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8490D  
8491A/B  
8493A,B,C  
Coaxial Fixed Attenuators

11581/2A  
11583C  
Attenuator Sets

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Operating and Service  
Manual

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## Warranty

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## Service and Support

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<b>United States</b> (tel) 1 800 452 4844	<b>Latin America</b> (tel) (305) 269 7500 (fax) (305) 269 7599	<b>Canada</b> (tel) 1 877 894 4414 (fax) (905) 282-6495	<b>Europe</b> (tel) (+31) 20 547 2323 (fax) (+31) 20 547 2390
<b>New Zealand</b> (tel) 0 800 738 378 (fax) (+64) 4 495 8950	<b>Japan</b> (tel) (+81) 426 56 7832 (fax) (+81) 426 56 7840	<b>Australia</b> (tel) 1 800 629 485 (fax) (+61) 3 9210 5947	

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### Asia Call Center Numbers

Country	Phone Number	Fax Number
Singapore	1-800-375-8100	(65) 836-0252
Malaysia	1-800-828-848	1-800-801664
Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
India	1-600-11-2929	000-800-650-1101

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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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## Description

### Attenuator Overview

The 8490D, 8491A,B, and 8493A,B,C are small, light-weight, low-power, 50-ohm coaxial fixed attenuators.

The attenuators cover broad frequency ranges and choice of connector types. Each model number has option numbers which correspond to attenuation values.

Model	Options	Frequency Range	Connector Type
8490D	003, 006, 010, 020, 030, 040	dc to 50 GHz	2.4 mm (m), (f)
8491A	003, 006, 010, 020, 030, 040, 050, 060	dc to 12.4 GHz	Type N (m), (f)
8491B	003, 006, 010, 020, 030, 040, 050, 060	dc to 18 GHz	Type N (m), (f)
8493A	003, 006, 010, 020, 030	dc to 12.4 GHz	SMA 3 mm (m), (f)
8493B	003, 006, 010, 020, 030	dc to 18 GHz	SMA 3 mm (m), (f)
8493C	003, 006, 010, 020, 030, 040	dc to 26.5 GHz	3.5 mm (m), (f)

### Features

- Ruggedness, reliability, and small size make these attenuators useful both on the bench and in systems applications.
- Accuracy and low SWRs make the attenuators well suited for extending the range of sensitive power meters for higher power measurements and applications such as calibration standards and RF substitution measurements.
- Each attenuator is tested with a vector network analyzer for attenuation, and a plot of actual attenuation values is printed on the label attached to the body of the attenuator (except for the 8490D and 8493C).

## Description

**Optional Calibration Data**

Option UK6 calibration data, which is generated by a network analyzer, provides a tabulated list of attenuation and SWRs at 26 to 67 frequencies depending on the model number and frequency range. Option UK6 calibration data is available when attenuators are first purchased and recalibrations are available through Agilent Technologies Service Centers.

**Attenuator Sets**

The 11581A, 11582A, and 11583C are boxed sets of four fixed coaxial attenuators of 3, 6, 10, and 20 dB as shown in [Table 1](#).

Each attenuator set comes with a printed calibration report that gives the actual attenuation and reflection coefficient of each port at frequencies from 100 MHz to 26.5 GHz, at increments from 100 to 500 MHz.

**Table 1** *Boxed Sets of Four Attenuators*

Attenuator Boxed Set	Contents
11581A	8491A (3, 6, 10, and 20 dB)
11582A	8491B (3, 6, 10, and 20 dB)
11583C	8493C (3, 6, 10, and 20 dB)

## Specifications

The specifications are the performance standards or limits against which the attenuators are tested.

**Table 2** *Specifications for 8490D Coaxial Attenuator*

8490D			
Attenuation (dB)			
Option <sup>1</sup>	Minimum (GHz) 0 to 50	Maximum (GHz) 0 to 26.5	Maximum (GHz) 26.5 to 50
003	2.5	3.9	4.8
006	5.4	6.9	7.8
010	9.4	10.9	11.3
020	19.2	21.3	21.7
030	29.2	31.3	31.7
040	38.2	42.5	42.5
SWR (maximum)			
	dc to 26.5 GHz	26.5 to 40 GHz	40 to 50 GHz
003	1.15	1.25	1.45
060	1.15	1.25	1.45
010	1.15	1.25	1.45
020	1.15	1.25	1.45
030	1.15	1.25	1.45
040	1.08	1.15	1.25
Maximum Input Power: 1 W avg, 100 W pk			
Connectors (50 Ω):	2.4 mm		
Dimensions:	1.06 in. (27 mm) 3, 6, 10, 20 dB 1.14 in. (29 mm) 30, 40 dB		
Diameter:	.312 in (8 mm)		

1. Option numbers are the same as attenuation values. Option UK6 calibration data provides a hard copy of the transmission and reflection data as tested on a network analyzer.

## Specifications

**Table 3 Specifications for 8491A,B, and 8493A,B Coaxial Attenuators**

	8491A <sup>3</sup> and 8493A <sup>1</sup>		8491B, <sup>1,3</sup> and 8493B <sup>1</sup>		
Frequency Range	dc to 12.4 GHz		dc to 12.4 GHz	12.4 to 18 GHz	
Attenuation Accuracy <sup>2</sup>					
3 dB	± 0.3 dB		±0.3 dB	±0.3 dB ±0.4 dB (8491C)	
6 dB	±0.3 dB		±0.3 dB ±0.4 dB (8491C)	±0.4 dB ±0.5 dB (8491C)	
10 dB	±0.5 dB		±0.6 dB		
20 dB	±0.5 dB		±0.6 dB		±1.0 dB
30 dB	±1.0 dB		±1.0 dB		
40 dB	±1.5 dB		±1.5 dB		
50 dB	±1.5 dB		±1.5 dB		
60 dB	± 2.0 dB		±2.0 dB		
SWR	dc to 8 GHz	8 to 12.4 GHz	dc to 8 GHz	8 to 12.4 GHz	12.4 to 18 GHz
3 dB	1.25	1.35	1.25	1.35	1.5
6 dB	1.2	1.3	1.2	1.3	1.5
10 dB	1.2	1.3	1.2	1.3	1.5
20 dB	1.2	1.3	1.2	1.3	1.5
30 dB	1.2	1.3	1.2	1.3	1.5
40 dB <sup>3</sup>	1.2	1.3	1.2	1.3	1.5
50 dB <sup>3</sup>	1.2	1.3	1.2	1.3	1.5
60 dB <sup>3</sup>	1.2	1.3	1.2	1.3	1.5
Maximum Input Power:	2 W avg, 100 W pk		2 W avg, 100 W pk		
Connectors (50 Ω):	8491A: Type N <sup>3</sup> 8493A: SMA <sup>4</sup>		8491B, C: Type N <sup>3</sup> 8493B: SMA <sup>4</sup>		
Dimensions:					
8491A: 2-7/16 x 13/16 in dia. 67 x 21 mm	8493A: 1-9/16 x 1/2 dia. 40 x 13 mm		8491B: 7/16 x 13/16 in dia. 67 x 21 mm	8493B: 1-9/16 x 1/2 in. dia. 40 x 13 mm	
Weight: Net	8491A: 110 g (4 oz) 8493A: 30 g (1 oz)		8491B, C: 110 g (4 oz) 8493B: 30 g (1 oz)		

1. 40, 50, 60 dB attenuation not available in 8493A,B
2. Option numbers are the same as attenuation values. Option UK6 calibration data provides a hard copy of the transmission and reflection data as tested on a network analyzer.
3. Mate with MIL-C-71 and MIL-C-39012 connectors
4. Miniature SMA type

**Table 4 Specifications for 8493C Coaxial Attenuator**

	8493C <sup>1</sup>		
Frequency Range	dc to 18 GHz	18 to 26.5 GHz	
Attenuation Accuracy <sup>2</sup>			
3 dB	± 0.5 dB	±1.0 dB	
6 dB	± 0.6 dB		
10 dB	± 0.3 dB	± 0.5 dB	
20 dB	± 0.5 dB	± 0.6 dB	
30 dB	± 0.7 dB	± 1.0 dB	
40 dB	± 1.0 dB	± 1.3 dB	
50 dB	N/A		
60 dB	N/A		
SWR	dc to 8 GHz	8 to 12.4 GHz	12.4 to 26.5 GHz
3 dB	1.10	1.15	1.25
6 dB	1.10	1.15	1.27
10 dB	1.10	1.15	1.25
20 dB	1.10	1.15	1.25
30 dB	1.10	1.15	1.25
40 dB	1.10	1.15	1.25
50 dB <sup>2</sup>	N/A	N/A	N/A
60 dB <sup>2</sup>	N/A	N/A	N/A
Maximum Input Power:	2 W avg, 100 W pk		
Connectors (50 Ω):	3.5 mm		
Dimensions:	3, 6, 10, 20 dB 1-15/16 x 5/16 in dia. 33.8 X 8 mm	30, 40 dB 1-7/16 x 5/16 in dia. 36.8 X 8 mm	
Weight: Net	9.4 g (0.33 oz)		

1. 50, 60 dB attenuation not available in 8493C.

2.. Option numbers same as attenuation values: e.g., Option 003 for 3 dB, Option 010 for 10 dB etc.  
Option UK6 calibration data provides a hard copy of the transmission and reflection data as tested on a network analyzer.

## Specifications

Table 5 and Table 6 apply to the following boxed sets of four attenuators.

- The 11581A attenuator set contains a 3, 6, 10, and 20 dB 8491A.
- The 11582A attenuator set contains a 3, 6, 10, and 20 dB 8491B.
- The 11583C attenuator set contains a 3, 6, 10, and 20 dB 8493C.

**Table 5 Accuracy of Insertion Loss Measurements ( $S_{21}$ ,  $S_{12}$ )**

Attenuation	dc	4 to 12 GHz	12 to 18 GHz
3 dB	$\pm 0.01$ dB	$\pm 0.06$ dB	$\pm 0.11$ dB
6 dB	$\pm 0.01$ dB	$\pm 0.07$ dB	$\pm 0.11$ dB
10 dB	$\pm 0.01$ dB	$\pm 0.07$ dB	$\pm 0.12$ dB
20 dB	$\pm 0.01$ dB	$\pm 0.08$ dB	$\pm 0.13$ dB

**Table 6 Accuracy of Reflection Coefficient Measurements ( $S_{11}$ ,  $S_{22}$ )**

Model Number	4 to 12 GHz		12 to 18 GHz	
	4 to 12 GHz	12 to 18 GHz	4 to 12 GHz	12 to 18 GHz
11581A	$\pm 0.006$ dB	—	$\pm 0.006$ dB	—
11582A	$\pm 0.006$ dB	$\pm 0.010$ dB	$\pm 0.006$ dB	$\pm 0.006$ dB
11583C	$\pm 0.007$ dB	$\pm 0.007$ dB	$\pm 0.007$ dB	$\pm 0.007$ dB

## Operating Environment

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

- Temperature . . . . . 0 to 55 °C
- Humidity . . . . . < 95% relative at 40 °C
- Altitude . . . . . < 4,600 meters (15,000 feet)

## Storage and Shipping Environment

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

- Temperature . . . . . -55 to 85 °C
- Humidity . . . . . < 95% relative at 40 °C
- Altitude . . . . . < 15,300 meters (50,000 feet)

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## 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” or “Performance Tests”.
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 Technologie snearest 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.

### Returning attenuators under warranty

“Bad contacts” attenuators are returnable under warranty while “burned out” attenuators are not. These terms are defined as follows:

- “Bad Contacts”: Attenuation is within specifications at 8 GHz or higher; attenuation is at least 3 to 5 dB higher than specification at dc and 1 kHz.
- “Burned Out”: Attenuation is at least 3 to 5 dB higher than specification at dc and entire rated frequency range.

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## Operating Instructions

### 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 (that is, the SWR meter). A reference level is set up on the detector using a through connection in place of the attenuator. The attenuator is then inserted and the change in the detector level is noted. This checks the low frequency accuracy of the attenuator.

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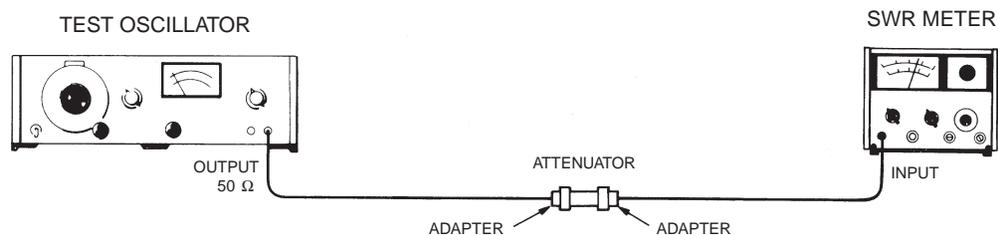
#### NOTE

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.

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#### Quick-Check Procedure

1. Connect the equipment as shown in the figure below except remove the attenuator and connect the adapters directly together.



2. Set the test oscillator to 0.3 V<sub>rms</sub> at 1 kHz.
3. Set the SWR meter range to 2 dB (expanded) or for the 3 dB, 6 dB, and 10 dB (expanded) as appropriate and adjust its bandwidth to the center of the adjustment range. Fine tune the oscillator frequency to obtain maximum meter indication. Adjust the oscillator output to obtain the SWR meter reading in the table below.
4. Connect the attenuator into the system, adjust the SWR meter range switch as listed below, and verify that the SWR meter indicates within the limits shown.

**Table 7 SWR Verification**

Attenuation	SWR Meter Range (dB)	Meter Indication (dB)		
		Minimum	Actual	Maximum
0 (System Cal)	2 (or 10)*	Set to 0.5 (or 0.0)*		
3	10	1.35		1.65
6	12	0.85		1.15
10	14	0.75		1.25
20	12	0.25		0.75
30	16	1.00		2.00
40	22	-0.25		1.25
50	26	0.75		2.25
60	32	-0.50		1.50

\* Set SWR meter range to 10 dB and power level to 0.0 dB for 3 dB, 6 dB, and 10 dB attenuators only.

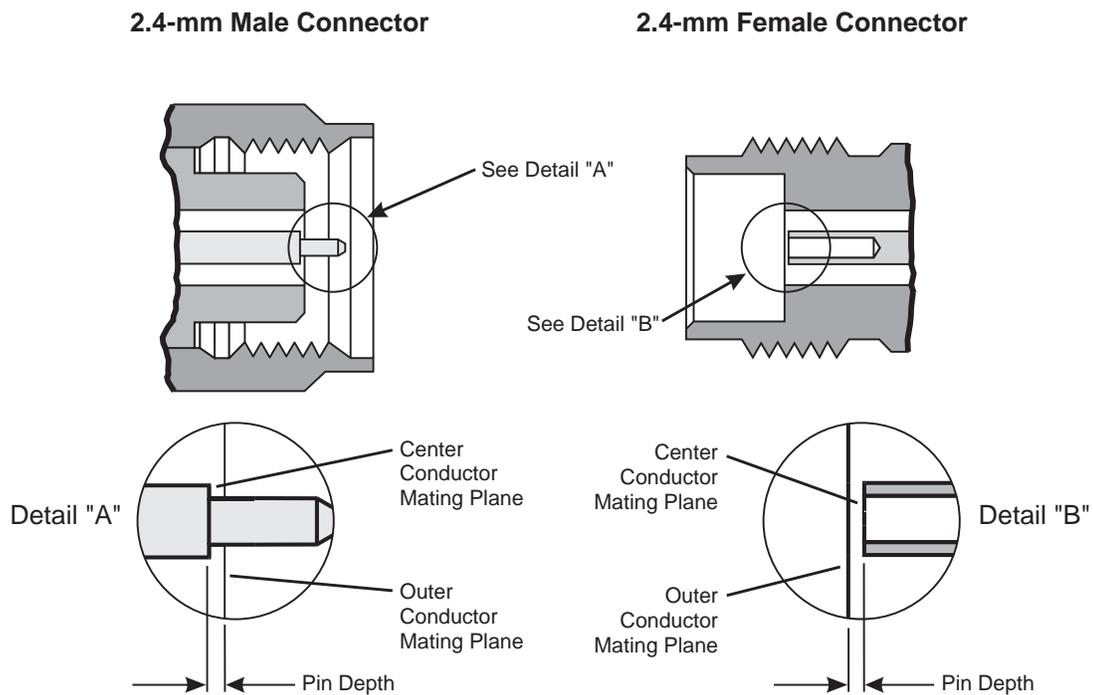
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## Making Connections

With any of the attenuators, do not depend upon the attenuator itself to bear any force. The units that the attenuator is connected to should bear their own weight and force. The attenuators are bidirectional, that is, the signal may be inserted from either end.

### 8490D

The 8490D 2.4-mm connectors mate with other 2.4-mm connectors of the opposite sex.



**Figure 1** 2.4-mm Connector Diagram

## 8491A,B

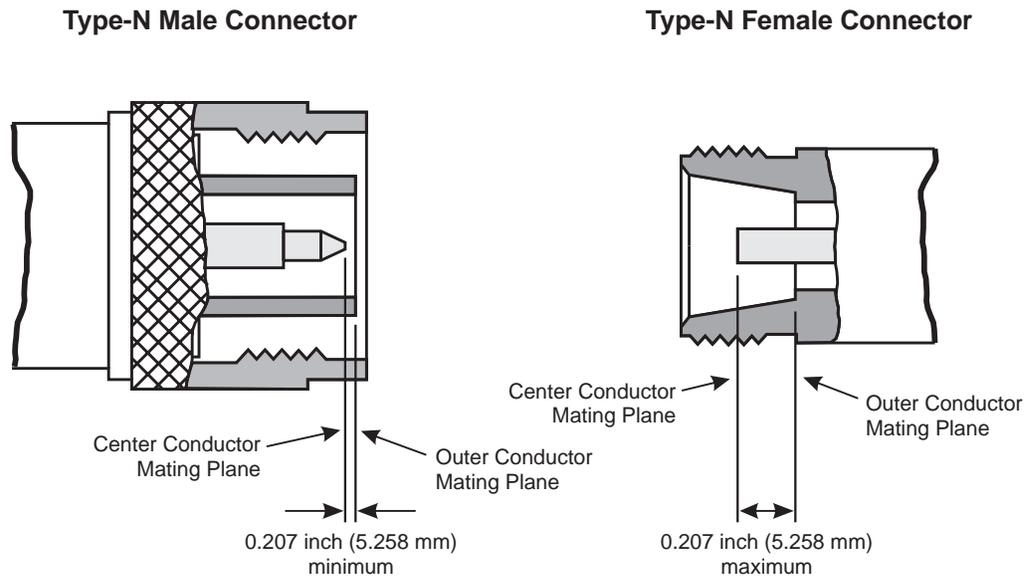
The 8491A,B type-N connectors mate with all type-N connectors whose dimensions conform to IEE STD 287.

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### CAUTION

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*Do not* mate with 0.071 inch diameter pin *male* connector. Damage will result.

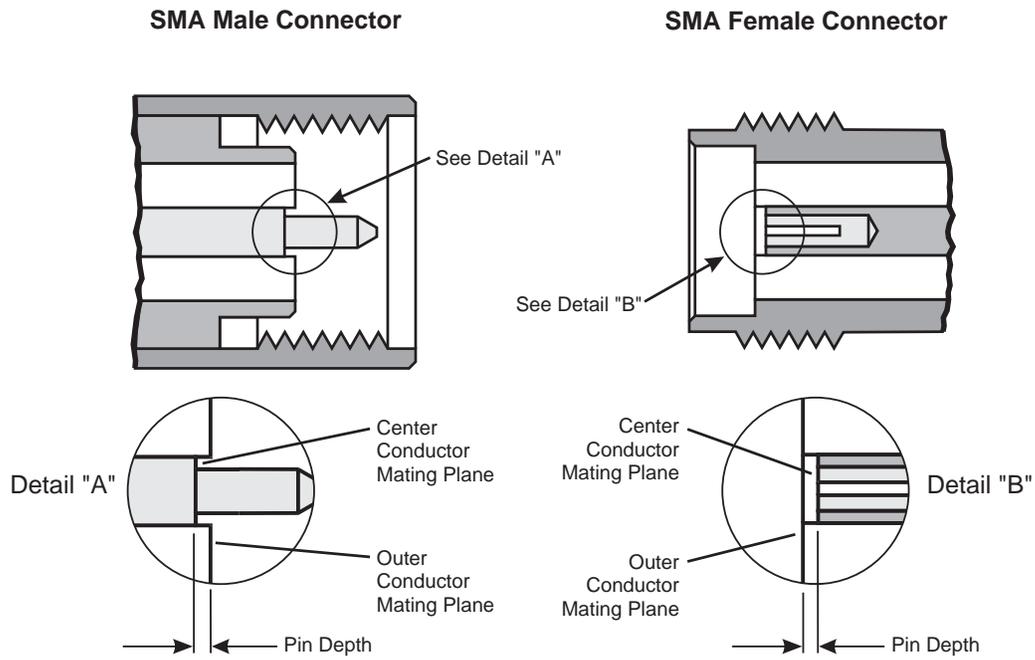


**Figure 2** *Type-N Connector Diagram*

Making Connections

8493A,B

The 8493A,B has a male SMA jack on one end and a female SMA on the other. These connectors mate with the opposite sex SMA connectors.



**Figure 3** SMA Connector Diagram

### 8493C

The 8493C has a male 3.5-mm connector on one end and a female 3.5-mm connector on the other side. These connectors mate with the opposite sex 3.5-mm or SMA connectors.

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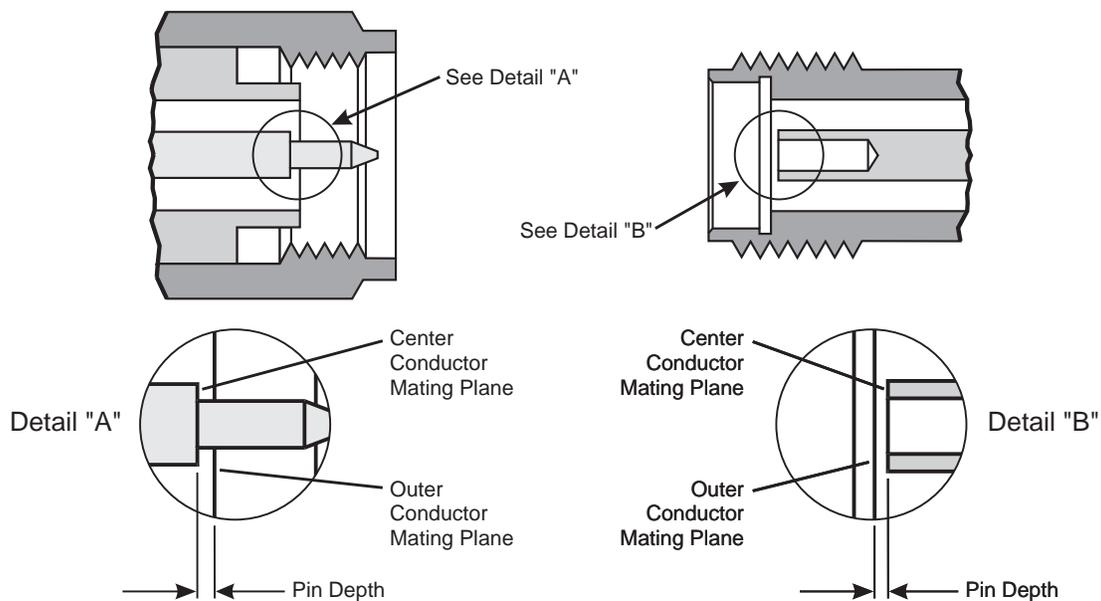
**CAUTION**

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Continued mating with SMA connectors could degrade the 3.5-mm connector.

#### 3.5-mm Male Connector

#### 3.5-mm Female Connector



**Figure 4** 3.5-mm Connector Diagram

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## Performance Tests

The attenuators can be tested to the accuracy of the specifications in Table 1 with a network analyzer or equivalent equipment of suitable accuracy. If a network analyzer is available, test the instrument using the procedure in the analyzer's operating manual.

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## Service Instructions

### Repair

The 8490D, 8491A,B the 8493A,B,C attenuators are not recommended for repair since the cards must be mounted in cartridges to test and testing costs more than a replacement attenuator.

### Maintenance

The connectors, particularly the connector faces, must be kept clean. This is especially true of the 8493A,B,C.

For instruction on connecting and care of your connectors, refer to the Microwave Connector Care Quick Reference Card (08510-90360).

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## Replaceable Parts

[Table 8](#) lists the replaceable parts which are the only parts that can be replaced without access to the interior of the attenuator.

**Table 8** *Replaceable Parts*

Description	Part Number
Foam Pad (top, all sets)	9220-1291
Foam Pad (bottom, all sets)	9220-3697
Box, Walnut (all sets)	9211-1009
Inner Conductor Contact (8492A)	1250-0816