

**HP 16047E Test Fixture**

# **Operation and Service Manual**

**First Edition**



HP Part No. 16047-90040

**April 1999**

Printed in: Japan

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## Notices

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## Manual Printing History

The manual's printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates that are incorporated at reprint do not cause the date to change.) The manual part number changes when extensive technical changes are incorporated.

April 1999      First Edition

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## Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS elsewhere in this manual may impair the protection provided by the equipment. In addition it violates safety standards of design, manufacture, and intended use of the instrument.

The Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

- **DO NOT Operate In An Explosive Atmosphere**

Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

- **Keep Away From Live Circuits**

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

- **DO NOT Service Or Adjust Alone**

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

- **DO NOT Substitute Parts Or Modify Instrument**

Because of the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

- **Dangerous Procedure Warnings**

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

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**WARNING**

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**Dangerous voltages, capable of causing death, are presenting this instrument. Use extreme caution when handling, testing, and adjusting this instrument.**

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## Certification

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institution's calibration facility, or to the calibration facilities of other International Standards Organization members.

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## Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period corresponding to the individual warranty periods of its component products. Instruments are warranted for a period of one year.

Fixtures and adapters are warranted for a period of 90 days. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instruction when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

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## **Limitation Of Warranty**

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

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### **IMPORTANT**

No other warranty is expressed or implied. HP specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

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## **Exclusive Remedies**

The remedies provided herein are buyer's sole and exclusive remedies. HP shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

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## **Assistance**

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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## Safety Symbol

General definitions of safety symbols used on the instrument or in manuals are listed below.



Instruction Manual symbol: the product is marked with this symbol when it is necessary for the user to refer to the instrument manual.



Alternating current.



Direct current.



On (Supply).



Off (Supply).



In position of push-button switch.



Out position of push-button switch.



Frame (or shassis) terminal. A connection to the frame (shassis) of the equipment which normally include all exposed metal structure.

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### WARNING

**This warning sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.**

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### CAUTION

This Caution sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

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### NOTE

Note denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

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<b>1. Installation Guide</b>	
Incoming Inspection . . . . .	10
Connecting the HP 16047E. . . . .	11
Connecting to the HP 4294A . . . . .	11
Connecting to the instrument other than HP 4294A . . . . .	12
Cleaning . . . . .	13
<b>2. Overview</b>	
Product Overview . . . . .	16
Functions. . . . .	17
<b>3. Operation</b>	
Performing Fixture Compensation . . . . .	20
Performing Open Compensation. . . . .	20
Performing Short Compensation. . . . .	20
Performing Load Compensation. . . . .	21
DUT Measurement . . . . .	22
Measuring 3-terminal device . . . . .	23
<b>4. Specifications and Supplemental Performance Characteristics</b>	
Specifications . . . . .	26
Supplemental Performance Characteristics . . . . .	27
Additional Error . . . . .	27
<b>5. Service</b>	
Maintenance . . . . .	32
Replacable Parts . . . . .	32





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# **1      Installation Guide**

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## 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 HP 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 Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of unusual stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

**Table 1-1**

### Contents

Description	HP Part Number	Qty.
HP 16047E Test Fixture	-	1
Shorting bar <sup>a</sup>	16047-00621	1
Operation and Service Manual	16047-90040	1

a. Fasten the guard terminal of the test fixture.

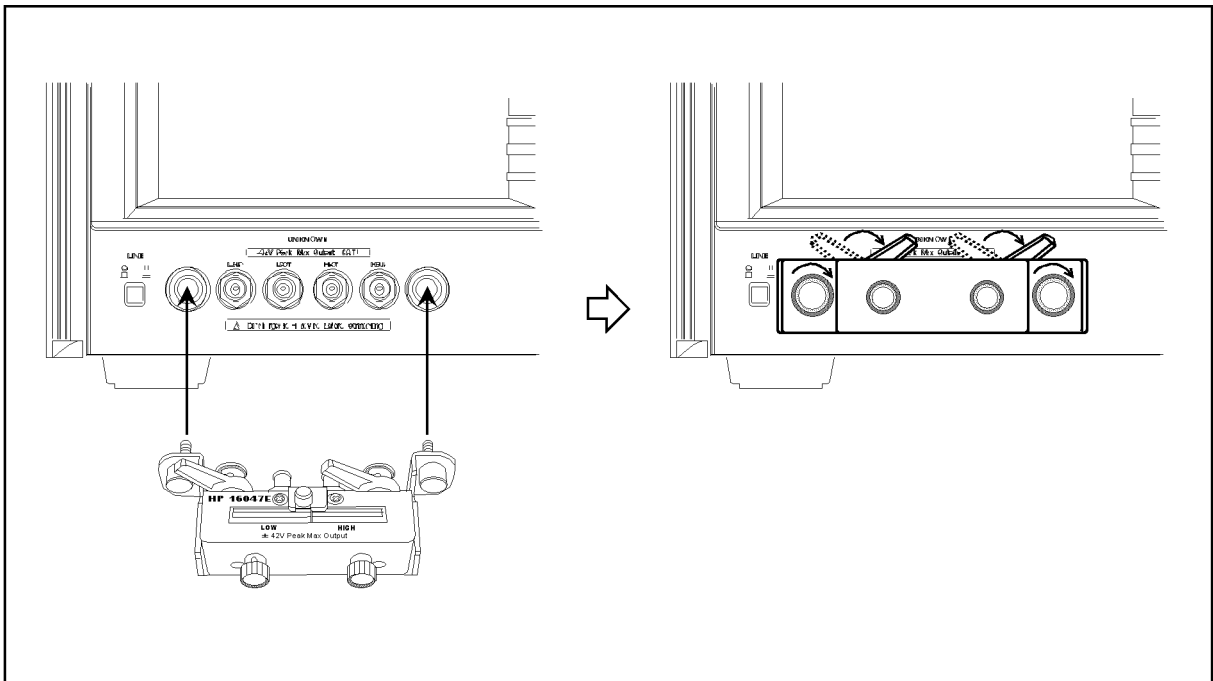
## Connecting the HP 16047E

### Connecting to the HP 4294A

Follow these steps below to connect the HP 16047E to the HP 4294A.

- Step 1.** Set the HP 16047E test fixture to the test connectors on the front panel of the HP 4294A 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 HP 16047E to HP 4294A



16047eoj0102

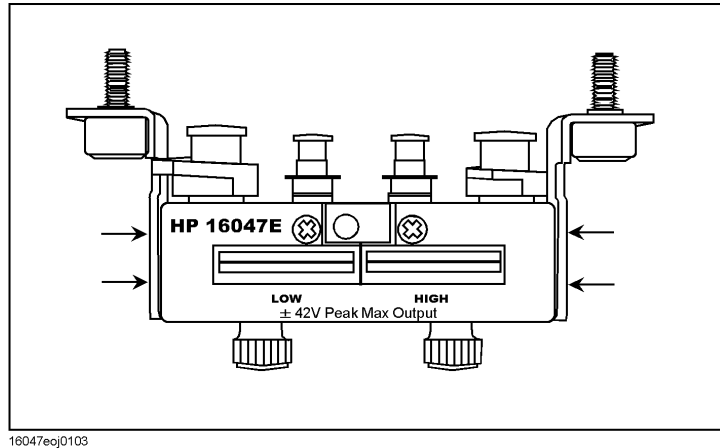
#### NOTE

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 other than HP 4294A

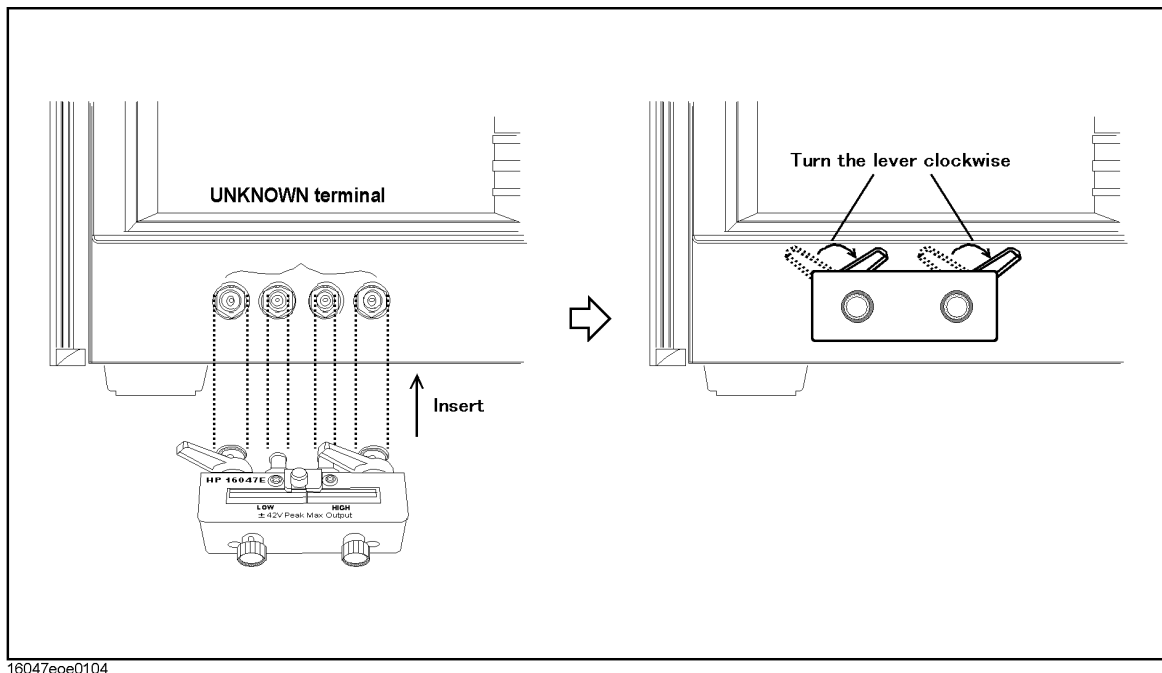
When connecting the HP 16047E to any instrument other than the HP 4294A, remove the four fastening screws as shown in Figure 1-2.

**Figure 1-2**      **Locations of fastening screws**



- Step 1.** Set the HP 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**



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## **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.



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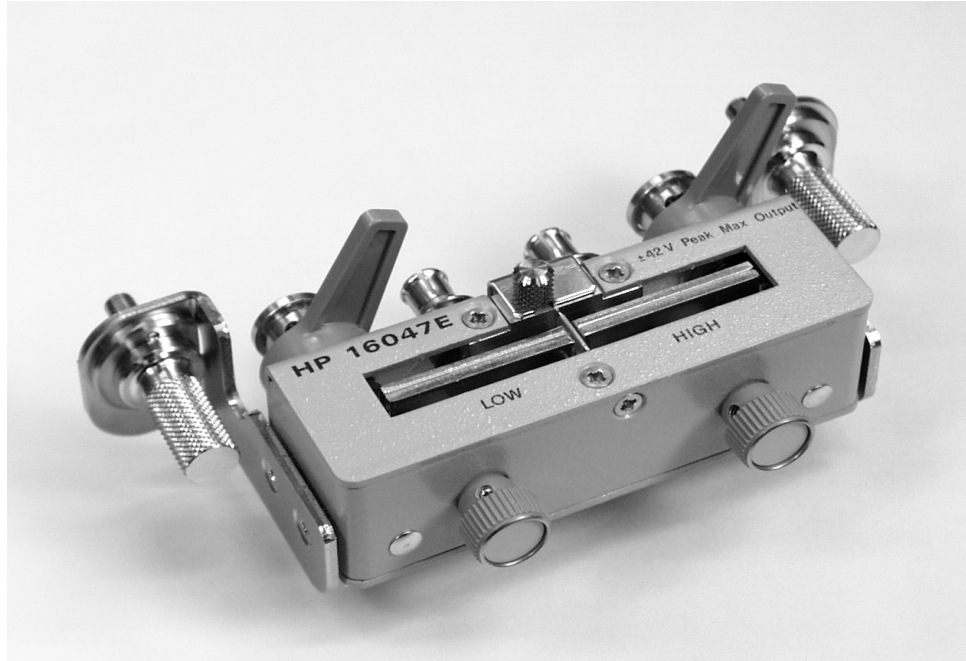
## **2 Overview**

## Product Overview

The HP 16047E is a test fixture used to measure parts with leads. When used with the HP 4294A, the fixture provides highly accurate measurement with wide frequency range up to 110 MHz. Also it gains mechanical stability and a prolonged life when it is secured to the HP 4294A with its fastening screws.

Figure 2-1

### Product Overview



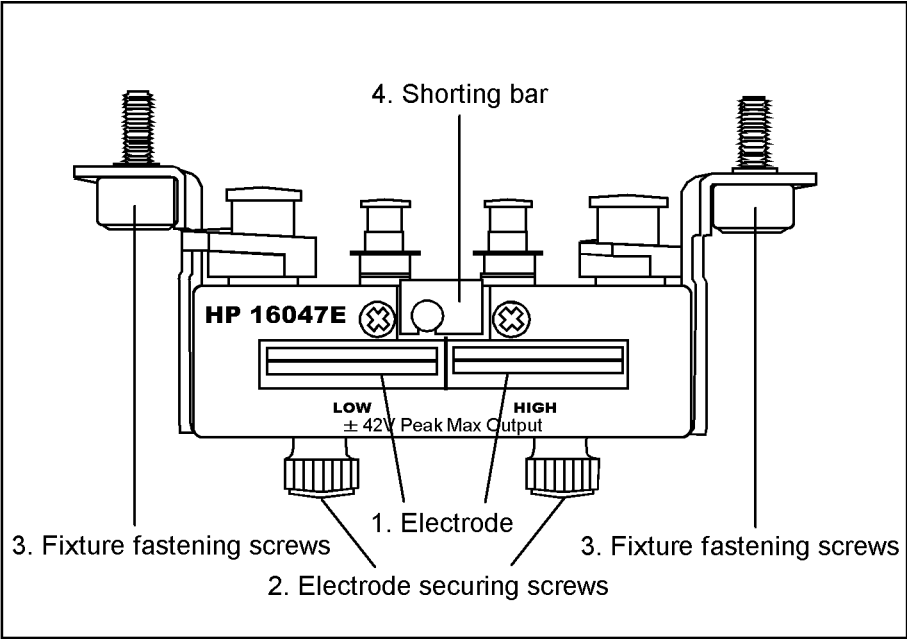


Functions

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

Figure 2-2

HP 16047E Parts



16047eoe0202

Table 2-1

HP 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.



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## **3      Operation**

This chapter describes the proper methods for fixture compensation with the HP 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 HP 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.

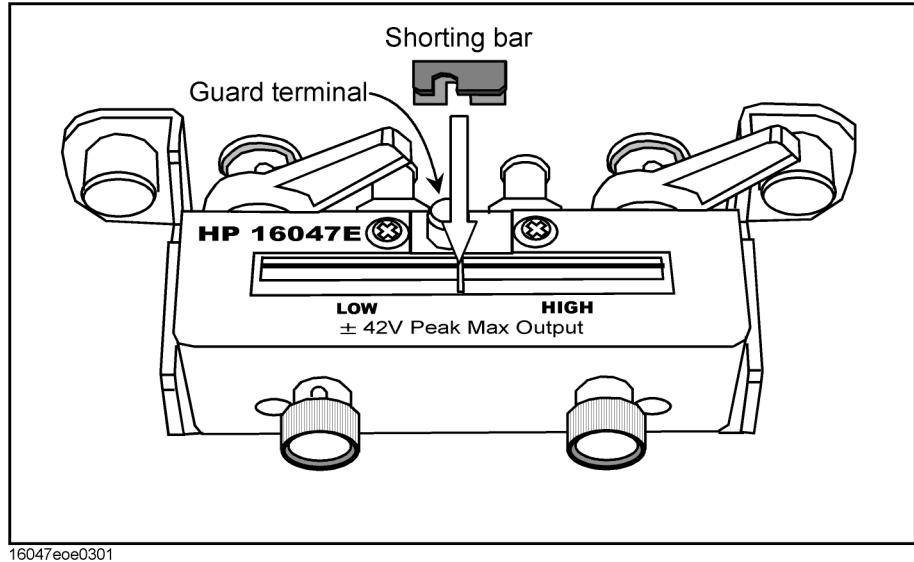
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**NOTE**

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

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**Figure 3-1** Performing short compensation



3. Fasten the electrode securing screws.

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**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.

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## DUT Measurement

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

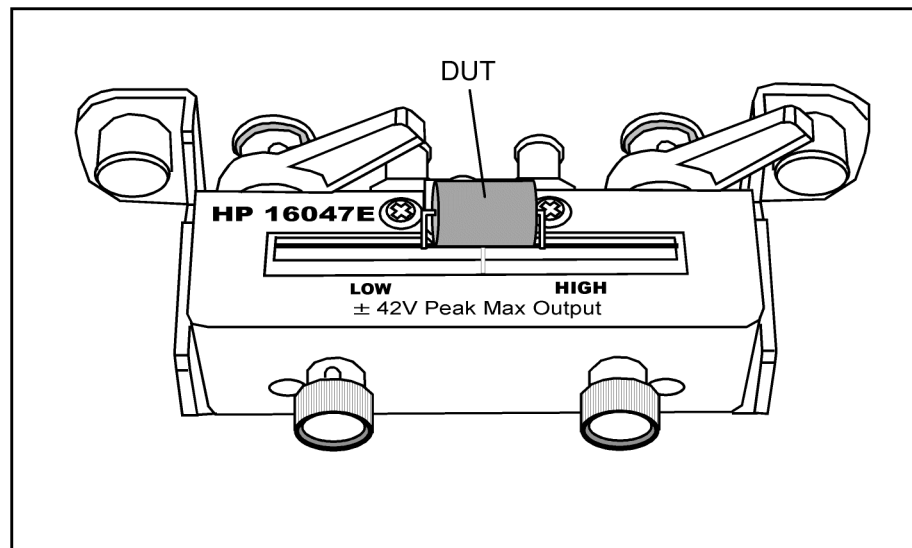
1. Loosen the electrode securing screws of both sides so that DUT leads are caught in the electrodes.
2. Fasten both of the securing screws.

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

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**Figure 3-2** Performing DUT Measurement



16047eoe0302

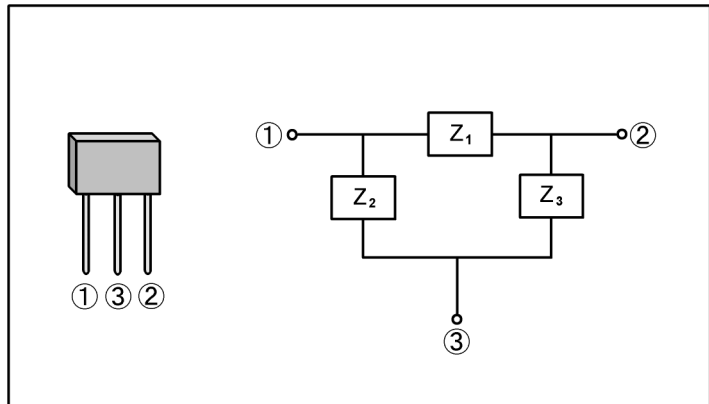
3. Follow the instruction manual that came with your instrument to measure your DUT.

## Measuring 3-terminal device

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

Figure 3-3

### 3-terminal device

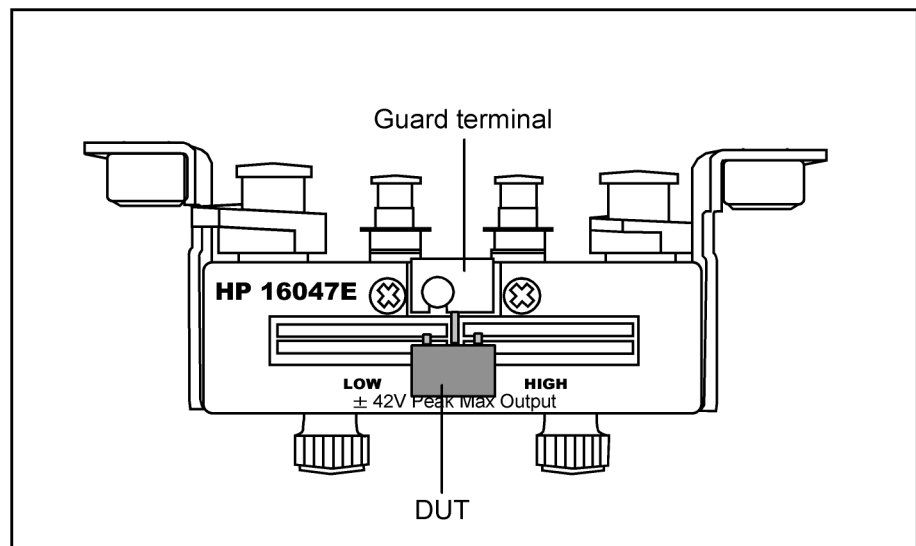


Use the guard terminal on the fixture to measure a 3-terminal device. Connect the lead No. 3 to the guard terminal in order to measure only characteristics of  $Z_1$  eliminating any effects from  $Z_2$  and  $Z_3$ .

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

Operation  
**Measuring 3-terminal device**

DUT.

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  $Z_3$ .

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**NOTE**

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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.



## Specifications and Supplemental Performance Characteristics

25

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## Specifications

Applicable Instruments		LCR meters and Impedance Analyzers with four-terminals
Applicable DUT Type		Lead components
Frequency		$\leq 110\text{MHz}$
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 $135\text{ (W)} \times 40\text{ (H)} \times 65\text{ (D)}\text{ mm}$
Weight		Approximately 200g

## Supplemental Performance Characteristics

This section provides useful data on the HP 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)

$Y_o$  [S] Open Repeatability (Admittance)

$Z_s$  [ $\Omega$ ] Short Repeatability (Impedance)

$Z_x$  [ $\Omega$ ] Measured Value (Impedance)

#### **Without extension cable**

Applicable Instruments : HP 4294A

$Y_o$		$2 \text{ n} + 10 \mu \times (f / 100) \text{ [S]}$
$Z_s$		$2 \text{ m} + 600 \text{ m} \times (f / 100) \text{ [}\Omega\text{]}$
$A$	$f \leq 15 \text{ MHz}$	$0.2 \% \times (f / 10)^2 \text{ [%]}$
	$f > 15 \text{ MHz}$	$4 \% \times (f / 100) \text{ [%]}$

where  $f$  is the measurement frequency (MHz).

#### **Without extension cable**

Applicable Instruments : HP 4192A, HP 4194A, HP 4263B, HP 4268A, HP4278A, HP4279A, HP 4284A, HP 4285A, HP 4338B

$Y_o$		$2 \text{ n} + 10 \mu \times (f / 100) \text{ [S]}$
$Z_s$		$2 \text{ m} + 600 \text{ m} \times (f / 100) \text{ [}\Omega\text{]}$
$A$		$0.2 \% \times (f / 10)^2 \text{ [%]}$

where  $f$  is the measurement frequency (MHz).

**HP 4194A (extension cable 1m)**

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

where f is the measurement frequency (MHz).

**HP 4285A, HP 4294A (extension cable 1m)**

Yo		$4 \text{ n} + 20 \mu \times ( \text{ f } / 100 ) \text{ [S]}$
Zs		$4 \text{ m} + 1200 \text{ m} \times ( \text{ f } / 100 ) \text{ [}\Omega\text{]}$
A	f ≤ 5 MHz	$0.6 \% \times ( \text{ f } / 10 )^2 \text{ [%]}$
	f > 5MHz	$8 \% \times ( \text{ f } / 100 ) \text{ [%]}$

where f is the measurement frequency (MHz).

**HP 4285A, HP 4294A (extension cable 2m)**

Yo		4 n + 20 μ × ( f / 100 ) [S]
Zs		4 m + 1200 m × ( f / 100 ) [Ω]
A	f ≤ 5 MHz	1 % × ( f / 10 ) <sup>2</sup> [%]
	f > 5MHz	8 % × ( 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  $D_x \leq 0.1$ :

$$De = Ze / 100$$

If  $0.1 < D_x \leq 0.5$ :

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

where D<sub>x</sub> 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 Rse[%] of the Rs measurement is calculated by additional error Ze [%] of |Z| measurement as follows.

If  $Dx \leq 0.1$ :

$$Rse [\%] = Ze / Dx$$

If  $0.1 < Dx \leq 0.5$ :

$$Rse [\%] = (Ze / Dx) \times \sqrt{(1 + Dx^2)}$$

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

$$Dx = 2 \times \pi \times f \times Csx \times Rsx,$$

where

f: measurement signal frequency

Csx: measured value of Cs

Rsx: measured value of Rs.



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## **5 Service**

This chapter provides information on servicing and proper maintenance.

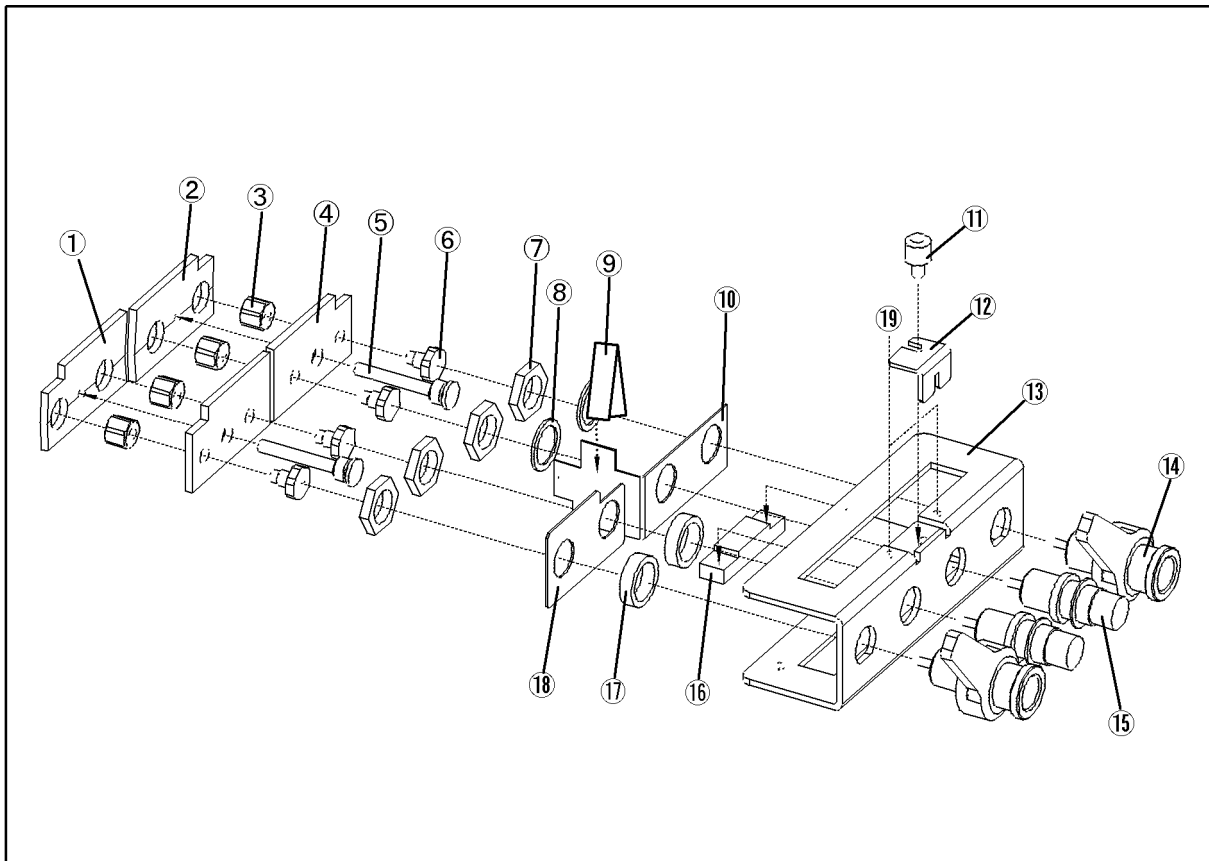
## Maintenance

An exploded view of the HP 16047E for parts identification is shown in Figure 5-1 and Figure 5-2. 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 Hewlett-Packard part numbers listed in Table 1-1 and Table 1-2. 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 Hewlett-Packard Sales/Service Office for repair or replacement.

### Replacable Parts

**Figure 5-1**      **Replacable Parts (part 1 of 2)**

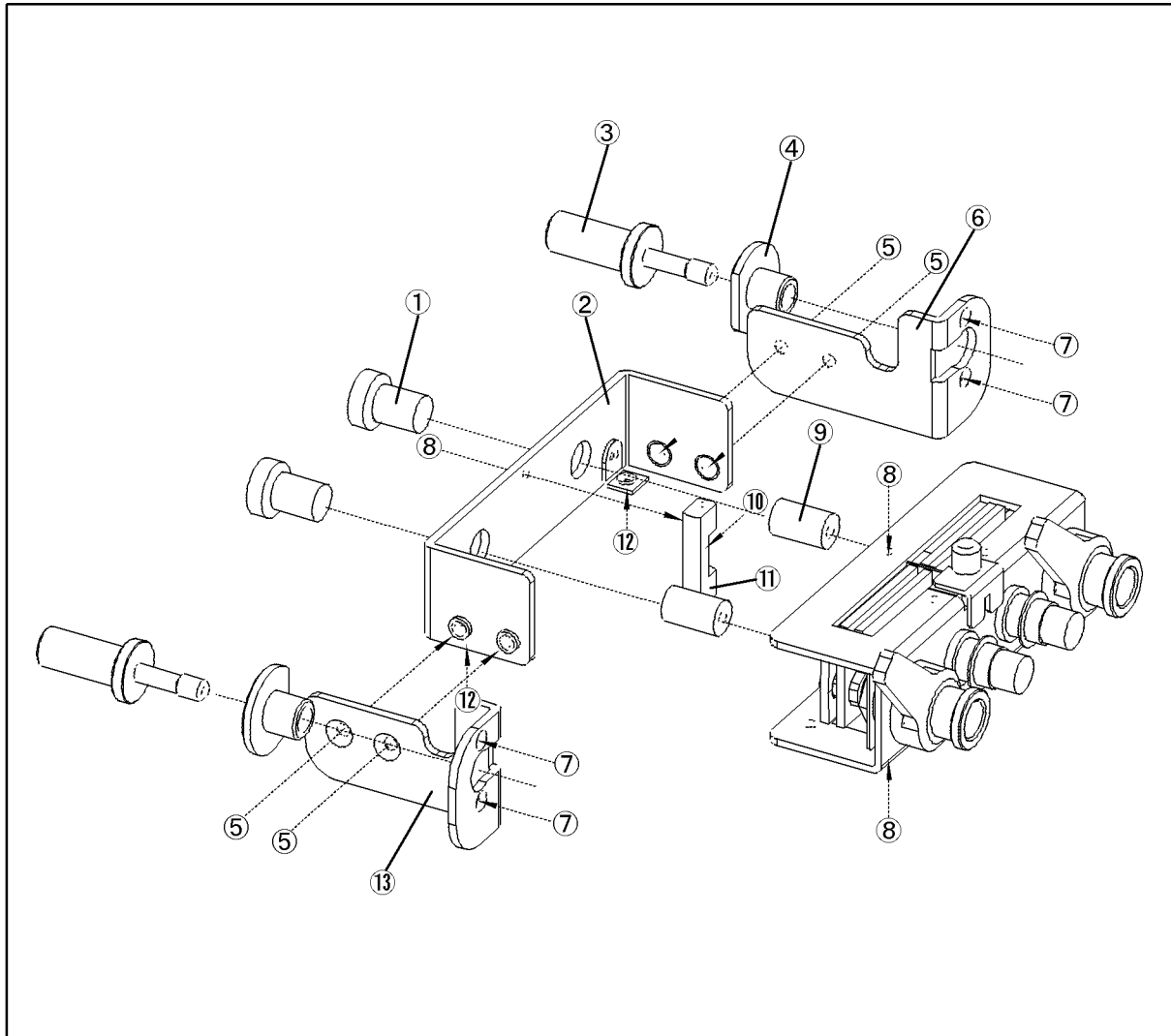




**Table 5-1**      **Replacable Parts (part 1 of 2)**

Reference Designator	HP Part No.	Qty.	Description
1	16047-00623	1	PLATE-H
2	16047-00624	1	PLATE-L
3	16047-24024	4	NUT
4	16047-00622	2	PLATE
5	16047-23021	2	SHAFT
6	16380-24001	4	TERMINAL
7	2950-0043	4	NUT
8	2190-0016	2	Washer
9	16047-09001	1	INSULATOR
10	16047-00625	1	SHIELD
11	16047-24022	1	SCREW
12	16047-00621	1	SHORT BAR
13	16047-04021	1	COVER
14	16047-60011	2	BNC LEVER ASSEMBLY
15	1250-1798	2	CONNECTOR-BNC
16	16047-00626	1	CONTACT
17	16047-24023	2	SLEEVE
18	16047-00627	1	PLATE
19	0515-0999	2	SCREW

**Figure 5-2**      **Replacable Parts (part 2 of 2)**



**Table 5-2**      **Replacable Parts (part 2 of 2)**

Reference Designator	HP Part No.	Qty.	Description
1	0370-2446	2	KNOB
2	16047-04022	1	COVER
3	16047-24021	2	KNOB
4	16047-24026	2	FLANGE
5	0515-0914	4	SCREW
6	16047-01222	1	ANGLE
7	0515-0952	4	SCREW
8	0515-0999	3	SCREW
9	16047-25021	2	INSULATER
10	0515-2791	1	SCREW
11	16047-24025	1	SLEEVE
12	0515-0914	2	SCREW
13	16047-01221	1	ANGLE

