Maximum 20 milliseconds including settling time

	Coil Voltage	Switching Current*	Nominal Coil Impedance
Solenoids	24V (20 to 30 V)	125 mA (24 V)	190Ω (65 mH)

*Current per section: approximately 8 milliseconds duration before internal contacts open the coil circuit. Solenoid pin and color code assignment guide

Mechanical

Connectors	APC 3.5 female (SMA compatible)
Net Weight	16 oz 454 grams
Dimensions	5.6x2.1x1.7 in 143x52x43 mm

Attenuators are warranted only when they are operated within their specifications, especially power handling capability. Be sure to observe the following caution.

CAUTION

Do not exceed the RF power rating of 1W average or 100W peak with a maximum pulse width of 10 μs. 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

Storage and Shipping Environment

The attenuator should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature	-40 to +75 °C
Humidity	< 95% @ 40 °C
Altitude	< 15300 m (50000 ft)

Specifications

Operating Environment

The operating environment of the attenuator should be within the following limitations:

Temperature	0 to +55 °C
Humidity	< 95% / -0 relative @ 40 °C
Altitude	< 4600 m (15000 ft)

Solenoid Cable Connectors

Refer to [Figure 3](#).

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 ¹	PUR	YEL	BLK	GRN	ORN	BLU	BRN	WHT	RED
Connector Plug Pin Number ²	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 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.

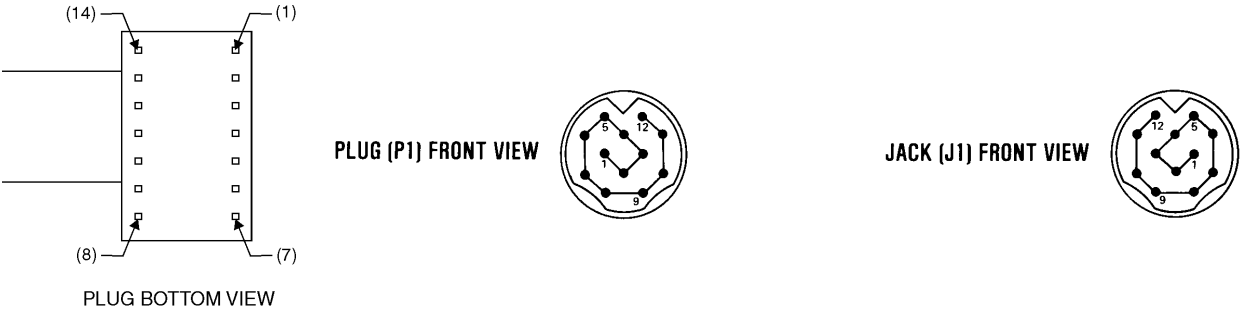


Figure 3 Solenoid Cable Pin Configurations

Installation

Initial Inspection

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 mechanically and electrically. A procedure for checking electrical performance is given under “[Operator's Check](#)” on [page 10](#) (also see “[Performance Tests](#)” on [page 11](#)). If the contents of the shipment are incomplete, if there is mechanical damage or defect, or if the attenuator does not pass the electrical performance test, notify the nearest Agilent Technologies office. Keep the shipping materials for the carrier's inspection.

NOTE

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

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 2 on page 3](#)).

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.

Attenuator (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 attenuator 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 and therefore the range changes and errors (read in dB) are twice that indicated by the meter.

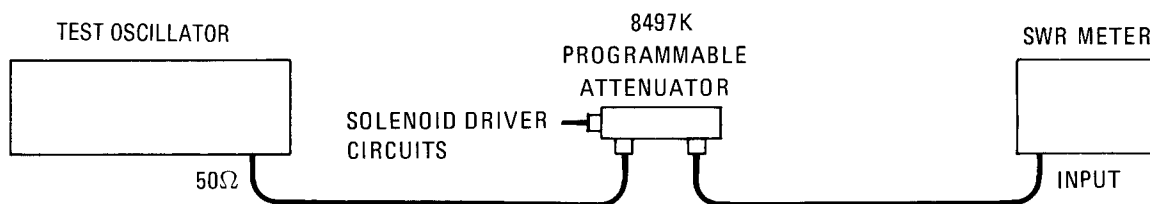


Figure 4 Operator's Check

Procedure

1. Connect equipment as shown in [Figure 4](#) 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 oscillator frequency to obtain maximum meter indication.
4. Set attenuator and SWR meter range switch as indicated in [Table 1](#) and verify that SWR meter indicates within limits shown.

Table 1 Attenuation and SWR Settings

SWR Meter Range (dB)	Attenuation (dB)	Meter Indication (dB)		
		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 ¹	40	0.15		0.85
26 ¹	50	1.10		1.90
32 ¹	60	0.00		1.00
36 ¹	70	0.95		2.05
42 ¹	80	-0.05		1.10
46 ¹	90	0.90		2.10

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

Performance Tests

The attenuator can be tested to the accuracy of the **Specifications**, page 4 with an automatic network analyzer or equivalent equipment of suitable accuracy. If an automatic network analyzer is available, test the attenuator using the procedures in the analyzer's operating manual. The attenuator must be programmed by a suitable circuit to provide the various values of attenuation (see [Figure 5 on page 13.](#))

NOTE

The attenuator has no internal adjustments and should not be opened. If defective, return the attenuator to the nearest Agilent Technologies office for repair.

Replaceable Parts

The following table lists replaceable parts. These are the only parts that can be replaced without access to the interior of the attenuator. If any parts not listed below need replacement, return the instrument to Agilent Technologies.

CAUTION

Due to special fixtures necessary for assembly, do *not* attempt to replace any parts not listed in table below. If the instrument is opened, the warranty is void.

To order a part listed in the replaceable parts table, quote the Agilent part number, indicate the quantity required, and address the order to the nearest Agilent Technologies office.

Description	Part Number
Cable, solenoid drive, 1.5 m (5 ft) long, connector plug on one end and other end un-terminated	8120-2178
Screws for both bases: 4-40 x 7/8 in. Fillister head	2220-0006
Base	5041-3888
Connector plug and contacts only without cable	*TKP12-100-P-TS-100-AU

*Available from distributors of Viking Industries, Inc., Chatsworth CA 91311

Troubleshooting

Troubleshooting consists of performing the Operator's Check shown in [Figure 4 on page 10](#). If the instrument does not perform within limits, return the instrument to Agilent Technologies for repair.

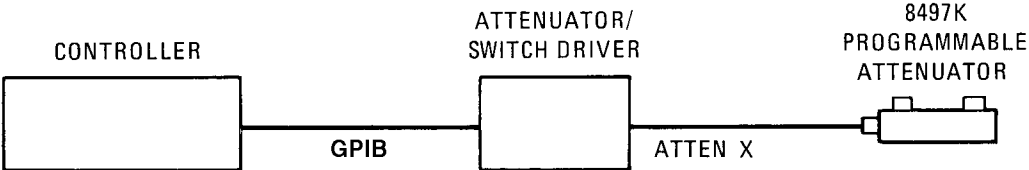


Figure 5 Typical GPIB Interconnection Diagram