Agilent Technologies 85033D
3.5 mm Calibration Kit

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Calibration Kit Overview

The Agilent 85033D 3.5 mm calibration kit is used to calibrate Agilent network analyzers up to 6 GHz for measurements of components with 3.5 mm connectors.

Kit Contents

The 85033D calibration kit includes the following items:

- offset opens and shorts, and broadband load terminations
- disk that contains the nominal calibration definitions of the devices in the calibration kit
- two open-short-load (OSL) holders
- 2.5 mm hex key for use with the (OSL) holder

Refer to Figure 6-1 and Table 6-1 for a complete list of kit contents and their associated part numbers.

Broadband Loads

The broadband loads are metrology-grade terminations that have been optimized for performance up to 6 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 in 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.

Adapters

Like the other devices in the kit, the adapters are built to very tight tolerances to provide good broadband performance. The adapters utilize a dual-beaded connector structure to ensure stable, repeatable connections. The beads are designed to minimize return loss and are separated far enough so that interaction between the beads is minimized.

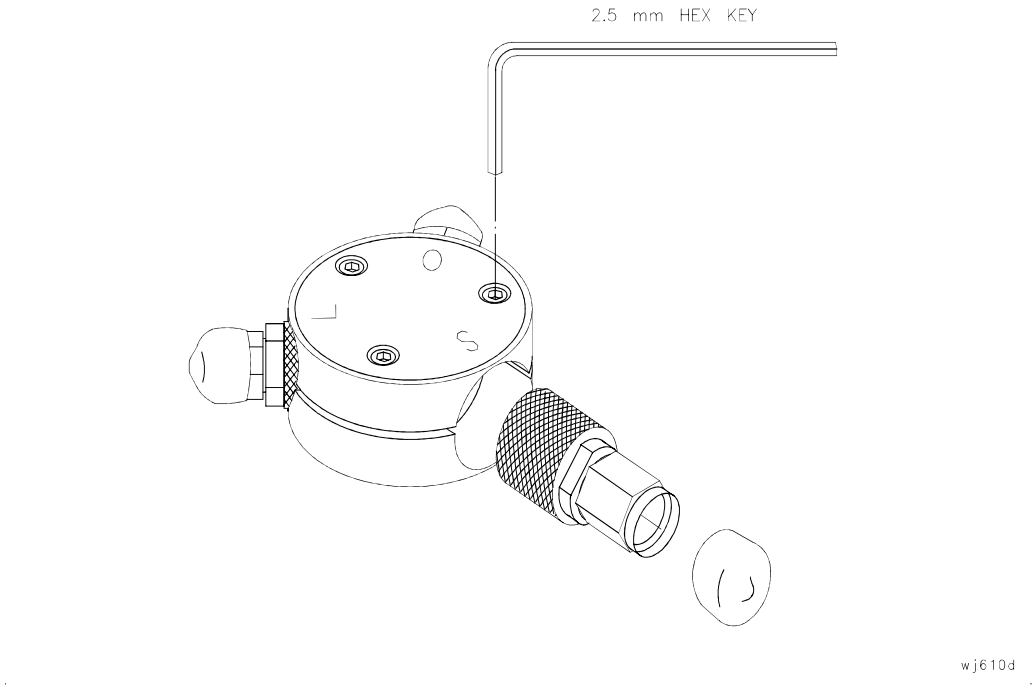
The adapters are designed so that their nominal electrical lengths are the same, which allows them to be used in calibration procedures for non-insertable devices.

Open-Short-Load Holders

The open-short-load (OSL) holders are included for your convenience. The OSL holders allow you to keep all of the calibration devices in two handy assemblies. Load each OSL holder with calibration devices of the same connector sex so that you can perform a calibration with just one assembly.

Use the 2.5-mm hex key included with the kit to secure the calibration devices in the holders. See Figure 1-1.

Figure 1-1 Open-Short-Load Holder



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:

- already 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

The following options are available for the 85033D:

Option 100

This option adds four 7-mm to 3.5-mm adapters.

Option 200

This option adds four type-N adapters:

- Type-N-male to 3.5-mm-male
- Type-N-male to 3.5-mm-female
- Type-N-female to 3.5-mm-male
- Type-N-female to 3.5-mm-female

Equipment Required but Not Supplied

Gages, torque and open-end wrenches, ESD protective devices, and various connector cleaning supplies are not supplied with the calibration kit but are required to ensure successful operation of the kit. Refer to Table 6-2 on page 6-4 for ordering information.

Incoming Inspection

Verify that the shipment is complete by referring to Table 6-1.

Check for damage. The foam-lined storage case provides protection during shipping. Verify that this case and its contents are not damaged.

If the case or any device appears damaged, or if the shipment is incomplete, contact Agilent Technologies. See Table 5-1 on page 5-3. 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 (found near the end of this manual) with the following information:

- your company name and address
- the name of a technical contact person within your company, and the person's complete phone number
- the model number and serial number of the kit

- the part number and serial number of the device
- the type of service required
- a *detailed* description of the problem

Recording the Device Serial Numbers

In addition to the kit serial number, the devices in the kit are individually serialized (serial numbers are labeled onto the body of each device). Record these serial numbers in Table 1-1. Recording the serial numbers will prevent confusing the devices in the kit with similar devices from other kits.

The adapters included in the kit are for measurement convenience only and are not serialized.

Table 1-1 Serial Number Record for 85033D

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

Clarifying the Sex of a 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.

However, during a measurement calibration, the network analyzer softkey menus label a calibration device with reference to the sex of the analyzer's test port connector—not the calibration device connector. For example, the label `SHORT(F)` on the analyzer's display refers to the short that is to be connected to the female test port. This will be a male short from the calibration kit.

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.

Preventive Maintenance

The best techniques for maintaining the integrity of the devices in the 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 2-2 on page 2-4) or from bad connection techniques, can also damage these devices.

Environmental Requirements

Table 2-1 Environmental Requirements

Parameter	Limits
Operating temperature[a]	+15 °C to +35 °C (+59 °F to +95 °F)
Error-corrected temperature range[b]	±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.

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

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 the 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 3-6 explains how to use gages to determine if the kit devices have maintained their mechanical integrity. (Refer to Table 2-2 on page 2-4 for typical and observed pin depth limits.)

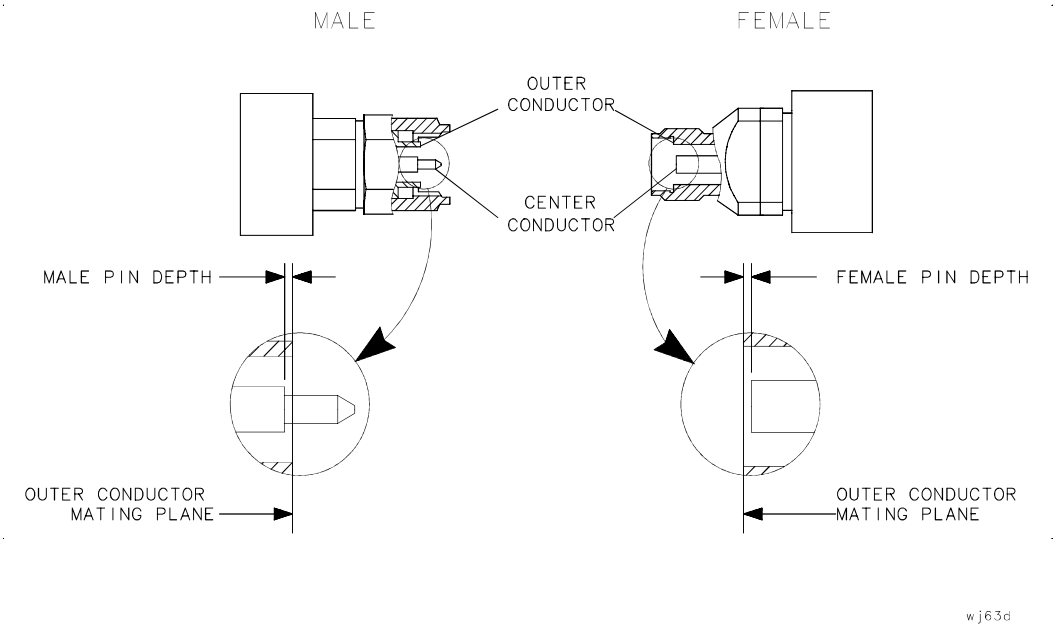
Pin Depth

Pin depth is the distance the center conductor mating plane differs from being flush with the outer conductor mating plane. See Figure 2-1. The pin depth of a connector can be in one of two states: either protruding or recessed.

Protrusion is the condition in which the center conductor extends beyond the outer conductor mating plane. This condition will indicate a positive value on the connector gage.

Recession is the condition in which the center conductor is set back from the outer conductor mating plane. This condition will indicate a negative value on the connector gage.

Figure 2-1 Connector Pin Depth



The pin depth value of each calibration device in the 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 the kit take into account the effect of pin depth on the device's performance. Table 2-2 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 (slightly recessed).

Table 2-2 Pin Depth Limits

Device	Typical Pin Depth	Measurement Uncertainty[a]	Observed Pin Depth Limits[b]
Opens	0 to –0.0127 mm 0 to –0.0005 in	+0.0064 to –0.0064 mm +0.00025 to –0.00025 in.	+0.0064 to –0.0191 mm +0.00025 to –0.00075 in
Shorts	0 to –0.0127 mm 0 to –0.0005 in	+0.0041 to –0.0041 mm +0.00016 to –0.00016 in	+0.0041 to –0.0168 mm +0.00016 to –0.00066 in
Fixed Loads	–0.0025 to –0.0254 mm –0.0001 to –0.001 in	+0.0041 to –0.0041 mm +0.00016 to –0.00016 in	+0.0016 to –0.02953 mm +0.00006 to –0.00116 in

a. Approximately +2 sigma to –2 sigma of gage uncertainty based on studies done at the factory according to recommended procedures.
b. Observed pin depth limits are the range of observation limits seen on the gage reading due to measurement uncertainty. The depth could still be within specifications.

Electrical Specifications

The electrical specifications in Table 2-3 apply to the devices in your calibration kit when connected with an Agilent precision interface.

Table 2-3 Electrical Specifications for 85033D 3.5 mm Devices

Device	Specification	Frequency (GHz)
Broadband loads (male and female)	Return loss ≥ 46 dB (ρ ≤ 0.005) Return loss ≥ 44 dB (ρ ≤ 0.006) Return loss ≥ 38 dB (ρ ≤ 0.013)	DC to ≤ 1.3 >1.3 to ≤ 3 >3 to ≤ 6
Offset opens[a] (male and female)	± 0.65 ° deviation from nominal ± 0.65 ° deviation from nominal ± 0.85 ° deviation from nominal	DC to ≤ 1.3 >1.3 to ≤ 3 > 3 to ≤ 6
Offset shorts[a] (male and female)	± 0.48 ° deviation from nominal ± 0.50 ° deviation from nominal ± 0.55 ° deviation from nominal	DC to ≤ 1.3 > 1.3 to ≤ 3 > 3 to ≤ 6

a. The specifications for the opens and shorts are given as allowed deviation from the nominal model as defined in the standard definitions (see Table A-3 and Table A-4 in Appendix A).

Supplemental Electrical Characteristics for Adapters

Supplemental electrical characteristics are provided as additional information that may be helpful in applying the devices. These characteristics are typical of most devices but are not warranted. Table 2-4 lists the typical characteristics for the adapters in Options 100 and 200.

Table 2-4 Supplemental Electrical Characteristics for Adapters

Adapter	Typical Return Loss	Frequency (GHz)
7-mm to 3.5-mm[a]	Return loss ≥ 34 dB (ρ ≤ 0.020)	DC to ≤ 6
Type-N-male to 3.5-mm-male[b]	Return loss ≥ 28 dB (ρ ≤ 0.040)	DC to ≤ 6
Type-N-male to 3.5-mm-female[b]	Return loss ≥ 28 dB (ρ ≤ 0.040)	DC to ≤ 6
Type-N-female to 3.5-mm-female[b]	Return loss ≥ 28 dB (ρ ≤ 0.040)	DC to ≤ 6
Type-N-female to 3.5-mm-male[b]	Return loss ≥ 24 dB (ρ ≤ 0.060)	DC to ≤ 6

a. See “Option 100” on page 1-4.
b. See “Option 200” on page 1-4.

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 Your Kit" on page 4-2 for more information.