

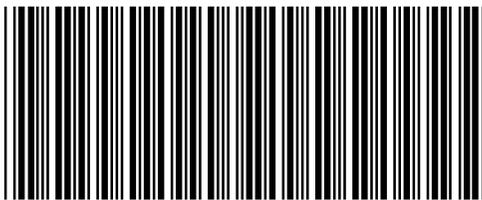


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Agilent Technologies  
8495D/K Attenuators

Operating and Service  
Manual

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08495-90027

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## What You'll Find in This Manual...

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04/04

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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.

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### WARNING

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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.

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### CAUTION

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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.



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## Instrument Definition

This manual contains installation, operation, and test information for the 8495D and 8495K.

### **Instruments Covered by Manual**

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 the following serial prefixes:

8495D:	1711A	2406A	2508A	2544A	2852A	3308A
8495K:	1711A	2406A	2508A	2544A	2808A	

An attenuator manufactured after the printing of this manual may have a serial prefix that is not listed above. This unlisted serial prefix indicates that the attenuator is different from those documented in this manual.

## Description

The Agilent 8495D and 8495K are 50-ohm, dc to 26.5 GHz, 0-70 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 3 shows the switching arrangement required to increase the amount of attenuation from 0 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.

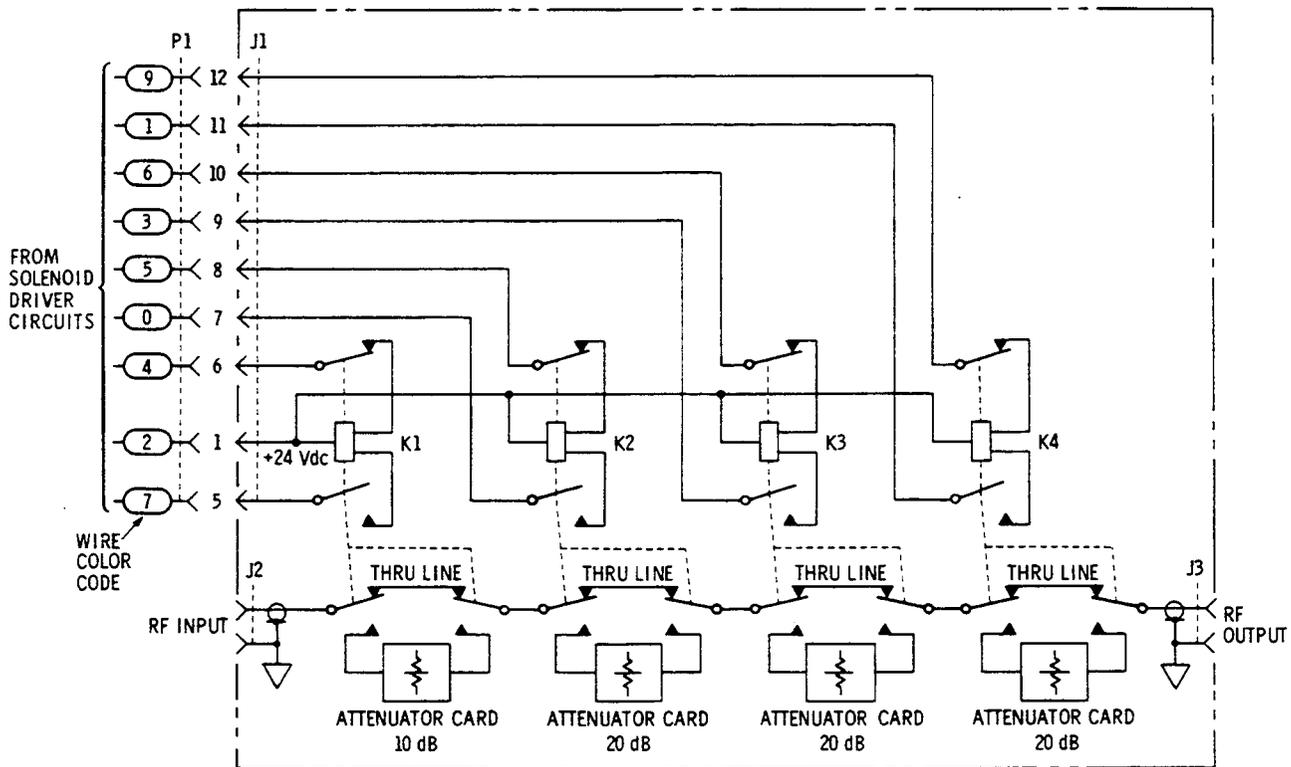


Figure 1 8495K Programmable Four-Section Attenuator Schematic Diagram

In the 8495K, each solenoid requires a drive of 20 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 2](#) and [Figure 3 on page 5](#)).

**Table 1 Attenuator Switching**

Attenuation (dB)	Attenuator Sections			
	1 10 dB	2 20 dB	3 20 dB	4 20 dB
10	X			
20			X*	X**
30	X		X*	X**
40		X		X
50	X	X		X
60		X	X	X
70	X	X	X	X

\* D model only

\*\* K model only

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**CAUTION**

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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.

**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 4](#)). The part number for this cable is 8120-2178, and is available as a spare or replacement. The cable connector plug and contacts are available from Viking Industries Inc. The part number is TKP12-100-P-TS-100-AU. The connector plug and contacts without the cable can be ordered from a Viking distributor. Information on replaceable parts is available in [Table 3 on page 5](#).

**Solenoid Cable Connectors**

Refer also to [Figure 2 on page 4](#).

Description

Table 2 Solenoid Cable Connectors

Section	Section 1		Section 2		Section 3		Section 4		Power
Solenoid Coil	Thru-Line	Atten Card	V+						
Cable Wire Color Code <sup>1</sup>	VIO	YEL	BLK	GRN	ORG	BLU	BRN	WHT	RED
Connector Plug Pin Number <sup>2</sup>	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 <sup>3</sup>	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.

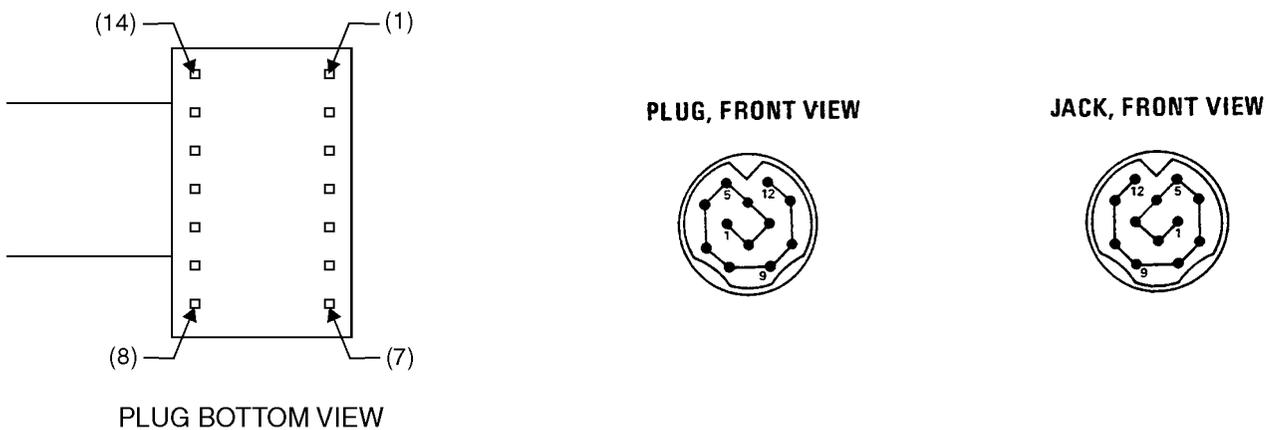
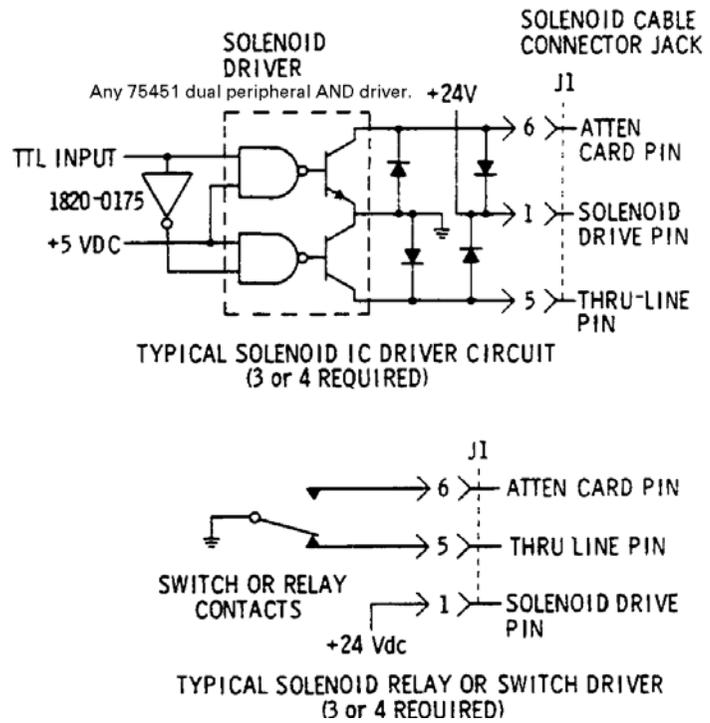


Figure 2 Solenoid Cable Pin Configuration

**Table 3 Solenoid Cable Replaceable Parts**

Part Number	Description
2220-0006	Screw, fillister Head 4-40x7/8 in. (for attaching base)
8120-2178	Cable, solenoid drive, 1.5 meters (5 feet) long, connector plug on one end and other end unterminated (8495K)
0370-1091	Knob (84950)
08496-20008	Base
TKP12-100-P-TS-100-AU <sup>1</sup>	Connector Plug and Contacts only without cable (8495K)

1. Available from Viking Industries, Inc., Chatsworth, California 91311.



**Figure 3 Typical Solenoid Coil Driver Circuit**

## Specifications

## Specifications

**Frequency Range  
and Attenuation**

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

**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**  $(0.4 + 0.09 f)$  dB  
where “f” is the frequency in GHz

**Attenuation Repeatability** 0.01 dB, dc to 18.0 GHz  
0.05 dB, 18.0 to 26.5 GHz

**RF Power Handling Capability** 1 W average, 100 W peak with maximum pulse width of 10 microseconds

**Solenoid Drive** For Agilent 8495K only.

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

**Switching speed** Maximum 20 milliseconds including settling time

## 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	1.9
	18 to 26.5	2.2

## Physical Characteristics

Instrument	Dimensions <sup>1</sup> (depth x width x height)	Weight
8495D	6.25 in x 2.0625 in x 1.6875 in	15 oz
	159 mm x 52 mm x 43 mm	425 g
8495K	5.625 in x 2.0625 in x 1.6875 in	16 oz
	159 mm x 52 mm x 43 mm	454g

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.

## Minimum Life

>5 million cycles per section

## Environment Limits

The attenuator should be stored in a clean, dry environment. The storage and operating environments of the instruments should be within the following limits.

Characteristic	Storage 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)

## 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 Technologies 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.

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## 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 for completeness and the instrument has 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 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.

### 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.

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#### CAUTION

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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.

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## Operating Instructions

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### 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.

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### 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.

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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.

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

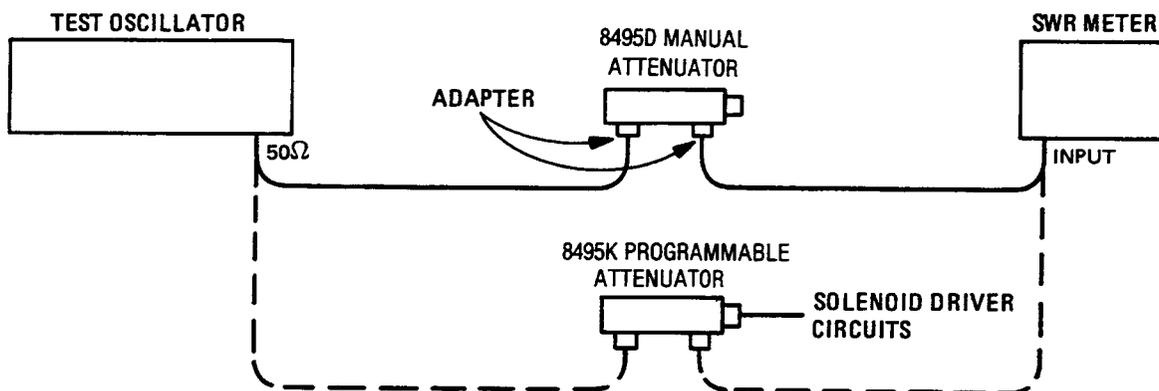


Figure 4 Operator's Check Setup

### 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 shown in Table 4 and verify that SWR meter indicates within the limits shown.

**Table 4 Attenuator and SWR Settings**

SWR Meter Range (dB)	Attenuation	Meter Indication (dB)		
		8495D/K	Minimum	Actual
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 <sup>1</sup>	40	-0.40		1.40
26 <sup>1</sup>	50	0.50		2.50
32 <sup>1</sup>	60	-0.60		1.60
36 <sup>1</sup>	70	0.35		2.65

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

## Performance Tests

The attenuator can be tested to the accuracy of the [Specifications](#) on page 6 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.

Refer to the *Agilent 11713A Attenuator/Switch Driver Operating and Service Manual* for programming instructions.

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### NOTE

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

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## Replaceable Parts

Table 5 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.

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### CAUTION

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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 5** *Replaceable Parts*

Description	Part Number
Knob (8495D)	0370-1091
Cable, solenoid drive, 1.5 m (5 ft) long, connector plug on one end and other end un-terminated (8495K)	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 (8495K)	*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](#)” on page 10. If the instrument does not perform within limits, return the instrument to Agilent Technologies.