



Maury Microwave

# User Guide

# Precision N

# Coaxial Calibration Kit

**DC to 18 GHz**

**Models: 8850CK10/11**  
**8850CK20/21**





---

# **User Guide**

# **Precision N**

# **Coaxial Calibration Kit**

**DC to 18 GHz**

**Models: 8850CK10/11**  
**8850CK20/21**



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

[maurymw.com](http://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.

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.

## ***Limitation of Warranty***

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or wear resulting from normal use. No other warranty is expressed or implied. Maury Microwave specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

The remedies provided herein are the Buyer's sole and exclusive remedies. Maury Microwave shall not be liable for any direct, indirect, special, incidental, or consequential damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or any other financial loss) arising out of the Buyer's use of or inability to use the product, even if Maury or an authorized Maury dealer has been advised of the possibility of such damages.

---



**General Information ..... 1**

- Calibration Kit Description..... 1*
- Maintenance..... 1*
- Calibration ..... 1*
- Supporting Test Port Adapters..... 1*
- Electrostatic Discharge Precautions ..... 1*
- Connector Description..... 2*
- Connector Care..... 2*
- Connector Tightening..... 3*
- Sliding Termination Preparation..... 4*
- Connecting the Sliding Termination..... 6*
- Sliding the Termination Element..... 6*
- Flush Set Interface ..... 6*
- Calibration Kit Contents ..... 7*

**Standard Definitions ..... 9**

- Anritsu Network Analyzers..... 9*
- Keysight Network Analyzers ..... 10*
- Rohde & Schwarz Network Analyzers ..... 11*

**Appendix..... 13**

- Data Sheet Resources..... 13*

**Contacts..... 15**

## Tables

---

Table 1. Male Standard Definitions for Anritsu.....	9
Table 2. Female Standard Definitions for Anritsu.....	9
Table 3. Standard Definitions for Keysight .....	10
Table 4. Standard Definitions for Rohde & Schwarz .....	11

## Figures

---

Figure 1. Using the Torque Wrench .....	3
Figure 2. Sliding Termination Parts .....	4
Figure 3. Vector Diagram .....	6



### ***Calibration Kit Description***

This series of **Precision 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, Data 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](http://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***

All calibration standards and adapters in the 8850 series kits utilize the Maury Microwave Precision N Connector, which is compliant with MIL-C-39012 specifications. Refer to Maury Microwave data sheet 5E-049 for a complete description of the connector.

## ***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 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.

## Connector Tightening

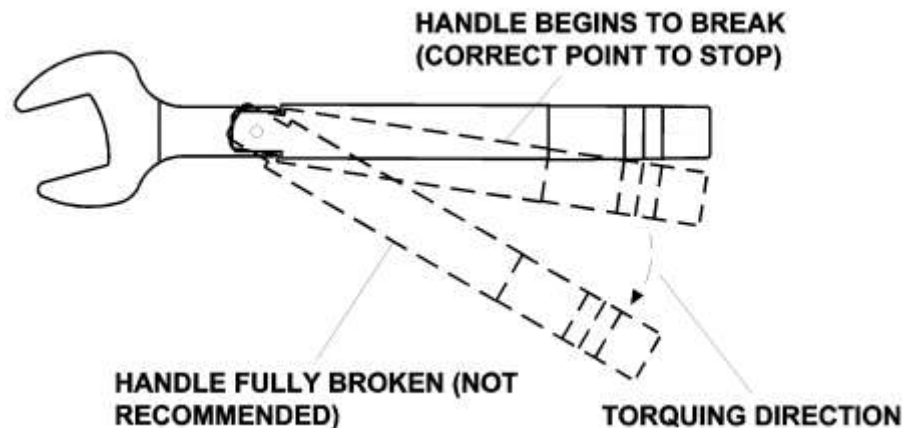
Damage to a calibration device or attaching connector can occur if the device is turned instead of the connector nut. ALWAYS turn the nut when making connections. Never turn the device itself.

Always use a torque wrench (Maury model **2698C2**) to final-tighten all connections. This will insure calibration accuracy and measurement repeatability.

When making connections, a **1/2 inch** open-end wrench or a **9/16 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 double-sided 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

## Sliding Termination Preparation

Assemble the female or male connector adapter per the following section *Installing the Connector Adapter* and then install the contact per the following section *Installing the Center Conductor* (a through b), to make the sliding termination ready for use.

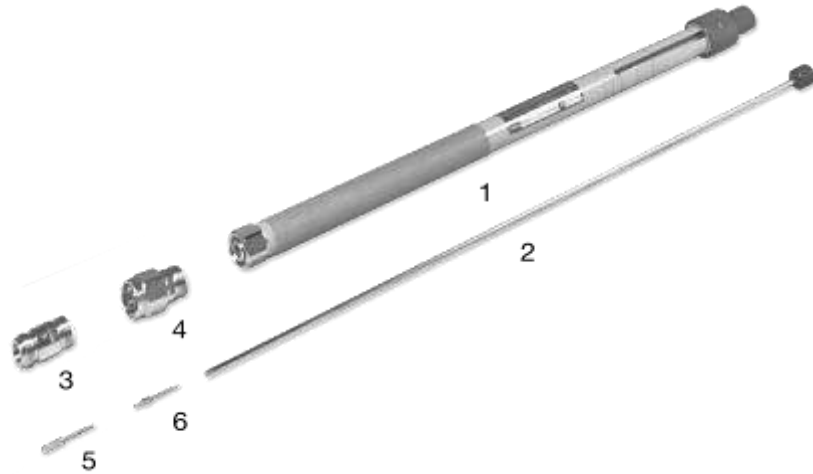


Figure 2. Sliding Termination Parts

### Installing the Connector Adapter (Male or Female)

- Referring to **Figure 2**, connect the adapter (3) or (4) to the sliding termination assembly (1). Use the thin flat 9/16" open-end wrench supplied to hold the connector adapter and a 3/4" wrench on the housing nut of the termination assembly, then gently tighten securely. A slight amount of torque is required – **do not over tighten**.
- To remove the connector adapter, hold it with the thin flat 9/16" open-end wrench and slowly unscrew by turning the nut on the housing using the 3/4" open-end wrench.
- After each use, remove the connector adapter and return it to the instrument case.

## ***Installing the Center Conductor***

**CAUTION:** Handle with care. Do not bend, allow sagging, or scratch. Keep in instrument case when not in use.

- a) Thread the center contact (5) Female or (6) Male into the end of the center conduct (2), then tighten securely – finger tight is adequate – **DO NOT USE PLIERS OR WRENCHES**. Make sure the contact is fully bottomed and no gap exists.

**NOTE:** Do not install contact while center conductor is in the instrument. Always remove the center conductor when changing contacts to prevent damage. It is good practice prior to each use to inspect the center conductors for nicks or scratches and wipe them off with a clean, soft, lint-free cloth.

- b) Loosen the collet lock at the rear of the termination assembly and insert the center conductor until it protrudes from the front end.
- c) To remove the center conductor, loosen the collet lock and pull the center conductor straight out.
- d) The center conductor, when not in use, should be kept in the instrument case to preserve straightness. Do not leave outside the instrument case and do not leave in termination assembly.
- e) Periodically inspect the center conductor using a surface plate to examine for straightness.

## Connecting the Sliding Termination

**NOTE:** The sliding termination should be properly supported by using a small lab jack (or equivalent) when connected to the device to be tested to avoid stress at the connector joint.

- With the rear collet lock loose and the center conductor protruding from the front end of the sliding termination, carefully align the center contact to the mating connector and gently insert the contact (engagement must be made straight on). Then screw on the connector adapter securely using the coupling nut.
- Push the center conductor knob at the rear of the housing (use slight pressure) to make sure a butt joint is achieved at the center contacts, then lock the rear collet (finger tight is adequate). This secures the center conductor so it will not move when the terminating element is moved.

**CAUTION:** Do not exert excessive axial pressure or bowing of the center conductor may result.

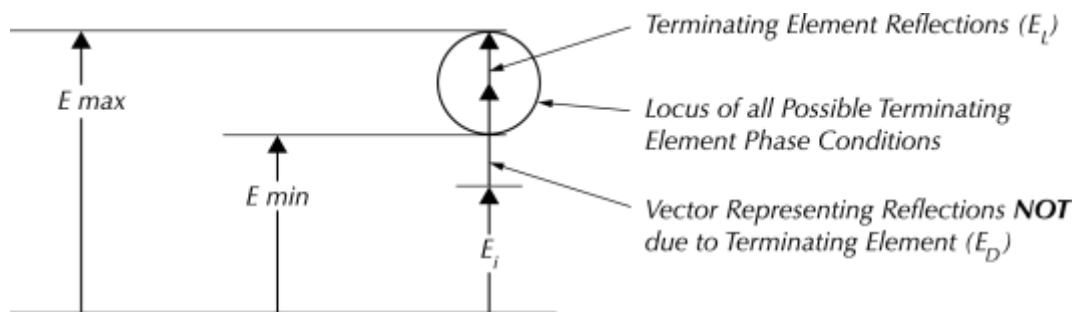
## Sliding the Termination Element

The purpose of sliding the terminating element is to change the phase of the reflection from the terminating element in order to separate it from other reflection present in the system (see **Figure 3**). The element is moved by the sliding collar on the termination assembly.

## Flush Set Interface

A flush set interface can be set for Type N connectors using the following recommended resources:

- Maury thread-on connector gage kit model A020D, to set the interface.
- Maury torque wrench 2698C2, to achieve repeatable connections.
- Maury data sheets 2Y-003, 2Y-003A, and 2Y-050A, for more information.



Vector Diagram showing rotating vector of terminating element (in phase with vector from other components causing reflection).

**Figure 3. Vector Diagram**

**Calibration Kit Contents****Standard Components – 8850CK10**

1 ea	Short, female	8806C
1 ea	Short, male	8807C
1 ea	Open, female	8809B1
1 ea	Open, male	8810B1
1 ea	Fixed Termination, female	2510A6
1 ea	Fixed Termination, male	2510B6
1 ea	Case Assembly	

**Standard Components – 8850CK11**

1 ea	Short, female	8806C
1 ea	Short, male	8807C
1 ea	Open, female	8809B1
1 ea	Open, male	8810B1
1 ea	Fixed Termination, female	2510A6
1 ea	Fixed Termination, male	2510B6
1 ea	Adapter, male to male	8828B
1 ea	Adapter, female to male	8828C
1 ea	Adapter, female to female	8828A
1 ea	Case Assembly	

**Standard Components – 8850CK20**

1 ea	Short, female	8806C
1 ea	Short, male	8807C
1 ea	Open, female	8809B1
1 ea	Open, male	8810B1
1 ea	Fixed Termination, female	2510A7
1 ea	Fixed Termination, male	2510B7
1 ea	Sliding Termination	2517A02
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 – 8850CK21**

1 ea	Short, female	8806C
1 ea	Short, male	8807C
1 ea	Open, female	8809B1
1 ea	Open, male	8810B1
1 ea	Fixed Termination, female	2510A7
1 ea	Fixed Termination, male	2510B7
1 ea	Adapter, male to male	8828B
1 ea	Adapter, female to male	8828C
1 ea	Adapter, female to female	8828A
1 ea	Sliding Termination	2517A02
1 ea	3/4 Torque Wrench, 12in.lbs	2698C2
1 ea	1/2 and 9/16 double-end wrench	2517S3
1 ea	Case Assembly	

(This page intentionally left blank)



## Standard Definitions

### Anritsu Network Analyzers

**Table 1.** Male Standard Definitions for Anritsu

Male Open Device			
C0	99.14	e-15	
C1	353.60	e-27	
C2	62.23	e-36	
C3	0.00	e-45	
Offset Length	1.1100 cm		
Serial Number	00000		

Male Short Device			
Offset Length	1.261 cm		
Serial Number	00000		

**Table 2.** Female Standard Definitions for Anritsu

Female Open Device			
C0	103.00	e-15	
C1	0.00	e-27	
C2	-110.00	e-36	
C3	10.20	e-45	
Offset Length	5.8220 cm		
Serial Number	00000		

Female Short Device			
Offset Length	7.3485 cm		
Serial Number	00000		

For specific loading instructions, see **Anritsu loading instructions**, which can be downloaded from our website: [maurymw.com](http://maurymw.com).

## Keysight Network Analyzers

Table 3. Standard Definitions for Keysight

Standard <sup>(1)</sup>		C0 x10 <sup>-15</sup> F	C1 x10 <sup>-27</sup> F/Hz	C2 x10 <sup>-36</sup> F/Hz <sup>2</sup>	C3 x10 <sup>-45</sup> F/Hz <sup>3</sup>	Fixed or Sliding <sup>(2)</sup>	Offset			Frequency GHz		Coax or W/G	Standard Label
Type	Description	L0 x10 <sup>-12</sup> H	L1 x10 <sup>-24</sup> H/Hz	L2 x10 <sup>-33</sup> H/Hz <sup>2</sup>	L3 x10 <sup>-42</sup> H/Hz <sup>3</sup>		Delay ps	Z <sub>0</sub> <sup>(3)</sup> Ω	Loss <sup>(4)</sup> GΩ/s	Min	Max		
Short	8806C Female Short						24.512	50	0.7	0.0	999.0	Coax	8806C
Open	8809B1 Female Open	103.0	0.0	-110.0	10.2		19.420	50	0.7	0.0	999.0	Coax	8809B1
Load	2510A( ) Broadband Female Load					Fixed	0.0	50	0.0	0.0	999.0	Coax	2510A( ) BB
Thru	Thru (0 cm)						0.0	50	0.0	0.0	999.0	Coax	Thru <sup>(5)</sup>
Load	2517( ) Sliding Female Load					Sliding	0.0	50	0.0	1.999	999.0	Coax	2517( ) F
Load	2510A( ) Lowband Female Load					Fixed	0.0	50	0.0	0.0	2.001	Coax	2510A( ) LB
Short	8807C Male Short						42.063	50	0.7	0.0	999.0	Coax	8807C
Open	8810B1 Male Open	99.14	353.6	62.23	0.0		37.026	50	0.7	0.0	999.0	Coax	8810B1
Load	2510B( ) Lowband Male Load					Fixed	0.0	50	0.0	0.0	2.001	Coax	2510B( ) LB
Load	2517( ) Sliding Male Load					Sliding	0.0	50	0.0	1.999	999.0	Coax	2517( ) M
Load	2510B( ) Broadband Male Load					Fixed	0.0	50	0.0	0.0	999.0	Coax	2510B( ) BB

<sup>(1)</sup> Open, short, load, delay/thru, or arbitrary impedance.<sup>(2)</sup> Load or arbitrary impedance only.<sup>(3)</sup> Z<sub>0</sub> normalized.<sup>(4)</sup> Skin loss factor, normalized at 1 GHz.<sup>(5)</sup> Test ports connected directly.

For specific loading instructions, see **Keysight loading instructions**, which can be downloaded from our website: [maurymw.com](http://maurymw.com)

Rohde & Schwarz Network Analyzers

**Table 4.** Standard Definitions for Rohde & Schwarz

<p><b>THROUGH (MF)</b>                      LABEL = THRU 0 mm                      MIN FREQ = 0 Hz                      MAX FREQ = 18 GHz                      LENGTH = 0 mm                      LOSS = 0 dB/<math>\sqrt{\text{GHz}}</math></p>	<p><b>SHORT (M)</b>                      LABEL = 8807C                      MIN FREQ = 0 Hz                      MAX FREQ = 18 GHz                      LENGTH = 12.61 mm                      LOSS = 0.005115 dB/<math>\sqrt{\text{GHz}}</math></p>
<p><b>OPEN (M)</b>                      Label = 8810B1                      Min Freq = 0 Hz                      Max Freq = 18.0 GHz                      Length = 11.1 mm                      Loss = 0.0045025 dB/<math>\sqrt{\text{GHz}}</math>                      C0 = 99.14 fF                      C1 = 0.3536 fF/GHz                      C2 = 0.06223 fF/GHz<sup>2</sup>                      C3 = -0.0 fF/GHz<sup>3</sup></p>	<p><b>SHORT (F)</b>                      LABEL = 8806C                      MIN FREQ = 0 Hz                      MAX FREQ = 18 GHz                      LENGTH = 7.349 mm                      LOSS = 0.0029807 dB/<math>\sqrt{\text{GHz}}</math></p>
<p><b>OPEN (F)</b>                      LABEL = 8809B1                      MIN FREQ = 0 Hz                      MAX FREQ = 18 GHz                      LENGTH = 5.822 mm                      LOSS = 0.0023615 dB/<math>\sqrt{\text{GHz}}</math>                      C0 L0 = 103.0 fF                      C1 = 0.0 fF/GHz                      C2 = -0.11 fF/GHz<sup>2</sup>                      C3 = 0.0102 fF/GHz<sup>3</sup></p>	<p><b>MATCH (M)</b>                      LABEL = 2510B( )                      MIN FREQ = 0 Hz                      MAX FREQ = 18 GHz</p>
	<p><b>MATCH (F)</b>                      LABEL = 2510A( )                      MIN FREQ = 0 Hz                      MAX FREQ = 18 GHz</p>
<p><b>SLIDING MATCH (F)</b>                      LABEL = 2517( )                      MIN FREQ = 2 GHz                      MAX FREQ = 18 GHz</p>	<p><b>SLIDING MATCH (M)</b>                      LABEL = 2517( )                      MIN FREQ = 2 GHz                      MAX FREQ = 18 GHz</p>

For specific loading instructions, see *Rohde & Schwarz loading instructions*, which can be downloaded from our website: [maurymw.com](http://maurymw.com).

(This page intentionally left blank)

***Data Sheet Resources***

2Z-061 – Precision Type N VNA Calibration Kits  
<http://maurymw.com/pdf/datasheets/2Z-061.pdf>

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

2Y-003 – Type N Precision Connector Gage Kit  
<http://maurymw.com/pdf/datasheets/2Y-003.pdf>

2Y-003A – Metrology Grade Type N Precision Connector Gage Kit  
<http://maurymw.com/pdf/datasheets/2Y-003A.pdf>

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



### **Corporate**

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

Tel. 909-987-4715  
Fax 909-987-5855  
Email [maury@maurymw.com](mailto:maury@maurymw.com)

### **Sales**

Tel. 909-204-3224  
Fax 909-987-1112  
Email [maury@maurymw.com](mailto:maury@maurymw.com)

### **Customer Support**

Tel. 909-204-3283  
Fax 909-987-1112  
Email [support@maurymw.com](mailto:support@maurymw.com)

**Website** [maurymw.com](http://maurymw.com)

### **Web Resources**

Maury Calibration Kits  
[http://maurymw.com/Precision/VNA\\_Cal\\_Kits.php](http://maurymw.com/Precision/VNA_Cal_Kits.php)

Maury Precision Coaxial and Waveguide-to-Coaxial Adapters  
[http://maurymw.com/Finder/Adapter\\_Finder.php](http://maurymw.com/Finder/Adapter_Finder.php)

Maury Applications Notes Library & Technical Articles Archive  
<http://maurymw.com/Support/tech-support.php>

Maury Sales Representative Finder  
<http://maurymw.com/Support/find-sales-rep.php>

***Visit our website for additional product information and literature.***