Agilent Technologies

Agilent Technologies 8494A/B, 8495A/B, and 8496A/B Attenuators

Operating and Service Manual

Agilent Part Number: 08494-90008
Printed in USA
Print Date: October 2000
Supersedes: August 1991

Notice

The information contained in this document is subject to change without notice.

Agilent Technologies makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Agilent Technologies assumes no responsibility for the use or reliability of its software on equipment that is not furnished by Agilent Technologies.

RESTRICTED RIGHTS LEGEND

Use, duplication, or disclosure by the U.S. Government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013 for DOD agencies, and subparagraphs (c)(1) and (c)(2) of the Commercial Computer Software Restricted Rights clause at FAR 52.227-19 for other agencies.

Agilent Technologies, Inc.
1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799, U.S.A.

What You'll Find In This Manual…

Warranty

Custom systems are warranted by contractual agreement between Agilent Technologies and the customer.

Certification

Agilent Technologies, Inc., 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 other International Standards Organization members.

Warranty

This Agilent Technologies system product is warranted against defects in materials and workmanship for a period corresponding to the individual warranty periods of its component products. Instruments are warranted for a period of one year. During the warranty period, Agilent Technologies will, at its option, either repair or replace products that prove to be defective.

Warranty service for products installed by Agilent Technologies and certain other products designated by Agilent Technologies will be performed at Buyer's facility at no charge within Agilent Technologies service travel areas. Outside Agilent Technologies service travel areas, warranty service will be performed at Buyer's facility only upon Agilent Technologies' prior agreement and Buyer shall pay Agilent Technologies' round trip travel expenses. In all other areas, products must be returned to a service facility designated by Agilent Technologies.

For products returned to Agilent Technologies for warranty service, Buyer shall prepay shipping charges to Agilent Technologies and Agilent Technologies shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Agilent Technologies from another country.

Agilent Technologies warrants that its software and firmware designated by Agilent Technologies for use with an instrument will execute its programming instructions when properly installed on that instrument. Agilent Technologies does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY. The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. AGILENT TECHNOLOGIES SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. AGILENT TECHNOLOGIES SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

YEAR 2000. Agilent Technologies warrants that each Agilent Technologies hardware, software, and firmware product on Agilent Technologies' Corporate Price List (dated July 1, 1998 or later) delivered under the product's contract of sale will be able to accurately process date data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000, including leap year calculations, when used in accordance with the product documentation provided that all other products (that is, hardware, software, firmware) used in combination with such Agilent Technologies product(s) properly exchange date data with it. If the agreement requires that specific Agilent Technologies products must perform as a system in accordance with the foregoing warranty, then that warranty will apply to those Agilent Technologies products as a system, and Customer retains sole responsibility to ensure the year 2000 readiness of its information technology and business environment. The duration of this warranty extends through January 31, 2001.

The remedies available under this warranty will be defined in, and subject to, the terms and limitations of the warranties contained in the contract of sale. To the extent permitted by local law, this warranty applies only to branded Agilent Technologies products and not to products manufacture by others that may be sold or distributed by Agilent Technologies. Nothing in this warranty will be construed to limit any rights or remedies provided elsewhere in the contract of sale with respect to matters other than year 2000 compliance.

Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products.

For assistance, call your local Agilent Technologies Sales and Service Office (refer to "Service and Support" on page vi).

Service and Support

Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your customer engineer through your local Agilent Technologies Service Center. You can find a list of local service representatives on the Web at:

`http://www.agilent.com/find/assist`

Click on “Contact Us” and select your country.

If you do not have access to the Internet, one of these centers can direct you to your nearest Agilent Technologies representative:

United States	(800) 403-0801
Canada	(877) 429-9969
Europe	(41 22) 780.6111 (Switzerland) (33 1) 69 82 66 66 (France) (49 7031) 464-6222 (Germany) (44 188) 9696622 (Great Britain)
Japan	0120-32-0119
Latin America	(11) 7297-3700 (Brazil)
Australia/New Zealand	1-800-802-540 (Australia) 0800-738-378 (New Zealand)
Asia-Pacific	080-047-669

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 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 contains installation, operation and test information for the Agilent Technologies 8494A/B, 8495A/B, and 8496A/B step attenuators.

The instruments covered by this manual have a two-part serial number. The first four digits and letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply to instruments with serial prefixes 2544A and above.

Older instruments, those with serial number prefixes of 2543A and below, are documented in this manual under "Manual Changes" below.

An instrument manufactured after the printing of this manual may have a serial prefix that is not listed above. An unlisted serial prefix indicates that the instrument is different from those documented in this manual. A manual for an unlisted instrument is supplied with a Manual Change supplement containing change information that documents the differences.

Manual Changes

This section contains information for adapting this manual to older instruments. If your instrument's serial number prefix is 2543A or lower, you may document your instrument by following the instructions below. If your instrument has a serial number prefix higher than is listed in this manual, it may be documented in a separate manual supplement.

If you have an older instrument, one with a serial number prefix of 2543A or lower, you must make the following changes to this manual in order for this manual to apply to your instrument.

- In "Specifications" on page 3, change the attenuation repeatability to ±0.03 dB, typical after 1 million cycles.
- In "Specifications" on page 3, change the minimum life to >1 million steps or switchings per section.

Description

Agilent 8494A/B, 8495A/B, and 8496A/B are 50-ohm 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.

- Agilent 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 1, "Attenuator Switching Order" on page 7 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 μs. Do not connect an attenuator RF input or output connector to greater the ±7 Vdc. If the attenuator must be connected to a device with a potential greater than ±7 Vdc, use a blocking capacitor.

Instrument Options

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

Option	Connector Description
001	Both connectors Type N female
002	Both connectors SMA female
003	Both connectors APC-7

Specifications

Frenquency Range and Attenuation

Product	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
Steps	1 dB	1 dB	10 dB	10 dB	10 dB	10 dB

Attenuation Accuracy (±dB): (Referenced from 0 dB)

8494A/B	8495A/B 8496A/B	8494A	8494B		8495A	8495B		8496A	8496B	
Attenuation Selection (dB)		dc–4 GHz	dc–12.4 GHz	12.4–18 GHz	dc–4 GHz	dc–12.4 GHz	12.4–18 GHz	dc–4 GHz	dc–12.4 GHz	12.4–18 GHz
1	10	0.2	0.3	0.7	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
3	30	0.3	0.4	0.7	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
5	50	0.3	0.5	0.7	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
7	70	0.4	0.6	0.8	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
9	90	0.4	0.6	0.8	-	-	-	1.5	2.7	3.6
10	100	0.4	0.6	0.9	-	-	-	1.6	3.0	4.0
11	110	0.5	0.7	0.9	-	-	-	1.8	3.3	4.4

Maximum SWR

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

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 d8 + 0.09 dB/GHz

Attenuation Repeatability

±0.01 dB typical after 5 million cycles

RF Power Handling Capability

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

Minimum Life

> 5 million cycles per section

Environment Limits

The instrument should be stored in a clean, dry environment. The following environmental limits apply to storage and shipment, and operation.

Characteristic	Storage and Shipping Value	Operating Value
Temperature	–40 to +75 °C	0 to +55 °C
Humidity	< 95% relative	< 95% relative
Altitude	< 7600 m (25000 ft)	< 4600 m (15000 ft)

Physical Characteristics

Instrument	Dimensions [1] (depth x width x height)	Weight [2]
8494A/B	6.25 in x 2.875 in x 1.6875 in 159 mm x 73 mm x 43 mm	15 oz 425 g
8495A/B	5.125 in x 2.875 in x 1.6875 in 130 mm x 73 mm x 43 mm	11 oz 312 g
8496A/B	6.25 in x 2.875 in x 1.6875 in 159 mm x 73 mm x 43 mm	15 oz 425 g

1. Dimensions are for general information only. If dimensions are required for building special enclosures, contact your Agilent field engineer.
2. Weight and width of the instrument varies with the option selected due to the type of connectors.

Installation

Initial Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material are damaged, they should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. A procedure for checking electrical performance is provided under “Operator’s Check” on page 8 (see also “Performance Tests” on page 9).

If the contents of the shipment are incomplete, or if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Agilent Technologies office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Agilent Technologies office. Keep the shipping materials for the carrier's inspection. The Agilent office will arrange for repair or replacement without waiting for claim settlement.

NOTE

Containers and materials identical to those used in factory packaging are available through Agilent Technologies offices. If the instrument 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 instrument by model number and full serial number.

Mating Connectors

Mating 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.

Installing with Base

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.

Operating Instructions

CAUTION

Do not apply 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 1 lists the attenuator switching order.

Table 1 Attenuator Switching Order

8494A/B Attenuator Sections					8495A/B Attenuator Sections				8496A/B Attenuator Sections				
Atten (dB)	1 1 dB	2 2 dB	3 4 dB	4 4 dB	Atten (dB)	1 10 dB	2 20 dB	3 40 dB	Atten (dB)	1 10 dB	2 20 dB	3 40 dB	4 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-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.

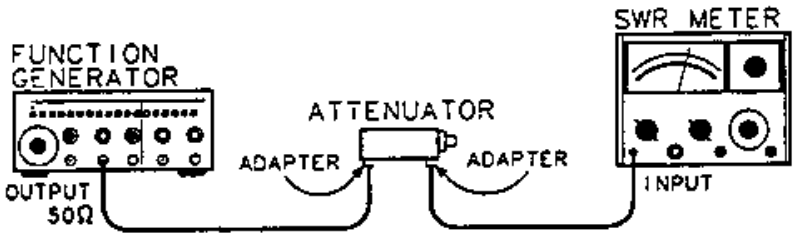

Figure 1 Operator Check Setup

Procedure

1. Connect equipment as shown in Figure 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) [or for the 8494A/B to 10 dB (expanded)] and adjust its bandwidth to center of adjustment range. Fine tune the oscillator frequency to obtain maximum meter indication.
4. Set the attenuator and SWR meter range switch as shown in Table 2 and verify that SWR meter indicates within limits shown.

Table 2 Attenuation 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 [1]	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 [1]	7	70	70	1.30	0.90	-	-	1.70	2.10
12 [1]	42 [1]	8	-	80	1.80	–0.15	-	-	2.20	1.15
14	46 [1]	9	-	90	0.30	0.75	-	-	0.70	2.25
14	52 [1]	10	-	100	0.80	–0.30	-	-	1.20	1.30
14	56 [1]	11	-	110	1.75	0.60	-	-	1.75	2.40

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

Performance Tests

The instrument can be tested to the accuracy of the "Specifications" on page 3, with an automatic network analyzer or equivalent equipment of suitable accuracy. If an automatic network analyzer is available, test the instrument using the procedures in the analyzer's operating manual.

NOTE

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

Replaceable Parts

Table 3 lists the replaceable parts which are the only parts that can be replaced without access to the interior of the instrument. 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 the table below. If the instrument is opened, the warranty is void.

Table 3 Replaceable Parts

Description	Part Number
Knob	0370-1091
Option 003 APC-7 center conductor contact	1250-0907
Option 003 APC-7 connector outer shell assembly	1250-0909
Option 001 Type N female connector outer shell	1250-0914
Screws for both bases: 4-40 x 7/8 in. Fillister head	2220-0006
Label 0-110 dB for 8496A and B	7120-0543
Label 0-70 dB for 8495A and B	7120-3376
Label 0-11 dB for 8494A and B	7120-4525
Base for 8495A & B	5041-3887
Base for 8494A and B and 8496A and B	5041-3888

NOTE

Option 002 (SMA) connectors are not replaceable without access to the interior of the instrument. If these connectors are damaged, return the instrument to Agilent Technologies.

Service

Troubleshooting

Troubleshooting consists of performing the "Operator's Check" on page 8. If the instrument does not perform within limits, return the instrument to Agilent Technologies.

Repair

The only recommended field repair is replacing the outer connector shell for the Option 001 and 003, or replacing the center contact in the 7 mm connector. For any other repair, return the entire instrument to Agilent Technologies.

Replacing the 7 mm Connector Center Conductor Contact

Through wear or damage, the contact in the 7 mm center conductor may need replacement. This contact is a small four-pronged contact which snaps into a recess in the center conductor. With a magnifying glass, examine the contact for the necessary outward spring action by carefully pushing it in.

CAUTION

Do not remove this contact for inspection. It may be damaged by removal. The prongs of the contact should be free from burrs or wear. If the contact is removed, *do not* reuse it. Order contact as Amphenol part number 131-129* or Agilent part number 1250-0907.

If this contact needs replacement, proceed as follows:

1. Place the instrument so the connector faces down.
2. Tap the connector lightly. The contact should now protrude slightly. Insert the centering pin of the contact extractor, p/n 5060-0370, with the jaws open.
3. Allow the jaws of the tool used to close and pull straight back from the connector without twisting.
4. Snap in a new contact by pushing it in place. Test the action of the new contact by pushing it in. It should spring out again when released.

Replacing the Connector Outer Shell

NOTE

The connector outer shell can be replaced only on the Option 001 (Type N female) or the Option 003 (7 mm). The outer shell on the Option 002 (SMA) cannot be replaced in the field.

* Ampheonol RF Division, Danbury, CT.

The connector outer shells on the Option 001 and 003 may be replaced as follows:

1. With a 9/16-inch (1/2-inch for 7 mm) thin open-end wrench, unscrew the outer connector body.
2. Replace the connector outer shell. See Table 3 on page 10 for replaceable parts numbers.
3. Tighten the connector with the same wrench called out in step 1.