Maury Microwave

User Guide

2.4mm Coaxial Calibration Kit

DC to 50 GHz

Models: 7950CK10/11
7950CK20/21

7950-511 (A) 2/15

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Warranty

Maury Microwave hardware products are warranted against defects in materials and workmanship for a period of one year from date of shipment. During the warranty period, Maury Microwave will, at its option, either repair or replace products which prove to be defective.

Maury Microwave software products are warranted against defects in material and workmanship of the media on which the product is supplied for a period of ninety (90) days from date of shipment. Maury also warrants that the product shall operate substantially in accordance with published specifications during the same warranty period. During the warranty period, Maury Microwave will, at its option, either repair or replace products which prove to be defective. Maury does not warrant that the operation of the product shall be uninterrupted or error-free.

For warranty service or repair, all products must be returned to Maury Microwave and must be issued a return authorization number by Maury prior to shipment. Buyer shall prepay shipping charges to Maury. Obligation is limited to the original Buyer.

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General Information

Calibration Kit Description

This series of **2.4mm** coaxial calibration kits is designed to provide accurate calibrations of network analyzers in the **DC to 50.0 GHz** range. Each of these kits includes all the necessary calibration standards and associated hardware needed for the accurate calibration of most network analyzers.

Refer to the ***Calibration Kits*** *Contents* section (see Appendix, Date Sheet Resources) for information on included components and available kit options.

NOTE: This document, software, and data sheet can be downloaded from our website: maurymw.com

NOTE: Legacy analyzer software is not on our website but is available for purchase.

Maintenance

This calibration kit is relatively maintenance free if the components are handled with the same care that is appropriate to all precision equipment. As with any precision component, proper care should be taken to assure clean mating surfaces, correct alignment when mating, and proper torquing of connectors or waveguide coupling screws. To help maintain the integrity of the components in this kit, routine visual inspection and cleaning of mating surfaces is recommended. Failure to do so may result in degraded repeatability and accuracy, as well as damage any mated devices.

Calibration

To maintain verification that a calibration kit is performing to traceable specifications, we recommend that all kits be periodically returned to Maury Microwave for calibration. The typical calibration cycle is one year, although actual need may vary depending on usage.

Supporting Test Port Adapters

When configuring a test setup, be sure that damaging stresses are not applied to the connectors on the test set. This is particularly critical when the attached components are heavy or long. Always properly support the test port adapters being used.

Electrostatic Discharge Precautions

Protection against electrostatic discharge (ESD) is essential while inspecting, cleaning, or making connections to connectors attached to a static-sensitive circuit, such as those found inside test sets.

When handling the connectors on the test set, be aware that you are coming in contact with exposed center conductors that are connected directly to the static-sensitive internal circuits of the network analyzer. Make sure that you and your equipment are well-grounded before inspecting, cleaning, or making connections to test set ports. Standard ESD precautions, such as the use of grounded wrist straps and grounded antistatic mats, are recommended.

Connector Description

Precision **2.4mm** (GPC2.4) connectors are miniature, instrument-grade, air-interface connectors that operate mode-free up to 50 GHz. They feature extremely low VSWR and insertion loss, and are designed to non-destructively mate with standard **2.4mm** connectors. These connectors generally have a high performance support bead and comply with the proposed IEEE standard 387 general precision connector, instrument-grade GPC2.4.

Connector Care

Precision connectors must be handled carefully if accurate calibrations and measurements are to be obtained. All connectors should be inspected prior to each use. For optimum measurement results, all interfaces should be visually inspected under magnification and cleaned on a regular basis. Proper connector contact pin depths should also be verified through regular inspections using a connector gage, such as the Maury Microwave A048A connector gage kit, to insure that the connectors on both calibration devices and devices under test (DUTs) have contact pin depths within recommended tolerances. Refer to Maury data sheet ***5E-064*** (available on our website) for proper pin depth specifications.

Care should be used whenever aligning connectors. Tighten connector coupling nuts using an appropriate torque wrench while holding the opposing connector with an open-end wrench.

When disconnecting devices, take care not to rock or bend any of the connections. Disconnect devices by disengaging the coupling nuts and gently pulling the connectors apart in a straight line.

Always use protective covers on all connectors when devices are not in use.

Should a connector become damaged, it should be repaired before it is used any further or replaced immediately. A damaged connector can damage other mated connectors.

Connector Tightening

Damage to a calibration device or attaching connector can occur if the device is turned instead of the connector nut. ALWAYS turn the nut when making connections. Never turn the device itself.

Always use a torque wrench (Maury model **8799A1**) to final-tighten all connections. This will insure calibration accuracy and measurement repeatability.

When making connections, a **5/16 inch** open-end wrench may be required to hold the body of one device stationary while torquing the nut on the other device or cable. This open-end wrench is supplied with this calibration kit for this purpose.

Using the torque wrench:

Hand-tighten the connection to be torqued by holding the calibration device steady and turning only the nut.

- Hold the torque wrench with your thumb and index finger, behind the groove in the handle (see **Figure 1**).
- Tighten the connection until the ball in the handle crests on the cam (as the handle begins to break). Do not "fully break" the handle of the torque wrench to reach the specified torque.
- Reverse the previous procedure to disconnect the connection.

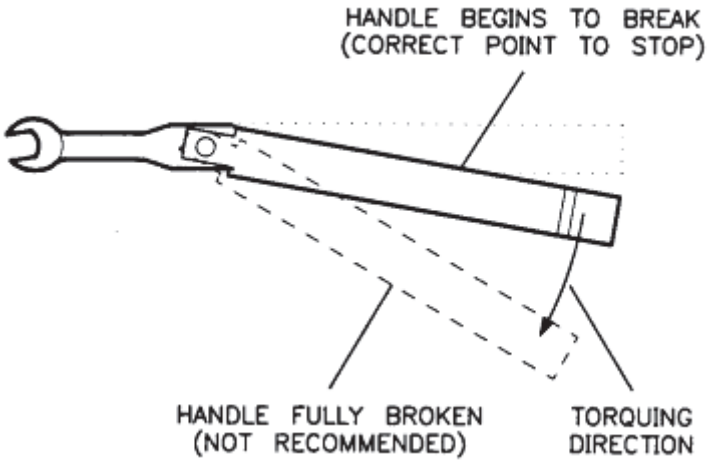

Figure 1. Using the Torque Wrench

Description of Sliding Terminations

The Sliding Terminations cover the frequency range of **4 to 50 GHz** and travel λ/2 wave at **4 GHz**. They also incorporate a mechanical design for the following operation:

- **"Flush Set Adjustment"** – allows the center contact to be flush set to the outer conductor connector reference plane by means of a simple screw adjustment.
- **"Pull Back Mechanism"** – allows the center conductor to be unlocked so that it can be easily engaged with the mating conductor and then returned to its locked or flush set position.
- Refer to **Figures 2** and **3** which shows the sliding termination in its locked and unlocked positions, respectively.

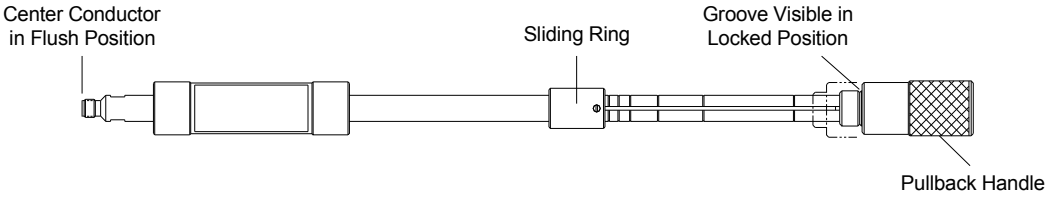

Figure 2. Sliding Termination in Locked Position

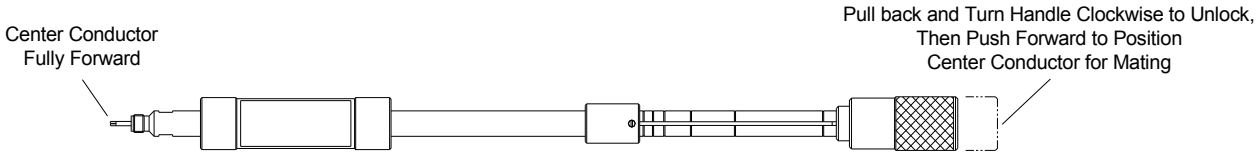

Figure 3. Sliding Termination in Unlocked Position
(Center Conductor Fully Forward)

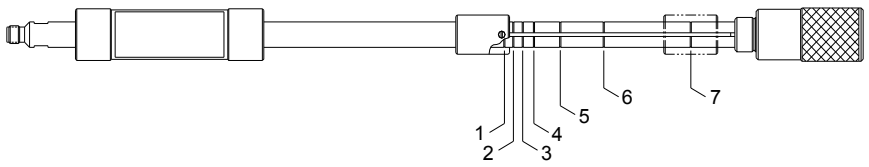

Figure 4. Sliding Ring Positions

Gaging the Sliding Terminations

Gage the sliding termination before each use using a model **A048A** connector gage.

Zero the connector gage according to its operating instructions.

CAUTION: *The sliding termination center conductor can be damaged if the sliding termination is not held in line when mating to the connector gage. Always line up the sliding termination when connecting or removing it from the connector gage.*

Remove the protective end cap from the sliding load. Release the center conductor pullback mechanism by pulling the handle back and turning clockwise as viewed from the rear. Carefully move the handle toward the connector end of the sliding termination (the center conductor will extend beyond the end of the connector) and move the sliding ring fully forward.

Keep the center conductor extended by holding the center conductor pullback mechanism toward the connector end of the sliding termination. Align the sliding termination with the mating connector gage and mate the sliding termination center conductor with the gage center conductor.

Release your hand from the center conductor pullback and move the body of the sliding termination toward the gage to mate the outer conductor of the sliding termination with the outer conductor of the gage connector. Torque the connector to **8 in-lb (90 N-cm)** with the model **8799A1** torque wrench.

Move the center conductor pullback handle back and then turn counter clockwise to lock.

The typical pin depth setting of the sliding load is **-0.00005 to -0.00020 inch**. If the pin depth is out of this range, complete the following procedure to adjust the pin depth setting.

The pin depth setting of the center conductor can be adjusted through the hole at the rear of the pullback handle. Using the special adjusting tool (model number **8777S02**), gently turn the center conductor pin depth adjustment screw until the gage pointer reads **-0.0001 inch**. ***CAUTION: Never use a standard screwdriver. This will result in damage to the sliding termination.***

Set the assembly down for five minutes to let the temperature stabilize. Repeat the previous adjustment procedure if the reading on the gage drifts out of the allowable range.

Move the center conductor pullback to the unlocked position and then back to the locked position. The gage reading should return to the value arrived at after adjustment. If not, repeat the adjustment procedure. The gage reading should repeat to within **+ 0.0001**.

After the pin depth is set, loosen the connection and remove the gage from the sliding termination.

The sliding termination is now ready for use. Replace the protective cap on the sliding termination when it is not being used.

Connecting the Sliding Termination

CAUTION: The sliding termination center conductor can be damaged if the sliding termination is not held in line when mating to a connector. Always line up the sliding termination when connecting or removing it from a connector.

Release the center conductor pullback mechanism as described in the previous section. Carefully move the handle toward the connector end of the sliding termination. The center conductor will extend beyond the end of the connector.

Keep the center conductor extended by holding the center conductor pullback mechanism toward the connector end of the sliding termination. Align the sliding termination with the mating connector and mate the sliding termination center conductor with the center conductor of the cable or test port connector.

Release your hand from the center conductor pullback and move the body of the sliding termination toward the gage to mate the outer conductor of the sliding termination with the outer conductor of the gage connector. Torque the connector to **8 in-lb (90 N-cm)** with the model **8799A1** torque wrench.

Move the center conductor pullback handle back and then turn counterclockwise to lock.

Using the Sliding Termination

The sliding termination has radial rings for the sliding ring to ride over. The sliding ring is set using these rings as detents. The sliding ring is moved from mark to mark during calibration using the detents as set points.

Refer to **Figure 4**. Move the sliding ring forward as far as possible toward the connector end of the sliding termination.

Move the sliding ring back until you feel it detent at the first set mark. This is the first calibration position.

Continue to set the sliding ring to all of the seven positions as shown in **Figure 4**. This completes the calibration sequence.

Calibration Kit Contents

Standard Components – 7950CK10

1 ea	Short, female	7946A
1 ea	Short, male	7946B
1 ea	Open, female	7948A1
1 ea	Open, male	7948B1
1 ea	Fixed Termination, female	7931A1
1 ea	Fixed Termination, male	7931B1
1 ea	Case Assembly	

Standard Components – 7950CK11

1 ea	Short, female	7946A
1 ea	Short, male	7946B
1 ea	Open, female	7948A1
1 ea	Open, male	7948B1
1 ea	Fixed Termination, female	7931A1
1 ea	Fixed Termination, male	7931B1
1 ea	Adapter, male to male	7921B
1 ea	Adapter, female to male	7921C
1 ea	Adapter, female to female	7921A
1 ea	Case Assembly	

Standard Components – 7950CK20

1 ea	Short, female	7946A
1 ea	Short, male	7946B
1 ea	Open, female	7948A1
1 ea	Open, male	7948B1
1 ea	Fixed Termination, female	7931A1
1 ea	Fixed Termination, male	7931B1
1 ea	Sliding Termination, female	7935A
1 ea	Sliding Termination, male	7935B
1 ea	5/16 Torque Wrench, 8in.lbs	8799A1
1 ea	Wrench, 5/16	8770Z6
1 ea	Pin Depth Adjust Tool	8777S02
1 ea	Case Assembly	

Standard Components – 7950CK21

1 ea	Short, female	7946A
1 ea	Short, male	7946B
1 ea	Open, female	7948A1
1 ea	Open, male	7948B1
1 ea	Fixed Termination, female	7931A1
1 ea	Fixed Termination, male	7931B1
1 ea	Adapter, male to male	7921B
1 ea	Adapter, female to male	7921C
1 ea	Adapter, female to female	7921A
1 ea	Sliding Termination, female	7935A
1 ea	Sliding Termination, male	7935B
1 ea	5/16 Torque Wrench, 8in.lbs	8799A1
1 ea	Wrench, 5/16	8770Z6
1 ea	Pin Depth Adjust Tool	8777S02
1 ea	Case Assembly	

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Standard Definitions

Anritsu Network Analyzers

Table 1. Male Standard Definitions for Anritsu

Male Open Device	
C0	36.0 e-15
C1	50.0 e-27
C2	-0.95 e-36
C3	0.11 e-45
Offset Length	0.4475 cm
Serial Number	00000

Male Short Device	
Offset Length	0.5075 cm
Serial Number	00000

Table 2. Female Standard Definitions for Anritsu

Female Open Device	
C0	34.0 e-15
C1	60.0 e-27
C2	8.7 e-36
C3	-0.08 e-45
Offset Length	0.4475 mm
Serial Number	00000

Female Short Device	
Offset Length	0.5075 cm
Serial Number	00000

For specific loading instructions, see ***Anritsu loading instructions,*** which can be downloaded from our website: ***maurymw.com***.

Keysight Network Analyzers

Table 3. Standard Definitions for Keysight

Standard [1]			C0 x10^{-15} F	C1 x10^{-27} F/Hz	C2 x10^{-36} F/Hz^2	C3 x10^{-45} F/Hz^3	Fixed or Sliding [2]	Offset			Frequency GHz		Coax or W/G	Standard Label
	Type	Description	L0 x10^{-12} H	L1 x10^{-24} H/Hz	L2 x10^{-33} H/Hz^2	L3 x10^{-42} H/Hz^3		Delay ps	Z_0 [3] Ω	Loss [4] GΩ/s	Min	Max		
	Short	7946A Female Short	0.0	0.0	0.0	0.0		16.929	50	2.806	0	999	Coax	7946A
	Open	7948A1 Female Open	34.0	60.0	8.7	-0.08		14.927	50	2.57	0	999	Coax	7948A1
	Load	7931A1 Broadband Female Load					Fixed	0	50	0	0	999	Coax	7931A1 BB
	Load	7935A Sliding Female Load					Sliding	0	50	0	3.999	999	Coax	7935A
	Load	7931A1 Lowband Female Load					Fixed	0	50	0	0	4.001	Coax	7931A1 LB
	Load	7931B1 Broadband Male Load					Fixed	0	50	0	0	999	Coax	7931B1 BB
	Load	7935B Sliding Male Load					Sliding	0.0	50	0	3.999	999	Coax	7935B
	Thru	Thru (0 cm)						0	50	0	0	999	Coax	Thru [5]
	Load	7931B1 Lowband Male Load					Fixed	0.0	50	0	0	4.001	Coax	7931B1 LB
	Short	7946B Male Short	0.0	0.0	0.0	0.0		16.929	50	2.806	0	999	Coax	7946B
	Open	7948B1 Male Open	36.0	50.0	-0.95	0.11		14.927	50	2.57	0	999	Coax	7948B1

[1] Open, short, load, delay/thru, or arbitrary impedance.
[2] Load or arbitrary impedance only.
[3] Z_0 normalized.
[4] Skin loss factor, normalized at 1 GHz.
[5] Test ports connected directly.

For specific loading instructions, see ***Keysight loading instructions***, which can be downloaded from our website: ***maurymw.com***

Rohde & Schwarz Network Analyzers

Table 4. Standard Definitions for Rohde & Schwarz

Short (M) Min Freq = 0 Hz Max Freq = 50.0 GHz Length = 5.075 mm Loss = 0.00825 dB/√GHz	Through (MF) Min Freq = 0 Hz Max Freq = 50.0 GHz Length = 0 mm Loss = 0 dB/√GHz
Short (F) Min Freq = 0 Hz Max Freq = 50.0 GHz Length = 5.075 mm Loss = 0.00825 dB/√GHz	Through (MM) Min Freq = 0 Hz Max Freq = 50.0 GHz Length = 19.702 mm Loss = 0.01467 dB/√GHz
Open (M) Min Freq = 0 Hz Max Freq = 50.0 GHz Length = 4.475 mm Loss = 0.00666 dB/√GHz C0 = 36.0 fF C1 = 0.05 fF/GHz C2 = -0.00095 fF/GHz^2 C3 = 0.00011 fF/GHz^3	Through (FF) Min Freq = 0 Hz Max Freq = 50.0 GHz Length = 19.702 mm Loss = 0.01467 dB/√GHz
	Match (M) Min Freq = 0 Hz Max Freq = 50.0 GHz
Open (F) Min Freq = 0 Hz Max Freq = 50.0 GHz Length = 4.475 mm Loss = 0.00666 dB/√GHz C0 = 34.0 fF C1 = 0.060 fF/GHz C2 = 0.00870 fF/GHz^2 C3 = 0.000080 fF/GHz^3	Match (F) Min Freq = 0 Hz Max Freq = 50.0 GHz
	Sliding Match (M) Min Freq = 4.0 GHz Max Freq = 50.0 GHz
	Sliding Match (F) Min Freq = 4.0 GHz Max Freq = 50.0 GHz

For specific loading instructions, see ***Rohde & Schwarz loading instructions***, which can be downloaded from our website: ***maurymw.com***.

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Appendix

Data Sheet Resources

2Z-057 – 2.4mm Calibration Kits
http://maurymw.com/pdf/datasheets/2Z-057.pdf

2Y-001 – Connector Gages and Connector Gage Kits
http://maurymw.com/pdf/datasheets/2Y-001.pdf

2Y-048 – Metrology Grade 1.85/2.4mm Digital Connector Gage Kit
http://maurymw.com/pdf/datasheets/2Y-048.pdf

2Y-050A – Torque Wrenches
http://maurymw.com/pdf/datasheets/2Y-050A.pdf

5E-064 – Precision 2.4mm Coaxial Connectors
http://maurymw.com/pdf/datasheets/5E-064.pdf

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Web Resources

Maury Calibration Kits
http://maurymw.com/Precision/VNA_Cal_Kits.php

Maury Precision Coaxial and Waveguide-to-Coaxial Adapters
http://maurymw.com/Finder/Adapter_Finder.php

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