Keysight Technologies 11645A Series R, Q, U, V, and W Waveguide Verification Kit

This manual applies to the 11645A series calibration devices with serial number prefix 3014A.

KEYSIGHT TECHNOLOGIES

User's and Service Guide

NOTICE: This document contains references to Agilent Technologies. Agilent's former Test and Measurement business has become Keysight Technologies. For more information, go to **www.keysight.com.**

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For any assistance, contact Keysight Technologies. Refer to "Contacting Keysight" on page 5-7.

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- Go to www.keysight.com.
- Enter the document's part number (located on the title page) in the **Search** box.
- Click **Search**.
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1 General Information

KEYSIGHT TECHNOLOGIES

Verification Kit Overview

The 11645A series of verification kits provide a set of standards with known characteristics, traceable to a reference (golden) standard in Keysight Technologies calibration lab. The sets of standards are used to verify your measurement calibration and also to verify that your PNA series network analyzer system is operating within its specifications.

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 Keysight. See "Contacting Keysight" on page 5-7 for a list of telephone numbers.

Kit Contents

The 11645A series verification kit includes the following items:

- 20 dB attenuator
- 50 dB attenuator
- mismatch line
- match line
- User's and Service Guide (this manual)
- USB drive that contains factory-measured verification data for use with the PNA system verification process
- data sheet for each device that contains factory-measured verification data
- anti-virus scan report

Refer to Chapter 6, "Replaceable Parts" for a complete list of replaceable part numbers.

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

NOTE 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 Keysight. See "Contacting Keysight" on page 5-7.

Calibration Definitions

Each verification kit is intended to be used with a respective R, Q, U, V, or W11644A calibration kit. Prior to performing a calibration with your PNA, the calibration kit must be selected and the calibration definitions for the devices in the kit installed in the PNA. Refer to your PNA Help system for instructions on selecting the calibration kit and performing a calibration.

Installation of the Calibration Definitions

The calibration definitions for the kit should be permanently installed in the internal memory or hard disk of the PNA. They may already be resident within the analyzer, or you can download them from Keysight's

Calibration Kit Definitions Web page at http://na.support.keysight.com/pna/caldefs/stddefs.html. In addition, the calibration definitions may be entered manually from the front panel. Refer to your PNA Help system for instructions.

Equipment Required but Not Supplied

Cleaning supplies and various electrostatic discharge (ESD) protection devices are not supplied with the verification kit but are required to ensure successful operation of the kit. Refer to the tables in Chapter 6 for ordering information.

Incoming Inspection

Verify that the shipment is complete by referring to the contents list in the shipping container. Use Table 1-1 to record the serial numbers of all serialized devices in your kit.

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, refer to "Contacting Keysight" on page 5-7. Keysight will arrange for repair or replacement of incomplete or damaged shipments without waiting for a settlement from the transportation company. Refer to "Returning a Kit or Device to Keysight Technologies" on page 5-6 for instructions.

Recording the Device Serial Numbers

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

Table 1-1 Serial Number Record

Device	Serial Number
Frequency band	_____
Verification kit	_____
20 dB attenuator	_____
50 dB attenuator	_____
match line	_____
mismatch line	_____

Preventive Maintenance

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

- routine visual inspection
- routine cleaning
- proper connection techniques

All of these are described in Chapter 3. Failure to detect and remove dirt or metallic particles can degrade repeatability and accuracy and can damage any mating surface connected to it. Improper connections can also damage these devices.

2 Specifications

Environmental Requirements

Table 2-1 Environmental Requirements

Parameter	Required Values/Ranges
Temperature	
Operating[a]	+20 °C to +26 °C (+68 °F to +79 °F)
Error-corrected range[b]	±1 °C (1.8 °F) of measurement calibration temperature
Altitude	
Operating	< 4,500 meters (ª15,000 feet)
Storage	< 15,000 meters (ª50,000 feet)
Relative humidity	Always non–condensing
Operating	0 to 80% (26 °C maximum dry bulb)
Storage	0 to 90%

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

Due to the small dimensions of the devices, electrical characteristics will change with temperature. Therefore, the operating temperature is a critical factor in their performance, and must be stable before use.

IMPORTANT Avoid unnecessary handling of the devices during use because your fingers act as a heat source and may increase the temperature of the device.

Electrical Specifications

At the factory, each verification device is electrically characterized on a PNA measurement system. These factory measurements are traceable to the National Institute of Standards and Technology (NIST) through mechanical and electrical paths. For more information on traceability, contact Keysight Technologies. Refer to "Contacting Keysight" on page 5-7 for a list of Keysight contacts.

Two pieces of information constitute the standard electrical specification of a verification device:

- the S-parameter measurement data for the device
- the measurement uncertainties of the system on which the device was measured

The factory-measured data for each device is supplied with your kit in print form (data sheets), and on USB drive.

Certification

Keysight Technologies certifies that this product met its published specifications at the time of shipment from the factory. Keysight 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 Keysight Verifies the Devices in Your Kit" on page 4-2 for more information.

3 Use, Maintenance, and Care of the Devices

KEYSIGHT TECHNOLOGIES

Electrostatic Discharge

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

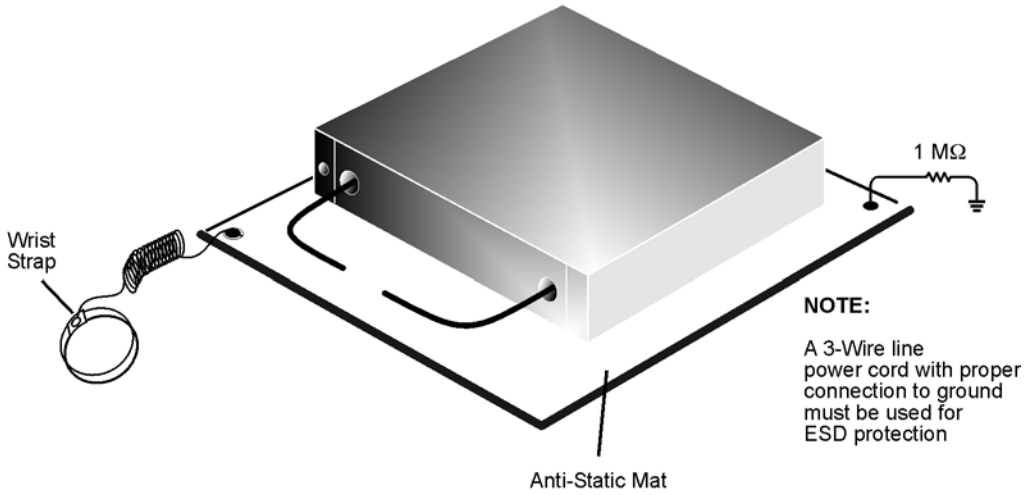
Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. Devices such as calibration components and devices under test (DUTs), can also carry an electrostatic charge. To prevent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

- *always* wear a grounded wrist strap having a 1 MΩ resistor in series with it when handling components and devices or when making connections to the test set.
- *always* use a grounded, conductive table mat while making connections.
- *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 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 for part numbers and instructions for ordering ESD protection devices.

Figure 3-1 ESD Protection Setup



esd_setup

Visual Inspection

Examine the mating surfaces first for obvious defects or damage. If necessary, cleaning should be done every time a connection is made. Metal particles or dirt may fall onto the mating surface during the connection and disconnection process.

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

In some cases, magnification is necessary to see damage to a connector; a magnifying device with a magnification of $\geq$ 10x is recommended. However, 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.

What Causes Mating Surface Wear?

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

Mating surfacer 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. Replace devices with worn mating surfaces.

The test port connectors on the PNA 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 test port connectors.

Inspect the Mating Plane Surfaces

Flat contact between the mating plane surfaces is required for a good connection. Look especially for deep scratches or dents, and for dirt and metal particles on the 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 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 mating surface shows deep scratches or dents, clinging particles, or uneven wear, clean and inspect it again.

Cleaning the Mating Plane Surfaces

1. **Use Compressed Air or Nitrogen**

   Clean mating surfaces are essential for ensuring the integrity of the waveguide.

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

Use compressed air (or nitrogen) to loosen particles on the 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 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 device. These electrostatic effects can damage the device. Refer to "Electrostatic Discharge" on page 3-2 for additional information.

WARNING **Keep isopropyl alcohol away from heat, sparks, and flame. Store in a tightly closed container. It 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 regulations.

2. **Clean the Mating Plane Surfaces**

   a. Apply a small amount of isopropyl alcohol to a lint-free cleaning swab.

   b. Clean the mating plane surfaces.

   c. Let the alcohol evaporate, then blow the surface dry with a gentle stream of clean, low-pressure compressed air or nitrogen. Always completely dry the surfaces before you use it.

3. **Inspect the Mating Surfaces**

   Inspect the mating surface to make sure that no particles or residue remain. Refer to "Visual Inspection" on page 3-3.

Connections

Good connections require a skilled operator. Instrument sensitivity and mechanical tolerances are such that slight errors in operator technique can have a significant effect on measurements and measurement uncertainties. *The most common cause of measurement error is bad connections.*

Connecting Waveguide Devices

IMPORTANT Unlike threaded devices, the WR-28, WR-22, WR-19, WR-15, and WR-10 waveguide mating planes are flanges (often precision) that you must carefully screw together. Always connect port 1 of the device to port 1 of the PNA during the system verification procedure. When you are reading the label on the device, port 1 is on the left or at the top, depending on whether the label is oriented horizontally or vertically. See the following pictures.

Figure 3-2 Flange Example 1

xd905a

Figure 3-3 Flange Example 2

xd906a

The following procedures illustrate how to make good connections.

How to Connect: R-band WR-28

Always connect the waveguide with the same flange orientation. For example, always connect a device with the label facing the same direction.

Follow theses recommendations for optimum connection technique:

1. Place two alignment pins (with heads) in opposite holes of each flange. For example, one in the top left, and one in the bottom right.
2. Using the pins as guides, carefully align the flanges, and insert screws in the two open corner holes.
3. Place a lock washer and nut on each screw, and finger tighten.
4. Remove the alignment pins and insert the remaining two screws.
5. Place a lock washer and nut on each screw, and finger tighten.
6. Inspect each lock washer to be sure they are similarly compressed.
7. In an X pattern (for equal compression), use the hex ball driver to tighten all four screws. *Do not over-tighten.*

NOTE Apply symmetrical pressure as you gradually tighten the screws.

8. Visually inspect the connection:
   a. Place an electric light or white paper behind the connection.
   b. Check the flange matings for any gap. A good connection has no gaps between the connected waveguide flanges, and the waveguide walls are flush (there is no step or offset).
   c. Inspect the washers for symmetrical compression. This ensures that all four screws are equally torqued.

How to Connect: Q-band WR-22 U-band WR-19 V-band WR-15 W-band WR-10

To ensure proper flange mating, each device has two attached alignment pins, and two alignment holes through which you slide additional pins. You don't have to use nuts or washers when connecting Q, U, V, or W-band waveguide. The flanges have tapped screw holes; captive screws (threaded half-way up the shaft) are provided in these kits.

Follow these recommendation for optimum connection technique:

1. Install four captive screws into the test port.
2. Install the alignment pins.
3. Using the pins as a guide, bring the flanges together and gently engage the first few threads of each

screw.

4. In an X pattern (for equal compression), use the hex ball driver to tighten all four screws. *Do not over-tighten*.
5. Visually inspect the connection:
   a. Place an electric light or white paper behind the connection.
   b. Check the flange mating for any gap. A good connection has no gaps between the connected waveguide flanges, and the waveguide walls are flush (there is no step or offset).

Handling and Storage

- *Do* install the protective end caps over the mating surfaces and store the devices in the foam-lined storage case when not in use.
- *Do* keep devices clean.
- *Do not* store devices loose in a box, or in a desk or bench drawer. This is the most common cause of damage during storage.
- *Do not* touch mating plane surfaces. Natural skin oils and microscopic particles of dirt are easily transferred to a the interface and are very difficult to remove.
- *Do not* set devices 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 verification kit can only be verified by returning the kit to Keysight Technologies for recertification. The equipment and calibration standards required to verify the specifications of the devices in the kit have been specially manufactured and are not commercially available.

How Keysight Verifies the Devices in Your Kit

Keysight 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. For the initial (before sale) testing of the devices, Keysight 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 or 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 Keysight 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 Keysight Technologies.

Recertification

The following will be provided with a recertified kit:

- a new calibration sticker affixed to the case
- a certificate of calibration
- a calibration report for each device in the 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.

Keysight Technologies offers a *Standard* calibration for the recertification of the kit. For more information, contact Keysight Technologies. Refer to "Contacting Keysight" on page 5-7.

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 Keysight Technologies for information on where to send your kit for recertification. See "Contacting Keysight" on page 5-7. Refer to "Returning a Kit or Device to Keysight Technologies" on page 5-6 for details on sending your kit.

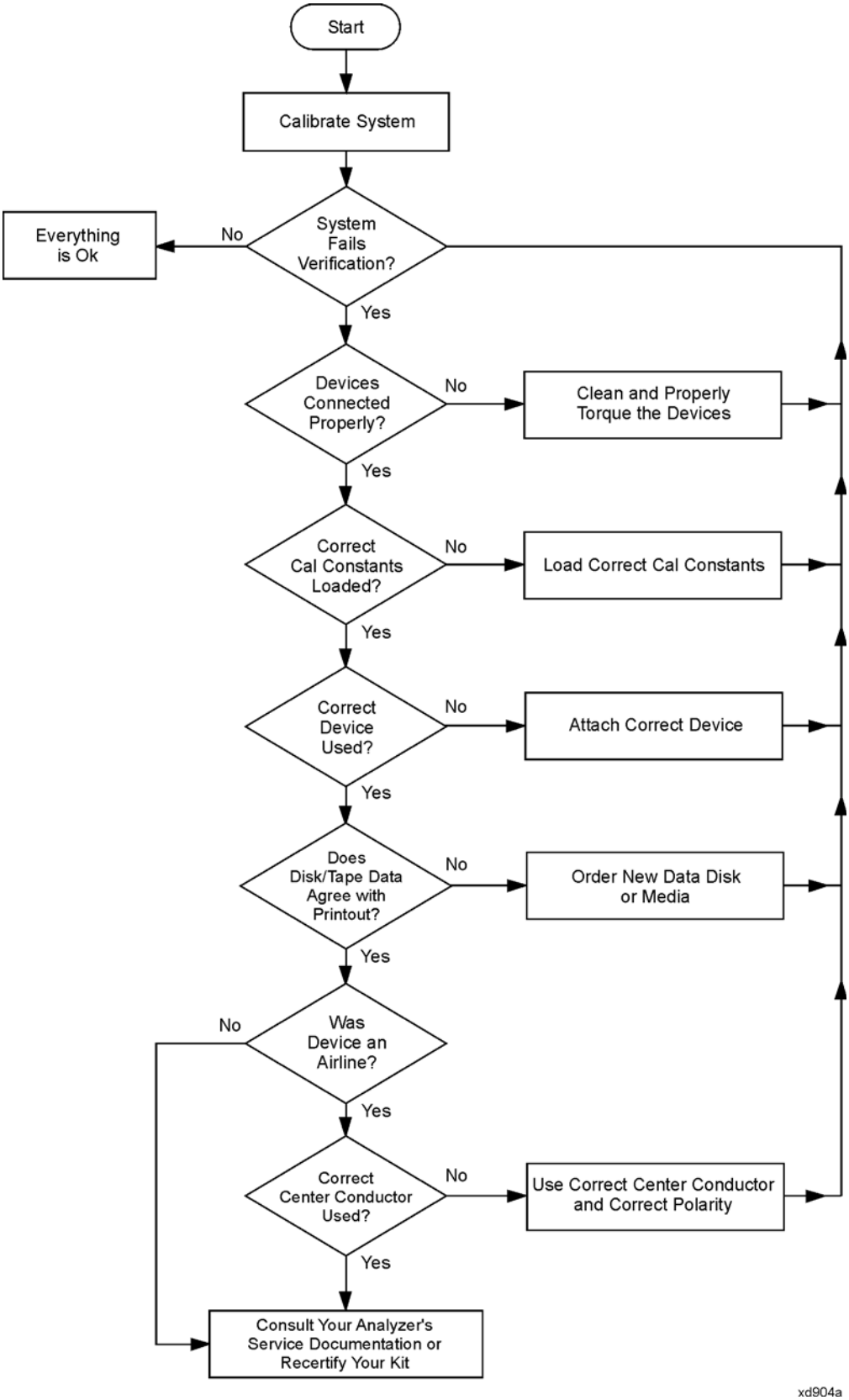
5 Troubleshooting

Troubleshooting Process

This manual contains limited information about PNA network analyzer system operation. For complete information, refer to the instrument documentation.

If your PNA does not pass performance verification, follow the steps in Figure 5-1 to determine the cause of the failure and the correct action to take to correct the failure.

Figure 5-1 Troubleshooting Flowchart



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 this 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 analyzers. Since these analyzers have been discontinued, the data disks are no longer provided in new kits. When old verification kits that include the data disks are returned to Keysight 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.

Where to Look for More Information

This manual contains limited information about PNA series network analyzer system operation. For detailed information on using a PNA, 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, see "Contacting Keysight" on page 5-7.

Returning a Kit or Device to Keysight Technologies

If your kit or device requires service, contact Keysight Technologies for information on where to send it. See "Contacting Keysight" on page 5-7 for contact information. Include a service tag (located at the back 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 telephone number including country code and area code
- the model number and serial number of the kit (if returning a complete kit)
- the part number and serial number of each device being returned
- the type of service required
- a *detailed* description of the problem (if applicable) and how the device was being used when the problem occurred

Contacting Keysight

Assistance with test and measurements needs and information on finding a local Keysight office are available on the Web at:
www.keysight.com/find/assist

If you do not have access to the Internet, please contact your Keysight field engineer.

NOTE In any correspondence or telephone conversation, refer to the Keysight product by its model number and full serial number. With this information, the Keysight representative can determine whether your product is still within its warranty period.

6 Replaceable Parts

Replacing the Verification Data

The verification data contains unique performance 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 Keysight for replacement verification data - refer to "Contacting Keysight" on page 5-7. Please specify the information in the table below.

- **If recertification will be required in the near future.**

  Keysight recommends that you have the verification kit recertified early. New verification data will be generated during the recertification process. Refer to "Recertification" on page 4-3.

Table 6-1 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: _____			

Copying Replacement Device Verification Data to the Original Verification Data Media

IMPORTANT The information in the following two processes applies only to writable USB drives. If the USB drive shipped with your verification kit or replacement device has either the Keysight or Keysight logo on it, it is read-only, and the following two processes do not apply. If this is the case, simply use the USB drive that was shipped with your replacement device when you connect that device during the system verification process.

This section describes how to copy the new replacement device verification data from the USB drive provided with the device, to the verification data media (floppy disk or USB) included with the original verification kit. Please be aware that once you write over the "old" data, the data cannot be recovered. Therefore, it is highly recommended that you follow the procedure below in "Old Verification Device Data – Backup Process" to make a backup copy of the "old" verification data BEFORE you perform the "New Verification Device Data -Transfer Process" procedure. Be sure to keep the new USB drive. It will be your backup copy of the new replacement device verification data.

NOTE This procedure assumes you have access to a PC or a PNA to perform these tasks.

Old Verification Device Data – Backup Process

1. Insert the old verification device data media (floppy disk or USB) into your computer or PNA and view the contents with Windows Explorer.
2. Copy all of the files to the clipboard.
3. Remove the old verification device data media (floppy disk or USB) from your computer or PNA.
4. Insert the new USB drive into your computer or PNA and view the contents with Windows Explorer.
5. Create a new directory on the new USB drive and name it using the format Model_Serial_YYYYMMDD. Use your kit's model number, serial number, and the current date. Example: 85055A_2815A01234_20120827.
6. Open the new directory you created in the previous step and paste the files from the clipboard. All of the files (nine files: one .txt file, four .dat files, and four .unc files) you copied from the old verification device data media should be present. You now have a complete backup of the old verification device data on the new USB drive.

New Verification Device Data – Transfer Process

1. If not already done, insert the new USB drive into your computer or PNA and view the contents with Windows Explorer.
2. Copy all of the files with .DAT and .UNC file extensions to the clipboard, except the old files you copied in the new directory.
3. Note the dates of the files you just copied to the clipboard.

4. Remove the new USB drive from your computer or PNA.
5. Insert the old verification device data media (floppy disk or USB) into your computer or PNA and view the contents with Windows Explorer.
6. Paste the files from the clipboard into the top-level directory.
7. When prompted if you want to write-over existing files, click YES.
   The new .DAT and .UNC files should show newer dates relative to your original files.
8. Select the “kitparts.txt” file and open it with Notepad or Wordpad.
9. Locate the line for the verification device you just replaced (device 1, 2, 3 or 4).
10. Change the serial number at the end of the line to the serial number of the new device you received in the replacement kit.
11. Save and close the kitparts.txt file.
12. Remove the old verification device data media (floppy disk or USB) from your computer or PNA.
    Your new replacement device is now ready to use with your PNA.

Replaceable Parts

The following tables list the replacement part numbers for the Keysight R11645A, Q11645A, U11645A, V11645A, and W11645A waveguide calibration kit contents. Table 6-7 lists the replacement part numbers for items *not* included in the calibration kit that are either required or recommended for successful operation of the kit.

To order a listed part, note the description, the part number, and the quantity desired. Telephone or send your order to Keysight Technologies. Refer to "Contacting Keysight" on page 5-7 for further information.

Table 6-2 Replaceable Parts for the R11645A WR-28

Description	Qty Per Kit	Keysight Part Number
Attenuators		
20 dB attenuator with data	1	R11645AR01
50 dB attenuator with data	1	R11645AR02
Airlines		
Match line with data	1	R11645AR03
Mismatch line with data	1	R11645AR04
Miscellaneous Items		
Pad	1	11645-80026
Storage case	1	5181-5517
Storage box assembly	1	1540-0034
User's and service guide	1	11645-90013[a]
Hardware		
Lock Washer	6	2190-0030
Hex Nut	6	2260-0002
Waveguide Alignment Pin (short)	6	11644-20009
Waveguide Alignment Pin (long)	6	11644-20006
4-40 Hex ball screw (0.75 inches)	6	3030-0721
3/32-inch hex ball driver	1	8710-0523

a. See "Printing Copies of Documentation from the Web" on page iii.

Figure 6-1 R-Band Component Identification Sheet

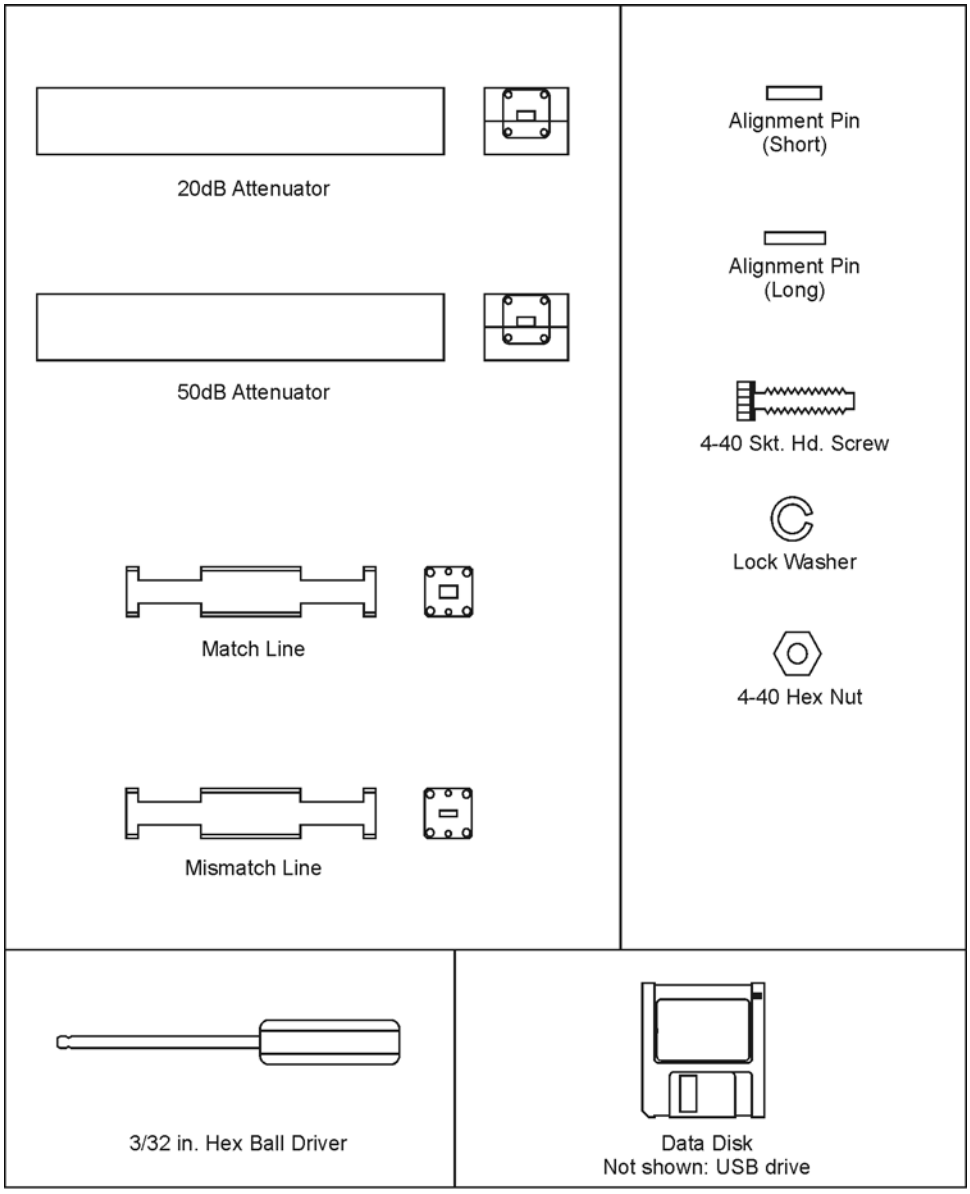


Table 6-3 Replaceable Parts for the Q11645A WR-22

Description	Qty Per Kit	Keysight Part Number
Attenuators		
20 dB attenuator with data	1	Q11645AR01
50 dB attenuator with data	1	Q11645AR02
Airlines		
Match line with data	1	Q11645AR03
Mismatch line with data	1	Q11645AR04
Miscellaneous Items		
Pad	1	11645-80027
Storage case	1	5181-5517
Storage box assembly	1	1540-0034
User's and service guide	1	11645-90013[a]
Hardware		
Waveguide Alignment Pin (short)	6	11644-20008
Waveguide Alignment Pin (long)	6	11644-20006
4-40 Hex ball screw (0.31 inches)	6	1390-0671
4-40 Hex ball screw (0.43 inches)	6	1390-0764
3/32-inch hex ball driver	1	8710-0523

a. See "Printing Copies of Documentation from the Web" on page iii.

Figure 6-2 Q-Band Component Identification Sheet

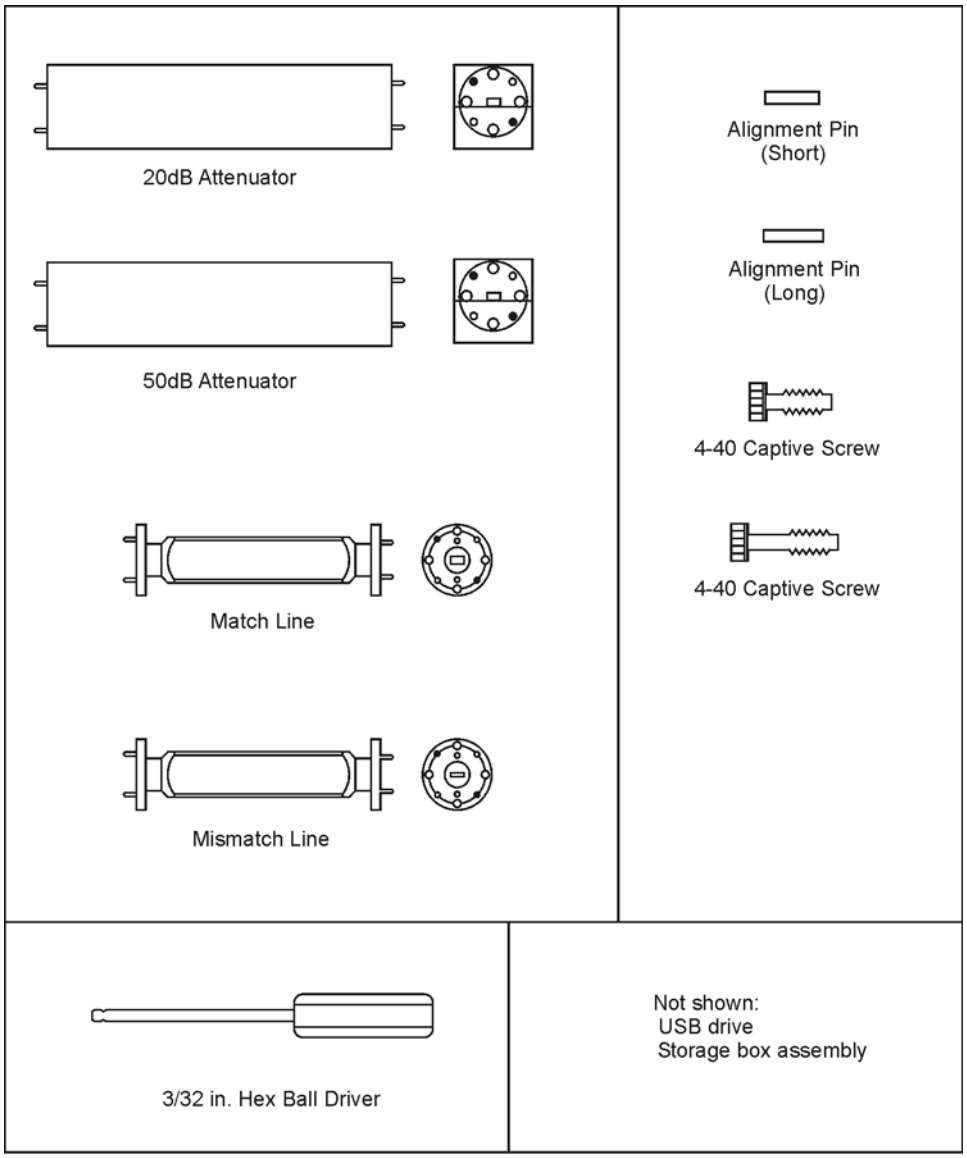


Table 6-4 Replaceable Parts for the U11645A WR-19

Description	Qty Per Kit	Keysight Part Number
Attenuators		
20 dB attenuator with data	1	U11645AR01
50 dB attenuator with data	1	U11645AR02
Airlines		
Match line with data	1	U11645AR03
Mismatch line with data	1	U11645AR04
Miscellaneous Items		
Pad	1	11645-80027
Storage case	1	5181-5517
Storage box assembly	1	1540-0034
User's and service guide	1	11645-90013[a]
Hardware		
Waveguide Alignment Pin (short)	6	11644-20008
Waveguide Alignment Pin (long)	6	11644-20006
4-40 Hex ball screw (0.31 inches)	6	1390-0671
4-40 Hex ball screw (0.43 inches)	6	1390-0764
3/32-inch hex ball driver	1	8710-0523

a. See "Printing Copies of Documentation from the Web" on page iii.

Figure 6-3 U-Band Component Identification Sheet

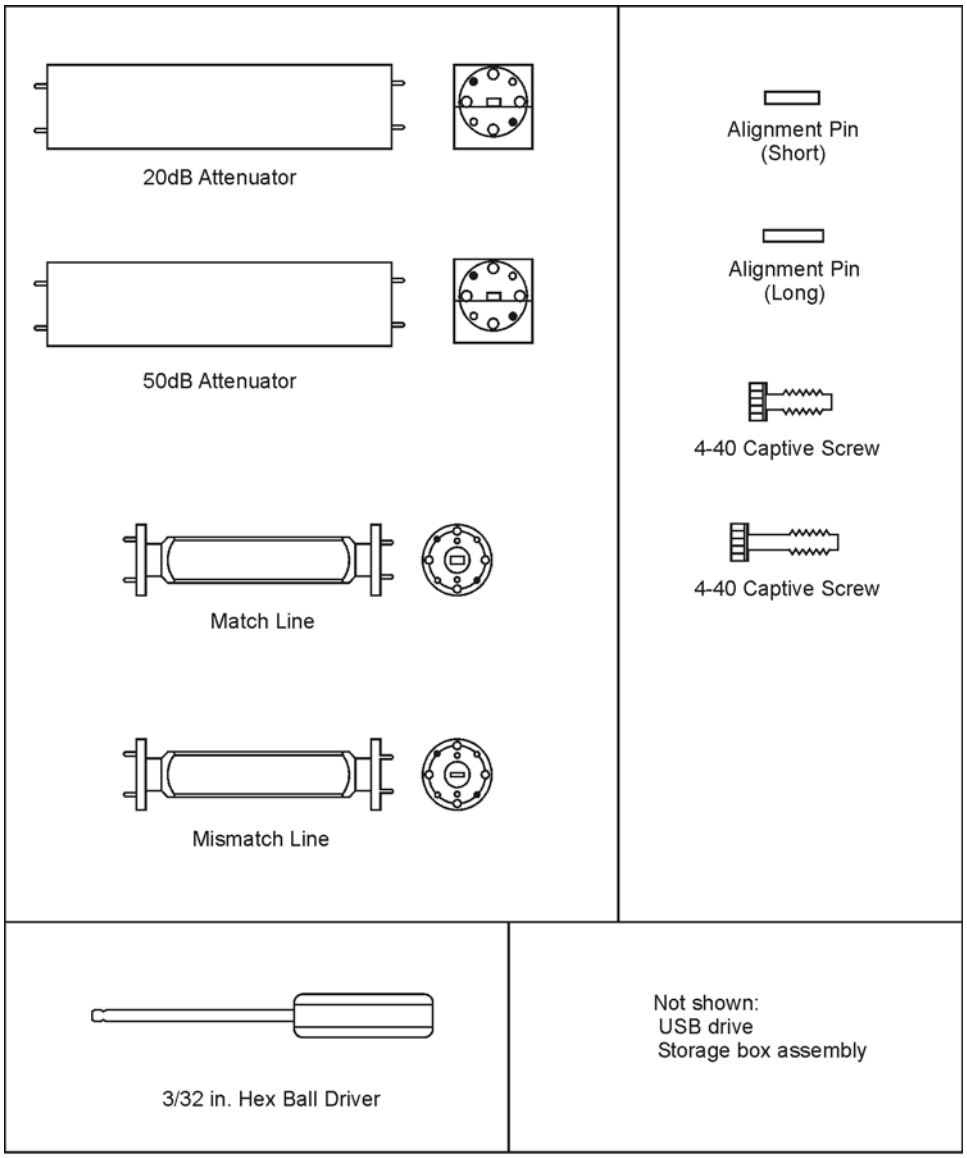


Table 6-5 Replaceable Parts for the V11645A WR-15

Description	Qty Per Kit	Keysight Part Number
Attenuators		
20 dB attenuator with data	1	V11645AR01
50 dB attenuator with data	1	V11645AR02
Airlines		
Match line with data	1	V11645AR03
Mismatch line with data	1	V11645AR04
Miscellaneous Items		
Pad	1	11645-80028
Storage case	1	5181-5517
Storage box assembly	1	1540-0034
User's and service guide	1	11645-90013[a]
Hardware		
Waveguide Alignment Pin V/W	6	11644-20007
4-40 Hex ball screw (0.31 inches)	6	1390-0671
4-40 Hex ball screw (0.41 inches)	6	1390-0765
3/32-inch hex ball driver	1	8710-0523

a. See "Printing Copies of Documentation from the Web" on page iii.

Figure 6-4 V-Band Component Identification Sheet

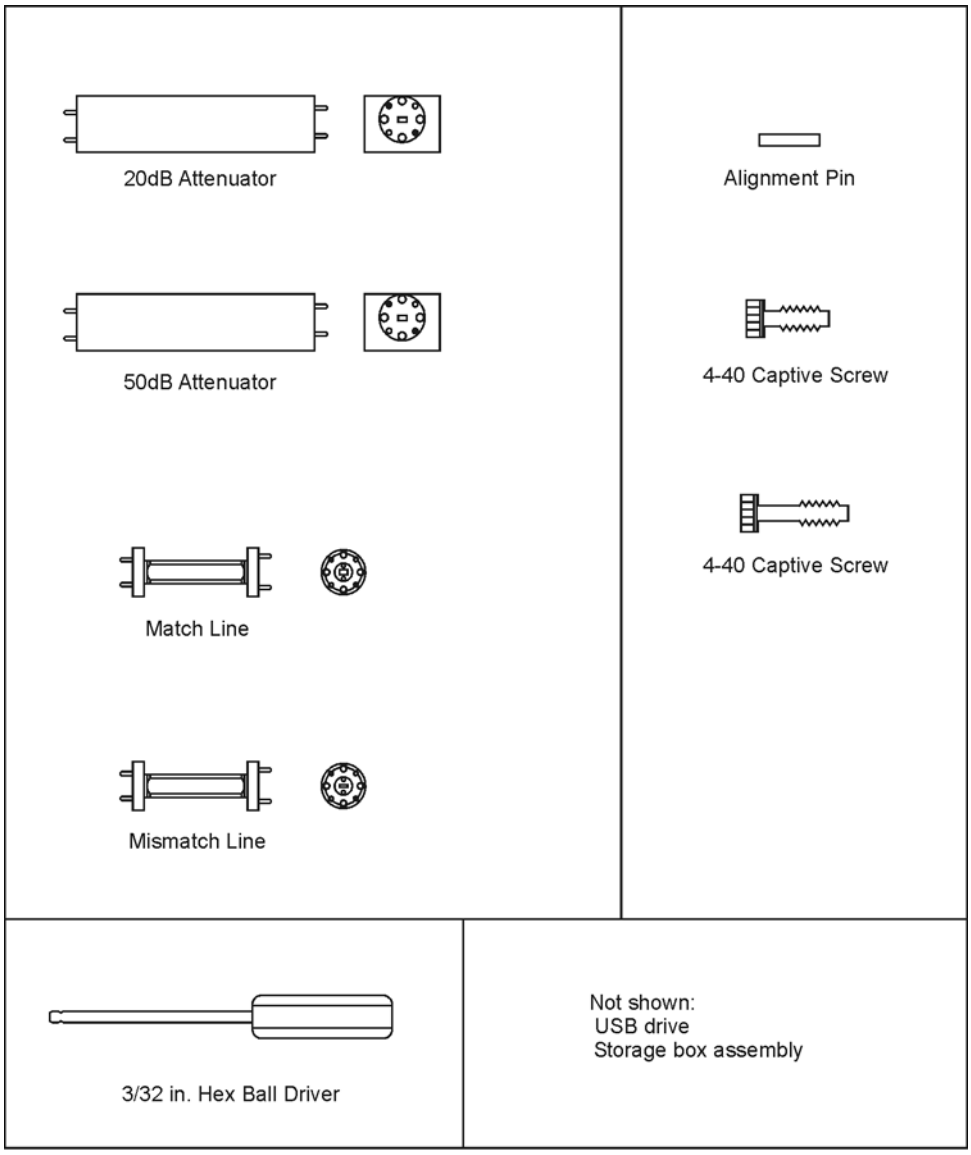


Table 6-6 Replaceable Parts for the W11645A WR-10

Description	Qty Per Kit	Keysight Part Number
Attenuators		
20 dB attenuator with data	1	W11645AR01
50 dB attenuator with data	1	W11645AR02
Airlines		
Match line with data	1	W11645AR03
Mismatch line with data	1	W11645AR04
Miscellaneous Items		
Pad	1	11645-80028
Storage case	1	5181-5517
Storage box assembly	1	1540-0034
User's and service guide	1	11645-90013[a]
Hardware		
Waveguide Alignment Pin V/W	6	11644-20007
4-40 Hex ball screw (0.31 inches)	6	1390-0671
4-40 Hex ball screw (0.41 inches)	6	1390-0765
3/32-inch hex ball driver	1	8710-0523

a. See "Printing Copies of Documentation from the Web" on page iii.

Figure 6-5 W-Band Component Identification Sheet

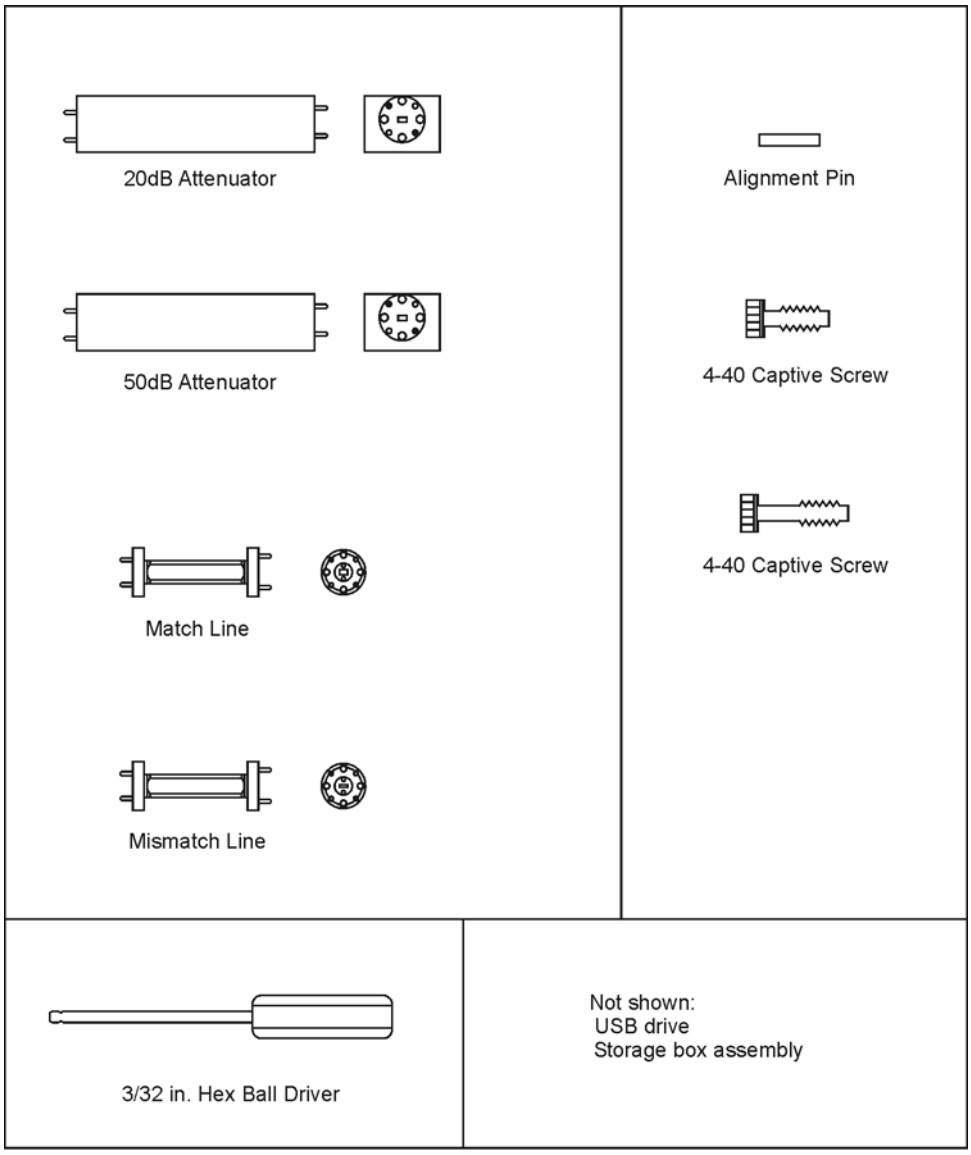


Table 6-7 Items Not Included in the Verification Kit

Description	Qty	Keysight Part Number
ESD Protection Devices		
Grounding wrist strap	1	9300-1367
5 ft grounding cord for wrist strap	1	9300-0980
2 ft by 4 ft conductive table mat with 15 ft grounding wire	1	9300-0797
ESD heel strap	1	9300-1308
Connector Cleaning Supplies		
Anhydrous isopropyl alcohol (>92% pure)[a]	--	--
Cleaning swabs	100	9301-1243

a. Keysight can no longer safely ship isopropyl alcohol, so customers should purchase it locally.

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11645-90013
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