Agilent Technologies

Agilent Technologies 85059A 1.0 mm Precision Calibration and Verification Kit

Operating and Service Manual

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Contents

1 General Information

Calibration and Verification Kit Overview

The 85059A 1.0 mm precision calibration and verification kit is used to calibrate and verify your PNA series network analyzer system. This kit is used for the measurement of components with 50Ω, 1.0 mm connectors with a frequency range of DC to 110 GHz.

Because it is physically impossible to construct a slotless version of the 1.0 mm female contact, the female devices in this kit use slotted contacts. The slotted female contact does not have the same electrical characteristics as a solid conductor, and therefore, the male and female devices in this kit have different coefficients.

Although the male and female devices are designed to have the same mechanical length, their electrical delays are different. This reflects the differences in the connector interface compression. When the male and female devices are torqued together the male side compresses more than the female side.

The 1.0 mm connector utilizes an air dielectric interface for the highest accuracy and repeatability. The coupling diameter and thread size were chosen to maximize strength, increase durability and provide highly repeatable connections. The connectors are designed so that the outer conductors engage before the center conductors.

To obtain the best performance possible, the manufacturing tolerances of the connectors are tighter than the standard 1.0 mm specifications per the IEEE 287 precision connector standard.

The verification kit provides a set of standards with known characteristics, traceable to primary standards in the Agilent Technologies calibration lab. This set of standards is used to verify your measurement calibration and also to verify that your PNA system is operating within its specifications. The kit includes the following verification items:

- Mismatched thru adapter
- Matched thru adapter
- USB drive that contains factory-measured verification data
- Data sheet for each device that contains factory-measured verification data
- Anti-virus scan report

About This Manual

This manual describes the 85059A calibration and verification kit and provides replacement part numbers, specifications, and procedures for using, maintaining and troubleshooting this kit.

Make Backup Copies

Backup copies of the data sheets, anti-virus scan reports, and the data on the USB drive should be made immediately upon receipt of the verification kit.

A file containing the verification data for your kit is maintained for one year from the time of measurement. If you lose this data, contact Agilent.

How To Identify Shorts

The shorts in this kit are identified by the number of rings (or bands) around the body of the short.

- 1.0 x 1.30 mm short has 1 ring or band and is identified as Short 1
- 1.0 x 1.825 mm short has 2 rings or bands and is identified as Short 2
- 1.0 x 2.45 mm short has 3 rings or bands and is identified as Short 3
- 1.0 x 3.0 mm short has 4 rings or bands and is identified as Short 4

Kit Contents

Use the Contents List in the shipping container to verify the completeness of your shipment. Although this list is the most accurate, you can also use the illustration in Figure 7-1 on page 7-2 to verify the items in your shipment. If your shipment is not complete, contact Agilent Technologies - refer to "Contacting Agilent" on page 6-2.

Compatible Network Analyzers

The devices in this kit and their data are compatible with the PNA series network analyzers. The USB drive provided contains the unique factory-measured S-parameter data for each device in the kit. It also contains the factory measurement uncertainty used in the PNA system verification procedure to calculate the test limits.

Older models of this verification kit provided data disks for the 8510, 8720, and 8722 network analyzers. Since these analyzers have been discontinued, the data disks are no longer provided. When old verification kits that include the data disks are returned to Agilent for recertification, the disks will be reproduced with new data for each device in the kit. Please specify your VNA model(s) when returning kits for service or when ordering kit replacement parts.

Achieving Specified Frequency Performance

The standards in this calibration and verification kit allow you to perform simple 1- or 2-port calibrations, as well as TRM (thru-reflect-match) calibrations, and to verify the performance of your PNA system.

NOTE Above 50 GHz, offset shorts are substituted for the opens and loads.

NOTE For best results, before beginning calibration refer to "Clarifying Connector Gender" on page 1-10.

Calibration Standards

Table 1-1 Calibration Techniques and Standards

Frequency Range	Calibration Technique	"Open" Standard (Reflection)	"Short" Standard (Reflection)	"Load" Standard (Reflection)	"Thru" Standard (not used for 1-port cal)	"Isolation" Standard[1]
DC - 50 GHz	SOLT[2]	Open	Short 3	50 GHz Load	Thru	50 GHz Load
50 - 75 GHz	Offset Shorts	Short 3	Short 1	Short 4	Thru	Load BB[3]
75 - 110 GHz	Offset Shorts	Short 3	Short 1	Short 2	Thru	Load BB[3]
		To Combine Frequency Ranges[4]				
DC - 75GHz	SOLT[2] and Offset Shorts	Open Short 3	Short 3 Short 1	50 GHz Load Short 4	Thru	Load BB[3]
50 - 110 GHz	Offset Shorts	Short 3	Short 1	Short 4 Short 2	Thru	Load BB[3]
DC - 110 GHz	SOLT[2] and Offset Shorts	Open Short 3	Short 3 Short 1	50 GHz Load Short 4 Short 2	Thru	Load BB[3]

1. For best measurement results, the isolation standard should be the equivalent impedance of the device under test.
2. SOLT = Short, Open, Load and Thru standards
3. The broadband load is a combination of a lossy delay line plus a 50 GHz load (see Figures 1-1 and 1-2 on page 1-5).
4. Combinations of the calibration methods shown in the upper half of Table 1-1 are used to calibrate over the frequency ranges shown in the lower half of the table.

Broadband SOLT Calibration

As a time saver, you can use an alternate SOLT technique. You can calibrate from DC to 110 GHz using the standards in Table 1-2. The broadband SOLT technique is quicker than the full calibration outlined in Table 1-1 on page 1-3, but it is substantially *less* accurate.

CAUTION

The broadband SOLT technique is not recommended. It is meant to be used *only* in situations where measurement accuracy is *not* critical.

Table 1-2 Broadband SOLT[1]

Frequency Range	Calibration Technique	"Open" Standard	"Short" Standard	"Load" Standard	"Thru" Standard (not used for 1-port cal)	"Isolation" Standard
DC - 110 GHz	SOLT[1]	Open (broadband)	Short 3 (broadband)	Load BB[2]	Thru	Load BB[3]

1. SOLT = Short, Open, Load and Thru standards

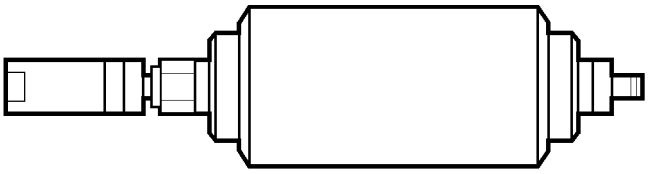
2. The broadband load is a combination of a lossy delay line plus a 50 GHz load (see Figures 1-1 and 1-2 on page 1-5).

Broadband Load Construction

For broadband calibration it is necessary to add the Lossy Delay Line to the appropriate gender 50 GHz load (see Figures 1-1 and Figures 1-2).

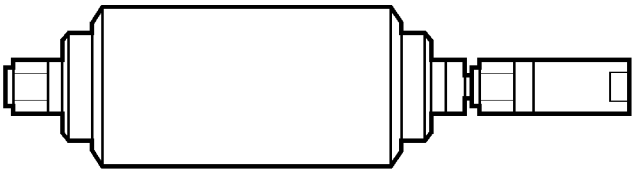
CAUTION

The two Lossy delay lines in this kit are the same and may be used interchangeably. However, once they are mated with a particular 50 GHz load and the calibration sequence is started, the assembly should be considered a matched unit until the calibration has been completed.



lossyf

Figure 1-1 Lossy Delay Line (male end) Attached To 50 GHz Load (female end)



lossym

Figure 1-2 Lossy Delay Line (female end) Attached To 50 GHz Load (male end)

Equipment Required but Not Supplied

Various connector cleaning supplies and electrostatic discharge safety supplies are *not* provided in this kit. (Refer to Chapter 7, "Replaceable Parts" for ordering information.)

Serial Numbers

Serial Number Prefix

A serial number label is attached to the calibration and verification kit. A typical kit serial number label is shown in Figures 1-3. The prefix is made up of six characters. The first two characters show the country, the next two digits represent the year, and the last two digits designate the week of manufacturing.

Serial Number Suffix

The last five digits are the suffix numbers. The suffix numbers are unique to each calibration kit.

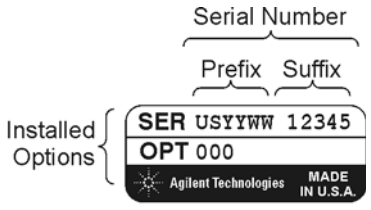


Figure 1-3 Typical Kit Serial Number Label

serial

Device Serial Numbers

In addition to the kit serial number, the devices in this kit are individually serialized (serial numbers are printed on an attached label, or scribed onto the body of each device). Record these serial numbers in Table 1-3 on page 1-8. This can help you avoid confusing the devices in this kit with similar devices from other kits.

Serial Number Record Log

Table 1-3 Kit and Device Serial Number Record

Device Description	Serial Number
-m- Short 1	
-f- Short 1	
-m- Short 2	
-f- Short 2	
-m- Short 3	
-f- Short 3	
-m- Short 4	
-f- Short 4	
-m- Load	
-f- Load	
Lossy Delay Line (1)	
Lossy Delay Line (2)	
-m- Open	
-f- Open	
Mismatched Thru Adapter	
Matched Thru Adapter	
-m- to -m- Adapter	
-f- to -f- Adapter	
-m- to -f- Adapter	

Incoming Inspection

The foam-lined storage case provides protection during shipping. If the case or any device appears damaged, contact Agilent Technologies - refer to "Contacting Agilent" on page 6-2. Agilent will arrange for repair or replacement of incomplete or damaged shipments without waiting for a settlement from the transportation company. When you send the kit or device to Agilent, include a service tag (located at the rear of this manual) on which you provide the following information:

- Your company name and address.
- A technical contact person within your company, and the person's complete phone number.
- If you are returning a complete kit, include the model number and serial number.
- If you are returning one or more devices, include the part numbers and serial numbers.
- Indicate the type of service required.
- Include any applicable information.

Clarifying Connector Gender

In this manual, connectors are referred to in terms of their device gender unless otherwise stated. For example, a male open has a male connector.

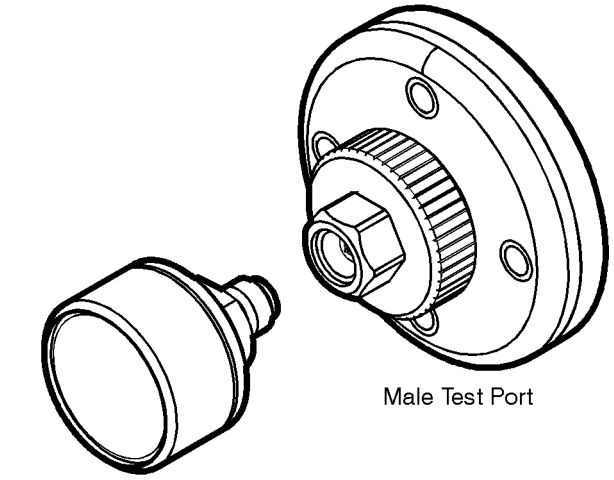


Figure 1-4 Clarifying Connector Gender

Figure 1-5 Male and Female Connectors

Preventive Maintenance

The best techniques for maintaining the integrity of the devices in this kit include routine visual inspection, cleaning and proper connection techniques. Failure to detect and remove dirt or metallic particles on a mating plane surface can degrade repeatability and accuracy, and can damage any connector mated to it. Improper connections resulting from poor connection techniques can also damage these devices.

Visual inspection, cleaning techniques, and connection techniques are all described in Chapter 3, “Making Connections”.

When to Calibrate

A PNA calibration remains valid as long as the changes in the systematic error are insignificant. This means that changes to the uncorrected leakages (directivity and isolation), mismatches (source match and load match), and frequency response of the system are small (<10%) relative to accuracy specifications.

Change in the environment (especially temperature) between calibration and measurement is the major cause in calibration accuracy degradation. The major effect is a change in the physical length of external and internal cables. Other important causes are dirty and damaged test port connectors and calibration standards. If the connectors become dirty or damaged, measurement repeatability and accuracy is affected. Fortunately, it is relatively easy to evaluate the general validity of the calibration. To test repeatability, remeasure one of the calibration standards. If you can not obtain repeatable measurements from your calibration standards, maintenance needs to be performed on the test port connectors, cables and calibration standards. Also, maintain at least one sample of the device under test or some known device as your reference device. A verification kit may be used for this purpose. After calibration, measure the reference device and note its responses. Periodically remeasure the device and note any changes in its corrected response which can be attributed to the test system. With experience you will be able to see changes in the reference responses that indicate a need to perform the measurement calibration again.

2 Specifications

Environmental Requirements

Table 2-1 shows the environmental requirements necessary for optimum performance.

Table 2-1 Environmental Requirements

Parameter	Required Values/Ranges
Operating Temperature [1]	20° to 26°C (68° to 79° F)
Error-Corrected Temperature Range[2]	± 1 °C of measurement calibration temperature
Storage Temperature	–40° to +75°C (–40° to +167° F)
Relative Humidity	Relative Humidity: Type tested, 0% to 95% at 40°C, Non-Condensing

1. The temperature range over which the calibration standards maintain performance to their specifications.
2. The allowable network analyzer ambient temperature drift during measurement calibration and during measurements when the network analyzer correction is turned on. Also, the range over which the network analyzer maintains its specified performance while correction is turned on.

Temperature –What To Watch Out For

Due to the small dimensions and tight tolerances of the calibration and verification devices, electrical characteristics will change with temperature. Therefore, the operating temperature is a critical factor in their performance. During a measurement calibration, the temperature of the calibration devices must be stable and within the range shown in Table 2-1 on page 2-1.

NOTE

Remember your fingers are a heat source, so avoid handling the devices unnecessarily during calibration.

Performance verification and measurements of devices-under-test (DUT's) do not need to be performed within the operating temperature range of the calibration devices. However, the DUT's must be within the error-corrected temperature range of the network analyzer (±1° C of the measurement calibration temperature). For example, if the calibration is performed at +20° C, the error-corrected temperature range is +19° to +21° C. It is then appropriate to perform measurements and performance verifications even though +19° is outside the operating temperature range of the calibration devices.

Mechanical Characteristics

Supplemental Mechanical Characteristics

Supplemental mechanical characteristics are values which are typically met by the majority of calibration and verification kit devices that have been tested at Agilent Technologies. These supplemental characteristics are intended to provide useful information in calibration and verification kit applications. These are typical but non-warranted performance parameters. The following table lists the typical mechanical characteristics of the devices in this kit.

Table 2-2 Offset Short Typical Mechanical Characteristics

Characteristic	Typical Value
Inside Diameter of Outer Conductor	1.000 ± 0.005 mm
Outside Diameter of Center Conductor	0.434 ± 0.003 mm
Offset Length	Nominal ± 0.008 mm
Pin Depth	0 (flush) to 0.010 mm (maximum recession)
Flatness of Reference Plane	0.002 mm (worst case)

Center Conductor Protrusion and Pin Depth

Mechanical characteristics such as center conductor protrusion and pin depth are *not* performance specifications. They are, however, important supplemental characteristics related to electrical performance.

Agilent Technologies verifies the mechanical characteristics of the devices in this kit with special gaging processes and electrical testing. This ensures that the device connectors do not exhibit any center conductor protrusion and have proper pin depth when the kit leaves the factory.

Electrical Characteristics

Supplemental Electrical Characteristics

Table 2-3 Offset Short Electrical Characteristics

Characteristic	Typical Value @ 50 GHz to 110 GHz
Phase Error (with respect to calibration constant model)	2.0 °
Connector Repeatability	–40 dB
Residual Directivity	–30 dB
Residual Port Match	–30 dB
Residual Reflection Tracking	± 0.25 dB

Table 2-4 Adapter Electrical Characteristics

Characteristic	Typical Value @ 0 - 110 GHz
Return Loss	16 dB
Insertion Loss	< 0.50 dB

Electrical Specifications

Table 2-5 Electrical Specifications for 1.0 mm 50Ω Devices

Device	Frequency	Parameter	Specifications	
			Male	**Female**
Loads	DC to 2 GHz 2 GHz to 18 GHz 18 GHz to 40 GHz 40 GHz to 50 GHz	Return Loss	30 dB 30 dB 26 dB 24 dB	30 dB 30 dB 26 dB 24 dB
Opens	DC to 2 GHz 2 GHz to 18 GHz 18 GHz to 50 GHz	Deviation from Nominal Phase	± 1.0 degrees ± 1.5 degrees ± 2.5 degrees	± 1.0 degrees ± 3.0 degrees ± 4.0 degrees
Short 3	DC to 2 GHz 2 GHz to 18 GHz 18 GHz to 50 GHz 50 GHz to 110 GHz	Deviation from Nominal Phase	± 0.8 degrees ± 1.2 degrees ± 1.5 degrees ± 3.0 degrees	± 1.0 degrees ± 2.0 degrees ± 2.5 degrees ± 5.0 degrees
Short1	50 GHz to 110 GHz	Deviation from Nominal Phase	± 2.5 degrees	± 4.0 degrees
Short 2	75 GHz to 110 GHz	Deviation from Nominal Phase	± 2.5 degrees	± 4.0 degrees
Short 4	50 GHz to 75 GHz	Deviation from Nominal Phase	± 2 degrees	± 3.5 degrees
Device	**Frequency**	**Parameter**	**Specifications**	
Lossy Delay Line	DC to110 GHz	Return Loss	18 dB	
Adapters	DC to 20 GHz 20 GHz to 50 GHz 50 GHz to 75 GHz 75 GHz to 110 GHz	Return Loss	24 dB 20 dB 18 dB 14 dB	
Verification Match Thru (adapter)	DC to 20 GHz 20 GHz to 50 GHz 50 GHz to 75GHz 75 GHz to 110 GHz	Return Loss	24 dB 20 dB 18 dB 14 dB	
Verification Mismatch Thru (adapter)	DC to 110 GHz	Return Loss	6 dB @ ~ 22.6 GHz intervals	

Table 2-6 Typical Electrical Specifications for 1.0 mm 50Ω Devices

Device	Frequency	Parameter	Specifications	
			Male	**Female**
Load + Lossy Delay Lines or load (broadband)	DC to 2 GHz 2 GHz to 18 GHz 18 GHz to 50 GHz 50 GHz to 110 GHz	Return Loss	25 dB 20 dB 20 dB 18 dB	25 dB 20 dB 20 dB 18 dB
Short 3	DC to 2 GHz 2 GHz to 18 GHz 18 GHz to 50 GHz 50 GHz to 110 GHz	Deviation from Nominal Phase	± 1.0 degrees ± 1.5 degrees ± 2.0 degrees ± 3.0 degrees	± 1.0 degrees ± 2.5 degrees ± 3.0 degrees ± 7.0 degrees
Open (broadband)	DC to 2 GHz 2 GHz to 18 GHz 18 GHz to 50 GHz 50 GHz to 110 GHz	Deviation from Nominal Phase	±1.0 degrees ± 1.8 degrees ± 2.5 degrees ± 5.0 degrees	± 1.5 degrees ± 3.5 degrees ± 4.5 degrees ± 8.0 degrees
Device	**Frequency**	**Parameter**	**Specifications**	
Lossy Delay Line	DC to 110 GHz	Delay Insertion Loss	7.01 ± 0.4 n-sec 1.63 dB *$(f/GHz)^{1/2}$	

3 Making Connections

Electrostatic Discharge

Protection against ESD (electrostatic discharge) is essential while cleaning, inspecting, or connecting any connector attached to a static–sensitive circuit (such as those found in test sets).

Static electricity builds up on the body, and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt, can cause permanent damage. Devices such as calibration and verification components and devices under test can also carry an electrostatic charge. To prevent damage to the test set, components and devices:

- Always wear a grounded wrist strap having a 1 meg-ohm resistor in series with it when handling components and devices or when making connections to the test set.
- Always have a grounded antistatic mat in front of your test equipment.
- Always wear a heel strap when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.
- Always ground the center conductor of a test cable before making a connection to the analyzer test port or other static-sensitive device. This can be done as follows:

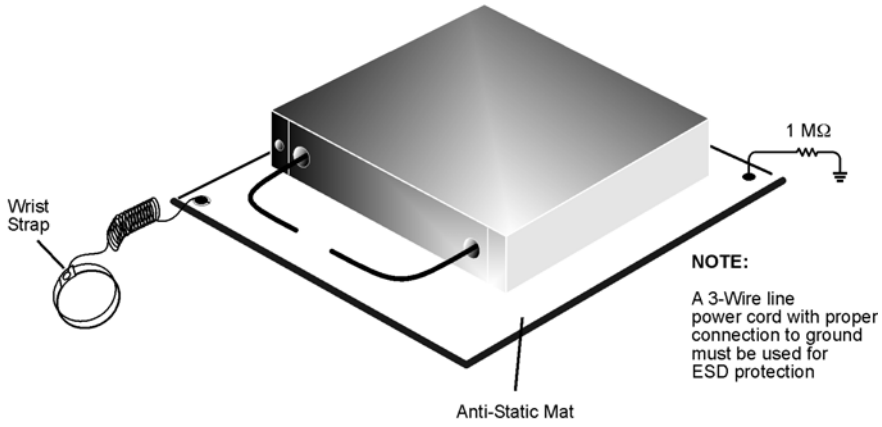
  1) Connect a short (from your calibration kit) to one end of the cable to short the center conductor to the outer conductor.

  2) While wearing a grounded wrist strap, grasp the outer shell of the cable connector.

  3) Connect the other end of the cable to the test port.

  4) Remove the short from the cable.

The following graphic shows a typical ESD protection setup using a grounded mat and wrist strap. Refer to Chapter 7, "Replaceable Parts" for information on ordering supplies for ESD protection.


1 MΩ
Wrist
Strap
NOTE:
A 3-Wire line
power cord with proper
connection to ground
must be used for
ESD protection
Anti-Static Mat

esd_setup

Visual Inspection

Visual inspection and, if necessary, cleaning should be done every time a connection is made. Metal particles from the connector threads may fall into the connector when it is disconnected. One connection made with a dirty or damaged connector can damage both connectors beyond repair.

Magnification is helpful when inspecting connectors, but it is not required and may actually be misleading. Defects and damage that cannot be seen without magnification generally have no effect on electrical or mechanical performance. Magnification is of great use in analyzing the nature and cause of damage and in cleaning connectors, but it is not required for inspection.

Obvious Defects or Damage

Examine the connectors first for obvious defects or damage:

- Plating
  - Bare metal showing
  - Burrs or blisters
- Deformed threads
- Center Conductors
  - Bent
  - Broken
  - Misaligned
  - Concentricity

Connector nuts should move smoothly and be free of:

- Burrs
- Loose metal particles
- Rough spots

Any connector that has obvious defects should be discarded or sent for repair - refer to "Contacting Agilent" on page 6-2.

Connector Contacts

Inspect the connector contacts for integrity. It is necessary to use good lighting (such as a halogen task light) to see the contacts.

NOTE

Notice the location of the cross hairs in relationship to the center of the figures.

See Figure 3-1 for visual guidelines when evaluating the contact integrity of a connector.

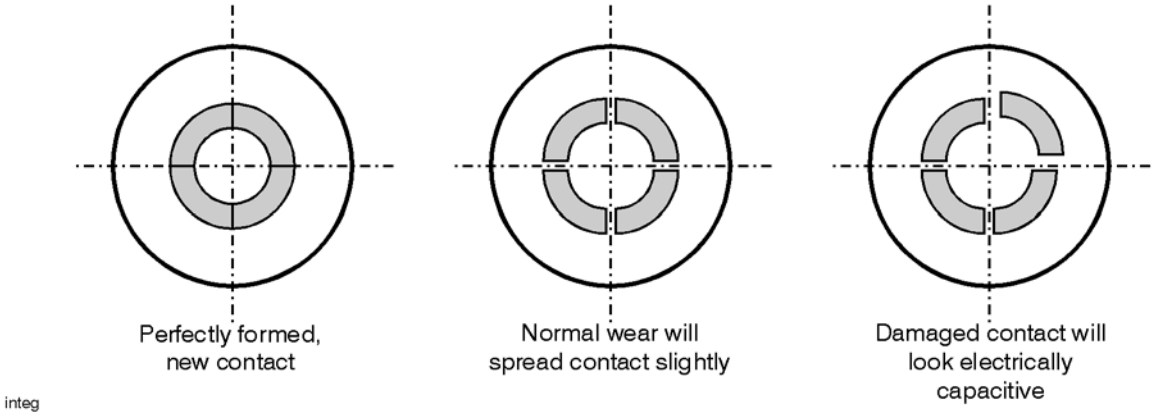


Figure 3-1 Contact Integrity

Concentricity

Figure 3-2 and Figure 3-3 on page 3-5 show the concentricity of both the male and female 1.0 mm connectors.

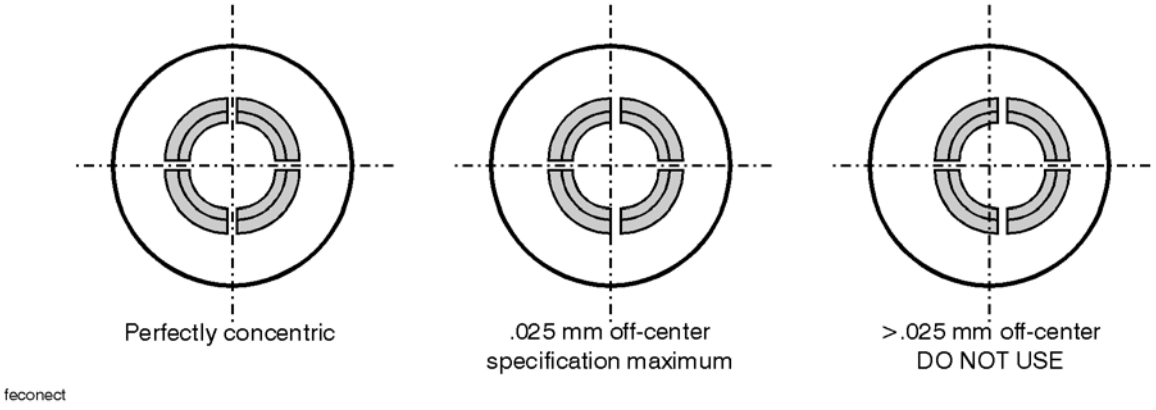


Figure 3-2 Concentricity - Female Connector

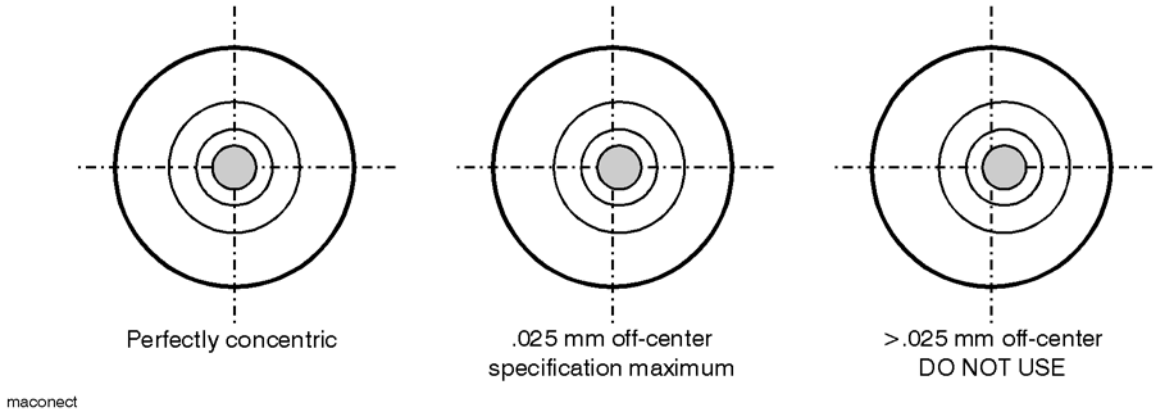


Figure 3-3 Concentricity - Male Connector

Mating Plane Surfaces

Flat contact between the connectors at all points on their mating plane surfaces is required for a good connection.

Look for deep scratches or dents, and for dirt and metal particles on the connector mating plane surfaces. Also look for “dings” on the mating plane surfaces of the center and outer conductors, and for signs of damage due to misalignment, and excessive or uneven wear.

A light burnishing of the mating plane surfaces is normal. This is evident as light scratches, or shallow circular marks distributed more or less uniformly over the mating plane surface. Other small defects and cosmetic imperfections are also normal. None of these affect electrical or mechanical performance.

Clean and inspect the connector again if it shows:

- Deep scratches or dents
- Particles clinging to the mating plane surfaces
- Uneven wear

Damaged connectors should be discarded or sent for repair. Try to determine the cause of damage before connecting a new, undamaged connector in the same configuration. Magnification is of great use in analyzing the nature and cause of damaged connectors.

Connector Wear

Connector wear eventually degrades performance. The more use a connector gets, the faster it wears and degrades. The wear is greatly accelerated when connectors are not kept clean.

Calibration devices should have a long life if their usage is a few times per week. The test port connectors on your network analyzer test set may have many connections each day, and therefore, are more subject to wear. It is recommended that an adapter be used as a test port saver. The use of an adapter will help to minimize the wear on your test set's connectors. When your connectors become worn, replace them.

Supplies and Equipment Needed

The supplies and equipment needed to perform the cleaning procedure, and their Agilent Technologies part numbers are listed in Table 7-1 on page 7-2 and page 7-3.

Pin Depth

Pin depth is the distance that the center conductor mating plane differs from being flush with the outer conductor mating plane. The pin depth of a connector can be in one of two states, either protruding or recessed.

Protrusion and Recession

- **Protrusion** - the center conductor *extends* beyond the outer conductor mating plane.

CAUTION

At *no* time should the pin depth of the 1.0 mm connector be protruding.

- **Recession** - the center conductor is *set back* from the outer conductor mating plane.

The pin depth value of each calibration device in your kit is not specified, but is an important mechanical parameter. The electrical performance of the device depends, to some extent, on its pin depth.

Agilent verifies the pin depth characteristics of the connectors in this kit with special gaging processes and electrical testing. This ensures that the device connectors do not exhibit any center conductor protrusion and have proper pin depth when the kit leaves the factory.

The electrical specifications for each device in this kit take into account the effect of pin depth on the device's performance. See Figure 3-4 on page 3-8 for a visual representation of proper pin depth (slightly recessed).

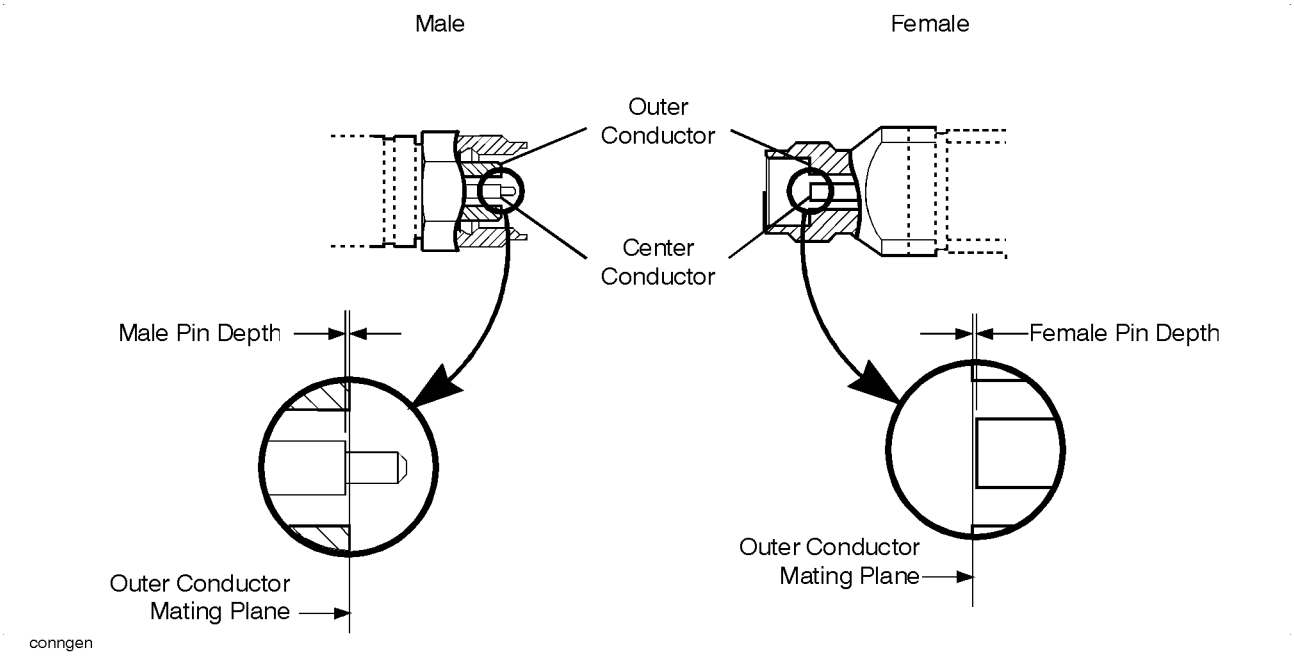


Figure 3-4 Connector Pin Depth

Making Connections

Good connections require a skilled operator. Instrument sensitivity and coaxial connector mechanical tolerances are such that slight errors in operator technique can have a significant effect on measurements and measurement uncertainties.

NOTE

*The most common cause of measurement error is poor connection*s.

Connection Procedure

1. Ground yourself and all devices (wear a grounded wrist strap and work on an antistatic mat).
2. Visually inspect the connectors (refer to "Visual Inspection" on page 3-3).
3. If necessary, clean the connectors (refer to "Cleaning Connectors" on page 3-12).
4. Carefully align the connectors. The male connector center pin must slip concentrically into the contact fingers of the female connector (see Figure 3-5 on page 3-10 and Figure 3-6 on page 3-11).
5. Push the connectors straight together. Do *not* twist or screw them together. As the center conductors mate, there is usually a slight resistance.

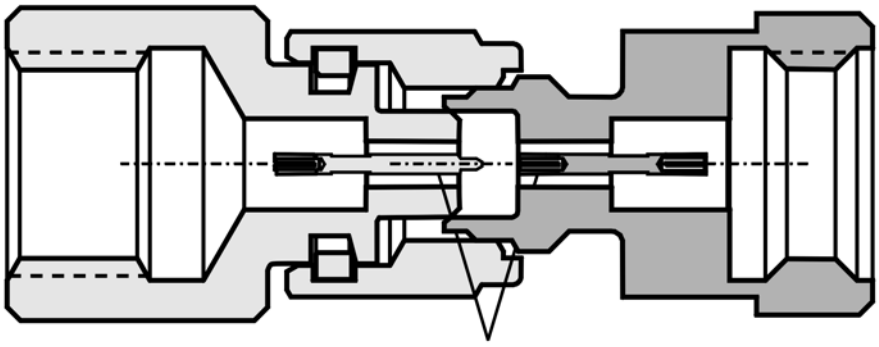
CAUTION

Do *not* twist one connector into the other (like inserting a light bulb). This happens when you turn the device body, rather than the connector nut. Major *damage* to the center conductor and the outer conductor can occur if the device body is twisted.

6. Initial tightening can be done by hand, or with a 6 mm open-end wrench. Tighten until "snug" or where the connectors are first making contact. The preliminary connection is tight enough when the mating plane surfaces make uniform, light contact. *Do not overtighten* this connection.

At this point, all you want is for the outer conductors to make gentle contact on both mating surfaces. Use very light finger pressure (no more than 2 inch–pounds of torque).

7. Relieve any side pressure on the connection from long or heavy devices, or cables. This assures consistent torque (refer to "Using the Torque Wrench" on page 3-14).



alignmnt

Figure 3-5 Alignment

Connector Misalignment

Forced misalignment could damage the female center conductor.

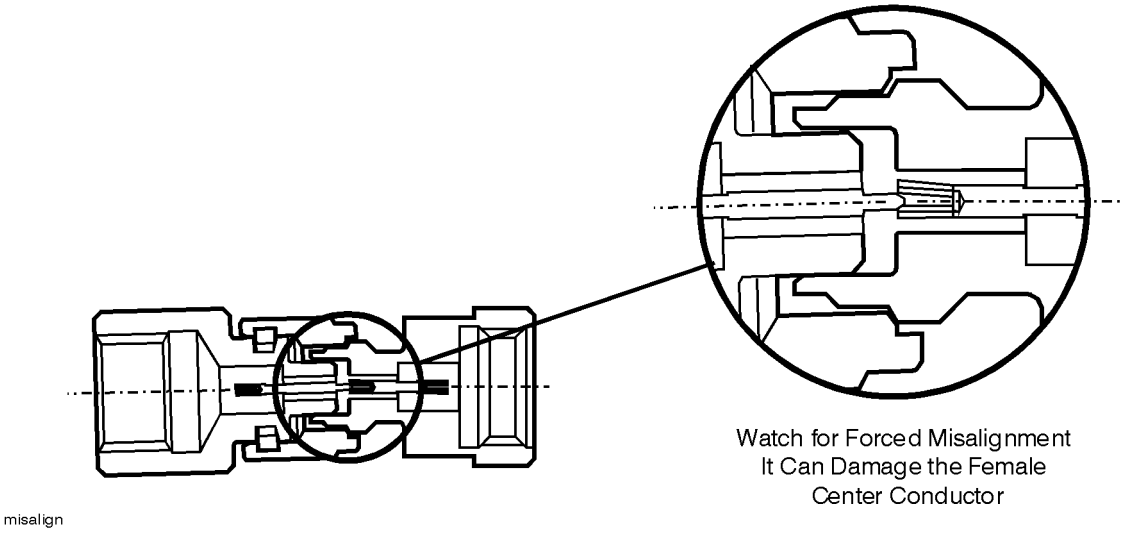


Figure 3-6 Misalignment

Cleaning Connectors

Supplies and Equipment Needed

The supplies and equipment that are needed to perform the cleaning procedures, and their Agilent Technologies part numbers are listed in Table 7-1 on page 7-2 and page 7-3.

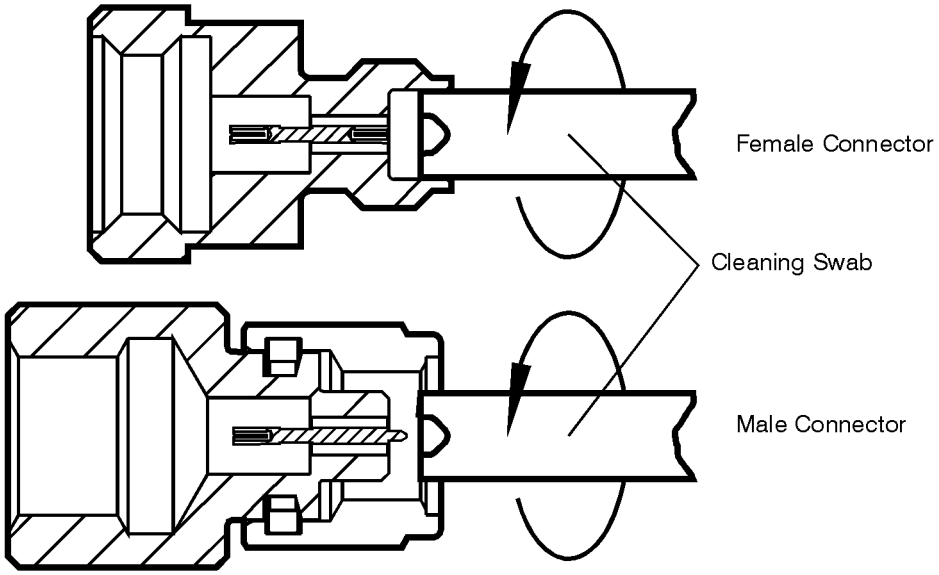
Basic Cleaning Procedure

1. Inspect the connectors for dust, dirt, metal fragments, oils or films, and debris.
2. Blow off any dust with a filtered, clean supply of compressed air.
3. Add a few drops of high-purity isopropyl alcohol to a small cleaning swab (do not apply alcohol directly to the parts).

NOTE

When using isopropyl alcohol to clean connectors *do not* allow the liquid to flow down inside the connector. This may cause measurement errors due to residue inside the connector. If possible keep the connector facing down.

4. *Gently* wipe connecting surfaces with the end of the cleaning swab (see Figure 3-7).
5. Blow dry with compressed air.
6. Inspect and repeat cleaning procedure if necessary.



cleaning

Figure 3-7 Cleaning Illustration

Using the Torque Wrench

Table 3-1 provides information on the required settings and tolerances for the 1.0 mm torque wrench supplied in this kit.

Table 3-1 Torque Wrench Information

Connector Type	Torque Setting	Torque Tolerance
1.0 mm	45 N–cm (4 in–lb)	5.4 N–cm (± 0.5 in–lb)

Torque Wrench Procedure

Using the torque wrench guarantees that a connection is not too tight. This will help prevent possible connector damage. It also guarantees that all connections are equally tight each time. Figure 3-10 on page 3-16 shows you where to hold the torque wrench for optimum performance.

NOTE

Do not pre-tighten the connector nut so much that there is no rotation of the nut with the torque wrench. Static friction must *not* be present during torquing.

1. Use the torque wrench supplied with your kit to make the final connections.
2. Rotate *only* the connector nut when you tighten the connector.

In *all* situations, use an open–end wrench to keep the body of the device from turning. Position both wrenches within 90 degrees of each other before applying force (see Figure 3-8 on page 3-15). Wrenches opposing each other (180 degrees apart) will cause a *lifting action.* This lifting action can misalign, and stress the connections of the devices involved. This is especially true when several devices are connected together.

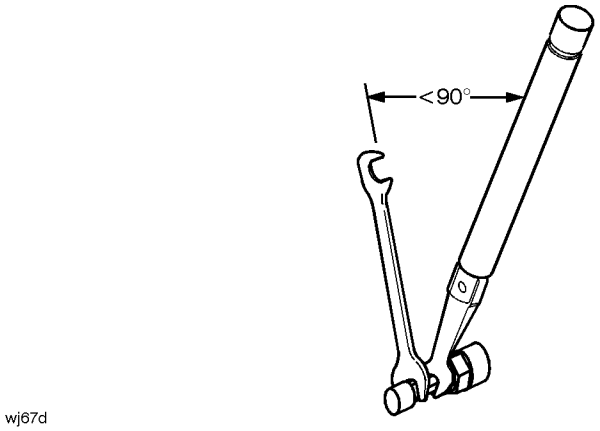


Figure 3-8 Correct Wrench Position

Narrow separation of the wrenches produces a small residual lateral force on the structure of connected devices.

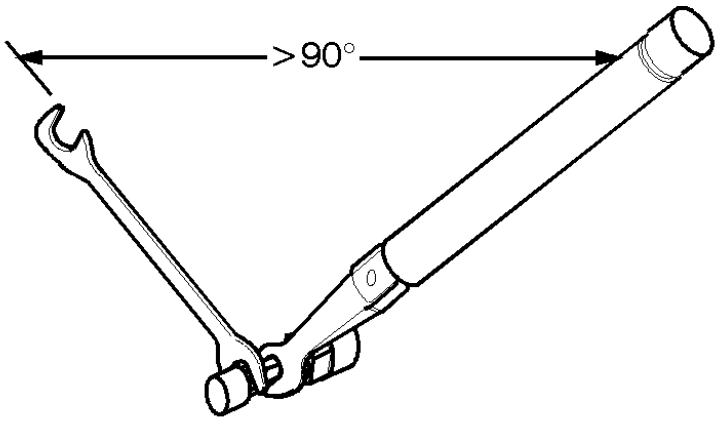


Figure 3-9 Incorrect Wrench Position

Wide separation of the wrenches produces a larger residual lateral force on the structure of connected devices. This can *degrade* connector repeatability.

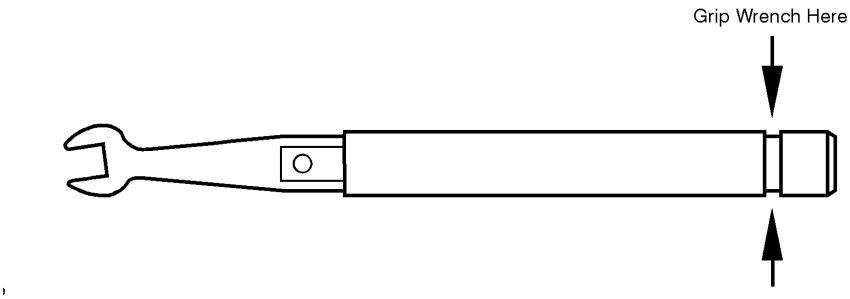


Figure 3-10 Where to Hold the Torque Wrench

3. Hold the torque wrench lightly at the end of the handle *only* (beyond the groove). See Figure 3-10.

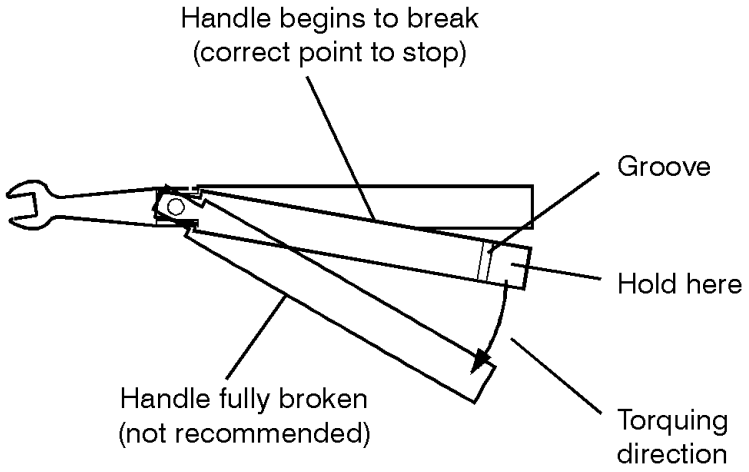


Figure 3-11 Using the Torque Wrench

4. Apply force perpendicular to the wrench handle. This applies torque to the connection *through* the wrench.

Do *not* hold the wrench so tightly that you push the handle straight down along its length rather than pivoting it. Doing so may apply an unlimited amount of torque.

5. Tighten the connection just to the torque wrench "break" point (see Figure 3-11). Do *not* tighten the connection further.

CAUTION

You don't have to “fully break” the handle of the torque wrench to reach the specified torque; doing so can cause the handle to kick back and loosen the connection. Any give at *all* in the handle is sufficient torque.

Do *not* pivot the wrench handle on your thumb or other fingers, you may apply an unknown amount of torque to the connection when the wrench reaches its “break” point.

Do *not* twist the head of the wrench relative to the outer conductor mating plane. If you do, you will apply more than the recommended torque.

Disconnection Procedure

To avoid lateral (bending) force on the connector mating plane surfaces, always support the devices and connections.

1. Use an open–end wrench to prevent the device body from turning.
2. Use another wrench to loosen the connector nut.
3. Complete the disconnection by hand, turning *only* the connector nut.

CAUTION

Do *not* twist one connector out of the other, (like removing a light bulb). Turn the connector nut, not the device body. Major damage to the center conductor and the outer conductor can occur if the device body is twisted.

4. Pull the connectors straight apart without twisting or bending.

Handling and Storage

- Store calibration and verification devices with end caps on, in a foam–lined storage case.
- Never store connectors loose in a box, in a desk, or in a bench drawer. This is the most common cause of connector damage during storage.
- Keep connectors clean.
- Do not touch mating plane surfaces. Natural skin oils and microscopic particles of dirt are easily transferred to the connector interface and are very difficult to remove.
- Do not set connectors contact–end down on a hard surface. The plating and the mating plane surfaces can be damaged if the interface comes in contact with any hard surface.
- When you are not using a connector, use plastic end caps over the mating plane surfaces to keep them clean and protected.

4 User Information

Calibration and Verification Devices

The following section briefly describes the design and construction of all the calibration and verification kit devices.

Offset Opens and Shorts

The offset opens and shorts are built from parts that are machined to the current state–of–the–art in precision machining. The offset short's inner conductors have a one–piece construction, common with the shorting plane. This construction provides for extremely repeatable connections. The offset opens have inner conductors that are supported by a strong, low dielectric plastic to provide repeatability and reliability. Both the opens and shorts are constructed so that the pin depth can be controlled very tightly, thereby minimizing phase errors. The length of the offset opens are designed so that the difference in phase of their reflection coefficients is approximately 180° at all frequencies, with respect to offset short 3.

Above 50 GHz, the offset short calibration technique is used. Different combinations of offset shorts using three different lengths are used to calibrate frequency ranges from 50 to 75 GHz and from 75 to 110 GHz.
The calibration coefficients for these offset shorts are optimized for their applicable bandwidths.

Offset Shorts (3 rings)

The offset shorts with three rings have three sets of calibration coefficients. The lowband and broadband sets are optimized over the frequency range of DC to 50 GHz. The highband optimized over the 50 to 110 GHz frequency range. Again, female and male devices have different coefficients.

Verification Devices

The verification devices are designed to provide S-parameter measurement comparisons over a broad range of signal levels. The matched thru (adapter) checks the system performance for low loss and low reflection characteristics. The mismatch thru (adapter) checks the system performance over the medium to high reflection and medium loss ranges. The verification devices in this kit are not totally a pass or fail system, but should be considered probability indicators.

Adapters

Like the other devices in your kit, the adapters are built to very tight tolerances. This provides a good performance and ensures stable, repeatable connections. The adapters are designed so that their nominal electrical lengths are the same, this allows them to be used in the calibration procedures for non–insertable devices, but can also be used as connector savers.

Loads

The loads have been optimized for broadband performance up to 50 GHz. The Load can be combined with the Lossy Delay Line to construct a broadband termination. The Load and Lossy Delay Line combination can be used for such purposes as terminating an unused port on a device-under-test, or a “quick” open/short/load calibration from DC to 110 GHz.

NOTE

The best operating region of the load is from DC to 50 GHz. Performance degrades quickly above 50 GHz. For best results, the “lowband load” definition should be used. If desired, an open/short/ broadband load calibration may be performed up to 110 GHz by choosing the broadband load, broadband open and then the broadband Short 3.

Performing A Calibration

Using a Network Analyzer

To find information about performing a calibration with your network analyzer, refer to your analyzer's User's Guide or Help system. To find an online copy on the Agilent web site:

- Go to www.agilent.com.
- Enter the analyzer's model number in the **Search** box.
- Click **Search**.
- Next to the heading "Technical Support," click **Manuals**.
- Click the link for the document you want to view.

5 Performance Verification

System Verification

After installation of the system is complete, a performance verification is necessary to assure proper system operation. The initial verification is included with the installation of your system, but it is necessary to perform system verification at regular intervals. Included with this kit are a matched thru adapter and a mismatched thru adapter for use in system verification. For more information on system verification see the analyzer's *User's Guide* or *Help System.*

Calibration Kit Verification

The performance of your calibration and verification kit can only be verified by returning the kit to Agilent Technologies for recertification. The equipment and calibration standards required to verify the specification limits of the devices inside this kit have been specially manufactured, and are not commercially available. Agilent recognizes its responsibility to provide you with procedures to reconfirm the published specifications of any product offered. That commitment applies equally to the 85059A 1.0 mm calibration and verification kit.

What Recertification Provides

The following will be provided with a recertified kit:

- New calibration sticker affixed to the case
- Certificate of Calibration
- A calibration report for each device in this kit listing measured values, specifications, and uncertainties.

NOTE

A list of NIST traceable numbers may be purchased upon request to be included in the calibration report.

For more information, contact the nearest Agilent Technologies office (sales and service offices are listed in the front of this manual).

How Often to Recertify

The suggested initial interval for recertification is 12 months or sooner. The actual need for recertification depends on the use of your kit. After reviewing the results of the initial recertification, you may want to establish a different recertification interval that reflects the usage and wear of your kit.

NOTE

In some cases, the first time a kit is used after being recertified occurs some time after the actual recertification date. The recertification interval should begin on the date the kit is *first* used.

Where to Send a Kit for Recertification

Contact Agilent for information on where to send your kit for recertification - refer to "Contacting Agilent" on page 6-2.

How Agilent Technologies Verifies Devices in this Kit

Agilent verifies the specifications of these devices as follows:

1. The residual microwave error terms of the test system are verified with precision airlines and shorts that are directly traced to the National Institute of Standards and Technology (NIST). The airline and short characteristics are developed from mechanical measurements. The mechanical measurements and material properties are carefully modeled to give very accurate electrical representation. The mechanical measurements are then traced to NIST through various plug and ring gages and other mechanical measurements.
2. Each device is electrically tested on this system. The measurement uncertainty for each device is recorded in the calibration report that accompanies every kit.

These two steps establish a traceable link to NIST for Agilent to the extent allowed by the institute's calibration facility. The specifications data provided for the devices in the kit is traceable to NIST through Agilent Technologies

6 Troubleshooting

If you suspect a bad calibration, or if your network analyzer does not pass performance verification, follow the steps in Figure 6-1 on page 6-2.

Returning a Kit or Device to Agilent Technologies

If your kit or device requires service, contact Agilent - refer to "Contacting Agilent" on page 6-2. When you send the kit or device to Agilent, include a service tag (found at the end of this manual) on which you provide the following information:

- Your company name and address.
- A technical contact person within your company, and the person's complete phone number.
- If you are returning a complete kit, include the model number and serial number.
- A list of your network analyzer model numbers.
- If you are returning one or more devices, include the part numbers and serial numbers.
- Indicate the type of service required.
- Include any applicable information.

Where To Look For More Information

This manual contains limited information about network analyzer system operation. For complete information, refer to the PNA Help System. To do so, press the Help key on the front panel of the PNA.

If you need additional information, contact your local Agilent Technologies representatives- refer to "Contacting Agilent" on page 6-2.

Contacting Agilent

Assistance with test and measurements needs and information on finding a local Agilent office are available at:
www.agilent.com/find/assist

If you don't have Internet access, please contact your Agilent field engineer.

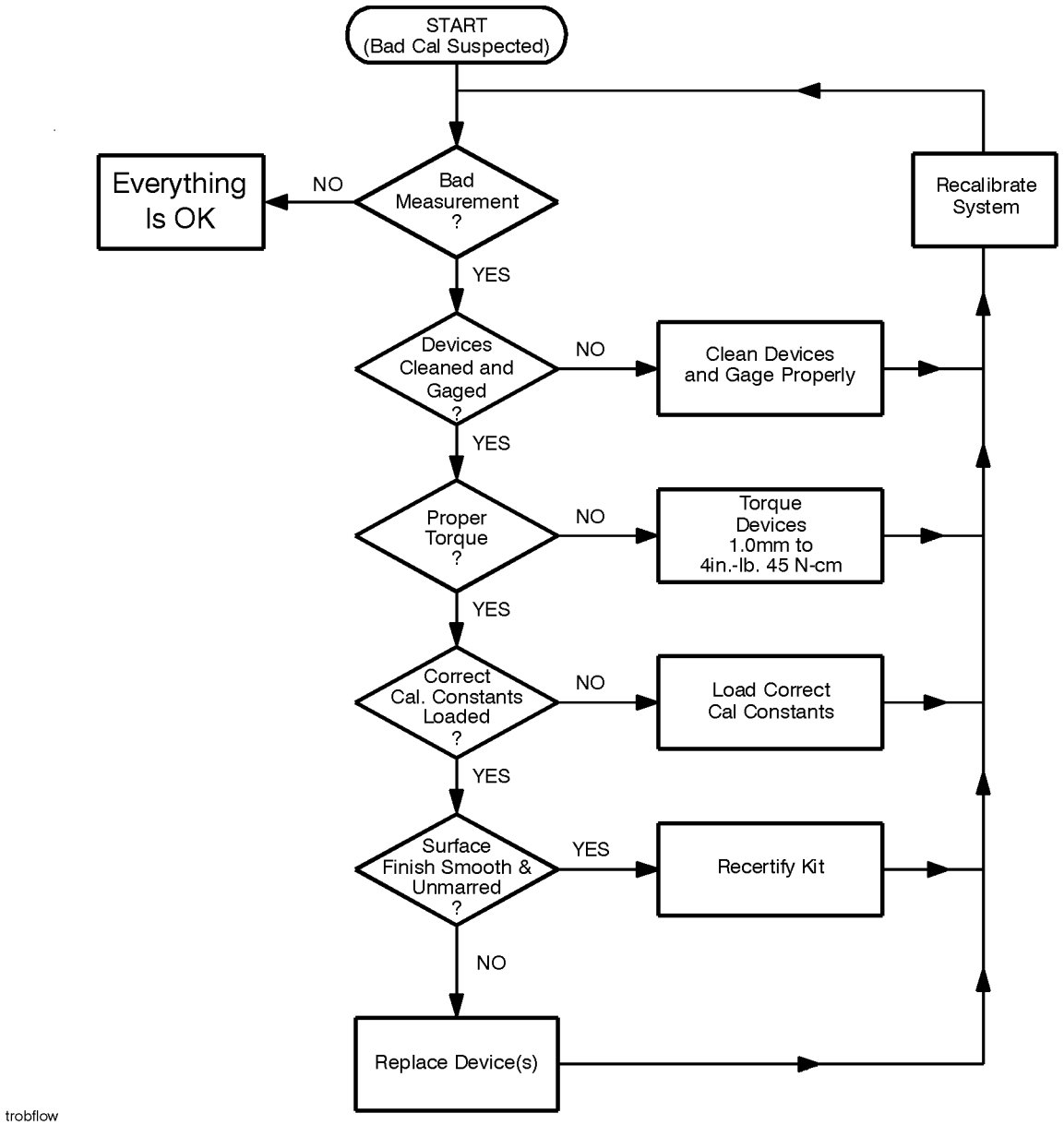


Figure 6-1 Troubleshooting Flowchart

7 Replaceable Parts

The following replaceable parts table lists the replacement part numbers for the 85059A calibration and verification kit contents. To order a listed part, note the description, part number, and the quantity desired and contact Agilent Technologies - refer to "Contacting Agilent" on page 6-2.

Replacing the Verification Data

The verification data contains unique data that applies to the individual verification devices. No two devices have the same performance data. It is not a trivial matter to replace lost or damaged data, so it is important to make one or more backup copies.

If your verification data is lost or damaged, and you have no backup copies, take one of the following actions:

If Recertification is not required in the near future. Contact your nearest Agilent service office for a replacement. Please specify the information in the table below.

If recertification will be required soon. Agilent recommends that you have the verification kit recertified early. New verification data will be generated during the recertification process.

Table 7-1 Information to Specify When Ordering Replacement Verification Data

Device	Model Number	Serial Number	Part Number
Kit	_____	_____	
Device 1		_____	_____
Device 2		_____	_____
Device 3		_____	_____
Device 4		_____	_____
Needed: (check) PNA USB drive____; Data sheets ____			
Last Recertification: Date _____; Serviced by _____			

2.4 mm 1.85 mm

Table 7-1 Replaceable Parts

Description	Qty Per Kit	Replaceable Part Number
Calibration Devices		
Shorts:		
-m- Short 3	1	85059–60003
-f- Short 3	1	85059–60007
-m- Short 4	1	85059–60004
-f- Short 4	1	85059–60008
-m- Short 2	1	85059–60002
-f- Short 2	1	85059–60006
-m- Short 1	1	85059–60001
-f- Short 1	1	85059–60005
Opens:		
Male Open	1	85059–60009
Female Open	1	85059–60010
Loads:		
Male Load	1	85059–60019
Female Load	1	85059–60020
Lossy Delay Line	2	85059–60021
Adapters:		
Male to Male Adapter	1	11920–60001
Female to Female Adapter	1	11920–60002
Male to Female Adapter	1	11920–60003
Cables:		
Female to Female Cable (8.8 cm)	1	11500–60001

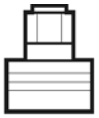
Table 7-1 Replaceable Parts (Continued)

Description	Qty Per Kit	Replaceable Part Number
Verification Devices		
Mismatched Thru Adapter with data	1	85059AR01
Matched Thru Adapter with data	1	85059AR02
Wrenches		
6 mm 4 in–lb Torque	1	8710–2079
6 mm Open–end	1	8710–2156
Miscellaneous Items		
Disk Holder	1	5180–8491
Operating and Service Manual	1	85059–90003
Plastic Box	1	1540–1218
Cleaning Swabs	1	9301–1243
10X Magnifying Glass	1	1000–1114
Items Not Included In Kit		
Anhydrous Isopropyl Alcohol (>92% pure)		--
Grounding Wrist Strap		9300–1367
5 Foot Grounding Cord (for wrist strap)		9300–0980
2′ x 4′ Conductive Table Mat & 15′ Ground Wire		9300–0797
ESD Heel Strap (for conductive floors)		9300–1126


M Short 1


M Short 2


M Short 3


M Short 4


M Open

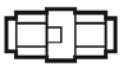

F Short 1


F Short 2

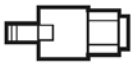

F Short 3

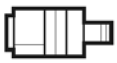

F Short 4


F Open

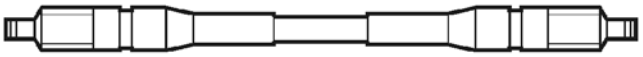

M-M Adapter

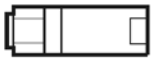

F-F Adapter


M-F Adapter


Mismatch Thru Adapter

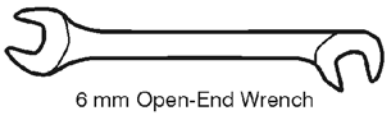

Match Thru Adapter

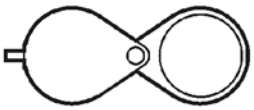

Cable
F-F (8.8 cm)

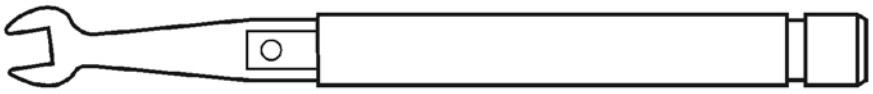

Male Load


Lossy Delay Line
(2 per kit)


Female Load


6 mm Open-End Wrench


Magnifying Glass


4in-lb Torque Wrench

Included in 85059A Cal Kit but not shown:

- USB drive containing PNA system verification data
- Data sheets
- Device replacement instructions sheets
- Anti-virus scan report
- Cleaning swabs

connector

8 Standard Definitions

Class Assignments and Standard Definitions Values are Available on the Web

Class assignments and standard definitions may change as more accurate model and calibration methods are developed. You can download the most accurate class assignments and standard definitions from Agilent's Calibration Kit Definitions Web page at
http://na.tm.agilent.com/pna/caldefs/stddefs.html.

For a detailed discussion of calibration kits, refer to the Agilent Application Note, "Specifying Calibration Standards and Kits for Agilent Vector Network Analyzers." This application note covers calibration standard definitions, calibration kit content and its structure requirements for Agilent vector network analyzers. It also provides some examples of how to set up a new calibration kit and how to modify an existing calibration kit definition file. To download a free copy, go to www.agilent.com and enter literature number 5989-4840EN in the Search window.

Numerics

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