

# Keysight 16047E Test Fixture

Operation and  
Service Manual

# Notices

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## Manual Part Number

16047–90040

## Edition

Edition 5, June 2018

Printed in Malaysia

Published by:

Keysight Technologies International  
Japan G.K,  
1-3-3 Higashikawasaki-cho  
Chuo-ku  
Kobe-shi, Hyogo, Japan

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## Contents

# 1 Installation Guide

## Incoming Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the 16047E has been checked mechanically and electrically. The contents of the shipment should be as listed in **Table 1-1**. If the contents are incomplete, if there is mechanical damage or defect, notify the nearest Keysight Technologies office. If the shipping container is damaged, or the cushioning material shows signs of unusual stress, notify the carrier as well as the Keysight Technologies office. Keep the shipping materials for the carrier's inspection.

Table 1-1

### Contents

Description	Part Number	Qty
16047E Test Fixture	-	1
Shorting bar <sup>a</sup>	16047-00621	1
Operation and Service Manual	Option ABA <sup>b</sup>	1

a. Fasten the guard terminal of the test fixture.

b. The manual is furnished only Option ABA is ordered.

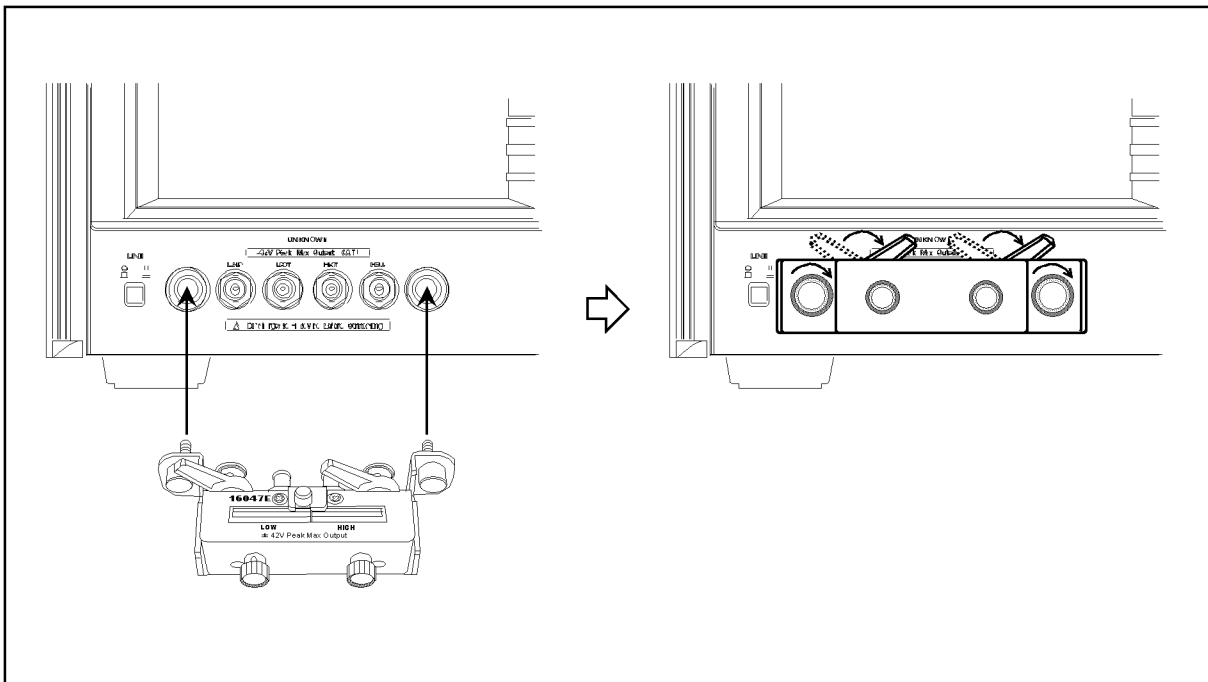
## Connecting the 16047E

### Connecting to the instrument with screw holes

Follow these steps below to connect the 16047E to the instrument with screw holes.

- Step 1.** Set the 16047E test fixture to the test connectors on the front panel of the Impedance Analyzer by gradually coupling the four BNC connectors and fastening screws of the fixture with the test connectors and accessory mounting holes of the instrument until they come to complete contact.
- Step 2.** Fasten two of the four BNC connectors to the mating test connectors by gradually turning the two BNC connectors' rotation levers until each pair of connectors are securely connected. Be sure to align the grooves on both sides.
- Step 3.** Turn clockwise the fixture's two fastening screws together, so that the fixture is secured to the instrument.
- Step 4.** Finally, secure the remaining two BNC connectors of the fixture by turning clockwise their rotation levers.

Figure 1-1 Connecting 16047E to Impedance Analyzer



16047eoj0102

#### NOTE

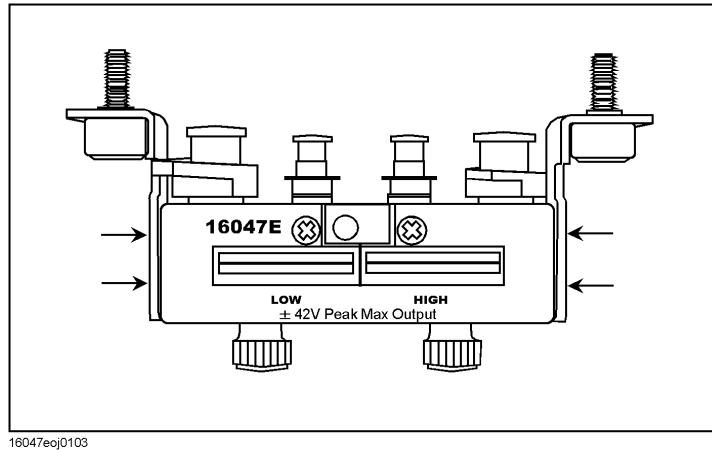
The fastening screws are designed to provide the fixture with mechanical stability and a prolonged life. Removing these screws will not affect measurement values.

### Connecting to the instrument without the screw holes

When connecting the 16047E to instrument that is without screw holes, remove the four fastening screws as shown in **Figure 1-2**.

Figure 1-2

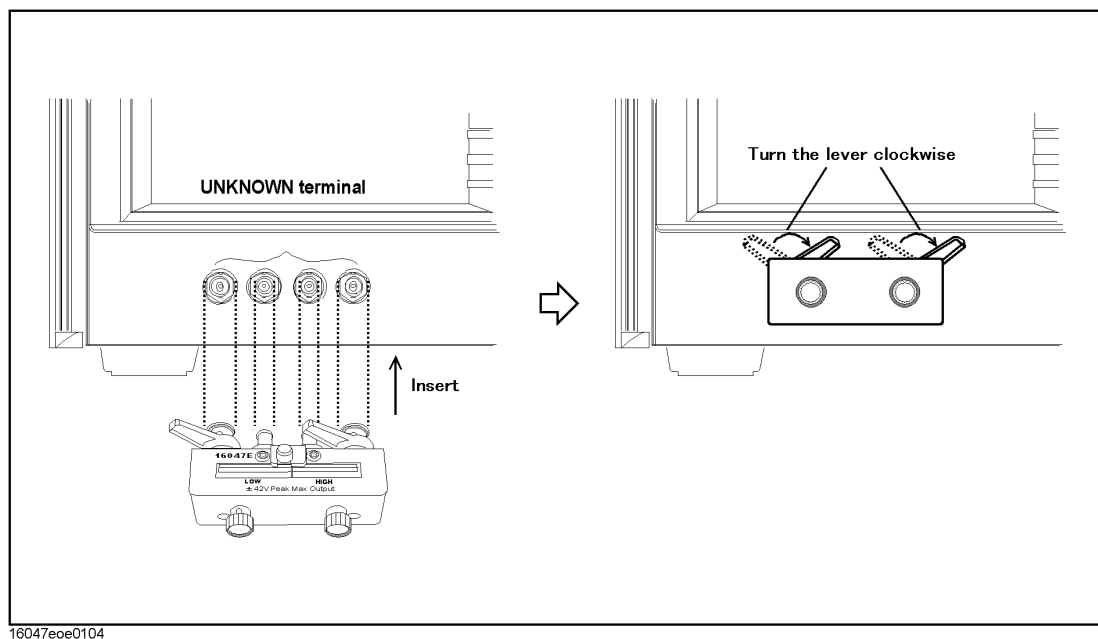
Locations of fastening screws



- Step 1.** Set the 16047E test fixture to the UNKNOWN connectors on the instrument by gradually coupling the four BNC connectors and fastening screws of the fixture with the connectors of the instrument until they come to complete contact. Be sure to align the grooves on both sides.
- Step 2.** Secure the two BNC connectors of the fixture by turning clockwise their rotation levers.

Figure 1-3

Connecting the fixture to the instrument



## Cleaning

When the electrodes get dirty, their contact resistance increases resulting in inaccurate measurement. Use soft cloth to clean the electrode to remove dust particles or any other dirt.

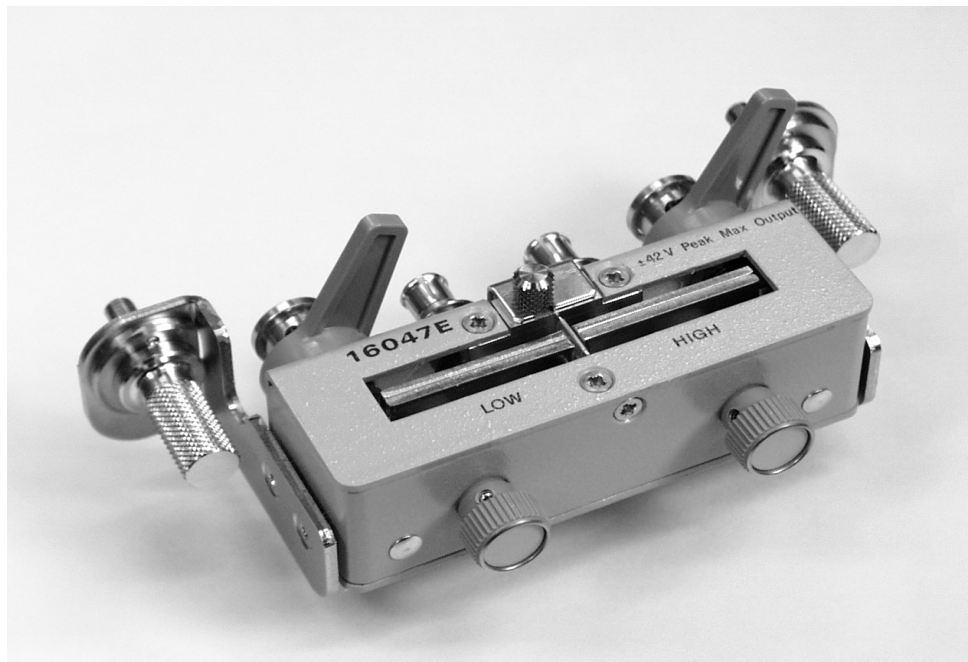


## 2 Overview

### Product Overview

The 16047E is a test fixture used to measure parts with leads. When used with the Impedance Analyzer, the fixture provides highly accurate measurement with wide frequency range up to 120 MHz. Also it gains mechanical stability and a prolonged life when it is secured to the Impedance Analyzer with its fastening screws.

Figure 2-1 Product Overview



## Functions

**Figure 2-2** shows name of each part of the 16047E and **Table 2-1** shows function.

Figure 2-2 16047E Parts

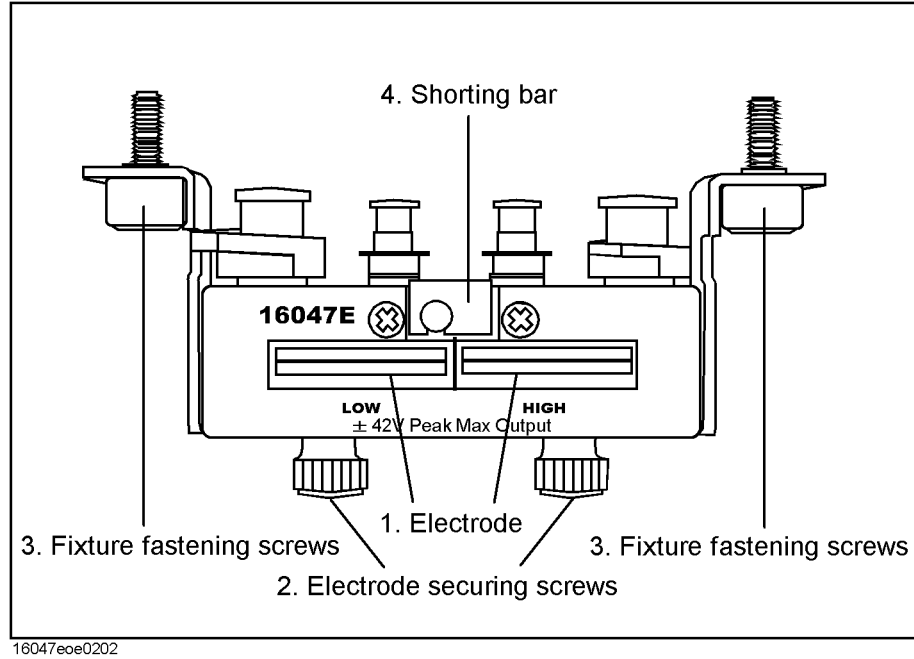


Table 2-1 16047E Function

No.	NAME	FUNCTION
1	Electrode	Contact for DUT electrode. The LOW side electrode connected to an instrument's $L_{CUR}$ , $L_{POT}$ and the HIGH side electrode connected to an instrument's $H_{CUR}$ , $H_{POT}$ .
2	Electrode securing screws	Secures the electrodes with DUT leads caught.
3	Fixture fastening screws	Secures the fixture to an instrument.
4	Shorting bar	Detached and used as a shorting bar when performing short correction. Also used as a guard terminal securing plate when measuring a 3-terminal device.

## 3 Operation

This chapter describes the proper methods for fixture compensation with the 16047E and DUT measurement.

### Performing Fixture Compensation

To enhance measurement accuracy, fixture compensation should be done before DUT measurement. The fixture compensation requires measurements with the 16047E for open and short compensation data. The following procedure shows the measurement for the compensation data.

#### Performing Open Compensation

The open compensation procedure is as follows.

1. Fasten the electrode securing screws at the HIGH and LOW sides with no DUT leads caught in the electrodes.

**NOTE**

**Do not fasten the screws too tightly to prevent the electrodes from damaged.**

---

2. Follow the instruction manual that came with your instrument to perform a measurement to obtain open compensation data.

#### Performing Short Compensation

The short compensation procedure is as follows.

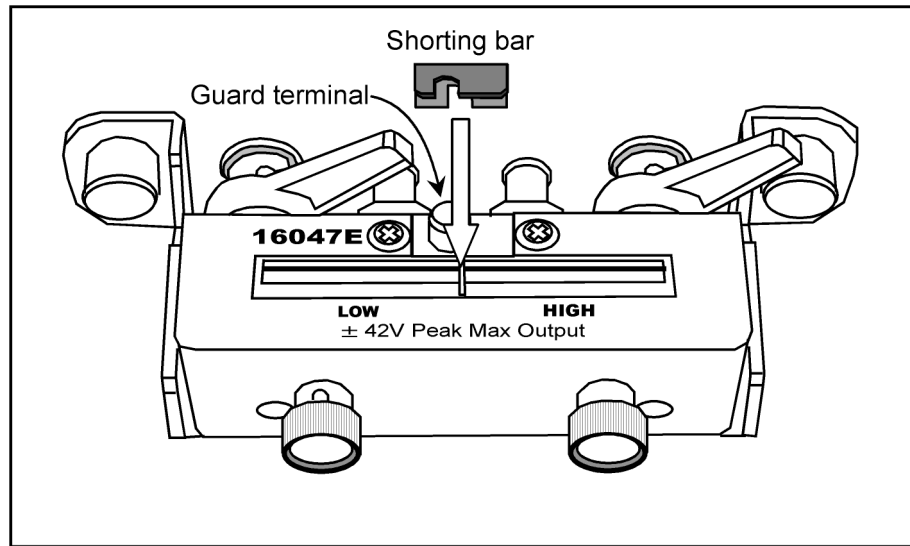
1. Remove the shorting bar secured on the guard terminal.
2. Loosen the electrode securing screws so that the shorting bar is caught in the electrodes.

**NOTE**

**Place the shorting bar in the proper direction so that it does not contact to the guard terminal.**

---

Figure 3-1 Performing short compensation



16047eoe0301

3. Fasten the electrode securing screws.

**NOTE**

**Do not fasten the screws too tightly to prevent the electrodes from damaged.**

4. Follow the instruction manual that came with your instrument to perform a measurement to obtain short compensation data.

### Performing Load Compensation

Generally, there is no need to perform load compensation. If you have any standard device or you need to keep consistency in measured data, perform load compensation.

The load compensation procedure is as follows.

1. Fasten the electrode securing screws at the HIGH and LOW sides with load leads caught in the electrodes.

**NOTE**

**Do not fasten the screws too tightly to prevent the electrodes from damaged.**

2. Follow the instruction manual that came with your instrument to perform a measurement to obtain load compensation data.

## DUT Measurement

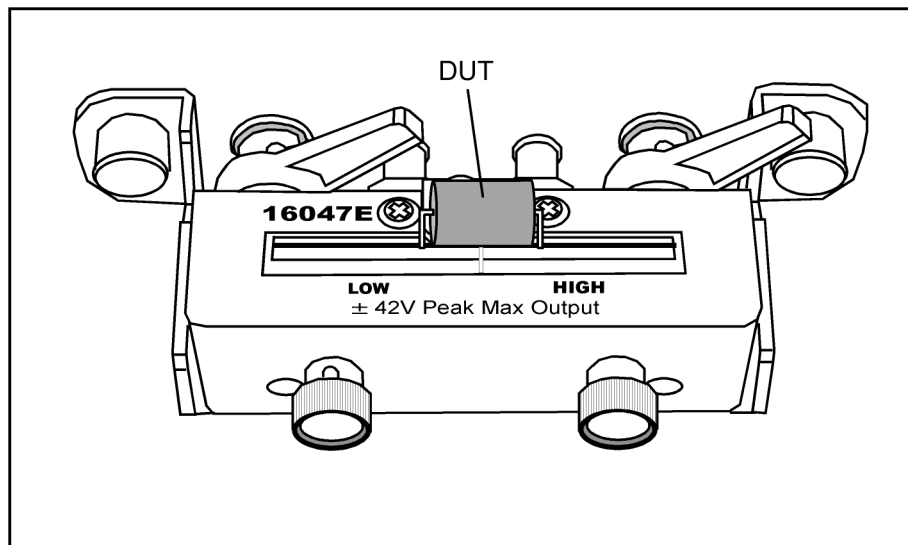
Before performing DUT measurement, open and short compensation should be done as described in the previous sections.

1. Loosen the electrode securing screws of both sides so that DUT leads are caught in the electrodes.
2. Fasten both of the securing screws.

**NOTE**

Do not fasten the screws too tightly to prevent the electrodes from damaged.

Figure 3-2 Performing DUT Measurement



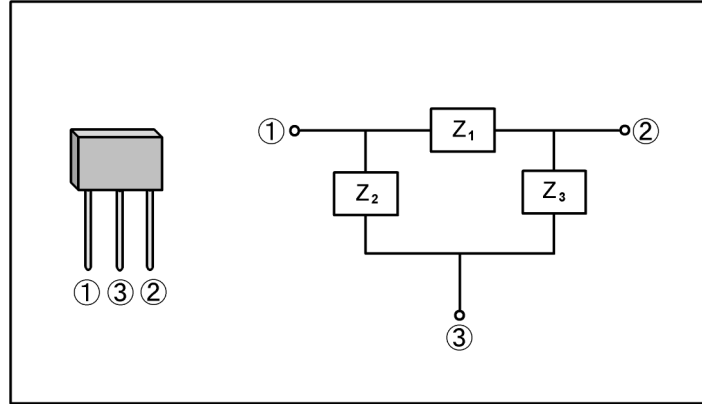
16047eoe0302

3. Follow the instruction manual that came with your instrument to measure your DUT.

## Measuring 3-terminal device

The 16047E allows you to measure a 3-terminal device shown in **Figure 3-3**.

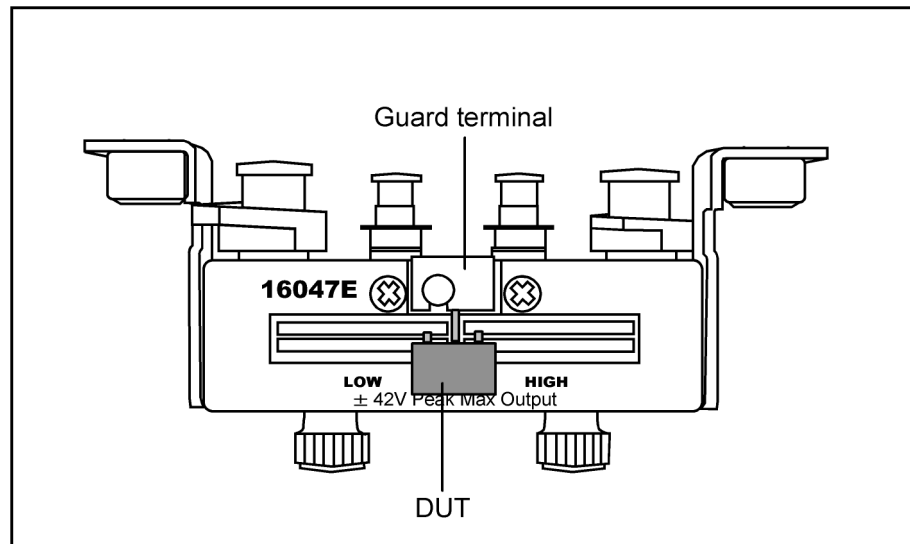
Figure 3-3 3-terminal device



Use the guard terminal on the fixture to measure a 3-terminal device. Connect the lead No. 3 to the guard terminal in order to measure only characteristics of  $Z_1$  eliminating any effects from  $Z_2$  and  $Z_3$ .

1. Loosen the electrode securing screws of both sides and the screw of the guard terminal.
2. Insert the leads No. 1 or 2 into the electrodes, then fasten the screws. Insert the lead No. 3 into the guard terminal, then secure it with the screw.

Figure 3-4 Measuring 3-terminal device



16047eoe0304

3. Follow the instruction manual that came with your instrument to measure your DUT.

Operation  
Measuring 3-terminal device

Similarly, connect the lead No. 2 to the guard terminal in order to measure only characteristics of  $Z_2$  eliminating any effects from  $Z_1$  and  $Z_3$ .

**NOTE**

**Connect your device to the guard terminal with a shortest possible lead. Longer lead will degrade the guard effect resulting in less accurate measurement result.**

---

Operation  
Measuring 3-terminal device



## 4 Specifications and Supplemental Performance Characteristics

This chapter provides specifications and supplemental performance characteristics of the 16047E test fixture.

### Specifications

Applicable Instruments		LCR meters and Impedance Analyzers with four-terminals
Applicable DUT Type		Lead components
Frequency		$\leq 120\text{MHz}$
DC Bias		$\pm 42\text{V}$ peak max. (AC+DC)
Operating Environment	temp.	$-20^{\circ}\text{C}$ to $+75^{\circ}\text{C}$
	humidity	15% to 95%RH( @ wet bulb temp. $< 40^{\circ}\text{C}$ )
Non Operating Environment.	temp.	$-40^{\circ}\text{C}$ to $+70^{\circ}\text{C}$
	humidity	$\leq 90\%$ RH ( @ wet bulb temp. $< 65^{\circ}\text{C}$ )
Dimension		Approximately 135 (W) x 40 (H) x 65 (D) mm
Weight		Approximately 200g

## Supplemental Performance Characteristics

This section provides useful data on the 16047E. These supplemental performance characteristics should not be considered specifications.

### Additional Error

Additional errors are calculated as follows.

#### **|Z| Measurement**

Additional error  $Z_e$  [%] of the  $|Z|$  measurement is calculated by substituting the values in the table below into the following equation.

$$Z_e [\%] = \pm \{A + (Z_s/Z_x + Y_o \times Z_x) \times 100\}$$

where

**A [%]**                      **Additional Error (Proportional Error)**

**Y<sub>o</sub> [S]**                    **Open Repeatability (Admittance)**

**Z<sub>s</sub> [Ω]**                    **Short Repeatability (Impedance)**

**Z<sub>x</sub> [Ω]**                    **Measured Value (Impedance)**

#### **Without extension cable**

Applicable Instruments: E4990A

Y <sub>o</sub>		$2 \text{ n} + 10 \mu \times (f / 100) \text{ [S]}$
Z <sub>s</sub>		$2 \text{ m} + 600 \text{ m} \times (f / 100) \text{ [}\Omega\text{]}$
A	$f \leq 15 \text{ MHz}$	$0.2 \% \times (f / 10)^2 \text{ [%]}$
	$f > 15 \text{ MHz}$	$4 \% \times (f / 100) \text{ [%]}$

where f is the measurement frequency (MHz).

#### **Without extension cable**

Applicable Instruments: E4980A, E4980AL, E4981A

Y <sub>o</sub>		$2 \text{ n} + 10 \mu \times (f / 100) \text{ [S]}$
Z <sub>s</sub>		$2 \text{ m} + 600 \text{ m} \times (f / 100) \text{ [}\Omega\text{]}$
A		$0.2 \% \times (f / 10)^2 \text{ [%]}$

where f is the measurement frequency (MHz).

where f is the measurement frequency (MHz).

**E4990A (extension cable 1m)**

Y <sub>o</sub>		$4 n + 20 \mu \times ( f / 100 ) [S]$
Z <sub>s</sub>		$4 m + 1200 m \times ( f / 100 ) [\Omega]$
A	f ≤ 5 MHz	$0.6 \% \times ( f / 10 )^2 [\%]$
	f > 5MHz	$8 \% \times ( f / 100 ) [\%]$

where f is the measurement frequency (MHz).

**E4990A (extension cable 2m)**

Y <sub>o</sub>		$4 n + 20 \mu \times ( f / 100 ) [S]$
Z <sub>s</sub>		$4 m + 1200 m \times ( f / 100 ) [\Omega]$
A	f ≤ 5 MHz	$1 \% \times ( f / 10 )^2 [\%]$
	f > 5MHz	$8 \% \times ( f / 100 ) [\%]$

where f is the measurement frequency (MHz).

**D Measurement**

Additional error De of the D measurement is calculated by additional error Ze [%] of |Z| measurement as follows.

If  $Dx \leq 0.1$ :

$$De = Ze / 100$$

If  $0.1 < Dx \leq 0.5$ :

$$De = ( Ze / 100 ) \times ( 1 + Dx )$$

where Dx is the measured value of D. It is necessary for Ze to be below 10 %.

**NOTE**

**D is not expressed as a percentage but as an absolute value.**

### **Rs (ESR) Measurement**

Additional error  $R_{se}[\%]$  of the  $R_s$  measurement is calculated by additional error  $Z_e [\%]$  of  $|Z|$  measurement as follows.

If  $Dx \leq 0.1$ :

$$R_{se} [\%] = Z_e / Dx$$

If  $0.1 < Dx \leq 0.5$ :

$$R_{se} [\%] = (Z_e / Dx) \times \sqrt{(1 + Dx^2)}$$

$Dx$  is the measured value of  $D$  and is calculated as follows.

$$Dx = 2 \times \pi \times f \times C_{sx} \times R_{sx},$$

where

$f$ : measurement signal frequency

$C_{sx}$ : measured value of  $C_s$

$R_{sx}$ : measured value of  $R_s$ .

## 5 Service

This chapter provides information on servicing and proper maintenance.

Serial Number for Non-RoHS 16047E:

“MY431xxxx and below” / “SG431xxxx and below”

Serial Number for RoHS 16047E:

“MY432xxxx and above” / “SG432xxxx and above”

### Maintenance

Shown are the supported parts and their respective RoHS compliant replacement support part. RoHS conversion involves with design and dimension change which result in the RoHS support part backward incompatible with non-RoHS 16047E. Special handling is needed while using the RoHS replacement part on non-RoHS 16047E. The original support part number is replaced by the respective “RoHS Compliant Upper Level Assembly Replacement Part”. Once the original support part is depleted, please proceed to obtain the RoHS compliant support part.

Do not disassemble any further than shown. Maintenance consists principally of cleaning contacts and replacing worn or damaged parts. Take special care when cleaning contacts.

To order parts, use the Keysight Technologies part numbers listed in **Table 5-1** and **Table 5-2**. If a faulty part is located in an assembly that cannot be disassembled, order the next higher assembly or return the fixture to the nearest Keysight Technologies Sales/Service Office for repair or replacement.

Replaceable Parts

Figure 5-1 Replaceable Parts (part 1 of 2)

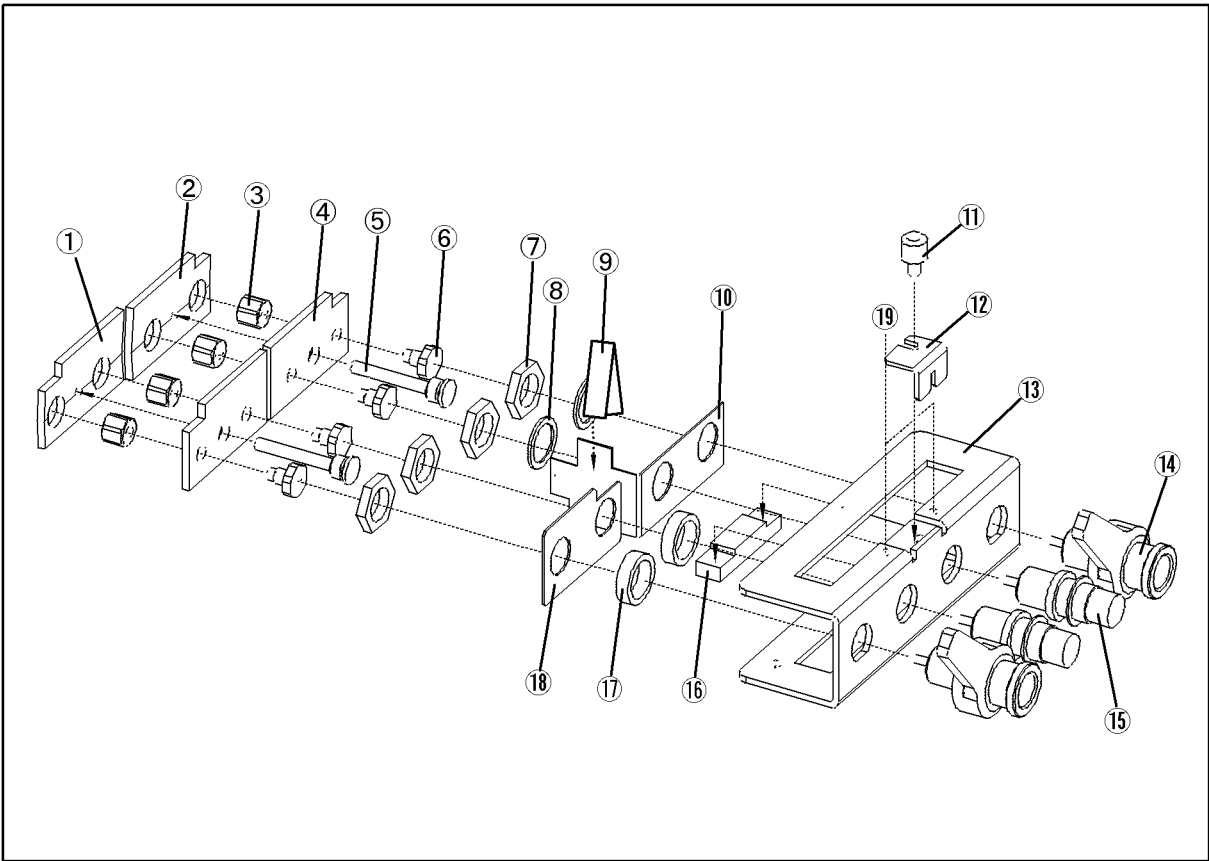


Table 5-1

Replaceable Parts (part 1 of 2)

Ref /D	Non-RoHS Part No.	Qty	Description	RoHS Compliant Replacement Part	Qty
1	16047-00623	1	PLATE-H	16047-60105	1
2	16047-00624	1	PLATE-L	16047-60105	1
3	16047-24024	4	NUT	16047-60105	1
4	16047-00622	2	PLATE	16047-60105	1
5	16047-23021	2	SHAFT	16047-60105	1
6	16380-24001	4	TERMINAL	16047-60105	1
7	2950-0043	4	NUT	16047-60105	1
8	2190-0016	2	Washer	16047-60105	1
9	16047-09001	1	INSULATOR	16047-60105	1
10	16047-00625	1	SHIELD	16047-60105	1
11	16047-24022	1	SCREW	16047-24022	1
12	16047-00621	1	SHORT BAR	16047-00621	1
13	16047-04021	1	COVER	16047-60105	1
14	16047-60015	2	BNC LEVER ASSEMBLY	16047-60105	1
15	16047-60016	2	CONNECTOR-BNC	16047-60105	1
16	16047-00626	1	CONTACT	16047-60105	1
17	16047-24023 (Removed)	2	SLEEVE	N/A	1
18	16047-00627 (Removed)	1	PLATE	N/A	1
19	0515-0999	2	SCREW	16047-60105	1

Figure 5-2 Replaceable Parts (part 2 of 2)

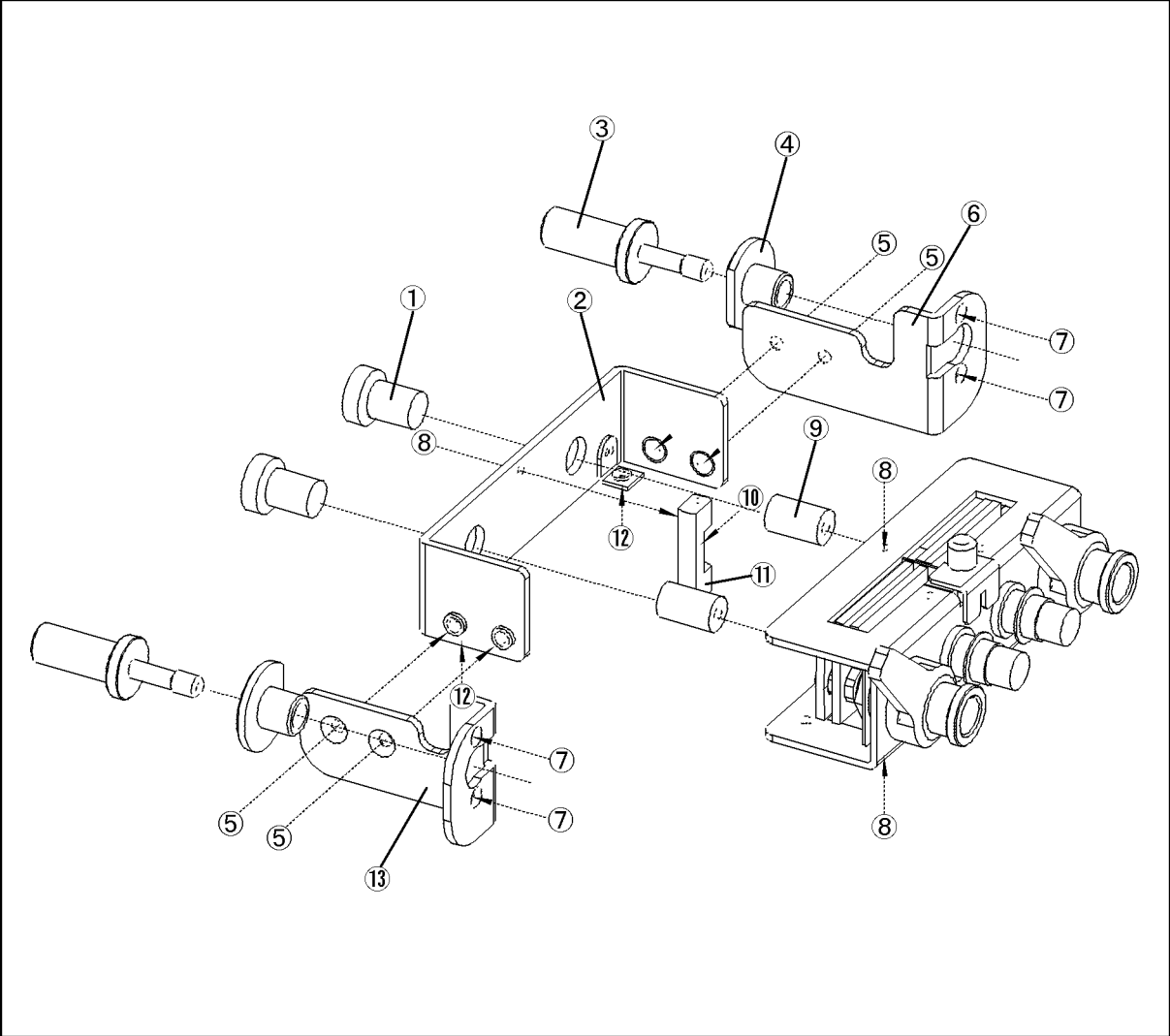




Table 5-2 Replaceable Parts (part 2 of 2)

Ref /D	Non-RoHS Part No.	Qty	Description	RoHS Compliant Replacement Part	Qty
1	0370-2446	2	KNOB	5012-9057	2
2	16047-04022	1	COVER	16047-04022	1
3	16047-24021	2	KNOB	16047-24021	2
4	16047-24026	2	FLANGE	16047-24026	2
5	0515-0914	4	SCREW	0515-1227	4
6	16047-01222	1	ANGLE	16047-01222	1
7	0515-0952	4	SCREW	0515-2151	4
8	0515-0999	3	SCREW	0515-1375	3
9	16047-25021	2	INSULATOR	16047-25021	2
10	0515-2791	1	SCREW	16047-60105	1
11	16047-24025	1	SLEEVE	16047-60105	1
12	0515-0914	2	SCREW	0515-1227	2
13	16047-01221	1	ANGLE	16047-01221	1

Service  
Maintenance

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Edition 5, June 2018



16047-90040

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