

# **User's and Service Guide**

## **Agilent Technologies 85032F Type-N 50 $\Omega$ Calibration Kit**



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## **Assistance**

Product maintenance agreements and other customer assistance agreements are available for Agilent products.

For any assistance, contact Agilent Technologies. Refer to [Table 5-1 on page 5-3](#).

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# **1 General Information**

## Calibration Kit Overview

The Agilent 85032F type-N 50  $\Omega$  calibration kit is used to calibrate Agilent network analyzer systems for measurements of components with type-N connectors up to 9 GHz. The standards in this calibration kit allow you to perform simple 1- or 2-port calibrations.

This manual describes the 85032F calibration kit and provides replacement part numbers, specifications, and procedures for using, maintaining and troubleshooting the kit.

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**NOTE** This manual assumes you practice proper connector care. For information, refer to [Chapter 3, “Use, Maintenance, and Care of the Devices.”](#) Also refer to the “Principles of Microwave Connector Care – Quick Reference Card,” located in the back of this manual.

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### Kit Contents

The 85032F type-N calibration kit contains the following:

- offset opens and shorts, and broadband load terminations with both male and female connectors
- disk that contains the calibration constants of the devices in this kit

### Broadband Loads

The broadband loads are metrology-grade, 50 ohm terminations that have been optimized for performance up to 9 GHz. The rugged internal structure provides for highly repeatable connections. A distributed resistive element on sapphire provides excellent stability and return loss.

### Offset Opens and Shorts

The offset opens and shorts are built from parts that are machined to the current state-of-the-art precision machining.

The offset short’s inner conductors have a one-piece construction, common with the shorting plane. The construction provides for extremely repeatable connections.

The offset opens have inner conductors that are supported by a strong, low-dielectric-constant plastic to minimize compensation values.

Both the opens and shorts are constructed so that the pin depth can be controlled very tightly, thereby minimizing phase errors. The lengths of the offsets in the opens and shorts are designed so that the difference in phase of their reflection coefficients is approximately 180 degrees at all frequencies.

## Calibration Definitions

The calibration kit must be selected and the calibration definitions for the devices in the kit installed in the network analyzer prior to performing a calibration. Refer to your network analyzer user's guide for instructions on selecting the calibration kit and performing a calibration.

The calibration definitions can be:

- resident within the analyzer
- loaded from the provided disk
- entered from the front panel

## Installation of the Calibration Definitions

The calibration definitions for the kit may be permanently installed in the internal memory or hard disk of the network analyzer.

If the calibration definitions for the kit are not permanently installed in the network analyzer, they must be manually entered. Refer to your network analyzer user's guide for instructions.

## Options

There are several optional adapters available for the 85032F. See [Table 6-1 on page 6-3](#) for further information.

## Equipment Required but Not Supplied

Connector gage sets, optional adapters, open-end wrenches and various connector cleaning supplies are *not* included with this calibration kit. These or similar items are recommended to ensure the successful operation of this calibration kit. Refer to [Table 6-2 on page 6-4](#) for ordering information.

## Incoming Inspection

Refer to [Figure 6-1 on page 6-2](#) to verify a complete shipment.

Check for damage. The foam-lined storage case provides protection during shipping. If the case or any device appears damaged, or if the shipment is incomplete, contact Agilent Technologies. See [page 5-3](#). Agilent will arrange for repair or replacement of incomplete or damaged shipments without waiting for a settlement from the transportation company. See [“Returning a Kit or Device to Agilent” on page 5-3](#).

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## Recording the Device Serial Numbers

In addition to the kit serial number, the devices in this kit are individually serialized (serial numbers are labeled onto the body of each device). For your convenience, the following table is provided for you to record these serial numbers. Recording the serial numbers will prevent you from confusing the devices with similar devices.

**Table 1-1 Kit and Device Serial Number Record**

Device	Serial Number
Calibration kit	_____
Male broadband load	_____
Female broadband load	_____
Male open	_____
Female open	_____
Male short	_____
Female short	_____



## Clarifying the Sex of the Connector

In this manual, calibration devices and adapters are referred to in terms of their connector interface. For example, a male open has a male connector.

Conversely, connector gages are referred to in terms of the connector that it measures. For instance, a male connector gage has a female connector on the gage so that it can measure male devices.

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## Preventive Maintenance

The best techniques for maintaining the integrity of the devices in this kit include:

- routine visual inspection
- cleaning
- proper gaging
- proper connection techniques

All of these are described in [Chapter 3, “Use, Maintenance, and Care of the Devices.”](#) 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 pin depth values being out of the *observed* limits (see [Table 2-3 on page 2-4](#)), or from poor connection techniques, can also damage these devices.



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## **2 Specifications**

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## Environmental Requirements

**Table 2-1 Environmental Requirements**

Parameter	Limits
Operating temperature <sup>a</sup>	+20 °C to +26 °C (+68 °F to +79 °F)
Error-corrected temperature range <sup>b</sup>	±1 °C of measurement calibration temperature
Storage temperature	-40 °C to +75 °C (-40 °F to +167 °F)
Altitude	
Operation	< 4,500 meters (≈15,000 feet)
Storage	< 15,000 meters (≈50,000 feet)
Relative humidity	Always Non-Condensing
Operation	0 to 80% (26 °C maximum dry bulb)
Storage	0 to 95%

- a. The temperature range over which the calibration standards maintain conformance to their specifications.
- b. The allowable network analyzer ambient temperature drift during measurement calibration and during measurements when the network analyzer error 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

Changes in temperature can affect electrical characteristics. Therefore, the operating temperature is a critical factor in performance. During a measurement calibration, the temperature of the calibration devices must be stable and within the range shown in [Table 2-1](#).

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**IMPORTANT** Avoid unnecessary handling of the devices during calibration because your fingers are a heat source.

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## Mechanical Characteristics

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 or improper pin depth when the kit leaves the factory.

“Gaging Connectors” on page 3-7 explains how to use gages to determine if the kit devices have maintained their mechanical integrity. (Refer to Table 2-3 on page 2-4 for *typical* and *observed* pin depth limits).

**Table 2-2 Mechanical Characteristics**

Dimension	Typical Value
Inside diameter of outer conductor	7.0000 ±0.0076 mm
Outside diameter of center conductor	3.0404 ±0.0051 mm

### Pin Depth

Pin depth is the distance the center conductor mating plane differs from being flush with the outer conductor mating plane. See Figure 2-1. Some coaxial connectors (such as 2.4 mm and 3.5 mm) are designed to have these planes nearly flush. Type-N connectors, however, are designed with a pin depth offset of approximately 5.26 mm (0.207 inch), not permitting these planes to be flush. The male center conductors are recessed by the offset value while the female center conductors compensate by protruding the same amount. This offset necessitates redefining of pin depth with regard to protrusion and recession.

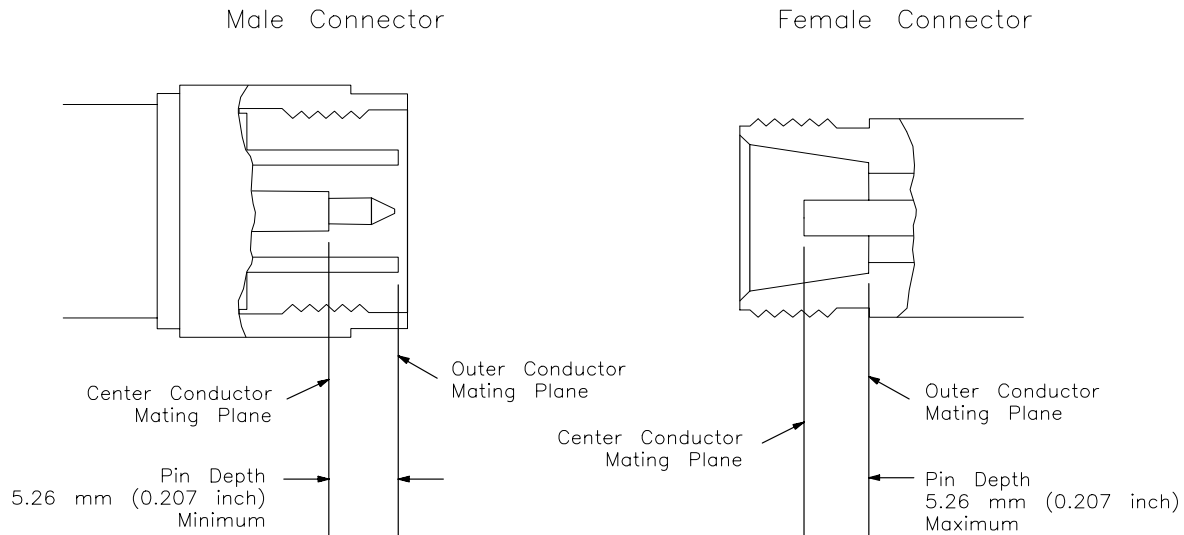
**Protrusion** refers to a male type-N connector center conductor having a pin depth value less than 5.26 mm (0.207 inch), or female type-N connector center conductor having a pin depth value greater than 5.26 (0.207 inch).

**Recession** refers to a male type-N connector center conductor having a pin depth value greater than 5.26 mm (0.207 inch), or female type-N connector center conductor having a pin depth value less than 5.26 (0.207 inch).

The pin depth value of each calibration device in this kit is not specified, but is an important mechanical parameter. The electrical performance of the device depends, to some extent, on its pin depth. The electrical specifications for each device in this kit take into account the effect of pin depth on the device’s performance. Table 2-3 lists the typical pin depths and measurement uncertainties, and provides observed pin depth limits for the devices in the kit. If the pin depth of a device does not measure within the *observed* pin depth limits, it may be an indication that the device fails to meet electrical specifications. Refer to Figure 2-1 for a visual representation of proper pin depth in type-N connectors.

**NOTE** The gages intended for measuring the type-N connectors compensate for the designed offset of 5.26 mm (0.207 inch). Therefore, protrusion and recession readings will be in relation to a *zero* reference plane (as if the inner and outer conductor planes were intended to be flush). Gage readings can be directly compared with the *observed* values listed in [Table 2-3](#).

**Figure 2-1 Connector Pin Depth**



**Table 2-3 Pin Depth Limits**

Device	Typical Pin Depth	Measurement Uncertainty <sup>a</sup>	Observed Pin Depth Limits
Opens	0 to -0.0127 mm (0 to -0.0005 in)	+0.0038 to -0.0038 mm (+0.00015 to -0.00015 in)	+0.0038 to -0.0165 mm (+0.00015 to -0.00065 in)
Shorts	0 to -0.0127 mm (0 to -0.0005 in)	+0.0038 to -0.0038 mm (+0.00015 to -0.00015 in)	+0.0038 to -0.0165 mm (+0.00015 to -0.00065 in)
Fixed Loads	0 to -0.0508 mm (0 to -0.002 in)	+0.0038 to -0.0038 mm (+0.00015 to -0.00015 in)	+0.0038 to -0.0546 mm (+0.00015 to -0.00215 in)

a. Approximately +2 sigma to -2 sigma of gage uncertainty based on studies done at the factory using the 85054-60049 gages kit (same as kit gages) according to recommended procedures.

**NOTE** When measuring pin depth, the measured value (resultant average of three or more measurements) is *not* the true value. Always compare the measured value with the *observed* pin depth limits in [Table 2-3](#) to evaluate the condition of device connectors.

## Electrical Specifications

The electrical specifications in [Table 2-4](#) apply to the devices in your calibration kit when connected with an Agilent precision interface.

**Table 2-4 Electrical Specifications**

Device	Frequency (GHz)	Parameter	Specification
Broadband Loads (male and female)	DC to $\leq 2$	Return Loss	$\geq 48$ dB ( $\leq 0.00398\rho$ )
	$> 2$ to $\leq 3$	Return Loss	$\geq 45$ dB ( $\leq 0.00562\rho$ )
	$> 3$ to $\leq 6$	Return Loss	$\geq 40$ dB ( $\leq 0.010\rho$ )
	$> 6$ to $\leq 9$	Return Loss	$\geq 38$ dB ( $\leq 0.0126\rho$ )
Adapters <sup>a</sup>	DC to $\leq 9$	Return Loss	$\geq 38$ dB ( $\leq 0.0126\rho$ )
Offset Opens <sup>b</sup> (male and female)	DC to $\leq 3$	Deviation from Nominal	$\pm 0.65^\circ$
	$> 3$ to $\leq 9$	Phase	$\pm 1.00^\circ$
Offset Shorts <sup>b</sup> (male and female)	DC to $\leq 3$	Deviation from Nominal	$\pm 0.65^\circ$
	$> 3$ to $\leq 9$	Phase	$\pm 1.00^\circ$

a. Specifications apply to Options 100, 200, and 300 only.

b. The specifications for the opens and shorts are given as allowed deviation from the nominal model as defined in the standard definitions. Refer to [Table A-7](#) through [Table A-9](#).

## Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST) to the extent allowed by the institute's calibration facility, and to the calibration facilities of other International Standards Organization members. See [“How Agilent Verifies the Devices in This Kit”](#) on [page 4-2](#) for more information.





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## **3 Use, Maintenance, and Care of the Devices**

## Electrostatic Discharge

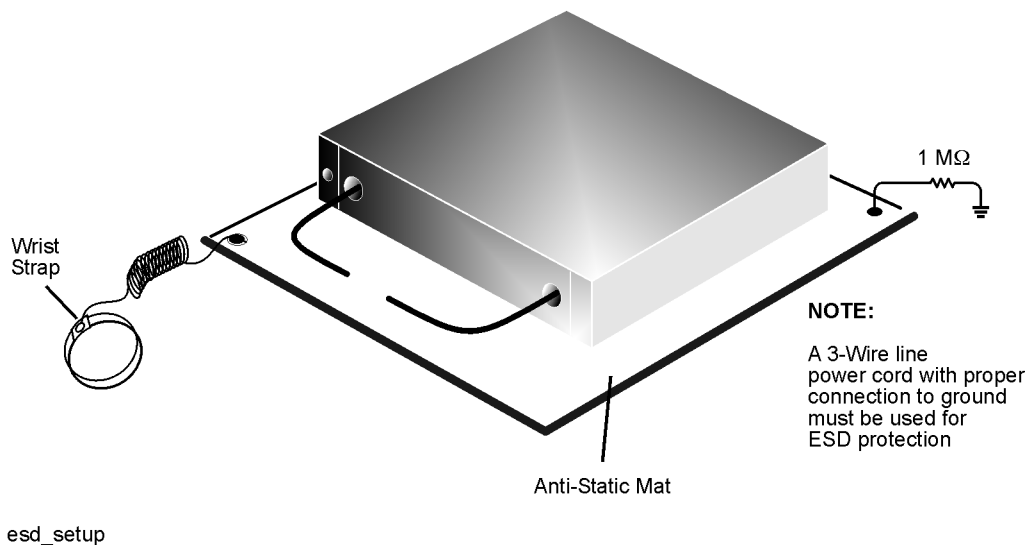
Protection against electrostatic discharge (ESD) is essential while connecting, inspecting, or cleaning connectors attached to a static-sensitive circuit (such as those found in test sets).

Static electricity can build up on your 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 components and devices under test (DUTs), 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 M $\Omega$  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.
- *always* ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port or cable connector briefly.
- *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.

Refer to [Chapter 6, “Replaceable Parts,”](#) for ordering ESD protection supplies.

**Figure 3-1 ESD Protection Using Mat, Wrist Strap, and Grounded Power Cord**



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## 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.

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**CAUTION** Devices with damaged connectors should immediately be discarded or clearly marked and set aside for repair. A damaged device will in turn damage any good connector to which it is attached. Try to determine the cause of damage before connecting a new, undamaged connector in the same configuration.

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In some cases, magnification is necessary to see damage on a connector. Not all defects that are visible only under magnification will affect the electrical performance of the connector. Use the following guidelines when evaluating the integrity of a connector.

### Look for Obvious Defects and Damage First

Examine the connectors first for obvious defects and damage: badly worn plating on the connector interface, deformed threads, or bent, broken, or misaligned center conductors.

### What Causes Connector Wear?

Connector wear is caused by connecting and disconnecting the devices. The more use the device gets, the faster it wears and degrades. The wear is greatly accelerated when connectors are not kept clean, or are not properly connected.

Connector wear eventually degrades performance of the device. Calibration devices should have a long life if their use is on the order of a few times per week.

The test port connectors on the network analyzer test set may have many connections each day, and are therefore more subject to wear. It is recommended that an adapter be used as a test port saver to minimize the wear on the test set's connectors. Replace devices with worn connectors.

### Inspect the Mating Plane Surfaces

Even contact between the connectors at all points on their mating plane surfaces is required for a good connection. See [Figure 2-1 on page 2-4](#). Look especially for deep scratches or dents, and for dirt and metal particles on the connector mating plane surfaces. Also look for signs of damage due to excessive or uneven wear or misalignment.

Light burnishing of the mating plane surfaces is normal, and 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. If a connector shows deep scratches or dents, particles clinging to the mating plane surfaces, or uneven wear, clean and inspect it again.

## **Inspect Female Connectors**

When using female connectors, pay special attention to the contact fingers in the female center conductor. These can be bent or broken, and damage to them is not always easy to see. A connector with damaged contact fingers will not make good electrical contact and must be replaced.

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**NOTE**      This is particularly important when you are mating nonprecision to precision devices.

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## Cleaning Connectors

Clean connectors are essential for ensuring the integrity of RF and microwave coaxial connections.

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**WARNING** Always use protective eyewear when using compressed air or nitrogen.

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### 1. Use Compressed Air or Nitrogen

Use compressed air (or nitrogen) to loosen particles on the connector mating plane surfaces.

You can use any source of clean, dry, low-pressure compressed air or nitrogen that has an effective oil-vapor filter and liquid condensation trap placed just before the outlet hose.

Ground the hose nozzle to prevent electrostatic discharge, and set the air pressure to less than 414 kPa (60 psi) to control the velocity of the air stream. High-velocity streams of compressed air can cause electrostatic effects when directed into a connector. These electrostatic effects can damage the device. Refer to “[Electrostatic Discharge](#),” earlier in this chapter, for additional information.

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**WARNING** Keep Isopropyl alcohol away from heat, sparks, and flame. Store in a tightly closed container. Isopropyl alcohol is extremely flammable. In case of fire, use alcohol foam, dry chemical, or carbon dioxide; water may be ineffective.

**Use isopropyl alcohol with adequate ventilation and avoid contact with eyes, skin, and clothing. It causes skin irritation, may cause eye damage, and is harmful if swallowed or inhaled. It may be harmful if absorbed through the skin. Wash thoroughly after handling.**

**In case of spill, soak up with sand or earth. Flush spill area with water.**

**Dispose of isopropyl alcohol in accordance with all applicable federal, state, and local environmental regulation.**

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## 2. Clean the Connector Threads

Use a lint-free swab or cleaning cloth moistened with isopropyl alcohol to remove any dirt or stubborn contaminants on a connector that cannot be removed with compressed air or nitrogen. Refer to [Table 6-2 on page 6-4](#) for part numbers for isopropyl alcohol and cleaning swabs.

- a. Apply a small amount of isopropyl alcohol to the lint-free cleaning swab.
- b. Clean the connector threads.
- c. Let the alcohol evaporate, then blow the threads dry with a gentle stream of clean, low-pressure compressed air or nitrogen. Always completely dry a connector before you reassemble or use it.

## 3. Clean the Mating Plane Surfaces

- a. Apply a small amount of isopropyl alcohol to a new swab.
- b. Clean the center and outer conductor mating plane surfaces. Refer to [Figure 2-1 on page 2-4](#). When cleaning a female connector, avoid snagging the swab on the center conductor contact fingers by using short strokes.
- c. Let the alcohol evaporate, then blow the threads dry with a gentle stream of clean, low-pressure compressed air or nitrogen. Always completely dry a connector before you reassemble or use it.

## 4. Inspect Each Connector

Inspect the connector again to make sure that no particles or residue are present.

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## Gaging Connectors

The gages available from Agilent Technologies are intended for preventive maintenance and troubleshooting purposes only (see [Table 6-2 on page 6-4](#) for part number information). They are effective in detecting *excessive* center conductor protrusion or recession, and conductor damage on DUTs, test accessories, and the calibration kit devices. *Do not use the gages for precise pin depth measurements.*

Gages are matched with gage masters at the factory. The paired master is then labeled (on the bottom) with an offset value to compensate for its inaccuracy with its gage. Always set the gage to the master offset value shown on the label and *not* to zero (unless that is the offset value indicated).

### Connector Gage Accuracy

The connector gages are only capable of performing coarse measurements. They do not provide the degree of accuracy necessary to precisely measure the pin depth of the kit devices. This is partially due to the repeatability uncertainties that are associated with the measurement. Only the factory—through special gaging processes and electrical testing—can accurately verify the mechanical characteristics of the devices.

With proper technique, however, the gages are useful in detecting gross pin depth errors on device connectors. To achieve maximum accuracy, random errors must be reduced by taking the average of at least three measurements having different gage orientations on the connector. Even the resultant average can be in error by as much as  $\pm 0.0001$  inch due to systematic (biasing) errors usually resulting from worn gages and gage masters. The information in [Table 2-3 on page 2-4](#) assumes new gages and gage masters. Therefore, these systematic errors were not included in the uncertainty analysis. As the gages endure more use, the systematic errors can become more significant in the accuracy of the measurement.

The measurement uncertainties are primarily a function of the assembly materials and design, and the unique interaction each device type has with the gage. Therefore, these uncertainties can vary among the different devices. For example, note the difference between the uncertainties of the opens and shorts in [Table 2-3 on page 2-4](#).

The *observed* pin depth limits in [Table 2-3 on page 2-4](#) add these uncertainties to the *typical* factory pin depth values to provide practical limits that can be referenced when using the gages. See “[Pin Depth](#),” on [page 2-3](#). Refer to “[Kit Contents](#)” on [page 1-2](#) for more information on the design of the calibration devices in this kit.

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**NOTE** When measuring pin depth, the measured value (resultant average of three or more measurements) is not the true value. Always compare the measured value with the observed pin depth limits in [Table 2-3 on page 2-4](#) to evaluate the condition of device connectors.

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## When to Gage Connectors

Gage a connector at the following times:

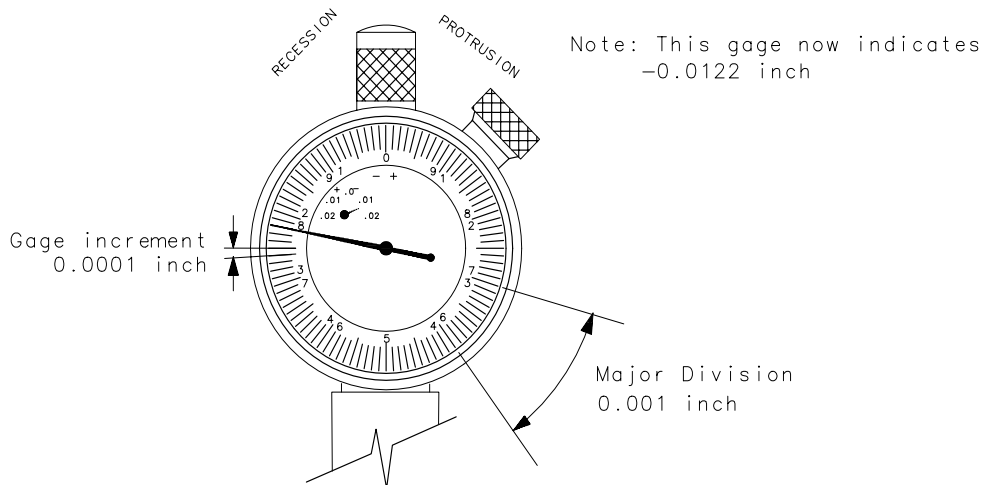
- Prior to using a device for the first time: record the pin depth measurement so that it can be compared with future readings. (It will serve as a good troubleshooting tool when you suspect damage may have occurred to the device.)
- If either visual inspection or electrical performance suggests that the connector interface may be out of typical range (due to wear or damage, for example).
- If a calibration device is used by someone else or on another system or piece of equipment.
- Initially after every 100 connections, and after that as often as experience suggests.

## Reading the Connector Gage

The gage dial is divided up into increments of 0.0001 inch and major divisions of 0.001 inch (see [Figure 3-2](#)). For each revolution of the large dial, the smaller dial indicates a change of 0.01 inch. Use the small dial as the indicator of multiples of 0.01 inch. In most connector measuring applications, this value will be zero.

When making a measurement, the gage dial indicator will travel in one of two directions. If the center conductor is recessed from the *zero* reference plane, the indicator will move counterclockwise to determine the amount of *recession*, which is read as a negative value. If the center conductor protrudes, the indicator will move clockwise to measure the amount of *protrusion*, which is read as a positive value.

**Figure 3-2** Reading the Connector Gage



wj57f



## Gaging Procedures

### Gaging Type-N Connectors

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**NOTE** Always hold a connector gage by the gage barrel, below the dial indicator. This gives the best stability, and improves measurement accuracy.

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1. Select the proper gage for your connector. Refer to [Table 6-2 on page 6-4](#) for gage part numbers.
2. Inspect and clean the gage, gage master, and device to be gaged. Refer to “[Visual Inspection](#),” and “[Cleaning Connectors](#),” earlier in this chapter.
3. Zero the connector gage (refer to [Figure 3-3](#)):
  - a. While holding the gage by the barrel, and without turning the gage or the gage master, connect the gage to the gage master by interconnecting the male and female connectors. Connect the nut finger tight. Do not overtighten.
  - b. Using an open-end wrench to keep the device body from rotating, use the torque wrench recommended for use with this kit to tighten the connecting nut to the specified torque. Refer to “[Final Connection Using a Torque Wrench](#)” on [page 3-12](#) for more information.
  - c. Loosen the dial lock screw on the gage and rotate the gage dial so that the pointer corresponds to the correction value noted on the gage master. Do not adjust the gage dial to zero, unless the correction value on the gage master is zero.
  - d. Tighten the dial lock screw and remove the gage master.
  - e. Attach and torque the gage master to the gage once again to verify that the setting is repeatable. Remove the gage master.
4. Gage the device connector (refer to [Figure 3-3](#)):
  - a. While holding the gage by the barrel, and without turning the gage or the device, connect the gage to the device by interconnecting the male and female connectors. Connect the nut finger-tight. Do not overtighten.
  - b. Using an open-end wrench to keep the device body from rotating, use the torque wrench recommended for use with this kit to tighten the connecting nut to the specified torque. Refer to “[Final Connection Using a Torque Wrench](#)” on [page 3-12](#) for more information.
  - c. Gently tap the barrel of the gage with your finger to settle the gage reading.
  - d. Read the gage indicator dial. If the needle has moved clockwise, the center conductor is *protruding* by an amount indicated by the black numbers. If the needle has moved counterclockwise, the center conductor is *recessed* by an amount indicated by the red numbers.

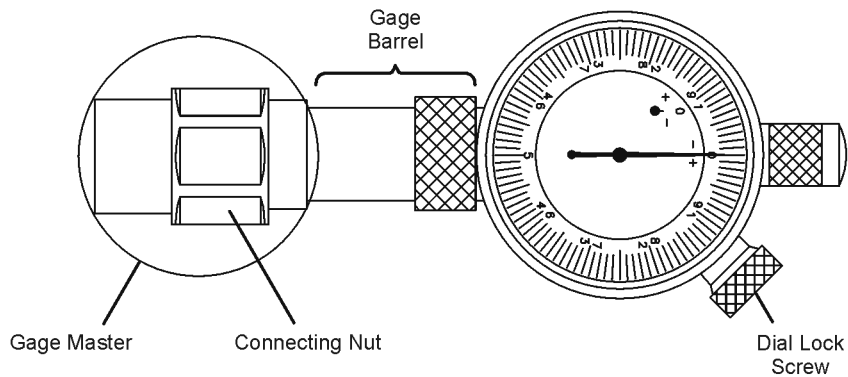
For maximum accuracy, measure the connector a minimum of three times and take an average of the readings. After each measurement, rotate the gage a quarter-turn to reduce measurement variations that result from the gage or the connector face not being exactly perpendicular to the center axis.
  - e. Compare the average reading with the pin depth specifications listed in [Table 2-3 on page 2-4](#).
  - f. Without turning either the gage or the device, remove the device from the gage.

### Figure 3-3 Gaging Type-N Connectors

**NOTE:** Although male devices are shown in this illustration, the procedure is essentially the same for the female devices.

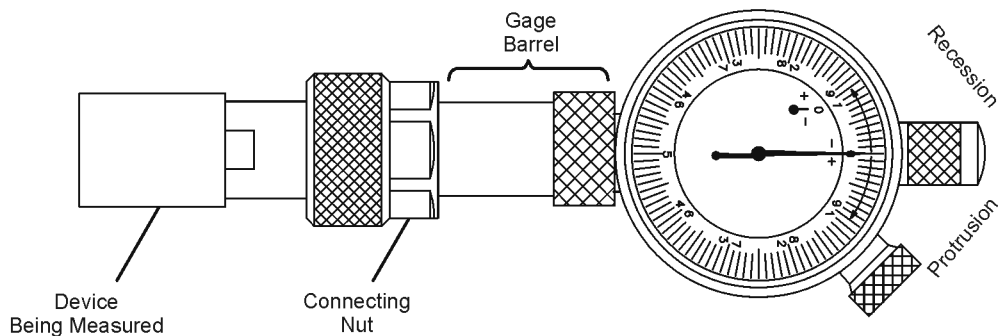
#### Zero the Connector Gage

- Connect the gage to the gage master.
- Torque the connecting nut.
- Loosen the dial lock screw.
- Adjust the gage to the correction value noted on the gage master.
- Tighten the dial lock screw.
- Remove the gage master.



#### Gage the Device Connector

- Connect the gage to the device being measured.
- Torque the connecting nut.
- Gently tap the gage barrel to settle the reading.
- Read recession or protrusion from the gage.
- Remove the device.
- Repeat two additional times and average the three readings.



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---

## Connections

Good connections are essential for accurate measurements and require a skilled operator. *The most common cause of measurement error is poor connections.*

### How to Make a Connection

#### Preliminary Connection

1. Ground yourself and all devices. Wear a grounded wrist strap and work on an antistatic mat.
2. Visually inspect the connectors. Refer to
3. If necessary, clean the connectors.
4. Use a connector gage to verify that all center conductors are within pin depth values in [Table 2-3 on page 2-4](#).
5. Carefully align the connectors. The male connector center pin must slip concentrically into the contact finger of the female connector.
6. 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* turn the device body. Only turn the connector nut. Damage to the center conductor can occur if the device body is twisted.

---

7. The preliminary connection is tight enough when the mating plane surfaces make uniform, light contact. Do not overtighten this connection.  
A connection in which the outer conductors make gentle contact at all points on both mating surfaces is sufficient. Very light finger pressure is enough.
8. Make sure the connectors are properly supported. Relieve any side pressure on the connection from long or heavy devices or cables.

## Final Connection Using a Torque Wrench

---

**NOTE** Using a torque wrench guarantees that the connection is not too tight, preventing possible connector damage. It also guarantees that all connections are equally tight.

---

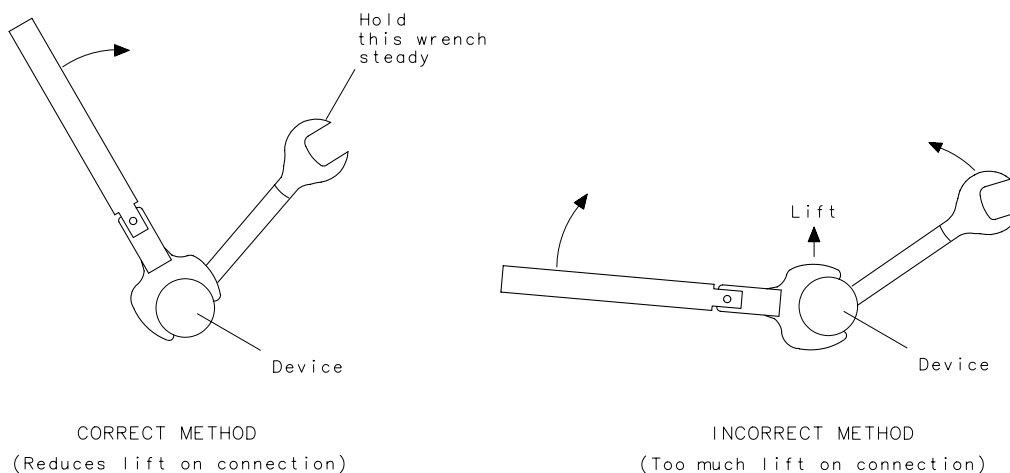
Use a torque wrench to make a final connection. [Table 3-1](#) provides information on the torque wrench recommended for use with this kit. Refer to [Chapter 6, "Replaceable Parts,"](#) for ordering information.

**Table 3-1 Torque Wrench Information**

Connector Type	Torque Setting	Torque Tolerance
Type-N	135 N-cm (12 in-lb)	13.5 N-cm ( $\pm 1.2$ in-lb)

1. Turn the connector nut. This may be possible to do by hand if one of the connectors is fixed (as on a test port). In all situations, the use of an open-end wrench to keep the body of the device from turning is recommended.
2. Position both wrenches within 90 degrees of each other before applying force. Wrenches opposing each other (greater than 90 degrees apart) will cause a lifting action that can misalign and stress the connections of the device involved. This is especially true when several devices are connected together. See [Figure 3-4](#).

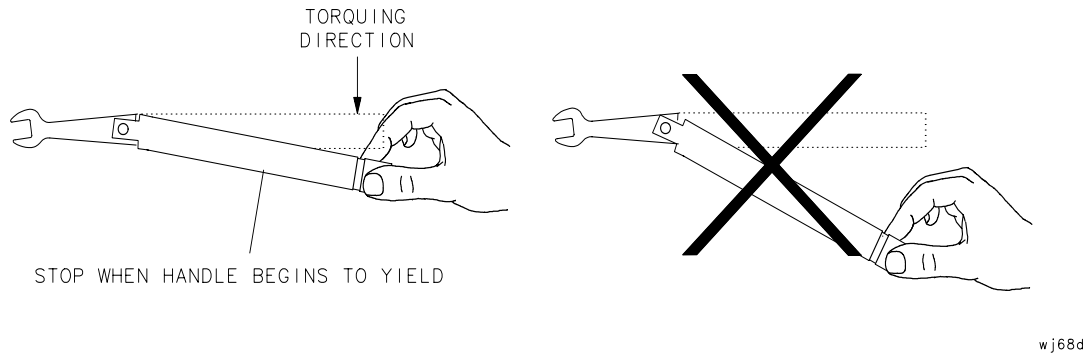
**Figure 3-4 Wrench Positions**



wj56f

3. Hold the torque wrench lightly, at the end of the handle only (beyond the groove). See [Figure 3-5](#).

**Figure 3-5 Using the Torque Wrench**



4. Apply force downward 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, otherwise you apply an unknown amount of torque.

---

**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.

---

5. Tighten the connection just to the torque wrench break point. The wrench handle gives way at its internal pivot point. See [Figure 3-5](#). Do *not* tighten the connection further.

### How to Separate a Connection

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

---

**CAUTION** Do *not* turn the device body. Only turn the connector nut. Damage to the center conductor can occur if the device body is twisted.

---

1. Use an open-end wrench to prevent the device body from turning.
2. Use another open-end wrench to loosen the connector nut.
3. Complete the separation by hand, turning only the connector nut.
4. Pull the connectors straight apart without twisting, rocking, or bending.

## Handling and Storage

- Use the plastic end caps and store the calibration devices in the foam-lined storage case when not in use.
- 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 a 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.

---

## **4 Performance Verification**

## Introduction

The performance of your calibration kit can only be verified by returning the kit to Agilent Technologies for recertification. The equipment and calibration standards required to verify the specifications of the devices inside the kit have been specially manufactured and are not commercially available.

### How Agilent Verifies the 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 NIST (National Institute of Standards and Technology). 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 back to NIST through various plug and ring gages and other mechanical measurements.
2. Each calibration device is electrically tested on this system. For the initial (before sale) testing of the calibration devices, Agilent includes the test measurement uncertainty as a guardband to guarantee each device meets the published specification. For recertifications (after sale), no guardband is used and the measured data is compared directly with the specification to determine the pass/fail status. The measurement uncertainty for each device is, however, recorded in the calibration report that accompanies recertified kits.

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 this kit are traceable to NIST through Agilent Technologies.



---

## Recertification

The following will be provided with a recertified kit:

- new calibration sticker affixed to the case
- certificate of calibration
- calibration report for each device in the kit listing measured values, specification, and uncertainties

---

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

---

Agilent Technologies offers a *Standard* calibration for the recertification of this kit. For more information, contact Agilent Technologies. See [page 5-3](#).

## 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 the kit. After reviewing the results of the initial recertification, you may establish a different recertification interval that reflects the usage and wear of the kit.

---

**NOTE** The recertification interval should begin on the date the kit is *first used* after the recertification date.

---

## Where to Send a Kit for Recertification

Contact Agilent for information on where to send your kit for recertification. See [page 5-3](#). Refer to “[Returning a Kit or Device to Agilent](#)” on [page 5-3](#) for additional information.



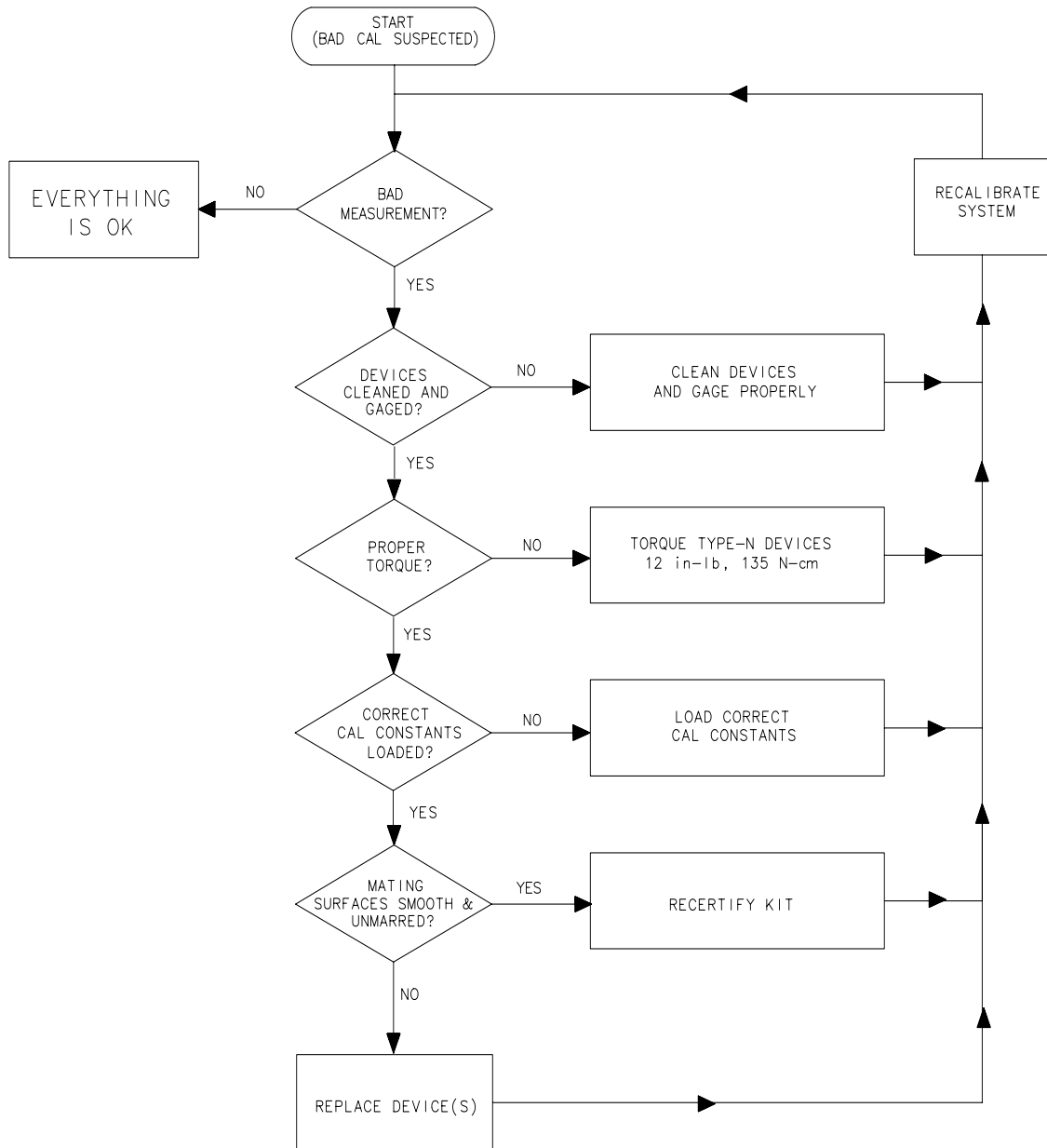
---

## **5 Troubleshooting**

## Troubleshooting Process

If you suspect a bad calibration, or if your network analyzer does not pass performance verification, follow the steps in [Figure 5-1](#).

**Figure 5-1 Troubleshooting Flowchart**



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## Returning a Kit or Device to Agilent

If your kit or device requires service, contact Agilent Technologies for information on where to send it. See [Table 5-1](#). 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 including the country code and area code
- the model number and serial number of the kit
- the part number and serial number of each device
- the type of service required
- a *detailed* description of the problem and how the device was being used when the problem occurred (such as calibration or measurement)

**Table 5-1 Contacting Agilent**

**Online assistance:** [www.agilent.com/find/assist](http://www.agilent.com/find/assist)

<b>United States</b> <i>(tel)</i> 1 800 452 4844	<b>Latin America</b> <i>(tel)</i> (305) 269 7500 <i>(fax)</i> (305) 269 7599	<b>Canada</b> <i>(tel)</i> 1 877 894 4414 <i>(fax)</i> (905) 282-6495	<b>Europe</b> <i>(tel)</i> (+31) 20 547 2323 <i>(fax)</i> (+31) 20 547 2390
<b>New Zealand</b> <i>(tel)</i> 0 800 738 378 <i>(fax)</i> (+64) 4 495 8950	<b>Japan</b> <i>(tel)</i> (+81) 426 56 7832 <i>(fax)</i> (+81) 426 56 7840	<b>Australia</b> <i>(tel)</i> 1 800 629 485 <i>(fax)</i> (+61) 3 9210 5947	<b>Singapore</b> <i>(tel)</i> 1 800 375 8100 <i>(fax)</i> (65) 836 0252
<b>Malaysia</b> <i>(tel)</i> 1 800 828 848 <i>(fax)</i> 1 800 801 664	<b>Philippines</b> <i>(tel)</i> (632) 8426802 <i>(tel) (PLDT subscriber only):</i> 1 800 16510170 <i>(fax)</i> (632) 8426809 <i>(fax) (PLDT subscriber only):</i> 1 800 16510288	<b>Thailand</b> <i>(tel) outside Bangkok:</i> (088) 226 008 <i>(tel) within Bangkok:</i> (662) 661 3999 <i>(fax)</i> (66) 1 661 3714	<b>Hong Kong</b> <i>(tel)</i> 800 930 871 <i>(fax)</i> (852) 2506 9233
<b>Taiwan</b> <i>(tel)</i> 0800-047-866 <i>(fax)</i> (886) 2 25456723	<b>People's Republic of China</b> <i>(tel) (preferred):</i> 800-810-0189 <i>(tel) (alternate):</i> 10800-650-0021 <i>(fax)</i> 10800-650-0121	<b>India</b> <i>(tel)</i> 1-600-11-2929 <i>(fax)</i> 000-800-650-1101	



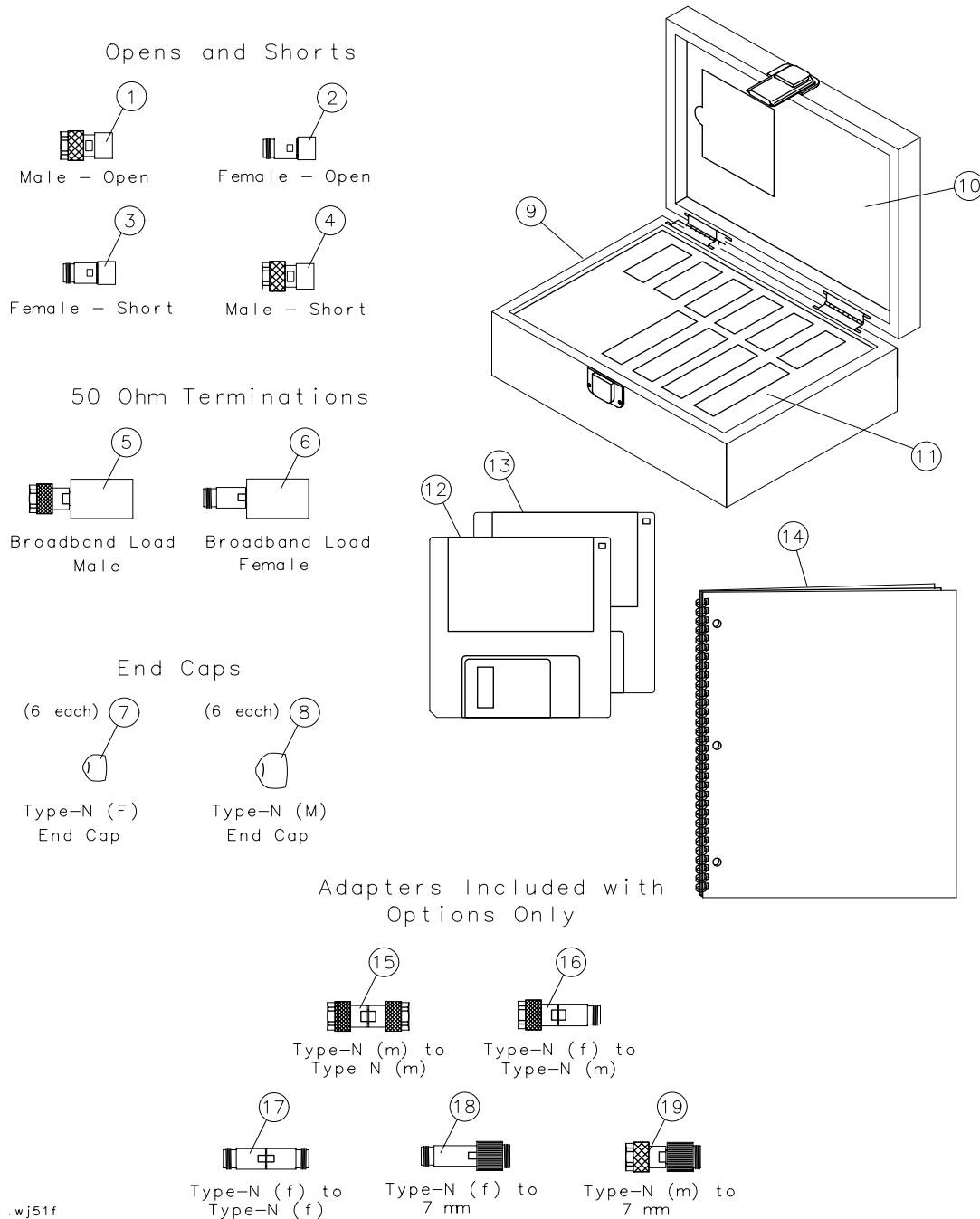
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## **6 Replaceable Parts**

## Introduction

Table 6-1 lists the replacement part numbers for the contents of the 85032F calibration kit. To order a listed part, note the description, the Agilent part number, and the quantity desired. Telephone or send your order to Agilent Technologies. See page 5-3.

**Figure 6-1 Replaceable Parts for the 85032F Calibration Kit**



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**Table 6-1 Replaceable Parts**

Item No.	Description	Qty	Agilent Part Number
<b>Calibration Devices (Type-N 50 Ω)</b>			
1	Male offset open	1	85032-60013
2	Female offset open	1	85032-60014
3	Female offset short	1	85032-60015
4	Male offset short	1	85032-60016
5	Male broadband load	1	85032-60017
6	Female broadband load	1	85032-60018
<b>Protective End Caps for Connectors (Type-N 50 Ω)</b>			
7	Female end cap	as required	1401-0225
8	Male end cap	as required	1401-0214
<b>Calibration Kit Storage Case</b>			
9	Box (without foam pads)	1	5180-8446
10	Box pads (top)	1	85032-80028
11	Box pads (bottom)	1	85032-80026
12	Disk holder (not shown in <a href="#">Figure 6-1</a> )	1	5180-8491
<b>Miscellaneous Items</b>			
13	Connector care-quick reference card (not shown in <a href="#">Figure 6-1</a> )	1	08510-90360
14	Calibration constants disk (PNA series)	1	85032-10002
15	Calibration constants disk (875x and 872x series)	1	85032-10003
16	User's and service guide	1	85032-90021
<b>Optional Adapters<sup>a</sup> (Type-N 50 Ω)</b>			
17	Type-N-male to type-N-male (Option 200)	1	85032-60019
18	Type-N-female to type-N-male (Option 300)	1	85032-60020
19	Type-N-female to type-N-female (Option 100)	1	85032-60021
20	Type-N-female to 7-mm adapter (Option 500)	2	85054-60001
21	Type-N-male to 7-mm adapter (Option 500)	2	85054-60009

a. The adapters are included when the applicable option is ordered.

**Table 6-2 Items Not Included in Kit**

<b>Description</b>	<b>Agilent Part Number</b>
<b>Miscellaneous</b>	
Type-N gage set	85054-60049
Adapter Kit (type-N 50 $\Omega$ to 3.5 mm)	11878A
<b>Wrenches</b>	
3/4 in, 135 N-cm (12 in-lb) torque wrench	8710-1766
1/2 in and 9/16 in open-end wrench	8710-1770
3/4 in open-end wrench	8720-0011
<b>Connector Cleaning Supplies</b>	
Isopropyl alcohol (30 ml)	8500-5344
Foam-tipped cleaning swabs (100)	9301-1243
<b>ESD Devices</b>	
Grounding wrist strap	9300-1367
5 ft grounding cord for wrist strap	9300-0980
2 x 4 ft conductive table mat and 15 ft. ground wire	9300-0797
ESD heel strap	9300-1308

---

# **A Standard Definitions**

## Standard Class Assignments

Class assignment organizes calibration standards into a format compatible with the error models used in the measurement calibration. A class or group of classes corresponds to the systematic errors to be removed from the measured network analyzer response. Table A-1 through Table A-3 list the classes of the devices in the kit for various network analyzers. This information resides on a calibration constants disks that accompany this kit.

**Table A-1 Standard Class Assignments for the 8510**

Disk File Name: CK_NTYPF1		Calibration Kit Label: <b>Type N F.1</b>						
Class	A	B	C	D	E	F	G	Standard Class Label
S <sub>11</sub> A	2							Open
S <sub>11</sub> B	1							Short
S <sub>11</sub> C	9							Loads
S <sub>22</sub> A	2							Open
S <sub>22</sub> B	1							Short
S <sub>22</sub> C	9							Loads
Forward Transmission	11							Thru
Reverse Transmission	11							Thru
Forward Match	11							Thru
Reverse Match	11							Thru
Forward Isolation <sup>a</sup>	9							Iso'n Std
Reverse Isolation	9							Iso'n Std
Frequency Response	1	2	11					Response
TRL Thru	14							undefined
TRL Reflect	1							undefined
TRL Line	15							undefined
Adapter	13	14						Adapter
<b>TRL Options</b>								
Cal Z <sub>0</sub> :	_____ System Z <sub>0</sub>				___ <b>X</b> ___ Line Z <sub>0</sub>			
Set Ref:	___ <b>X</b> ___ Thru				_____ Reflect			
Lowband Frequency:	___ <b>2.0</b> ___ GHz							

a. Forward isolation standard is also used for isolation part of response and isolation calibration.

**Table A-2 Standard Class Assignments for the PNA Series Network Analyzer**

Calibration Kit Label:	
Class	A <sup>a</sup>
S <sub>11</sub> A	2
S <sub>11</sub> B	1
S <sub>11</sub> C	3
S <sub>21</sub> T	4
S <sub>22</sub> A	2
S <sub>22</sub> B	1
S <sub>22</sub> C	3
S <sub>12</sub> T	4

a. For additional ports, make sure values match the correct sex of the port.

---

**IMPORTANT** The following calibrations are only supported by certain PNA analyzers. See your PNA series network analyzer embedded help system.

---

Notes:

**1. If you are performing a TRL calibration:**

- S<sub>21</sub>T and S<sub>12</sub>T must be defined as *thru* standards.
- S<sub>11</sub>A and S<sub>22</sub>A must be defined as *reflection* standards.
- S<sub>11</sub>B, S<sub>11</sub>C, S<sub>22</sub>B, and S<sub>22</sub>C must be defined as *line* standards.

**2. If you are performing a TRM calibration:**

- S<sub>21</sub>T and S<sub>12</sub>T must be defined as *thru* standards.
- S<sub>11</sub>A and S<sub>22</sub>A must be defined as *reflection* standards.
- S<sub>11</sub>B, S<sub>11</sub>C, S<sub>22</sub>B, and S<sub>22</sub>C must be defined as *match* standards.

**3. If you are performing an LRM calibration:**

- S<sub>21</sub>T and S<sub>12</sub>T must be defined as *line* standards.
- S<sub>11</sub>A and S<sub>22</sub>A must be defined as *reflection* standards.
- S<sub>11</sub>B, S<sub>11</sub>C, S<sub>22</sub>B, and S<sub>22</sub>C must be defined as *match* standards.

4. **S<sub>11</sub>B and S<sub>11</sub>C must be defined as the same standard.**

5. **S<sub>22</sub>B and S<sub>22</sub>C must be defined as the same standard.**

For additional information on performing TRL, TRM, and LRM calibrations, refer to your PNA series network analyzer embedded help system.

**Table A-3 Standard Class Assignments for the 875x and 872x Series**

Calibration Kit Label: <b>N 50 Ω</b>								
Class	A	B	C	D	E	F	G	Standard Class Label
S <sub>11</sub> A	2							Opens
S <sub>11</sub> B	1							Shorts
S <sub>11</sub> C	3							Loads
S <sub>22</sub> A	2							Opens
S <sub>22</sub> B	1							Shorts
S <sub>22</sub> C	3							Loads
Forward Transmission	4							Thru
Reverse Transmission	4							Thru
Forward Match	4							Thru
Reverse Match	4							Thru
Response	1	2	4					Response
Response & Isolation	1	2	4					Response
TRL Thru	4							Thru
TRL Reflect	2							Opens
TRL Line	3							Loads
TRL Options								
Cal Z <sub>0</sub> :	_____ System Z <sub>0</sub>			___ <b>X</b> ___ Line Z <sub>0</sub>				
Set Ref:	___ <b>X</b> ___ Thru			_____ Reflect				

## Blank Form

The blank forms (Table A-4 through Table A-6) are provided for use in modifying the standard class assignments to meet your individual requirements.

**Table A-4 Blank Form for the 8510 Network Analyzer**

Disk File Name:	Calibration Kit Label: <input type="text"/>							
Class	A	B	C	D	E	F	G	Standard Class Label
S <sub>11</sub> A								
S <sub>11</sub> B								
S <sub>11</sub> C								
S <sub>22</sub> A								
S <sub>22</sub> B								
S <sub>22</sub> C								
Forward Transmission								
Reverse Transmission								
Forward Match								
Reverse Match								
Forward Isolation <sup>a</sup>								
Reverse Isolation								
Frequency Response								
TRL Thru								
TRL Reflect								
TRL Line								
Adapter								
<b>TRL Options</b>								
Cal Z <sub>0</sub> :	_____ System Z <sub>0</sub>				_____ Line Z <sub>0</sub>			
Set Ref:	_____ Thru				_____ Reflect			
Lowband Frequency:	_____							

a. Forward isolation standard is also used for isolation part of response and isolation calibration.

**Table A-5 Blank Form for the PNA Series Network Analyzer**

Calibration Kit Label:	
Class	A <sup>a</sup>
S <sub>11</sub> A	
S <sub>11</sub> B	
S <sub>11</sub> C	
S <sub>21</sub> T	
S <sub>22</sub> A	
S <sub>22</sub> B	
S <sub>22</sub> C	
S <sub>12</sub> T	

a. For additional ports, make sure values match the correct sex of the port.

---

**IMPORTANT** The following calibrations are only supported by certain PNA analyzers. See your PNA series network analyzer embedded help system.

---

Notes:

**1. If you are performing a TRL calibration:**

- S<sub>21</sub>T and S<sub>12</sub>T must be defined as *thru* standards.
- S<sub>11</sub>A and S<sub>22</sub>A must be defined as *reflection* standards.
- S<sub>11</sub>B, S<sub>11</sub>C, S<sub>22</sub>B, and S<sub>22</sub>C must be defined as *line* standards.

**2. If you are performing a TRM calibration:**

- S<sub>21</sub>T and S<sub>12</sub>T must be defined as *thru* standards.
- S<sub>11</sub>A and S<sub>22</sub>A must be defined as *reflection* standards.
- S<sub>11</sub>B, S<sub>11</sub>C, S<sub>22</sub>B, and S<sub>22</sub>C must be defined as *match* standards.

**3. If you are performing an LRM calibration:**

- S<sub>21</sub>T and S<sub>12</sub>T must be defined as *line* standards.
- S<sub>11</sub>A and S<sub>22</sub>A must be defined as *reflection* standards.
- S<sub>11</sub>B, S<sub>11</sub>C, S<sub>22</sub>B, and S<sub>22</sub>C must be defined as *match* standards.



4. **S<sub>11</sub>B and S<sub>11</sub>C must be defined as the same standard.**
5. **S<sub>22</sub>B and S<sub>22</sub>C must be defined as the same standard.**

For additional information on performing TRL, TRM, and LRM calibrations, refer to your PNA series network analyzer embedded help system.

**Table A-6 Blank Form for the 875x and 872x Series**

Calibration Kit Label: _____								
Class	A	B	C	D	E	F	G	Standard Class Label
S <sub>11</sub> A								
S <sub>11</sub> B								
S <sub>11</sub> C								
S <sub>22</sub> A								
S <sub>22</sub> B								
S <sub>22</sub> C								
Forward transmission								
Reverse transmission								
Forward match								
Reverse match								
Response								
Response & isolation								
TRL thru								
TRL reflect								
TRL line or match								
TRL Option								
Cal Z <sub>0</sub> :    ___ System Z <sub>0</sub> ___ Line Z <sub>0</sub>								
Set ref:    ___ Thru                        ___ Reflect								

## Nominal Standard Definitions

Standard definitions provide the constants needed to mathematically model the electrical characteristics (delay, attenuation, and impedance) of each calibration standard. The nominal values of these constants are theoretically derived from the physical dimensions and material of each calibration standard, or from actual measured response. These values are used to determine the measurement uncertainties of the network analyzer. The standard definitions in [Table A-7](#) and [Table A-8](#) list typical calibration kit parameters used to specify the mathematical model of each device. This information must be loaded into the network analyzer in order to perform valid calibrations. Refer to your network analyzer's user's guide for instructions on loading calibration constants.

## Setting the System Impedance

This kit contains only 50 ohm devices. Ensure the system impedance ( $Z_0$ ) is set to 50 ohms. Refer to your network analyzer user's guide for instructions on setting system impedance.

**Table A-7 Standard Definitions for the 8510**

System $Z_0^a = 50 \Omega$ Disk File Name: CK_NTYPF1													Calibration Kit Label: <b>Type N F.1</b>	
Number	Standard <sup>b</sup> Type	$C0 \times 10^{-15} \text{ F}$	$C1 \times 10^{-27} \text{ F/Hz}$	$C2 \times 10^{-36} \text{ F/Hz}^2$	$C3 \times 10^{-45} \text{ F/Hz}^3$	Fixed or Sliding <sup>c</sup>	Offset			Frequency in GHz <sup>d</sup>		Coax or Waveguide	Standard Label	
		$L0 \times 10^{-12} \text{ H}$	$L1 \times 10^{-24} \text{ H/Hz}$	$L2 \times 10^{-33} \text{ H/Hz}^2$	$L3 \times 10^{-42} \text{ H/Hz}^3$		Delay in ps	$Z_0 \Omega$	Loss in GΩ/s	Min	Max			
1	Short <sup>e</sup>	3.3998	-496.4808	34.8314	-.7847		45.955	49.99	1.087	0	999	Coax	Short	
2	Open <sup>e</sup>	89.939	2536.80	-264.990	13.400		41.19	50	0.93	0	999	Coax	Open	
3														
4														
5														
6														
7														
8														
9	Load					Fixed	0	50	0	0	999	Coax	Broad-band	
10														
11	Delay/ Thru						0	50	0	0	999	Coax	Thru	
12														
13	Delay/ Thru						339.0	50	2.2	0	999	Coax	(f/f) Adapter	
14	Delay/ Thru						339.0	50	2.2	0	999	Coax	(m/m) Adapter	
15														
16														
17														
18														
19														
20														
21														

- Ensure system  $Z_0$  of network analyzer is set to this value.
- Open, short, load, delay/thru, or arbitrary impedance.
- Load or arbitrary impedance only.
- For waveguide, lower frequency is same as  $F_{CO}$ .
- Typical values only, disk file values may be different.

**Table A-8 Standard Definitions for the 875x, 872x, and PNA series**

System $Z_0^a = 50 \Omega$						Calibration Kit Label:											
Number	Type	$L0 \times 10^{-12}$ H	$C0 \times 10^{-15}$ F	$L1 \times 10^{-24}$ H/Hz	$C1 \times 10^{-27}$ F/Hz	$L2 \times 10^{-33}$ H/Hz <sup>2</sup>	$C2 \times 10^{-36}$ F/Hz <sup>2</sup>	$L3 \times 10^{-42}$ H/Hz <sup>3</sup>	$C3 \times 10^{-45}$ F/Hz <sup>3</sup>	Fixed or Sliding <sup>c</sup>	Offset			Frequency in GHz		Coax or Waveguide	Standard Label
											Delay in ps	$Z_0$ $\Omega$	Loss in G $\Omega$ /s	Min	Max		
1	Short <sup>d</sup>	3.3998		-496.4808		34.8314		-0.7847			45.955	49.99	1.087	0	999	Coax	Short
2	Open	89.939		2536.80		-264.990		13.400			41.19	50	0.93	0	999	Coax	Open
3	Load								Fixed		0	50	0	0	999	Coax	Broad-band
4	Delay/Thru										0	50	2.3	0	999	Coax	Thru
5																	
6																	
7																	
8																	

- a. Ensure system  $Z_0$  of network analyzer is set to this value.
- b. Open, short, load, delay/thru, or arbitrary impedance.
- c. Load or arbitrary impedance only.
- d. L terms apply to PNA and ENA series of network analyzers.

### Blank Form

The blank forms (Table A-9 through Table A-10) are provided for use in modifying the standard definitions to meet your individual requirements.

**Table A-9 Standard Definitions Blank Form for the 8510**

System $Z_0^a =$ _____							Calibration Kit Label: _____						
Standard <sup>b</sup>		$C0 \times 10^{-15}$ F	$C1 \times 10^{-27}$ F/Hz	$C2 \times 10^{-36}$ F/Hz <sup>2</sup>	$C3 \times 10^{-45}$ F/Hz <sup>3</sup>	Fixed or Sliding <sup>c</sup>	Offset			Frequency in GHz <sup>d</sup>		Coax or Waveguide	Standard Label
Number	Type	$L0 \times 10^{-12}$ H	$L1 \times 10^{-24}$ H/Hz	$L1 \times 10^{-33}$ H/Hz <sup>2</sup>	$L1 \times 10^{-42}$ H/Hz <sup>3</sup>		Delay in ps	$Z_0 \Omega$	Loss in GΩ/s	Min	Max		
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													

- a. Ensure system  $Z_0$  of network analyzer is set to this value.
- b. Open, short, load, delay/thru, or arbitrary impedance.
- c. Load or arbitrary impedance only.
- d. For waveguide, lower frequency is the same as  $F_{CO}$ .

**Table A-10 Standard Definitions for the 875x, 872x, and PNA series**

System $Z_0^a = 50 \Omega$		Calibration Kit Label:											
Number	Type	Standard <sup>b</sup>		Fixed or Sliding <sup>c</sup>	Offset			Frequency in GHz		Coax or Waveguide	Standard Label		
		$L_0 \times 10^{-12}$ H	$C_0 \times 10^{-15}$ F		Delay in ps	$Z_0 \Omega$	Loss in GΩ/s	Min	Max				
1	Short <sup>d</sup>												
2	Open												
3	Load												
4	Delay/Thru												
5													
6													
7													
8													

- a. Ensure system  $Z_0$  of network analyzer is set to this value.
- b. Open, short, load, delay/thru, or arbitrary impedance.
- c. Load or arbitrary impedance only.
- d. L terms apply to PNA and ENA series of network analyzers.

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