Maury Microwave

User Guide

Coaxial Calibration Kit

DC to 50 GHz

9050-1 (A) 5/19

User Guide

Coaxial Calibration Kit

DC to 50 GHz

Maury Microwave
2900 Inland Empire Boulevard
Ontario, California 91764-4804 USA
Telephone: (909) 987-4715
Fax: (909) 987-1112

maurymw.com

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.

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General Information

Calibration Kit Description

This series of coaxial calibration kits are designed to provide accurate calibrations of network analyzers in the **DC to 50 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, calibration constants software, and data sheet can be downloaded from our website: ***maurymw.com***

NOTE: Legacy analyzer software is not on our website.

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, and may 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.

7mm and Type N 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 **2698C2**) to final-tighten all connections. This will insure calibration accuracy and measurement repeatability.

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.

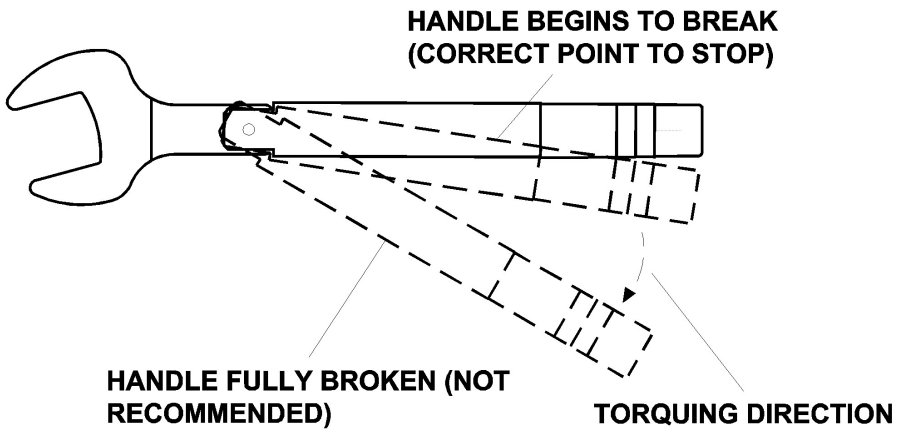

Figure 1. Using the Torque Wrench

3.5mm, 2.92mm, and 2.4mm 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.

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 4**).
- 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 above procedure to disconnect the connection.

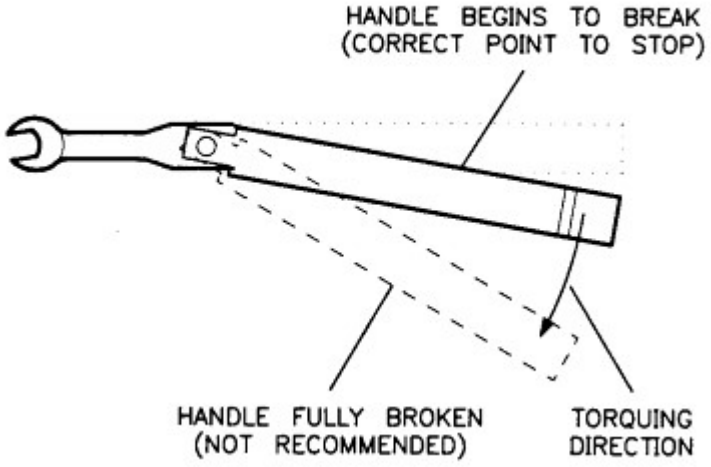

Figure 2. Using the Torque Wrench

7mm (DC - 18 GHz)

7mm Calibration Kit Description

This series of **7mm** coaxial calibration kits is designed to provide accurate calibrations of network analyzers in the **DC to 18.0 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, calibration constants software, and data sheet can be downloaded from our website: ***maurymw.com***

NOTE: Legacy analyzer software is not on our website.

Connector Description

All calibration standards and adapters in the 2650 series kits utilize the Maury Microwave Precision 7mm Connector, which is compliant with IEEE standard 287 for instrument-grade general precision connectors (GPC7).

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 A028D 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-060*** (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.

7mm Calibration Kit Contents

Standard Components – 2650CK40

1 ea	Short, fixed	2615D3
1 ea	Open, fixed	2616F1
1 ea	Fixed Termination	2610F1
1 ea	3/4 Torque Wrench, 12in.lbs	2698C2
1 ea	Case Assembly	

7mm Standard Definitions

Anritsu Network Analyzers

Table 1. Standard Definitions for Anritsu

Open Device	
C0	89.7534 e-15
C1	894.0915 e-27
C2	-76.5531 e-36
C3	6.8249 e-45
Offset Length	0.0178 mm
Serial Number	00000

Short Device	
L0	0.8809 e-12
L1	-110.3675 e-24
L2	11.4478 e-33
L3	-0.3932 e-42
Offset Length	0.000 mm
Serial Number	00000

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

Table 2. 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	2615D3 Short	0.8809	-110.3675	11.4478	-0.3932		0.0	50	0.0	0.0	999.0	Coax	2615D3
	Open	2616F1 Open	89.7534	894.0915	-76.5531	6.8249		0.0593	50	0.0	0.0	999.0	Coax	2616F1
	Load	2610F1 Broadband Load					Fixed	0.0	50	0.0	0.0	999.0	Coax	2610F1
	Thru	Thru (0 cm)						0.0	50	0.0	0.0	999.0	Coax	Thru[5]

[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 3. Standard Definitions for Rohde & Schwarz

Thru Label = Thru (0cm) Min Freq = 0 Hz Max Freq = 18.0 GHz Length = 0.0 mm Loss = 0.0 dB/$\sqrt{GHz}$	Short Label = 2615D3 Min Freq = 0 Hz Max Freq = 18.0 GHz Length = 0.0 mm Loss = 0.0 dB/$\sqrt{GHz}$ L0 = 0.8809 fH L1 = -0.1104 fH/GHz L2 = 0.0114 fH/GHz^2 L3 = -.0004 fH/GHz^3
Open Label = 2616F1 Min Freq = 0 Hz Max Freq = 18.0 GHz Length = 0.0178 mm Loss = 0.0 dB/$\sqrt{GHz}$ C0 = 89.7534 fF C1 = 0.8941 fF/GHz C2 = -0.0766 fF/GHz^2 C3 = 0.0068 fF/GHz^3	Match Label = 2610F1 Min Freq = 0 Hz Max Freq = 18.0 GHz

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

Type N (DC - 18 GHz)

Type N Calibration Kit Description

This series of **Type N** coaxial calibration kits is designed to provide accurate calibrations of network analyzers in the **DC to 18.0 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, calibration constants software, and data sheet can be downloaded from our website: ***maurymw.com***

NOTE: Legacy analyzer software is not on our website.

Connector Description

The Maury type N connector is a precision design that exhibits extremely low VSWR and operates from DC to 18 GHz. The male connectors are provided with a 3/4 hex coupling nut so they can be properly torqued to 12 in/lb. Connector bodies are made from stainless steel. Contacts are made gold-plated and heat-treated beryllium copper contacts to insure long life and reliability.

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 **A020K series** 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-049*** (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.

Type N Calibration Kit Contents

Standard Components – 8850CK40

1 ea	Short, female	8806G2
1 ea	Short, male	8807C2
1 ea	Open, female	8809B2
1 ea	Open, male	8810B2
1 ea	Fixed Termination, female	2510E2
1 ea	Fixed Termination, male	2510F2
1 ea	3/4 Torque Wrench, 12in.lbs	2698C2
1 ea	1/2 and 9/16 double-end wrench	2517S3
1 ea	Case Assembly	

Standard Components – 8850CK41

1 ea	Short, female	8806G2
1 ea	Short, male	8807C2
1 ea	Open, female	8809B2
1 ea	Open, male	8810B2
1 ea	Fixed Termination, female	2510E2
1 ea	Fixed Termination, male	2510F2
1 ea	Adapter, female to female	8828A2
1 ea	Adapter, male to male	8828B2
1 ea	Adapter, female to male	8828C2
1 ea	3/4 Torque Wrench, 12in.lbs	2698C2
1 ea	1/2 and 9/16 double-end wrench	2517S3
1 ea	Case Assembly	

Type N Standard Definitions

Anritsu Network Analyzers

Table 2. Male Standard Definitions for Anritsu

Male Open Device		
C0	91.6842	e-15
C1	2515.7257	e-27
C2	-202.3573	e-36
C3	10.3024	e-45
Offset Length	11.1005 mm	
Serial Number	00000	

Male Short Device		
L0	5.5791	e-12
L1	-2209.5013	e-24
L2	159.3365	e-33
L3	-2.8286	e-42
Offset Length	12.6327 mm	
Serial Number	00000	

Table 3. Female Standard Definitions for Anritsu

Female Open Device		
C0	105.0532	e-15
C1	-1835.5623	e-27
C2	265.3256	e-36
C3	-4.8156	e-45
Offset Length	11.1005 mm	
Serial Number	00000	
Female Short Device		
L0	-1.6624	e-12
L1	3684.9567	e-24
L2	-513.1948	e-33
L3	20.3536	e-42
Offset Length	12.6327 mm	
Serial Number	00000	

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

Table 4. 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	8806G2 Female Short	-1.6624	3684.9567	-513.1948	20.3536		42.1380	50	0.6992	0.0	999.0	Coax	8806G2
	Open	8809B2 Female Open	105.0532	-1835.5623	265.3256	-4.8156		37.0273	50	0.3969	0.0	999.0	Coax	8809B2
	Load	2510E2 Broadband Female Load					Fixed	0.0	50	0.5480	0.0	999.0	Coax	2510E2
	Thru	Thru (0 cm)						0.0	50	0.0	0.0	999.0	Coax	Thru (5)
	Short	8807C2 Male Short	5.5791	-2209.5013	159.3365	-2.8286		42.1380	50	0.9043	0.0	999.0	Coax	8807C2
	Open	8810B2 Male Open	91.6842	2515.7257	-202.3573	10.3024		37.0273	50	0.9273	0.0	999.0	Coax	8810B2
	Load	2510F2 Broadband Male Load					Fixed	0.0	50	0.9158	0.0	999.0	Coax	2510F2

(6) Open, short, load, delay/thru, or arbitrary impedance.
(1) Load or arbitrary impedance only.
(2) Z_0 normalized.
(3) Skin loss factor, normalized at 1 GHz.
(4) 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 5. Standard Definitions for Rohde & Schwarz

THROUGH (MF) LABEL = THRU 0 mm MIN FREQ = 0 Hz MAX FREQ = 18 GHz LENGTH = 0 mm LOSS = 0 dB/√GHz	**SHORT (M)** LABEL = 8807C2 MIN FREQ = 0 Hz MAX FREQ = 18 GHz LENGTH = 12.6327 mm LOSS = 0.00662 dB/√GHz L0 = 5.5791 fH L1 = -2.2095 fH/GHz L2 = 0.1593 fH/GHz^2 L3 = -0.0028 fH/GHz^3
OPEN (M) Label = 8810B2 Min Freq = 0 Hz Max Freq = 18.0 GHz Length = 11.1005 mm Loss = 0.005964 dB/√GHz C0 = 91.6842 fF C1 = 2.5157 fF/GHz C2 = -2024 fF/GHz^2 C3 = 0.0103 fF/GHz^3	**SHORT (F)** LABEL = 8806G2 MIN FREQ = 0 Hz MAX FREQ = 18 GHz LENGTH = 12.6327 mm LOSS = 0.005118 dB/√GHz L0 = -1.6624 fH L1 = 3.6850 fH/GHz L2 = -0.5132 fH/GHz^2 L3 = .0204 fH/GHz^3
OPEN (F) LABEL = 8809B2 MIN FREQ = 0 Hz MAX FREQ = 18 GHz LENGTH = 11.1005 mm LOSS = 0.002553 dB/√GHz C0 = 105.0532 fF C1 = -1.8356 fF/GHz C2 = 0.2653 fF/GHz^2 C3 = -0.0048 fF/GHz^3	**MATCH (M)** LABEL = 2510F2 MIN FREQ = 0 Hz MAX FREQ = 18 GHz **MATCH (F)** LABEL = 2510E2 MIN FREQ = 0 Hz MAX FREQ = 18 GHz

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

3.5mm (DC - 26.5 GHz)

3.5mm Calibration Kit Description

This series of **3.5mm** coaxial calibration kits is designed to provide accurate calibrations of network analyzers in the **DC to 26.5 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, calibration constants software, and data sheet can be downloaded from our website: ***maurymw.com***

NOTE: Legacy analyzer software is not on our website.

Connector Description

All calibration standards and adapters in the 8050 series kits utilize the Maury Microwave Precision **3.5mm** Connector, which is compliant with IEEE standard 287 for instrument grade general precision connectors (GPC3.5).

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 A050A 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-062 (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.

3.5mm Calibration Kit Contents

Standard Components – 8050CK40

1 ea	Short, female	8046F6
1 ea	Short, male	8047F6
1 ea	Open, female	8048A6
1 ea	Open, male	8048B6
1 ea	Fixed Termination, female	8031A6
1 ea	Fixed Termination, male	8031B6
1 ea	5/16 Torque Wrench, 8in.lbs	8799A1
1 ea	Wrench, 5/16	8770Z6
1 ea	Wrench, 7/16	8770Z7
1 ea	Case Assembly	

Standard Components – 8050CK41

1 ea	Short, female	8046F6
1 ea	Short, male	8047F6
1 ea	Open, female	8048A6
1 ea	Open, male	8048B6
1 ea	Fixed Termination, female	8031A6
1 ea	Fixed Termination, male	8031B6
1 ea	Adapter, female to female	8021A3
1 ea	Adapter, male to male	8021B3
1 ea	Adapter, female to male	8021C3
1 ea	5/16 Torque Wrench, 8in.lbs	8799A1
1 ea	Wrench, 5/16	8770Z6
1 ea	Wrench, 7/16	8770Z7
1 ea	Case Assembly	

3.5mm Standard Definitions

Anritsu Network Analyzers

Table 6. Male Standard Definitions for Anritsu

Male Open Device	
C0	49.7424 e-15
C1	1254.2466 e-27
C2	-67.5514 e-36
C3	1.5708 e-45
Offset Length	4.3625 mm
Serial Number	00000

Male Short Device	
L0	14.6818 e-12
L1	-2222.7208 e-24
L2	115.6479 e-33
L3	-1.7013 e-42
Offset Length	4.9926 mm
Serial Number	00000

Table 7. Female Standard Definitions for Anritsu

Female Open Device	
C0	52.8301 e-15
C1	1136.2844 e-27
C2	-70.2870 e-36
C3	1.7876 e-45
Offset Length	4.3625 mm
Serial Number	00000
Female Short Device	
L0	8.1344 e-12
L1	-716.4457 e-24
L2	58.1902 e-33
L3	-1.1408 e-42
Offset Length	4.9926 mm
Serial Number	00000

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

Keysight Network Analyzers

Table 8. 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	8046F6 Female Short	8.1344	-716.4457	58.1902	-1.1408		16.6535	50	1.5989	0	999	Coax	8046F6
	Open	8048A6 Female Open	52.8301	1136.2844	-70.2870	1.7876		14.5517	50	3.1023	0	999	Coax	8048A6
	Load	8031A6 Broadband Female Load					Fixed	0	50	2.3506	0	999	Coax	8031A6
	Thru	Thru (0 cm)						0	50	0	0	999	Coax	Thru [5]
	Short	8047F6 Male Short	14.6818	-2222.7208	115.6479	-1.7013		16.6535	50	1.8992	0	999	Coax	8047F6
	Open	8048B6 Male Open	49.7424	1254.2466	-67.5514	1.5708		14.5517	50	2.9161	0	999	Coax	8048B6
	Load	8031B6 Broadband Male Load					Fixed	0	50	2.4077	0	999	Coax	8031B6

[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 9. Standard Definitions for Rohde & Schwarz

Short (M) Min Freq = 0 Hz Max Freq = 26.5 GHz Length = 4.9926 mm Loss = 0.005494 dB/√GHz L0 = 14.6818 fH L1 = -2.2227 fH/GHz L2 = 0.1156 fH/GHz^2 L3 = -0.0017 fH/GHz^3	Match (M) Min Freq = 0 Hz Max Freq = 26.5 GHz
Short (F) Min Freq = 0 Hz Max Freq = 26.5 GHz Length = 4.9926 mm Loss = 0.004626 dB/√GHz L0 = 8.1344 fH L1 = -0.7164 fH/GHz L2 = 0.0582 fH/GHz^2 L3 = -0.0011 fH/GHz^3	Match (F) Min Freq = 0 Hz Max Freq = 26.5 GHz
Open (M) Min Freq = 0 Hz Max Freq = 26.5 GHz Length = 4.3625 mm Loss = 0.007372 dB/√GHz C0 = 49.7424 fF C1 = 1.2542 fF/GHz C2 = -0.0676 fF/GHz^2 C3 = 0.0016 fF/GHz^3	Open (F) Min Freq = 0 Hz Max Freq = 26.5 GHz Length = 4.3625 mm Loss = 0.007842 dB/√GHz C0 = 52.8301 fF C1 = 1.1363 fF/GHz C2 = -0.0703 fF/GHz^2 C3 = 0.0018 fF/GHz^3
Through (MM) Min Freq = 0 Hz Max Freq = 34 GHz Length = 17.3750 mm Loss = 0.0065 dB/√GHz	Through (FF) Min Freq = 0 Hz Max Freq = 34 GHz Length = 17.3750 mm Loss = 0.0065 dB/√GHz
Through (MF) Min Freq = 0 Hz Max Freq = 34 GHz Length = 0 mm Loss = 0.0000 dB/√GHz	

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

2.92mm (DC - 40 GHz)

2.92mm Calibration Kit Description

This series of **2.92mm** coaxial calibration kits is designed to provide accurate calibrations of network analyzers in the **DC to 40.0 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, calibration constants software, and data sheet can be downloaded from our website: ***maurymw.com***

NOTE: Legacy analyzer software is not on our website.

Connector Description

The **2.92mm** connector is a precision miniature air line interface connector that operates mode free to 40 GHz. It is mechanically compatible with SMA and 3.5mm connectors. The 2.92mm connector was originally introduced by Maury in 1974 as the MPC3 connector and reintroduced by Anritsu in 1984 as the 'K' connector, as it is now known today.

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 A050A 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-063*** (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.

2.92mm Calibration Kit Contents

Standard Components – 8770CK40

1 ea	Short, female	8771F4
1 ea	Short, male	8772F4
1 ea	Open, female	8773A4
1 ea	Open, male	8773B4
1 ea	Fixed Termination, female	8775A4
1 ea	Fixed Termination, male	8775B4
1 ea	5/16 Torque Wrench, 8in.lbs	8799A1
1 ea	Wrench, 5/16	8770Z6
1 ea	Wrench, 7/16	8770Z7
1 ea	Case Assembly	

Standard Components – 8770CK41

1 ea	Short, female	8771F4
1 ea	Short, male	8772F4
1 ea	Open, female	8773A4
1 ea	Open, male	8773B4
1 ea	Fixed Termination, female	8775A4
1 ea	Fixed Termination, male	8775B4
1 ea	Adapter, Female to Female	8714A2
1 ea	Adapter, Male to Male	8714B2
1 ea	Adapter, Female to Male	8714C2
1 ea	5/16 Torque Wrench, 8in.lbs	8799A1
1 ea	Wrench, 5/16	8770Z6
1 ea	Wrench, 7/16	8770Z7
1 ea	Case Assembly	

2.92mm Standard Definitions

Anritsu Network Analyzers

Table 10. Male Standard Definitions for Anritsu

Male Open Device	
C0	23.2403 e-15
C1	184.8151 e-27
C2	-9.5646 e-36
C3	0.2607 e-45
Offset Length	4.7690 mm
Serial Number	00000

Male Short Device	
L0	-10.7477 e-12
L1	-124.3960 e-24
L2	3.8445 e-33
L3	-0.0442 e-42
Offset Length	5.0841 mm
Serial Number	00000

Table 11. Female Standard Definitions for Anritsu

Female Open Device	
C0	31.8097 e-15
C1	-829.2704 e-27
C2	36.6550 e-36
C3	-0.3125 e-45
Offset Length	4.7690 mm
Serial Number	00000
Female Short Device	
C0	-17.3052 e-12
C1	1030.0272 e-24
C2	-47.5966 e-33
C3	0.5894 e-42
Offset Length	5.0841 mm
Serial Number	00000

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

Table 12. 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	8771F4 Female Short	-17.3052	1030.0272	-47.5966	0.5894		16.9588	50	1.7877	0	999	Coax	8771F4
	Open	8773A4 Female Open	31.8097	-829.2704	36.6550	-0.3125		15.9076	50	2.9263	0	999	Coax	8773A4
	Load	8775A4 Broadband Female Load					Fixed	0	50	2.3570	0	999	Coax	8775A4
	Thru	Thru (0 cm)						0	50	0	0	999	Coax	Thru [5]
	Short	8772F4 Male Short	-10.7477	-124.3960	3.8445	-0.0442		16.9588	50	1.3758	0	999	Coax	8772F4
	Open	8773B4 Male Open	23.2403	184.8151	-9.5646	0.2607		15.9076	50	2.0389	0	999	Coax	8773B4
	Load	8775B4 Broadband Male Load					Fixed	0	50	1.7073	0	999	Coax	8775B4

[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 13. Standard Definitions for Rohde & Schwarz

Short (M) Min Freq = 0 Hz Max Freq = 40.0 GHz Length = 5.0841 mm Loss = 0.004053 dB/√GHz L0 = -10.7477 fH L1 = -0.1244 fH/GHz L2 = 0.0038 fH/GHz^2 L3 = 0.0000 fH/GHz^3	Through (MF) Min Freq = 0 Hz Max Freq = 40.0 GHz Length = 0 mm Loss = 0 dB/√GHz
Short (F) Min Freq = 0 Hz Max Freq = 40.0 GHz Length = 5.0841 mm Loss = 0.005267 dB/√GHz L0 = -17.3052 fH L1 = 1.0300 fH/GHz L2 = -0.0476 fH/GHz^2 L3 = 0.0006 fH/GHz^3	Through (MM) Min Freq = 0 Hz Max Freq = 40.0 GHz Length = 17.155 mm Loss = 0.0114 dB/√GHz
Open (M) Min Freq = 0 Hz Max Freq = 40.0 GHz Length = 4.7690 mm Loss = 0.005634 dB/√GHz C0 = 23.2403 fF C1 = 0.1848 fF/GHz C2 = -0.0096 fF/GHz^2 C3 = 0.0003 fF/GHz^3	Through (FF) Min Freq = 0 Hz Max Freq = 40.0 GHz Length = 17.155 mm Loss = 0.0114 dB/√GHz Match (M) Min Freq = 0 Hz Max Freq = 40.0 GHz
Open (F) Min Freq = 0 Hz Max Freq = 40.0 GHz Length = 4.7690 mm Loss = 0.008087 dB/√GHz C0 = 31.8097 fF C1 = -0.8293 fF/GHz C2 = 0.0367 fF/GHz^2 C3 = -0.0003 fF/GHz^3	Match (F) Min Freq = 0 Hz Max Freq = 40.0 GHz

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

2.4mm Calibration Kit Description

This series of coaxial calibration kits are designed to provide accurate calibrations of network analyzers in the **DC to 50 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, calibration constants software, and data sheet can be downloaded from our website: ***maurymw.com***

NOTE: Legacy analyzer software is not on our website.

Connector Description

The **2.4mm** connector is a precision miniature, air-interface connector that operates mode free to 50 GHz. They feature extremely low VSWR and insertion loss, and are designed to non-destructively mate with standard 2.4mm connectors.

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 series** 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.

2.4mm Calibration Kit Contents

Standard Components – 7950CK40

1 ea	Short, female	7946A2
1 ea	Short, male	7946B2
1 ea	Open, female	7948A2
1 ea	Open, male	7948B2
1 ea	Fixed Termination, female	7931A2
1 ea	Fixed Termination, male	7931B2
1 ea	5/16 Torque Wrench, 8in.lbs	8799A1
1 ea	Wrench, 5/16	8770Z6
1 ea	Wrench, 7/16	8770Z7
1 ea	Case Assembly	

Standard Components – 7950CK41

1 ea	Short, female	7946A2
1 ea	Short, male	7946B2
1 ea	Open, female	7948A2
1 ea	Open, male	7948B2
1 ea	Fixed Termination, female	7931A2
1 ea	Fixed Termination, male	7931B2
1 ea	Adapter, female to female	7921A1
1 ea	Adapter, male to male	7921B1
1 ea	Adapter, female to male	7921C1
1 ea	5/16 Torque Wrench, 8in.lbs	8799A1
1 ea	Wrench, 5/16	8770Z6
1 ea	Wrench, 7/16	8770Z7
1 ea	Case Assembly	

2.4mm Standard Definitions

Anritsu Network Analyzers

Table 14. Male Standard Definitions for Anritsu

Male Open Device	
C0	39.4911 e-15
C1	138.8213 e-27
C2	-10.2131 e-36
C3	0.2922 e-45
Offset Length	4.4640 mm
Serial Number	00000

Male Short Device	
L0	-7.0462 e-12
L1	759.5828 e-24
L2	-17.5858 e-33
L3	0.0864 e-42
Offset Length	5.0815 mm
Serial Number	00000

Table 15. Female Standard Definitions for Anritsu

Female Open Device	
C0	39.4671 e-15
C1	49.8046 e-27
C2	-5.8029 e-36
C3	0.2417 e-45
Offset Length	4.4640 mm
Serial Number	00000
Female Short Device	
L0	-13.7680 e-12
L1	1770.4244 e-24
L2	-53.4641 e-33
L3	0.4679 e-42
Offset Length	5.0815 mm
Serial Number	00000

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

Table 16. 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	7946A2 Female Short	-13.7680	1770.4244	-53.4641	0.4679		16.9500	50	2.6172	0	999	Coax	7946A2
	Open	7948A2 Female Open	39.4671	49.8046	-5.8029	0.2417		14.8903	50	3.9667	0	999	Coax	7948A2
	Load	7931A2 Broadband Female Load					Fixed	0	50	3.2919	0	999	Coax	7931A2
	Thru	Thru (0 cm)						0	50	0	0	999	Coax	Thru [5]
	Short	7946B2 Male Short	-7.0462	759.5828	-17.5858	0.0864		16.9500	50	1.8570	0	999	Coax	7946B2
	Open	7948B2 Male Open	39.4911	138.8213	-10.2131	0.2922		14.8903	50	3.3654	0	999	Coax	7948B2
	Load	7931B2 Broadband Male Load					Fixed	0	50	2.6112	0	999	Coax	7931B2

[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 17. Standard Definitions for Rohde & Schwarz

Short (M) Min Freq = 0 Hz Max Freq = 50 GHz Length = 5.0017 mm Loss = 0.0038 dB/$\sqrt{GHz}$ L0 = 62.54 fH L1 = -1.284 fH/GHz L2 = 0.1076 fH/GHz^2 L3 = -0.001886 fH/GHz^3	Match (M) Min Freq = 0 Hz Max Freq = 50 GHz
Short (F) Min Freq = 0 Hz Max Freq = 50 GHz Length = 5.0815 mm Loss = 0.005468 dB/$\sqrt{GHz}$ L0 = -7.0462 fH L1 = 0.7596 fH/GHz L2 = -0.0176 fH/GHz^2 L3 = 0.0001 fH/GHz^3	Match (F) Min Freq = 0 Hz Max Freq = 50 GHz
Open (M) Min Freq = 0 Hz Max Freq = 50 GHz Length = 4.4640 mm Loss = 0.008705 dB/$\sqrt{GHz}$ C0 = 39.4911 fF C1 = 0.1388 fF/GHz C2 = -0.0102 fF/GHz^2 C3 = 0.0003 fF/GHz^3	Open (F) Min Freq = 0 Hz Max Freq = 50 GHz Length = 4.4640 mm Loss = 0.010261 dB/$\sqrt{GHz}$ C0 = 39.4671 fF C1 = 0.0498 fF/GHz C2 = -0.0058 fF/GHz^2 C3 = 0.0002 fF/GHz^3
Through (MM) Min Freq = 0 Hz Max Freq = 50 GHz Length = 19.7020 mm Loss = 0.01467 dB/$\sqrt{GHz}$	Through (FF) Min Freq = 0 Hz Max Freq = 50 GHz Length = 19.7020 mm Loss = 0.01467 dB/$\sqrt{GHz}$
Through (MF) Min Freq = 0 Hz Max Freq = 50 GHz Length = 0 mm Loss = 0 dB/$\sqrt{GHz}$	

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

Appendix

Data Sheet Resources

2Y-051 – Connector Gages and Connector Gage Kits
http://maurymw.com/pdf/datasheets/2Y-051.pdf

5E-060 – Precision 7mm Coaxial Connectors
http://maurymw.com/pdf/datasheets/5E-060.pdf

5E-049 – Precision Type N Coaxial Connectors
http://maurymw.com/pdf/datasheets/5E-049.pdf

5E-062 – Precision 3.5mm Coaxial Connectors
http://maurymw.com/pdf/datasheets/5E-062.pdf

5E-063 – Precision 2.92mm Coaxial Connectors
http://maurymw.com/pdf/datasheets/5E-063.pdf

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

2Z-001 – Test Port Cables (2.4mm, 3.5mm, & 7mm)
http://maurymw.com/pdf/datasheets/2Z-001.pdf

Contacts

Corporate

Maury Microwave Corporation
2900 Inland Empire Boulevard
Ontario, California 91764-4804
United States of America

Tel. 909-987-4415
Fax 909-987-5855
Email maury@maurymw.com

Sales

Tel. 909-204-3224
Fax 909-987-1112
Email maury@maurymw.com

Customer Support

Tel. 909-204-3283
Fax 909-987-1112
Email support@maurymw.com

Website

maurymw.com

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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