

HP 16192A Parallel Electrode SMD Test Fixture  
**Operation and Service Manual**



HP Part No. 16192-90010  
Printed in JAPAN October 1996

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## Manual Printing History

The manual 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.

December 1993 .....	First Edition
June 1996 .....	Second Edition
October 1996 .....	Third 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** given elsewhere in this manual 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 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 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 the 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**



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

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The voltage levels found in this test fixture when used with the intended instruments do not warrant more than normal safety precautions for operator safety.

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## Operating Precaution

Do not exceed the operating input power, voltage, and current level and signal type appropriate for the instrument being used, refer to your instrument's operation manual.

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### Caution



Electrostatic discharge (ESD) can damage the highly sensitive microcircuits in your instrument. ESD damage is most likely to occur as the test fixtures are being connected or disconnected. Protect them from ESD damage by wearing a grounding strap that provides a high resistance path to ground. Alternatively, ground yourself to discharge any static charge built-up by touching the outer shell of any grounded instrument chassis before touching the test port connectors.

Never touch the test clip contacts.

Use a work station equipped with an anti-static work surface.

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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 of one year from the date of shipment, except that in the case of certain components listed in *Instrument Specifications* of this manual, the warranty shall be for the specified period. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which 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 of the environmental specifications for the product, or improper site preparation or maintenance.

*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 Symbols

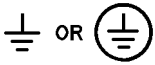
General definitions of safety symbols used on equipment or in manuals.



Instruction manual symbol: the product is marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.



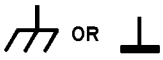
Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with wiring terminals to indicate the terminal which must be connected to ground before operating equipment.



Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (Operation) manual, and before operating the equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.



Alternating current (power line).



Direct current (power line).



Alternating or direct current (power line).

### Warning



**Warning** 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.

### Caution



**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 damage to or destruction of part or all of the product.

### 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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# General Information

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## Introduction

The purpose of this manual is to enable you to use your HP 16192A Parallel Electrode SMD Test Fixture efficiently and confidently.

## Manual Summary

This manual contains the following:

- The specifications of the HP 16192A (see this chapter).
- Installing the HP 16192A (see Chapter 2).
- Operating the HP 16192A (see Chapter 3).
- Ordering replaceable parts for the HP 16192A (see Chapter 4).

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## Product Description

The HP 16192A is used to measure a parallel electrodes surface mount device (SMD) with high repeatability.

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## Applicable Instruments

The HP 16192A has been designed to operate specifically with the following LCR meters and impedance analyzers:

You can directly connect the HP 16192A to:	HP 4191A, HP 4291A
You can use the HP 16192A with HP 41951A:	HP 4195A
You can use the HP 16192A with RF adapter HP 16085B:	HP 4194A <sup>1</sup>
You can use the HP 16192A with RF adapter HP 16099A:	HP 4194A with HP 41941A <sup>2,3</sup>

<sup>1</sup> The HP 4194A is a typical instrument. Other instruments that can be used with the HP 16085B are also applicable.

<sup>2</sup> The HP 4194A with HP 41941A is a typical instrument. Other instruments that can be used with the HP 16099A are also applicable.

<sup>3</sup> The HP 16192A is not adapted by some old type HP 16099A. For detail, please contact your HP sales office.

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## Options Available

The following option is supplied for the HP 16192A:

Option 001      Delete the magnifying lens and tweezers

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## Accessories Supplied

The following accessories are supplied with the HP 16192A:

**Table 1-1. Furnished Accessories**

Description	Part Number	Quantity
Operation and Service Manual	P/N 16192-90000	1
Shorting device (4 types)	P/N 16191-29001	1
	P/N 16191-29002	1
	P/N 16191-29003	1
	P/N 16191-29004	1
Case for shorting devices	P/N 1540-0692	1
Magnifying lens	P/N 16193-60002	1
Tweezers	P/N 8710-2081	1
Insulator	P/N 16192-09002	1

---

## Specifications

This section lists the complete HP 16192A specifications. These specifications are the performance standards and limits against which the HP 16192A is tested. When shipped from the factory, the HP 16192A meets the following specifications:

<b>Maximum DC Bias Voltage</b> .....	± 40V
<b>Operating Temperature</b> .....	-55 to +85°C
<b>Operating Humidity (@wet bulb temperature &lt;40°C)</b> .....	15 % to 95 % RH
<b>Non-operating Temperature</b> .....	-55 to +85°C
<b>Non-operating Humidity (@wet bulb temperature &lt;65°C)</b> .....	Up to 90 % RH
<b>Weight</b> .....	400 g
<b>Dimension</b> .....	150(W) × 70(H) × 90(D) [mm]

## Supplemental Performance Characteristics

This section lists supplemental performance characteristics. Supplemental performance characteristics are not specifications, but are typical characteristics included as additional information for the operator. Supplemental performance characteristics are not guaranteed.

<b>Frequency Range</b> .....	DC to 2 GHz
<b>Applicable DUT size</b> (see Figure 1-1) .....	1 mm to 20 mm
<b>Supplied shorting device size</b>	
P/N 16191-29001 .....	1 × 1 × 2.4 [mm]
P/N 16191-29002 .....	1.6 × 2.4 × 2 [mm]
P/N 16191-29003 .....	2.4 × 2.4 × 3.2 [mm]
P/N 16191-29004 .....	2.4 × 2.4 × 4.5 [mm]
<b>Electrical length</b> (when the length between electrodes is 2 mm) .....	11 mm
<b>Additional Error*</b> .....	1.5 × f <sup>2</sup> [%]
<b>Repeatability*</b>	
(for inductive component) .....	30 + 250 × f [mΩ]
	(impedance of 30 mΩ, 40 pH)
.....	2 + 30 × f [μS]
	(admittance of 2 μS, 5 fF)

\* f: frequency (GHz)

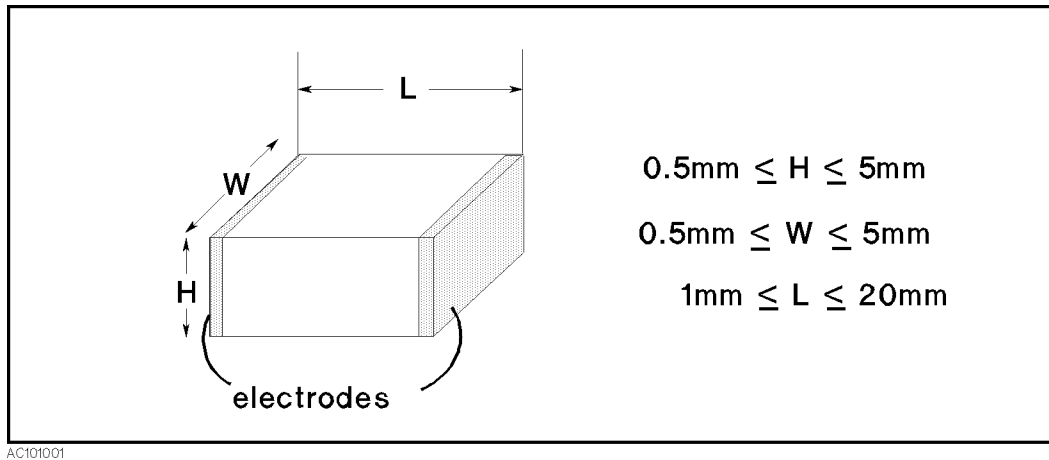


Figure 1-1. Applicable DUT Size

### Supplied Shorting Device Inductance

P/N 16191-29001 (l = 1 mm) .....	0.2 nH*1
P/N 16191-29002 (l = 2 mm) .....	0.2 nH*1
P/N 16191-29002 (l = 1.6 mm) .....	0.2 nH*1
P/N 16191-29002 (l = 2.4 mm) .....	0.7 nH*2
P/N 16191-29003 (l = 3.2 mm) .....	0.6 nH*2
P/N 16191-29004 (l = 4.5 mm) .....	0.6 nH*2

NOTE:

\*1 These inductance values are defined as the difference based on a disk-type 0 ohm termination on the APC-3.5 connector.

\*2 These inductance values are defined as the difference based on a disk-type 0 ohm termination on the APC-7 connector.



## Preparation for Use

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### Introduction

This chapter explains how to install the HP 16192A. The topics include the following:

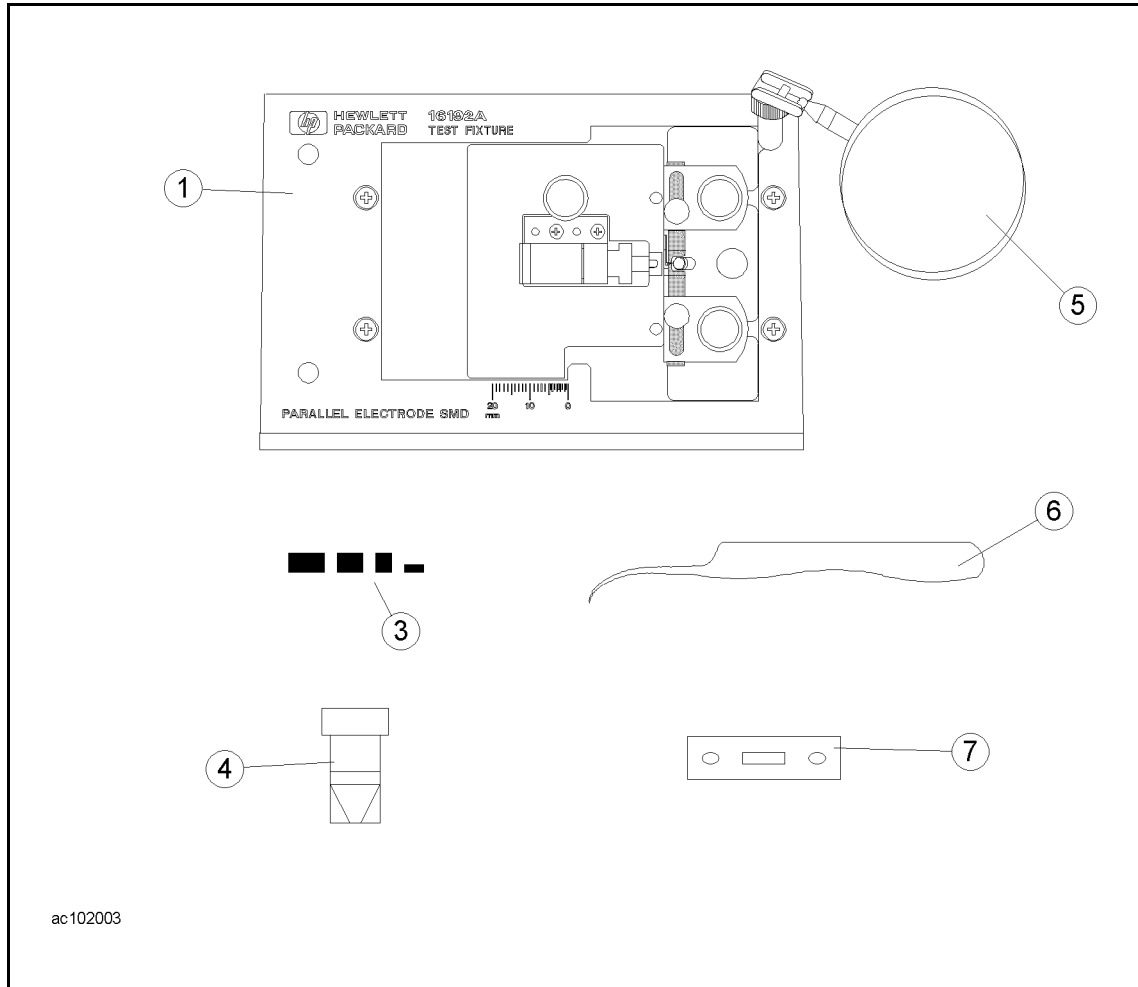
- Initial inspection.
- Connecting the test fixture for use.
- Repackaging the test fixture for shipment.
- Measurement error correcting function for each instrument.

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### Initial Inspection

The parallel electrode SMD test fixture has been carefully inspected before being shipped from the factory. It should be in perfect physical condition, no scratches, dents or the like. It should also be in perfect electrical condition. Verify this by carefully performing an incoming inspection to check the parallel electrode SMD test fixture set for signs of physical damage and missing contents. If any discrepancy is found, notify the carrier and Hewlett-Packard. Your HP sales office will arrange for repair and replacement without waiting for the claim to be settled.

- Inspect the shipping container for damage. Keep the shipping materials until the inspection is completed.
- Verify that the shipping container contains everything shown in Figure 2-1 and listed in Table 2-1.
- Inspect the exterior of the HP 16192A for any signs of damage.



**Figure 2-1. HP 16192A Product Overview**

**Table 2-1. HP 16192A Contents**

Description	HP Part Number	Quantity
① Test fixture	HP 16192A	1
② Operation and Service Manual <sup>1</sup>	P/N 16192-90000	1
③ Shorting device (1×1×2.4[mm])	P/N 16191-29001	1
(1.6×2.4×2[mm])	P/N 16191-29002	1
(2.4×2.4×3.2[mm])	P/N 16191-29003	1
(2.4×2.4×4.5[mm])	P/N 16191-29004	1
④ Case for shorting device	P/N 1540-0692	1
⑤ Magnifying lens <sup>2,3</sup>	P/N 16193-60002	1
⑥ Tweezers <sup>3</sup>	P/N 8710-2081	1
⑦ Insulator	P/N 16192-09002	1

1 Operation and Service Manual is not shown in Figure 2-1.

2 The magnifying lens is packed separately from the HP 16192A body. Connect it as shown in Figure 2-1.

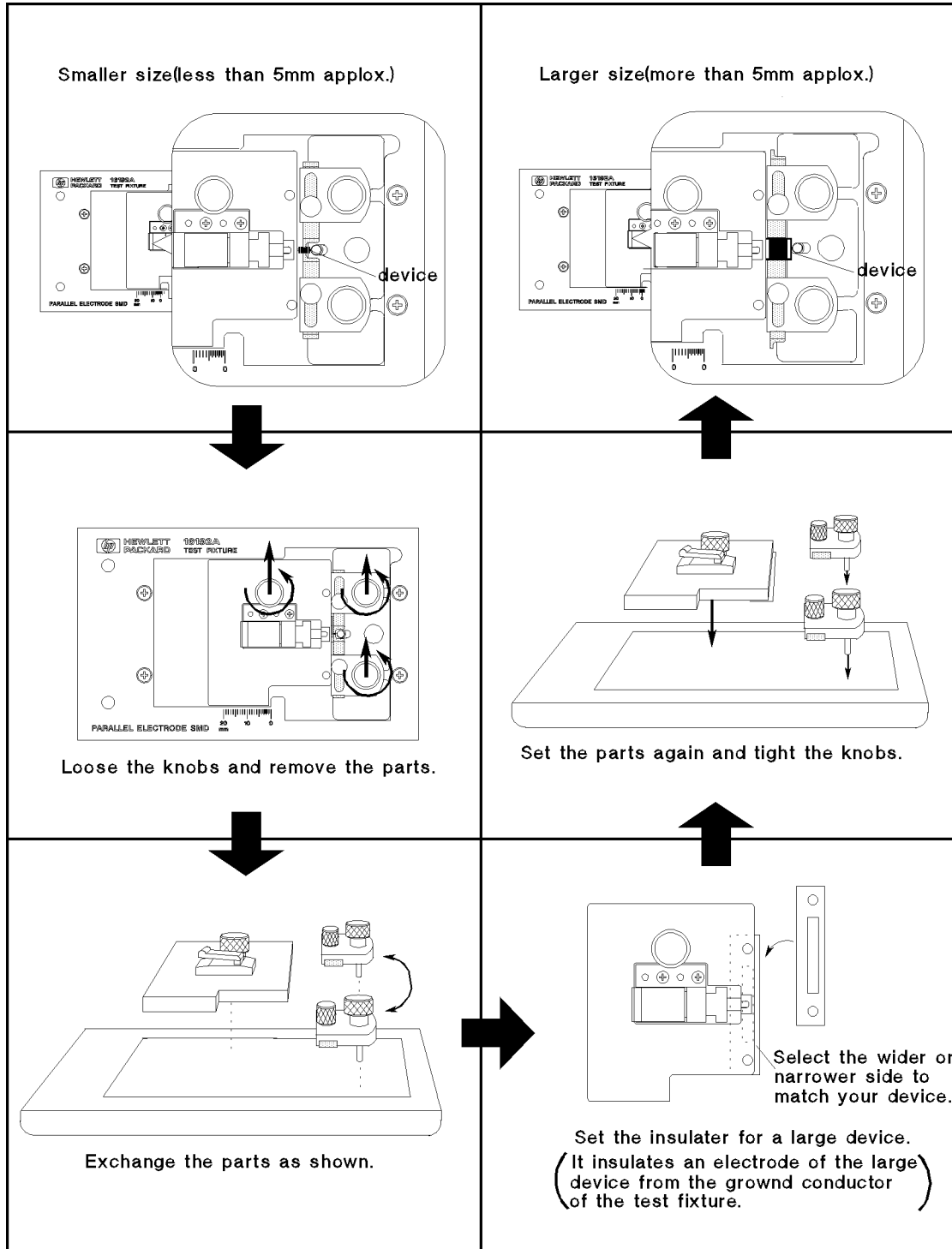
3 Not contained if you ordered the HP 16192A option 001.

## 2.2 Preparation for Use



## Adjusting the Configuration to SMD Size

The HP 16192A's applicable SMD size is 1 mm to 20 mm, changing the electrodes configuration as follows.



ACK02002

Figure 2-2. Electrodes configuration and SMD Size

## Connecting the Test Fixture for Use

### Note



Some instruments require an adapter to be connected to the HP 16192A (see “Applicable Instruments” in Chapter 1).

1. Calibrate your analyzer at the APC-7<sup>®</sup> connector plane before connecting test fixture. See Table 2-2 for the applicable error correcting function. After calibration, disconnect any standards from the APC-7<sup>®</sup> connector.
2. Place the fixture on the APC-7<sup>®</sup> connector.
3. Tighten (turn counterclockwise) the coupling nut of the APC-7<sup>®</sup> connector.

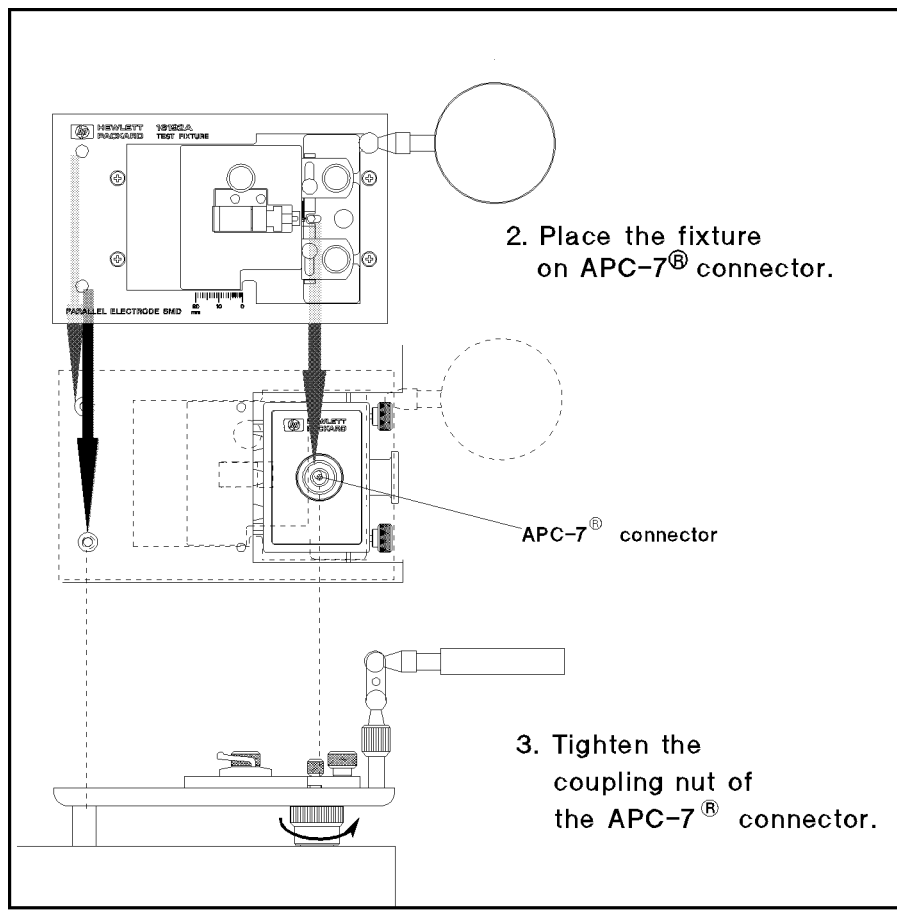


Figure 2-3. Connecting the Test Fixture with APC-7<sup>®</sup> Connector (HP 4291A)

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## **Repackaging the Test Fixture For Shipment**

If shipment to an Hewlett-Packard service center is required, each test fixture should be repackaged using the original factory packaging materials.

If this material is not available, comparable packaging materials may be used. Wrap the parallel electrode SMD test fixture in heavy paper and pack in anti-static plastic packing material. Use sufficient shock absorbing material on all sides of the HP 16192A to provide a thick, firm cushion and to prevent movement. Seal the shipping container securely and mark it *FRAGILE*.

## Measurement Error Correcting Function for Each Instrument

Each LCR meter or analyzer has measurement error correcting functions. Table 2-2 shows the functions of the instrument that can be used for calibration, setting the electrical length, and Open/Short/Load compensation.

**Table 2-2. Measurement Error Correcting Functions for Each Instrument**

Instrument	Calibration	Electrical length	OPEN Compensation	SHORT Compensation	LOAD Compensation
HP 4291A	Calibration OPEN SHORT LOAD LOW-LOSS Capacitor <sup>1</sup>	Selecting Test Fixture Port Extension	OPEN Compensation	SHORT Compensation	LOAD Compensation <sup>1</sup>
HP 4191A	Calibration 0 S 0 $\Omega$ 50 $\Omega$	Electrical Length	No capability	No capability	No capability
HP 4194A with HP 16085B	No capability	No capability	OPEN Correction	SHORT Correction	LOAD Correction <sup>1</sup>
HP 4195A with HP 41951A	Calibration OPEN SHORT LOAD	Port Extension (Port 1 or Port 2)	0 S OFFSET	0 $\Omega$ OFFSET	No capability
HP 4194A with HP 41941A/B, HP 16099A	Calibration 0 S 0 $\Omega$ 50 $\Omega$	No capability	Compensation ZERO OPEN	Compensation ZERO SHORT	No capability
HP 4194A with HP 16085B	Calibration 0 S 0 $\Omega$ 50 $\Omega$	No capability	Compensation ZERO OPEN	Compensation ZERO SHORT	No capability

<sup>1</sup> According to demand for precise measurement

# Operation

## Introduction

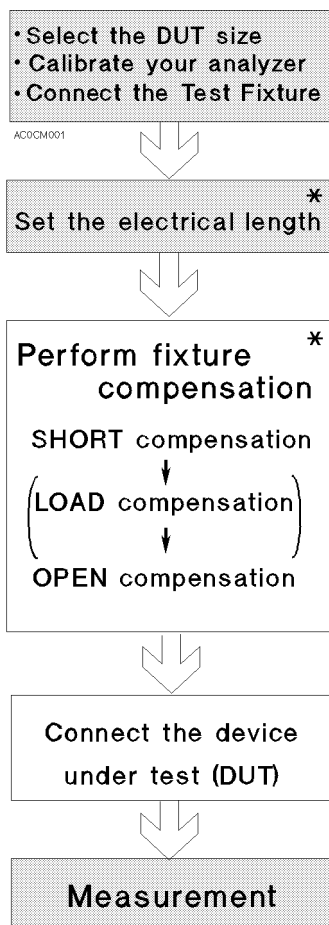
This chapter describes how to use the test fixture and the measurement error correcting techniques for the test fixture.

## Operating Flow

Before performing a measurement, you have to compensate for the residual error of the test fixture by using the measurement error correcting functions. Perform the following steps when measuring the DUT:

The HP 16192A has inherent stray capacitance, residual inductance, and residual resistance that affect the measurement. To compensate for these residuals and thus minimize their effect on measurement accuracy, the measurement instrument's OPEN and SHORT compensation capabilities must be used.

( ▶ indicates procedures in the following pages.)



Described in Chapter 2.

The HP 16192A's electrical length is 11 mm (typical value).  
To set the electrical length, see your analyzer's Operation Manual.

To set the fixture and devices for fixture compensation, see:

- ▶ "Placing Shorting Device, Load Standard, or Device Under Test"
- ▶ "Setting Open Condition"

These procedures show how to set the test fixture for the OPEN/SHORT/LOAD compensation procedure.

For how to measure OPEN/SHORT/LOAD, see the Operation Manual supplied with your analyzer. (You can omit LOAD compensation.)

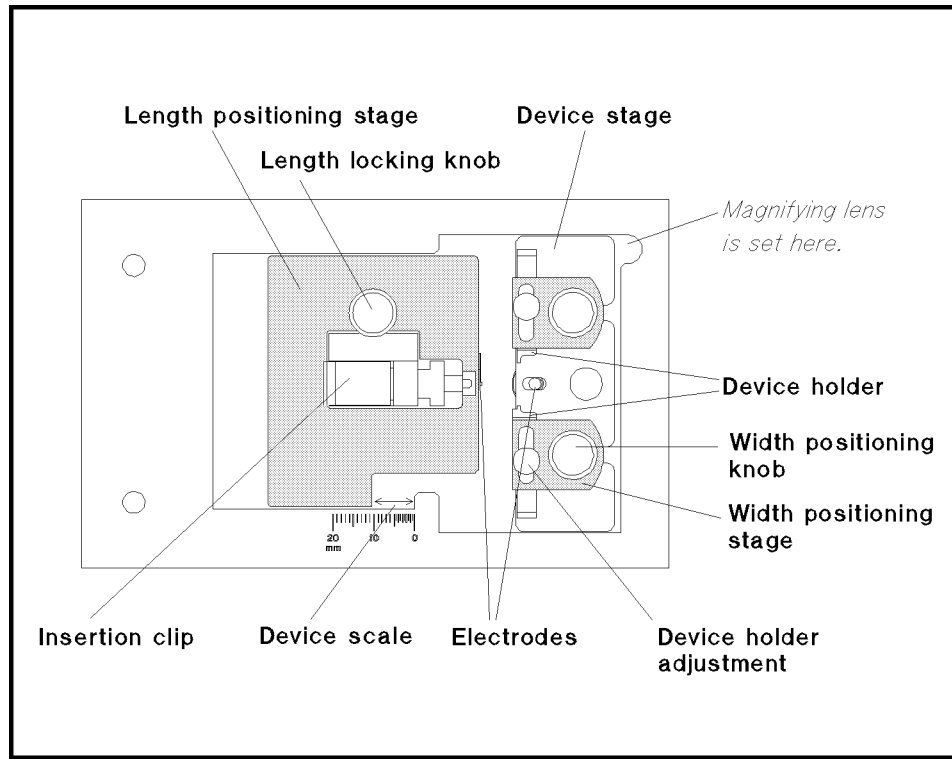
To connect the DUT, see:

- ▶ "Placing Shorting Device, Load Standard, or Device Under Test"

\* The compensating functions are different for each instrument. See Table 2-2 and perform the listed functions.

---

## Overview



**Figure 3-1. HP 16192A Test Fixture Overview**

<b>Length positioning stage</b>	Slides to fix an electrode.
<b>Length locking knob</b>	Fixes the length positioning stage.
<b>Device stage</b>	Teflon sheet to place the device.
<b>Device holder</b>	Fixes a device.
<b>Width locking knob</b>	Fixes the width positioning stage.
<b>Width positioning stage</b>	Fixes the device holder and the device stage.
<b>Device holder adjustment</b>	Moves the device holder.
<b>Electrodes</b>	These are connected to the device.
<b>Device scale</b>	Used for rough adjustment of the length positioning stage.
<b>Insertion clip</b>	Tightens or loosens an electrode.
<b>Shorting device</b>	<i>(Not shown in Figure 3-1)</i> Used for short compensation.

Four types of shorting devices are supplied with the HP 16192A. Use one that has dimensions similar to the DUT. When making a shorting device of same dimensions as your DUT, very low residual impedance and a high conductivity metal (that is not easily corroded) must be used to construct the shorting device. (It must also be clean.)

**Magnifying lens** *(Not shown in Figure 3-1)* Used when placing a small device within the electrodes.

---

**Warning** DO NOT look at the sun through the magnifying glass.



DO NOT operate or leave the magnifying glass under direct sunlight.

---

## Placing Shorting Device, Load Standard, or Device Under Test

1. Loosen (turn counterclockwise) all knobs to loosen the stages.
2. Set the device within the electrodes and adjust the device stage (Figure 3-2(a) ):
  - so that the device doesn't fall from the device stage.
  - so that one side of the device contacts the electrode post.
3. Keep pressing the insertion clip and adjust the length locking stage to contact another side of the device. Then tighten the length locking knob (Figure 3-2(b) ).
4. Adjust the device holders using the device holder adjustment and tighten the width positioning knob\* (Figure 3-2(c) ). (Then measure the device.)

\* list item 4 is not required for setting the shorting device.

---

## Setting Open Condition

1. If there is any device on the electrode, turn the big knob up and remove the device.
2. Set the DUT (see “Placing Shorting Device, Load Standard, or Device Under Test”) to space the electrodes.
3. Remove the DUT by pressing the insertion clip (Figure 3-2(d) ). (Then measure open.)

After the OPEN compensation, you may not adjust the stages again . Return the DUT to the electrode by pressing the insertion clip. You can now start the measurement.

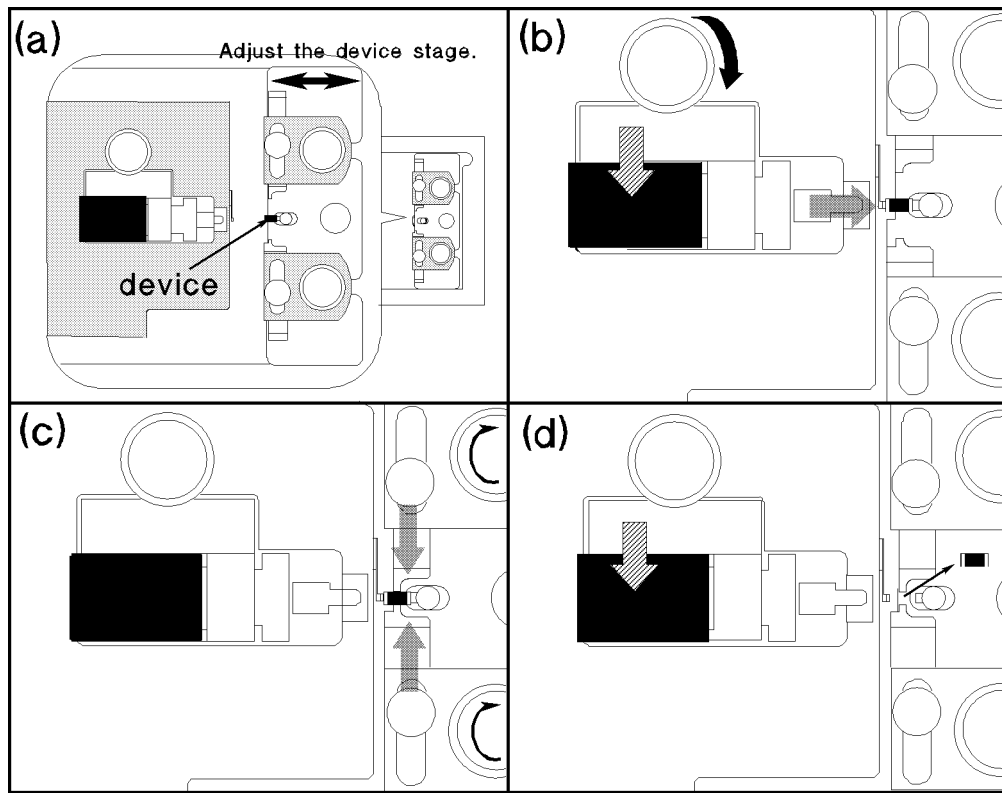


Figure 3-2. Setting Device and OPEN Condition





## Service

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### Introduction

This chapter covers the following subjects:

- General Information
- Assembly Replacement
  - Disassembly Procedure for main assembly
  - Replaceable Parts
- Troubleshooting

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#### Warning



**These servicing instructions are for use by qualified personnel only. Do NOT perform any servicing (other than that contained in the operating section) unless you are qualified to do so.**

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#### Caution



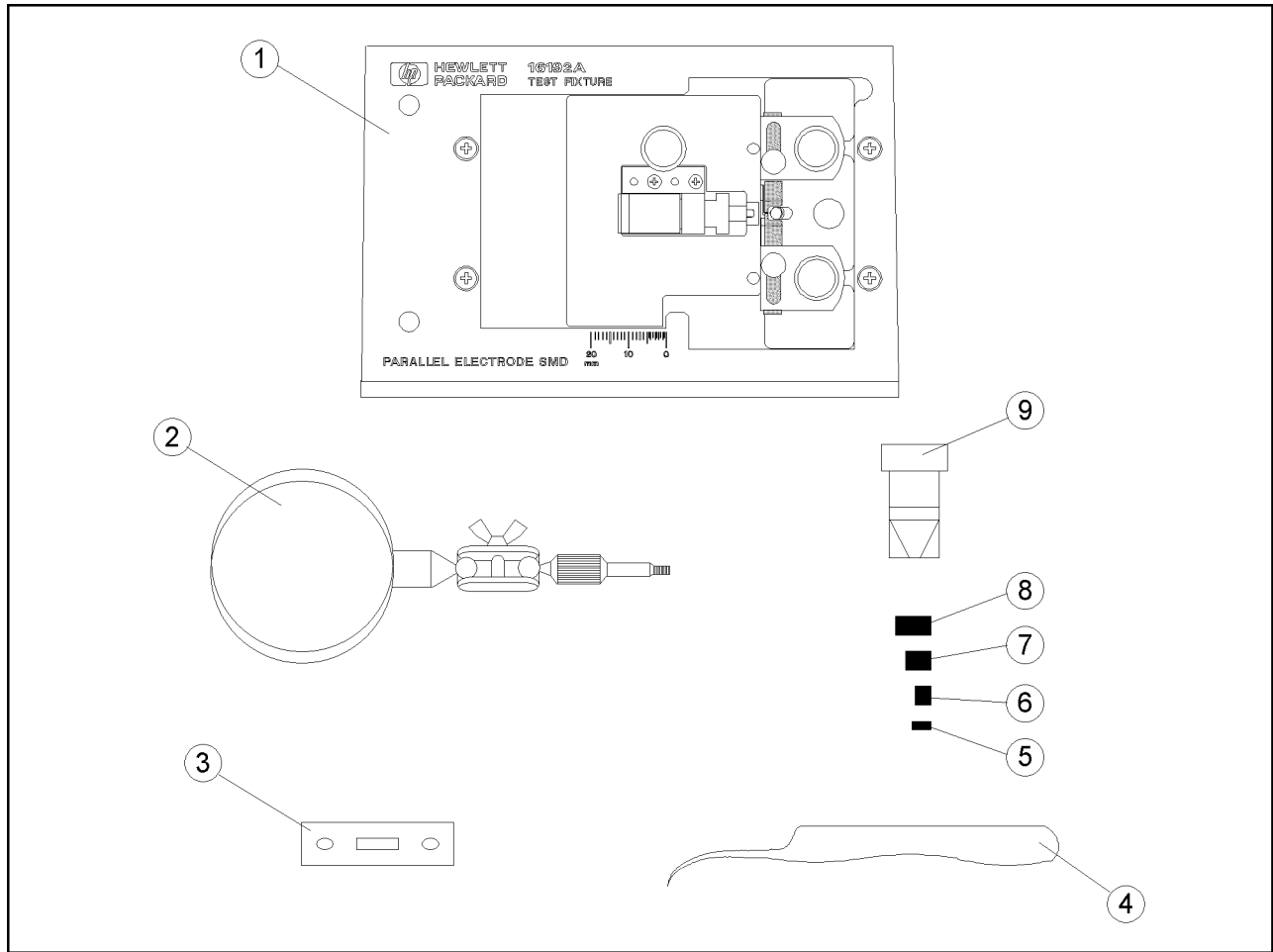
When you repair the HP 16192A, put on lint-free gloves to avoid contaminating inner parts of the HP 16192A. Hewlett-Packard supplies lint-free gloves (HP part number 9300-0163).

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### General Information

Table 4-1 shows all items included with the HP 16192A Parallel Electrode SMD Test Fixture.



ac104010

**Figure 4-1. HP 16192A Product Overview**

**Table 4-1. HP 16192A Product Overview**

Reference Designator	HP Part Number	Qty.	Description
1	(not assigned)	1	Main Assembly
2	16193-60002	1	Magnifying Glass
3	16192-09002	1	Insulator
4	8710-2081	1	Tweezers
5	16191-29001	1	Shorting Device (1×1×2.4 mm)
6	16191-29002	1	Shorting Device (1.6×2.4×2 mm)
7	16191-29003	1	Shorting Device (2.4×2.4×3.2 mm)
8	16191-29004	1	Shorting Device (2.4×2.4×4.5 mm)
9	1540-0692	1	Case for shorting devices
-	16191-29021	1	Styrofoam Holder <sup>1</sup>
-	16192-90000	1	Operation and Service Manual <sup>1</sup>

<sup>1</sup> Not shown in the figure.

---

## **Assembly Replacement**

This section includes Disassembly and Assembly Procedures and Replacement Parts for the Main Assembly.

### **Disassembly and Assembly Procedure**

This section contains the information required to disassemble and assemble the Main Assembly.

#### **Length Positioning Stage Assembly Removal:**

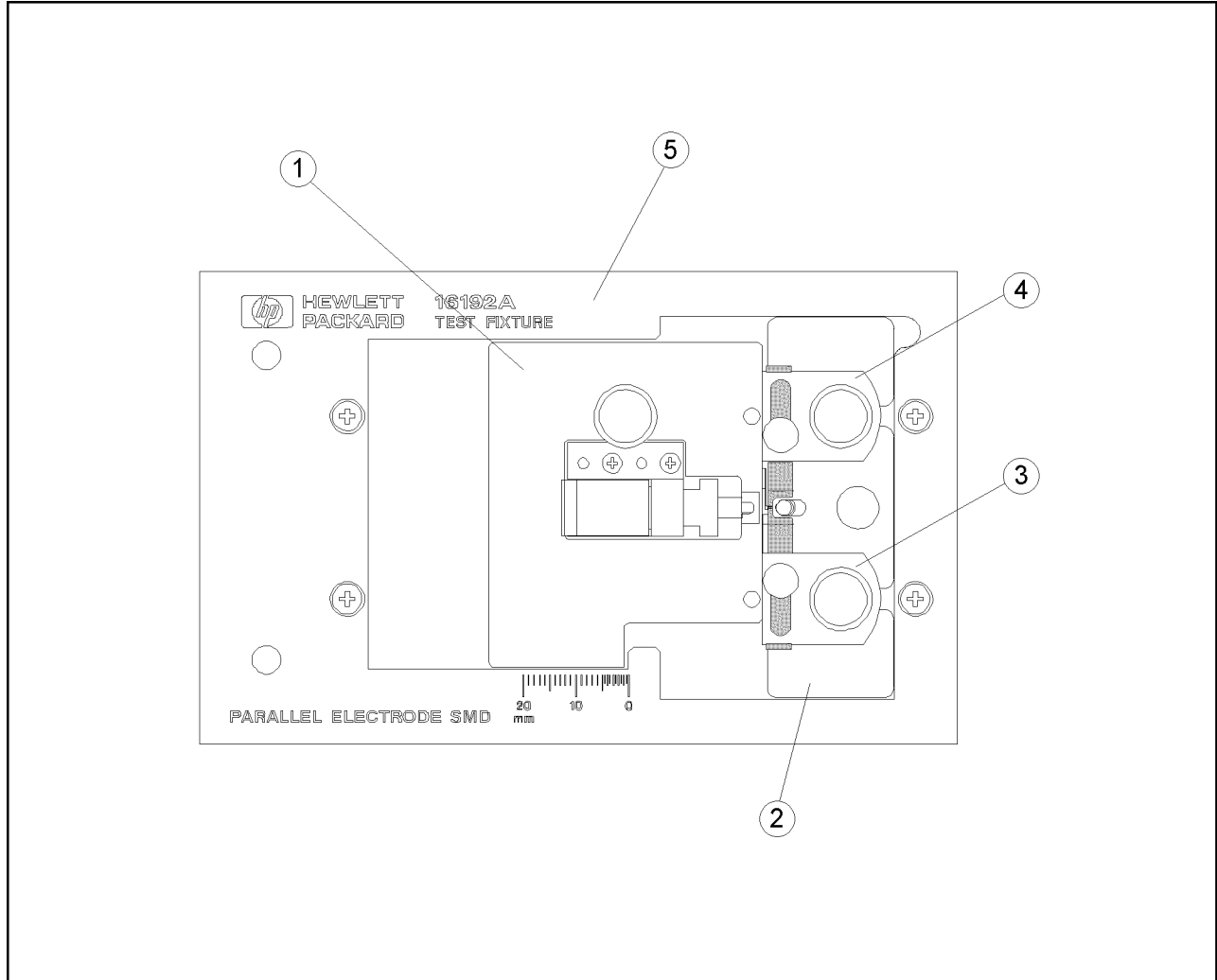
1. Loosen the Length Locking Knob (“1” in Table 4-3).
2. Remove the Length Positioning Stage Assembly (“1” in Table 4-2).

#### **Width Positioning Stage Assembly Removal:**

1. Loosen each Width Positioning Knob (“1” in Table 4-5).
2. Remove each Width Positioning Stage Assembly (“3” and “4” in Table 4-2).
3. Remove the Device Stage (“2” in Table 4-2).

## Replaceable Parts

Table 4-2 through Table 4-5 show and list the replaceable parts for the HP 16192A. The parts listed can be ordered from your nearest Hewlett-Packard Office. Ordering information must include the HP part number and the quantity required.

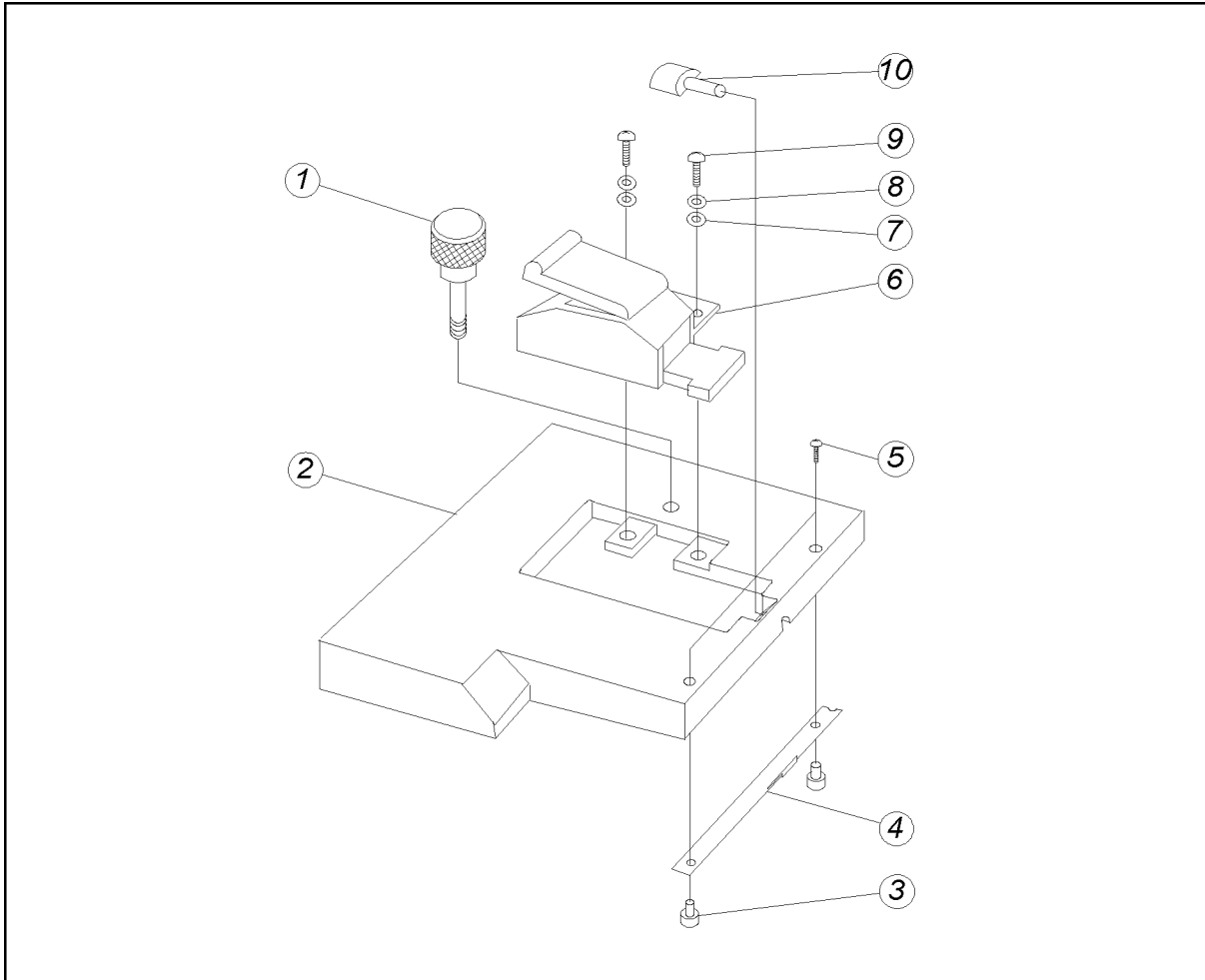


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**Figure 4-2. Replaceable Parts for Main Assembly**

**Table 4-2. Replaceable Parts for Main Assembly**

Reference Designator	HP Part Number	Qty.	Description
1	(not assigned)	1	Length Positioning Stage Assembly
2	16192-09001	1	Device Stage
3	(not assigned)	1	Width Positioning Stage Assembly
4	(not assigned)	1	Width Positioning Stage Assembly
5	(not assigned)	1	Test Stage Assembly

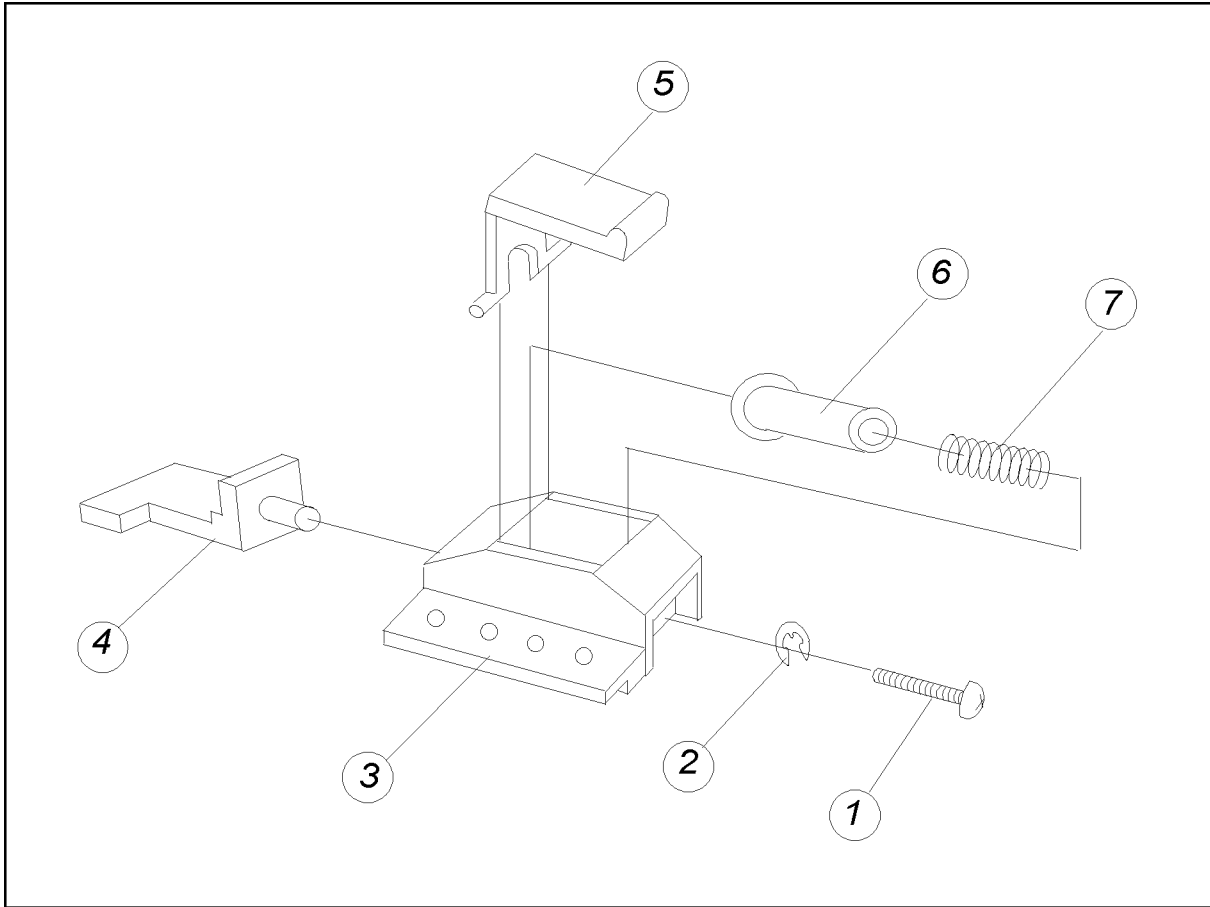


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**Figure 4-3. Replaceable Parts for Length Positioning Stage Assembly**

**Table 4-3. Replaceable Parts for Length Positioning Stage Assembly**

Reference Designator	HP Part Number	Qty.	Description
1	16192-24006	1	Length Locking Knob
2	16192-20002	1	Length Positioning Stage Block
3	16192-23001	2	Nut
4	16192-01202	1	Contact
5	0515-2421	2	Screw M1.4L3
6	(not assigned)	1	Insertion Clip Assembly
7	3050-1066	2	Washer
8	2190-0654	2	Washer
9	0515-0976	2	Screw Pan Head M2L6
10	16192-25004	1	Rod

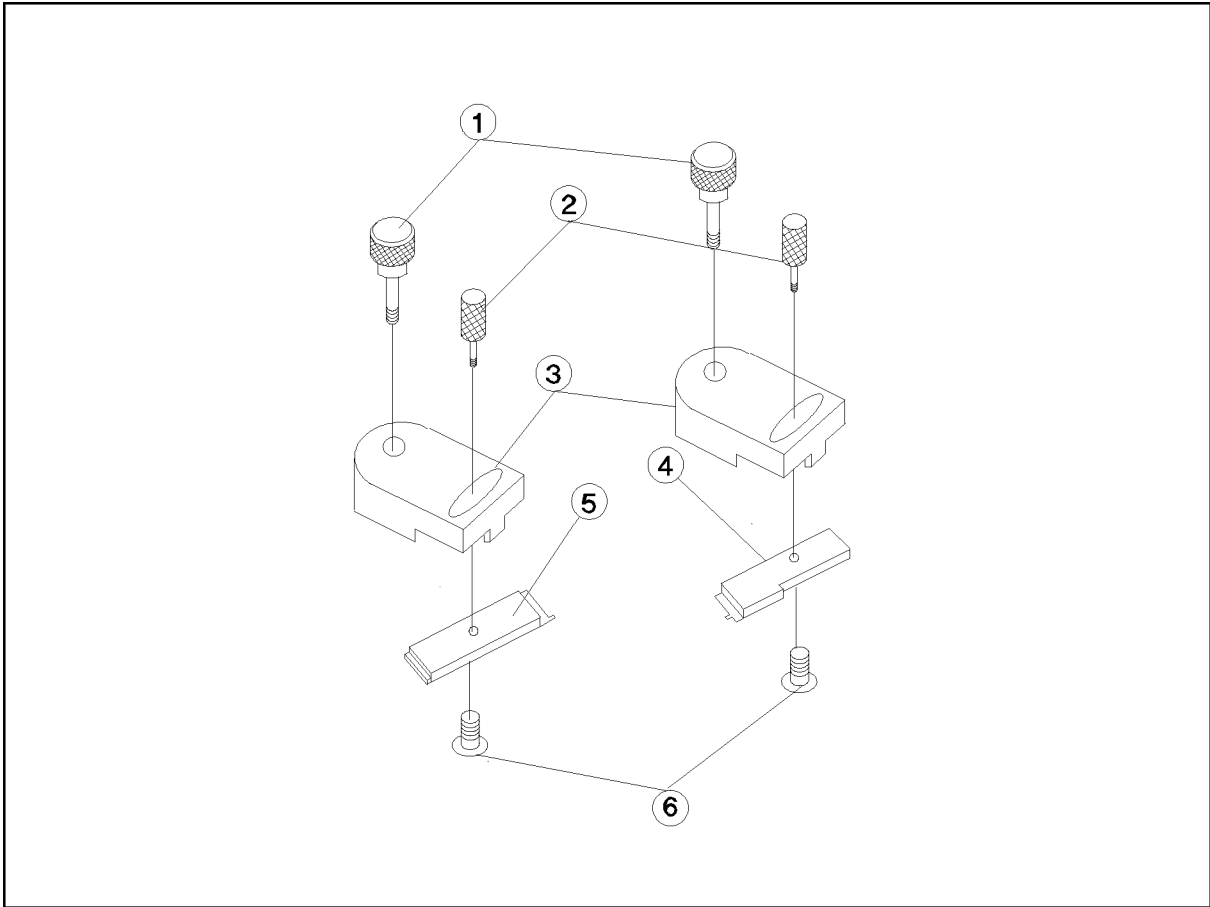


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**Figure 4-4. Replaceable Parts for Insertion Clip Assembly**

**Table 4-4. Replaceable Parts for Insertion Clip Assembly**

Reference Designator	HP Part Number	Qty.	Description
1	0520-0133	1	Screw
2	2190-0014	1	Washer
3	16092-40010	1	Holder
4	16092-40016	1	Holder
5	16092-40011	1	Lever
6	16092-23010	1	Shaft
7	1460-0352	1	Spring

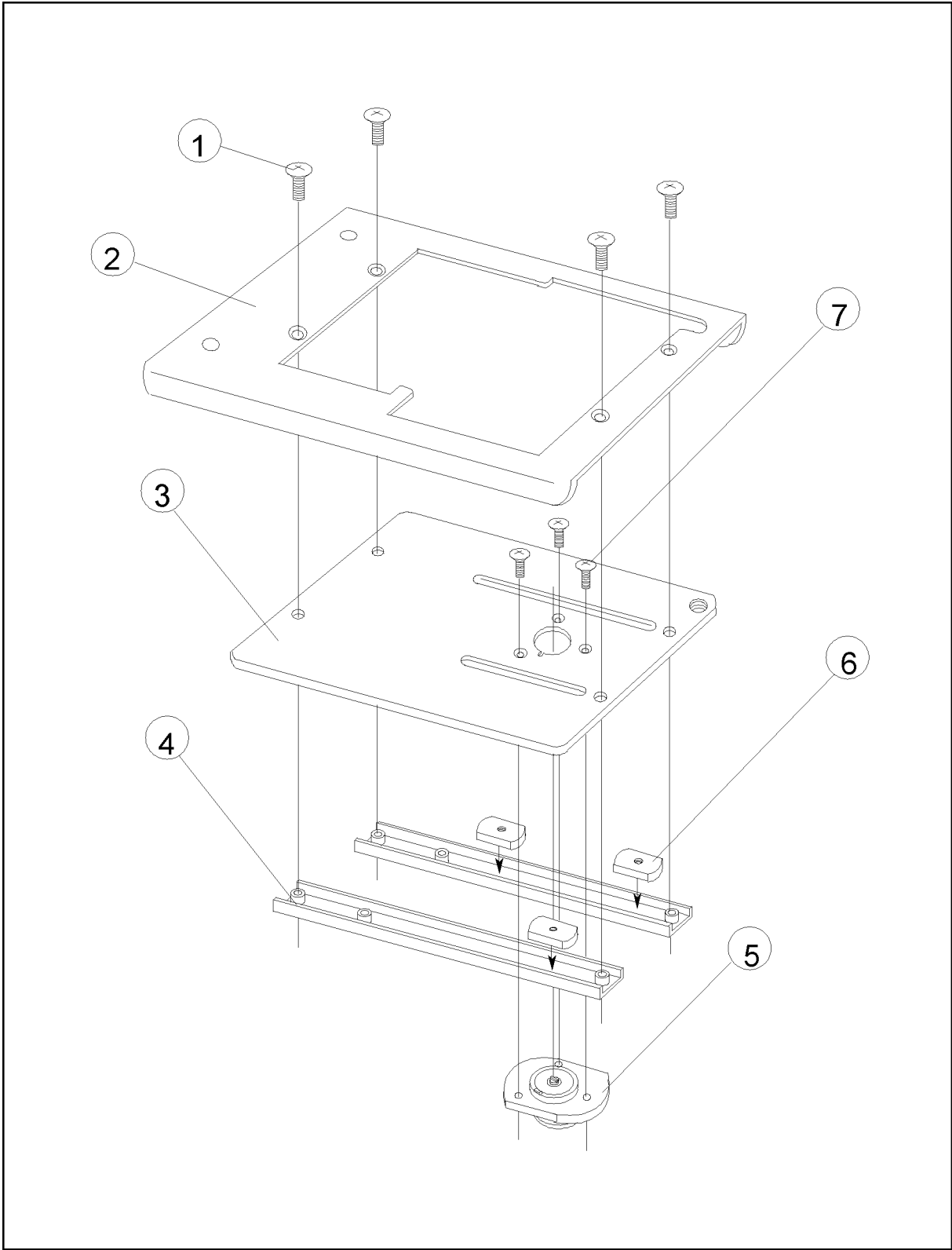


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**Figure 4-5. Replaceable Parts for Width Positioning Stage Assembly**

**Table 4-5. Replaceable Parts for Width Positioning Stage Assembly**

<b>Reference Designator</b>	<b>HP Part Number</b>	<b>Qty.</b>	<b>Description</b>
1	16192-24006	2	Width Positioning Knob
2	16192-24005	2	Device Holder Adjustment Knob
3	16192-24004	2	Holder
4	16192-25002	1	Device Holder L
5	16192-25003	1	Device Holder R
6	0515-0994	2	Screw Flat Head M2L6



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**Figure 4-6. Replaceable Parts for Test Stage Assembly**



**Table 4-6. Replaceable Parts for Test Stage Assembly**

<b>Reference Designator</b>	<b>HP Part Number</b>	<b>Qty.</b>	<b>Description</b>
1	0515-0914	4	Screw Flat Head M3L6
2	16192-00201	1	Table
3	16192-00603	1	Plate
4	16192-01201	2	Angle
5	16192-60001	1	Contact Assembly
6	16192-24013	3	Nut
7	0515-0952	3	Screw Flat Head M2L4

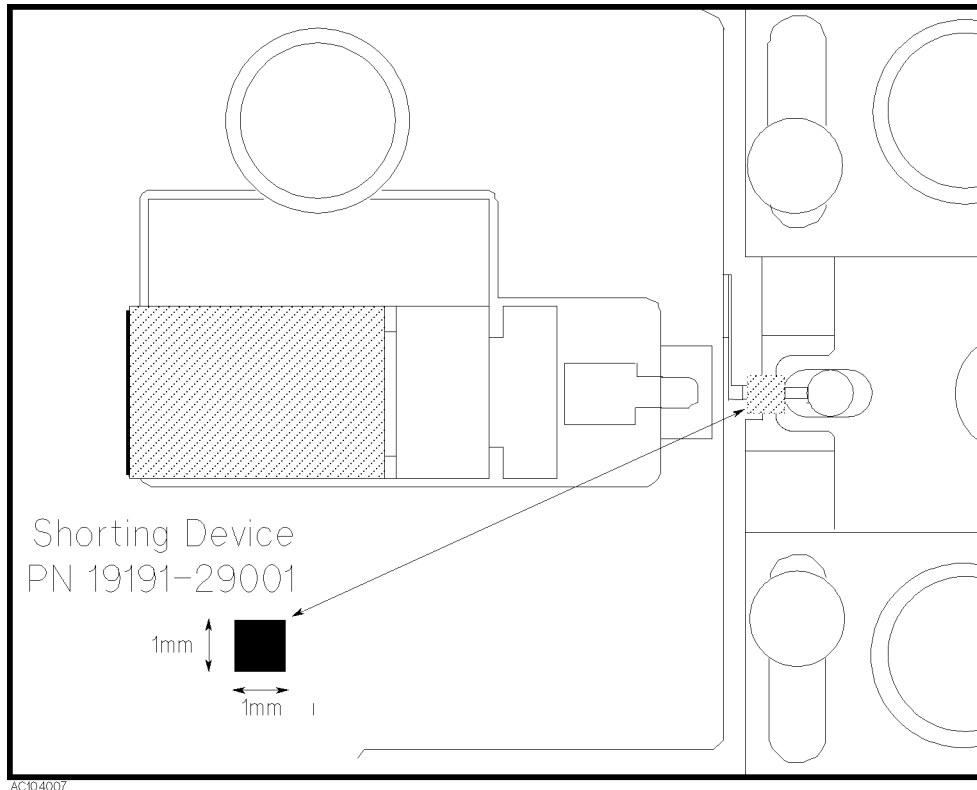
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## Troubleshooting

This section includes the functional check procedure used to troubleshoot the HP 16192A Parallel Electrode SMD Test Fixture.

### Open Impedance Check

1. Adjust the electrode distance for connecting the 1×1×2.4 mm Shorting Device (PN 16191-29001).  
(Refer to Figure 4-7.)



**Figure 4-7. Shorting Device Position**

2. Place the fixture on the calibrated APC-7<sup>®</sup> terminal of the HP 4291A RF Impedance/Material Analyzer.
3. Set the HP 4291A RF Impedance/Material Analyzer as follows:

Measurement Parameter	Cp (parallel capacitance)
Start Frequency	100 MHz
Stop Frequency	1 GHz
OSC Level	0.12 V
Number of Point	2
Point Averaging Factor	16
Point Averaging	ON
4. Perform a single sweep measurement.
5. Read Cp value at 100 MHz and 1 GHz.

The guideline for the open impedance value is as follows:

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**Table 4-7. Open Impedance Value Guideline**

Parameter	Frequency	Guideline (absolute value)
Cp	100 MHz	750 fF ± 300 fF
Cp	1 GHz	750 fF ± 300 fF

### Short Impedance Check

1. After the Open Impedance Check is completed, put the 1×1×2.4 mm Shorting Device (PN 16191-29001) between the electrodes (refer to Figure 4-7).
2. Set the HP 4291A RF Impedance Analyzer as follows:

Measurement Parameter	Ls (series inductance)
Start Frequency	100 MHz
Stop Frequency	1 GHz
OSC Level	0.12 V
Number of Point	2
Point Averaging Factor	16
Point Averaging	ON

3. Make a single sweep measurement.
4. Read Ls value at 100 MHz and 1 GHz.

The guideline of the short impedance value is as follows:

**Table 4-8. Short Impedance Value Guideline**

Parameter	Frequency	Guideline (absolute value)
Ls	100 MHz	4.5 nH ± 1.5 nH
Ls	1 GHz	4.5 nH ± 1.5 nH

### Short Impedance Repeatability Check

1. After the Short Impedance Check is completed, remove the Shorting Device and put it back on the same place again (refer to Figure 4-7).
2. Make a single sweep measurement with the same measurement conditions.
3. Read Lp value at 100 MHz and 1 GHz and check the value is within the Short Impedance Value Guideline described in Table 4-8.
4. Calculate the difference between the first Ls measurement value and second Ls measurement value at each frequency.

The guideline for the short impedance repeatability is as follows:

**Table 4-9. Short Impedance Repeatability Guideline**

Parameter	Frequency	Guideline (difference)
Ls	100 MHz	± 45 pH
Ls	1 GHz	± 20 pH

