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

11581A, 11582A, 11583C Attenuator Sets

KEYSIGHT

OPERATING AND SERVICE GUIDE

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Product category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.

Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/attenuators
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

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General Information

Attenuator overview

The 8490D/G, 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 comes with Options to accommodate various attenuation values as shown in Table 1-1.

Table 1-1 List of coaxial fixed attenuators

Model	Option	Frequency Range	Connector Type
8490D	003, 006, 010, 020, 030, 040	DC to 50 GHz	2.4 mm (m), (f)
8490G	003, 006, 010, 020, 030, 040	DC to 67 GHz	1.85 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)

The Option number indicates the attenuation value. For example, Option 003 indicates 3 dB attenuation, Option 010 indicates 10 dB attenuation, and so on.

Features

- Ruggedness, reliability, and small size make these attenuators useful both onthe 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/G and 8493C).

Optional calibration data

Option UK6 calibration data, which is generated by a network analyzer, provides a tabulated list of attenuations and reflection coefficients in which the number of frequency points provided depends on the model number and frequency range. Option UK6 calibration data is available when attenuators are first purchased and recalibrations are available through Keysight Technologies Service Centers.

Attenuator sets

The 11581A, 11582A, and 11583C are boxed sets of four coaxial fixed attenuators of 3, 6, 10, and 20 dB as shown in Table 1-2.

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 12.4 GHz for 11581A, 100 MHz to 18 GHz for 11582A, and 100 MHz to 26.5 GHz for 11583C, at increments from 100 to 500 MHz.

Table 1-2 List of attenuator boxed sets

Model	Contents	Frequency Range
11581A	8491A (3, 6, 10, and 20 dB)	DC to 12.4 GHz
11582A	8491B (3, 6, 10, and 20 dB)	DC to 18 GHz
11583C	8493 C (3, 6, 10, and 20 dB)	DC to 26.5 GHz

Specifications

The specifications refer to the performance standards or limits against which the coaxial fixed attenuators are tested.

Table 1-3 Specifications for 8490D coaxial fixed attenuator

	Minimum attenuation in dB	Maximum attenuation in dB	
Option[a]	DC to 50 GHz	DC to 26.5 GHz	26.5 to 50 GHz
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
		Maximum SWR	
Option[a]	DC to 26.5 GHz	26.5 to 40 GHz	40 to 50 GHz
003	1.15	1.25	1.45
006	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		
Dimension (length)	1.06 in. (27 mm) for Options 003, 006, 010, 020 1.14 in. (29 mm) for Options 030, 040		
Diameter	0.312 in. (8 mm)		

[a] Option numbers indicate the attenuation values. For example, Option 003 indicates 3 dB attenuation, Option 010 indicates 10 dB attenuation and so on.

Table 1-4 Specifications for 8490G coaxial fixed attenuator

	Minimum attenuation in dB	Maximum attenuation in dB		
Option[a]	DC to 67 GHz	DC to 26.5 GHz	26.5 to 50 GHz	50 to 67 GHz
003	2.5	3.9	4.4	4.8
006	5.4	6.9	7.4	7.8
010	9.4	10.9	11.1	11.3
020	19.2	21.3	21.5	21.7
030	29.2	31.3	31.5	31.7
040	38.0	42.5	42.5	42.5
	Maximum SWR			
Option[a]	DC to 26.5 GHz	26.5 to 40 GHz	40 to 50 GHz	
003	1.15	1.25	1.45	
006	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	1.10	1.15	1.25	
Maximum input power	1 W avg, 100 W pk			
Connectors (50 Ω)	1.85 mm			
Dimension (length)	1.06 in. (27 mm) for Options 003, 006, 010, 020 1.10 in. (28 mm) for Options 030, 040			
Diameter	0.312 in. (8 mm)			

[a] Option numbers indicate the attenuation values. For example, Option 003 indicates 3 dB attenuation, Option 010 indicates 10 dB attenuation and so on.

Table 1-5 Specifications for 8491A and 8493A coaxial fixed attenuators

	Attenuation accuracy in dB	
Option[a]	DC to 12.4 GHz	
003	± 0.3	
006	± 0.3	
010	± 0.5	
020	± 0.5	
030	± 1.0	
040[b]	± 1.5	
050[b]	± 1.5	
060[b]	± 2.0	
	SWR	
Option[a]	DC to 8 GHz	8 to 12.4 GHz
003	1.25	1.35
006	1.2	1.3
010	1.2	1.3
020	1.2	1.3
030	1.2	1.3
040[b]	1.2	1.3
050[b]	1.2	1.3
060[b]	1.2	1.3
Maximum input power	2 W avg, 100 W pk	
Connectors (50 Ω)	8491A: Type N[c]	8493A: SMA[d]
Dimension (length)	8491A: 2-7/16 in. (67 mm)	8493A: 1-9/16 in. (40 mm)
Diameter	8491A: 13/16 in. (21 mm)	8493A: 1/2 in. (13 mm)

[a] Option numbers indicate the attenuation values. For example, Option 003 indicates 3 dB attenuation, Option 010 indicates 10 dB attenuation and so on.

[b] Options 040, 050, and 060 are not available for 8493A.

[c] Mate with MIL-C-71 and MIL-C-39012 connectors.

[d] Miniature SMA type.

Table 1-6 Specifications for 8491B and 8493B coaxial fixed attenuators

	Attenuation accuracy in dB	
Option[a]	DC to 12.4 GHz	12.4 to 18 GHz
003	± 0.3	± 0.3
006	± 0.3	± 0.4
010	± 0.6	± 0.6
020	± 0.6	± 1.0
030	± 1.0	± 1.0
040[b]	± 1.5	± 1.5
050[b]	± 1.5	± 1.5
060[b]	± 2.0	± 2.0

	SWR		
Option[a]	DC to 8 GHz	8 to 12.4 GHz	12.4 to 18 GHz
003	1.25	1.35	1.5
006	1.2	1.3	1.5
010	1.2	1.3	1.5
020	1.2	1.3	1.5
030	1.2	1.3	1.5
040[b]	1.2	1.3	1.5
050[b]	1.2	1.3	1.5
060[b]	1.2	1.3	1.5
Maximum input power	2 W avg, 100 W pk		
Connectors (50 Ω)	8491B: Type N[c]	8493B: SMA[d]	

Dimension (length)	8491B: 2-7/16 in. (67 mm)	8493B: 1-9/16 in. (40 mm)
Diameter	8491B: 13/16 in. (21 mm)	8493B: 1/2 in. (13 mm)

[a] Option numbers indicate the attenuation values. For example, Option 003 indicates 3 dB attenuation, Option 010 indicates 10 dB attenuation and so on.

[b] Options 040, 050, and 060 are not available for 8493B.

[c] Mate with MIL-C-71 and MIL-C-39012 connectors.

[d] Miniature SMA type.

Table 1-7 Specifications for 8493C coaxial fixed attenuator

	Attenuation Accuracy in dB	
Option[a]	DC to 18 GHz	18 to 26.5 GHz
003	± 0.5	± 1.0
006	± 0.6	± 0.6
010	± 0.3	± 0.5
020	± 0.5	± 0.6
030	± 0.7	± 1.0
040	± 1.0	± 1.3

	SWR		
Option[a]	DC to 8 GHz	8 to 12.4 GHz	12.4 to 26.5 GHz
003	1.10	1.15	1.25
006	1.10	1.15	1.27
010	1.10	1.15	1.25
020	1.10	1.15	1.25
030	1.10	1.15	1.25
040	1.10	1.15	1.25
Maximum input power	2 W avg, 100 W pk		
Connectors (50 Ω)	3.5 mm		
Dimension (length)	1-15/16 in. (33.8 mm) for Options 003, 006, 010, 020 1-7/16 in. (36.8 mm) for Options 030, 040		
Diameter	5/16 in. (8 mm)		

[a] Option numbers indicate the attenuation values. For example, Option 003 indicates 3 dB attenuation, Option 010 indicates 10 dB attenuation and so on.

Table 1-8 and Table 1-9 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 1-8 Accuracy of insertion loss measurements (S_{21}, S_{12})

Attenuation	DC to 4 GHz	4 to 12 GHz	12 to 18 GHz
3 dB	± 0.01 dB	± 0.06 dB	± 0.11 dB
6 dB	± 0.01 dB	± 0.07 dB	± 0.11 dB
10 dB	± 0.01 dB	± 0.07 dB	± 0.12 dB
20 dB	± 0.01 dB	± 0.08 dB	± 0.13 dB

Table 1-9 Accuracy of reflection coefficient measurements (S_{11}, S_{22})

	Female		Male	
Model	4 to 12 GHz	12 to 18 GHz	4 to 12 GHz	12 to 18 GHz
11581A	± 0.006 dB	-	± 0.006 dB	-
11582A	± 0.006 dB	± 0.010 dB	± 0.006 dB	± 0.006 dB
11583C	± 0.007 dB	± 0.007 dB	± 0.007 dB	± 0.007 dB

Environmental Specifications

The 849x coaxial fixed attenuators and 1158x attenuator sets are designed to fully comply with Keysight Technologies' product operating environmental specifications as shown Table 1-10.

Table 1-10 849x coaxial fixed attenuator and 1158x attenuator sets environmental specifications

	Temperature	Humidity	Altitude
Operating	0 °C to +55 °C	<95% relative at 40 °C	<4,600 meters (15,000 feet)
Storage	–55 °C to +85 °C	<95% relative at 40 °C	<15,300 meters (50,000 feet)

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 22 or "Performance Test" on page 29.
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 Keysight Technologies Sales and Service office. Refer to the Service and Support information in the front matter of this manual. Keysight 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. Keysight 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 Keysight Technologies nearest 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.

Operating Instruction

Operator's check

The operator's check is supplied to allow the operator to make a quick check of the attenuators prior to use or if a failure is suspected.

Using oscillator and SWR meter

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.

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.**

Quick-check procedure

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

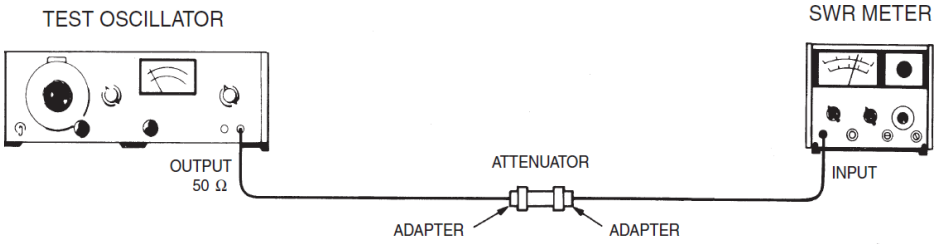

Figure 1-1 Equipment setup using oscillator and SWR meter

2 Set the test oscillator to 0.3 Vrms 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 in Table 1-11, and verify that the SWR meter indicates within the limits as shown Table 1-11.

Table 1-11 SWR verification

Attenuation (dB)	SWR meter range (dB)	Meter indication (dB)		
		Minimum	Actual	Maximum
0 (system cal)	2 (or 10)[a]	Set to 0.5 (or 0.0)[a]		
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

[a] Set SWR meter range to 10 dB and power level to 0.0 dB for 3 dB, 6 dB, and 10 dB attenuators only.

Description

All four s-parameters of the attenuator are measured using a network analyzer that is already calibrated with the necessary settings.

Quick-check procedure

Use correct cables and adapters on the test ports of the network analyzer. This depends on the type of the attenuator being checked. The equipment setup is as illustrated in Figure 1-2.

1. Calibrate the network analyzer with appropriate settings and setup necessary.
2. Measure the S21 or/and S12 of the attenuator. Compare with the specification to verify its electrical performance.
3. Measure the S11 and S22 of the attenuator. Compare with the specification to verify its electrical performance.

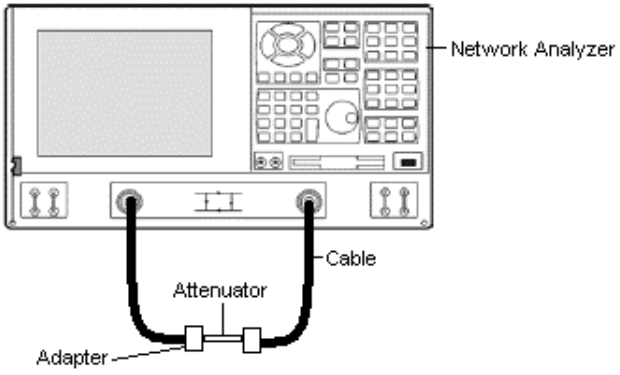

Figure 1-2 Equipment setup using network analyzer

Making Connections

The attenuators should not bear any force or weight contributed by other devices connected to them. The attenuators are bidirectional, that is, the signal may be inserted from either end.

8490D/G

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

The 8490G 1.85-mm connectors mate with other 1.85-mm connectors of the opposite sex.

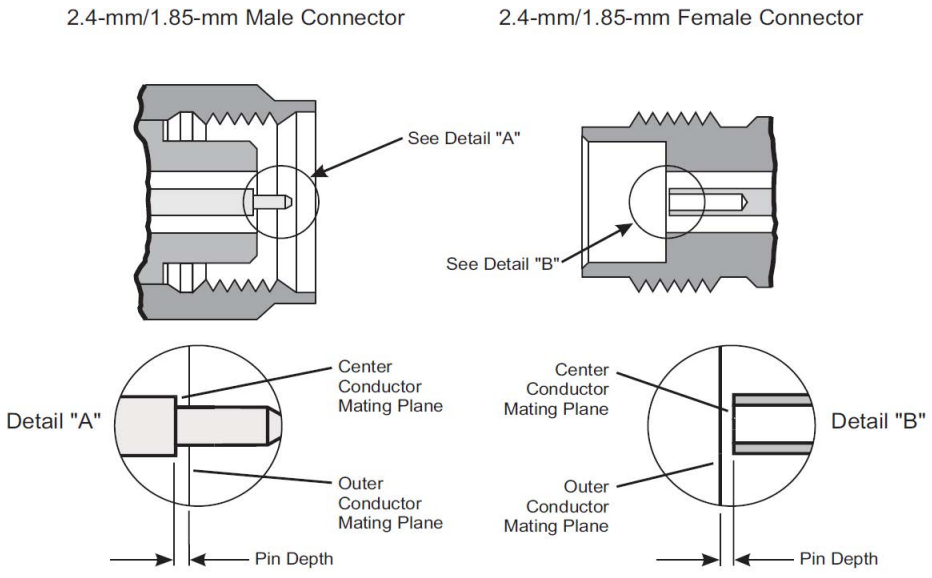

Figure 1-3 2.4-mm/1.85mm connector diagram

8491A/B

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

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

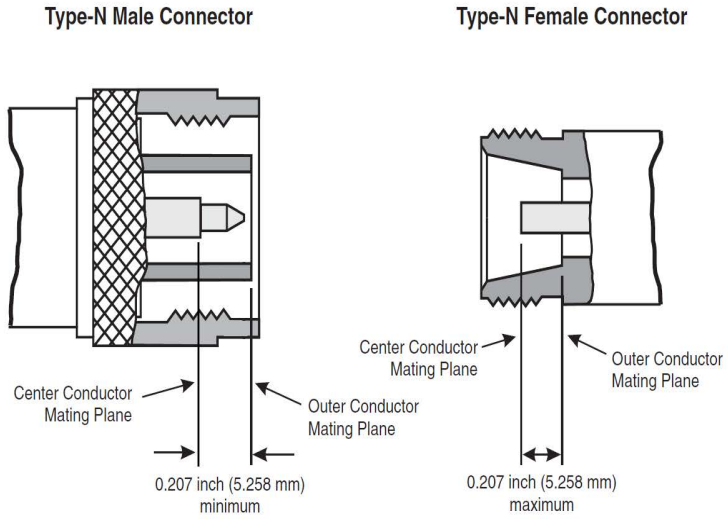

Figure 1-4 Type-N connector diagram

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

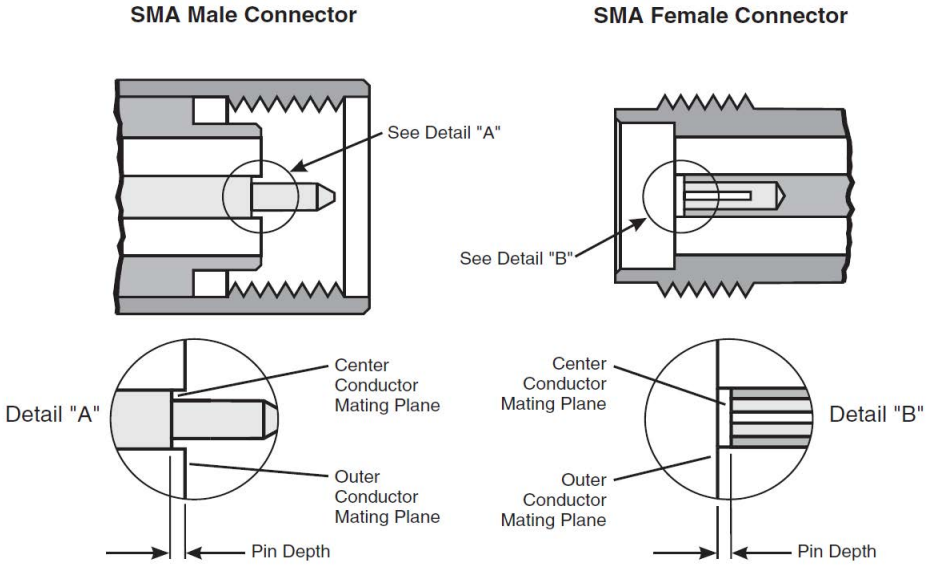

Figure 1-5 SMA connector diagram

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.

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

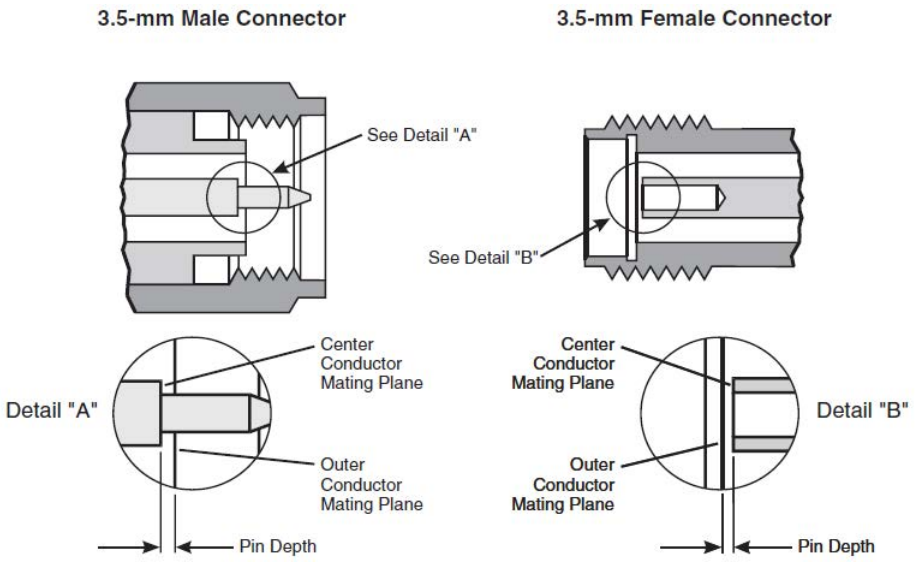

Figure 1-6 3.5-mm connector diagram

Performance Test

The 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 the instrument using the procedure in the analyzer's operating manual.

Service Instructions

Repair

The 8490D/G, 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).

This information is subject to change without notice. Always refer to the Keysight website for the latest revision.

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