Keysight 16197A Bottom Electrode SMD Test Fixture

Operation and Service Manual

KEYSIGHT TECHNOLOGIES

Notices

Trademark Acknowledgments

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CAUTION

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WARNING

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Table of Contents

1 Installation Guide

This chapter describes the necessary operations to perform before using the delivered Bottom Electrode SMD Test Fixture16197A.

Inspection before Unpacking

Upon receiving the product package, inspect the packing box before unpacking to make sure it is not damaged. If the packing box or packing materials have been damaged, keep the box and materials until it has been confirmed that all necessary components have been delivered and that product operation is normal both mechanically and electrically.

Check the package contents against Table 1-1. If any component is missing, or mechanically damaged or defective, please contact Keysight Technologies local sales office. If the packing box has been damaged or the packing materials have been severely deformed, please contact the freight company as well as our sales office. Until the freight company carries out its inspection, store the packing box and materials as they are, with all product components left inside.

NOTE

Before using this product for the first time after delivery, carry out "Deterioration Check" on page 47, which is necessary to ensure accurate measurement. For details, see "Acquiring Reference Values" on page 48 of the "Deterioration Check" section.

Figure 1-1 Package Contents of 16197A

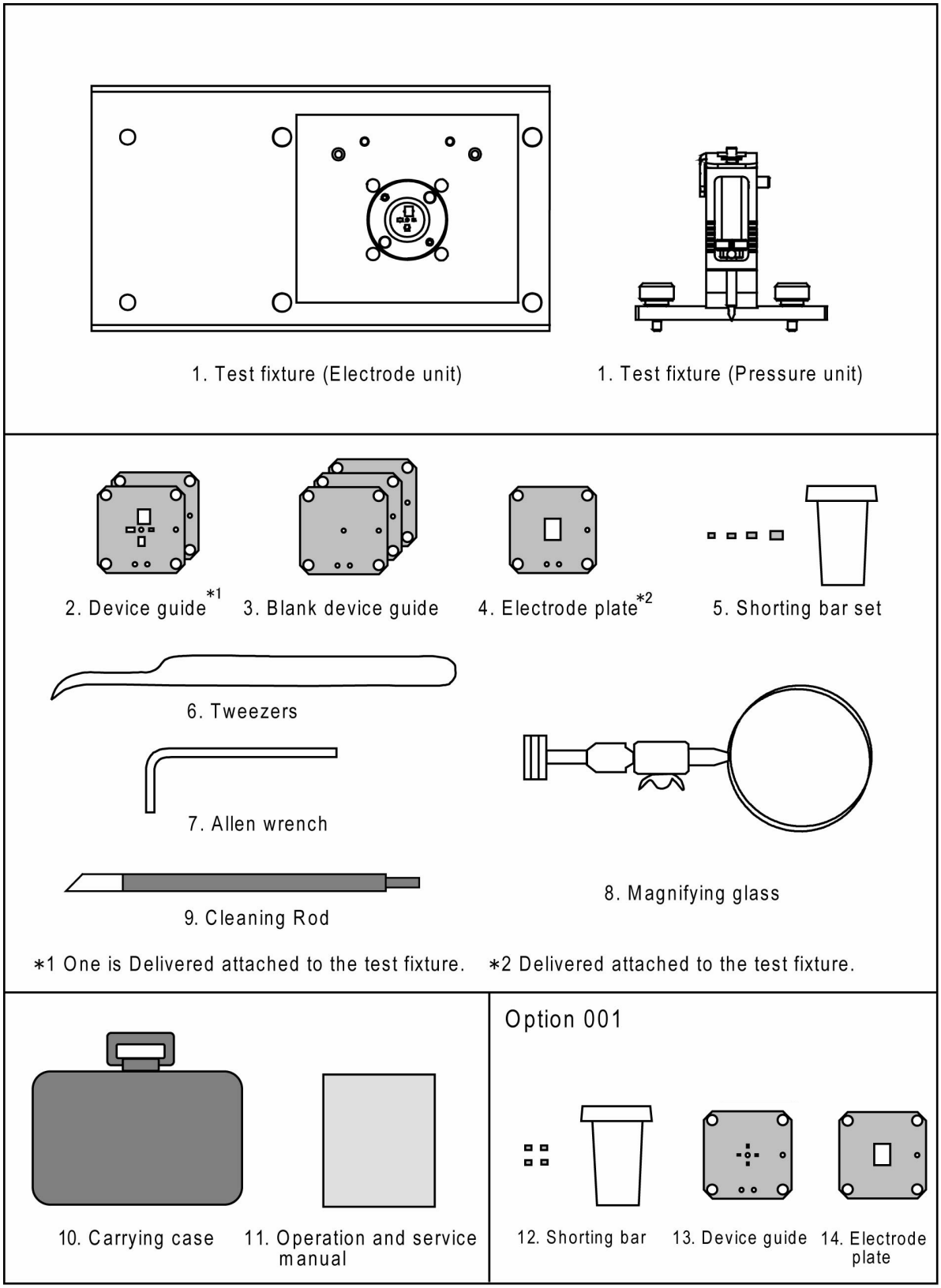


Table 1-1 Package Contents of 16197A

No	Name	Keysight part number	Qty
1	Bottom-electrode SMD test fixture 16197A	-	1
2	Device guide [1]	16197-25005	2
3	Blank device guide	16197-25006	3
4	Electrode plate[2]	16197-00603	1
5	EIA/EIAJ -size, Shorting bar set		
	Shorting bar 1.0 x 0.5 x 0.5[3]	16191-29005	1
	Shorting bar 1.6 x 0.8 x 0.8[3]	16191-29006	1
	Shorting bar 2.0 x 1.2 x 0.8[3]	16191-29007	1
	Shorting bar 3.2 x 1.6 x 0.8[3]	16191-29008	1
6	Tweezers	8710-2081	1
7	Allen wrench	8710-0909	1
8	Magnifying glass	16193-60002	1
9	Cleaning rod	5182-7586	1
10	Carrying case	16197-60060	1
11	Operation and service manual (this manual)	16197-90020	1
Option 001			
12	Shorting bar 0.6 x 0.3 x 0.3	16197-29001	4
13	Device guide	16197-25007	1
14	Electrode plate	16197-00604	1

1. One is Delivered attached to the test fixture
2. Delivered attached to the test fixture
3. Shorting bars are delivered together in one case.

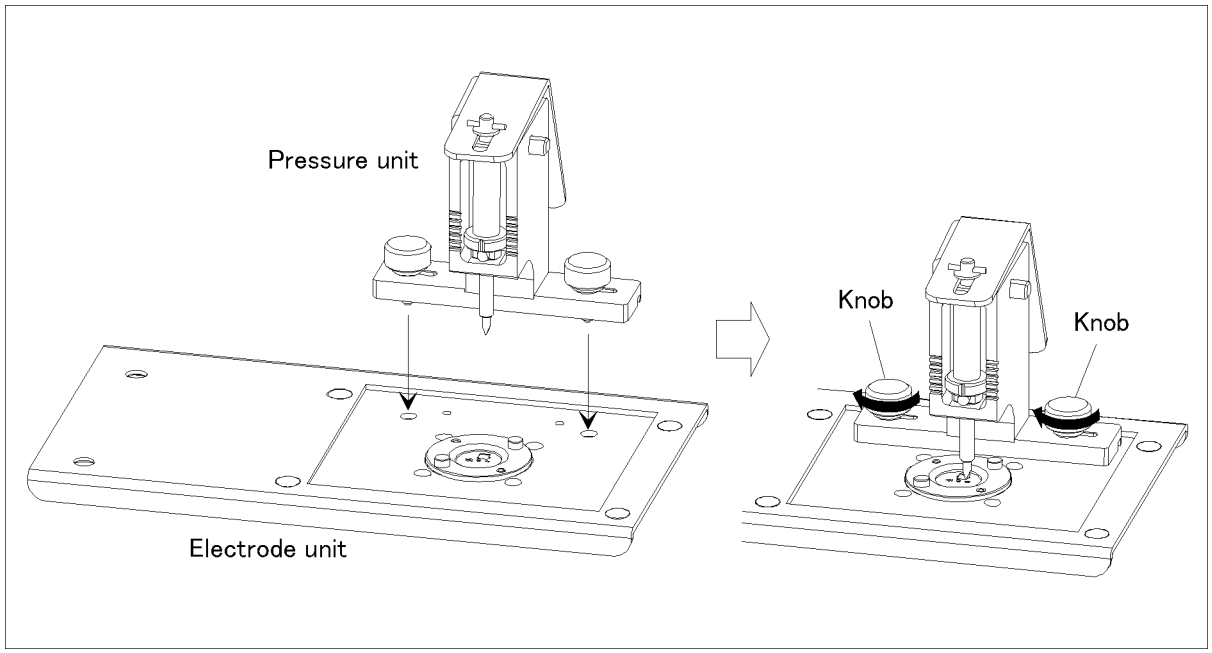
Assembly and Storage of 16197A

The 16197A is delivered in a carrying case, disassembled into a pressure unit and an electrode unit. Assemble the fixture before use. Disassemble the fixture when storing it in the carrying case.

Assembly of 16197A

Before using the 16197A, install the pressure unit onto the electrode unit as shown in Figure 1-2.

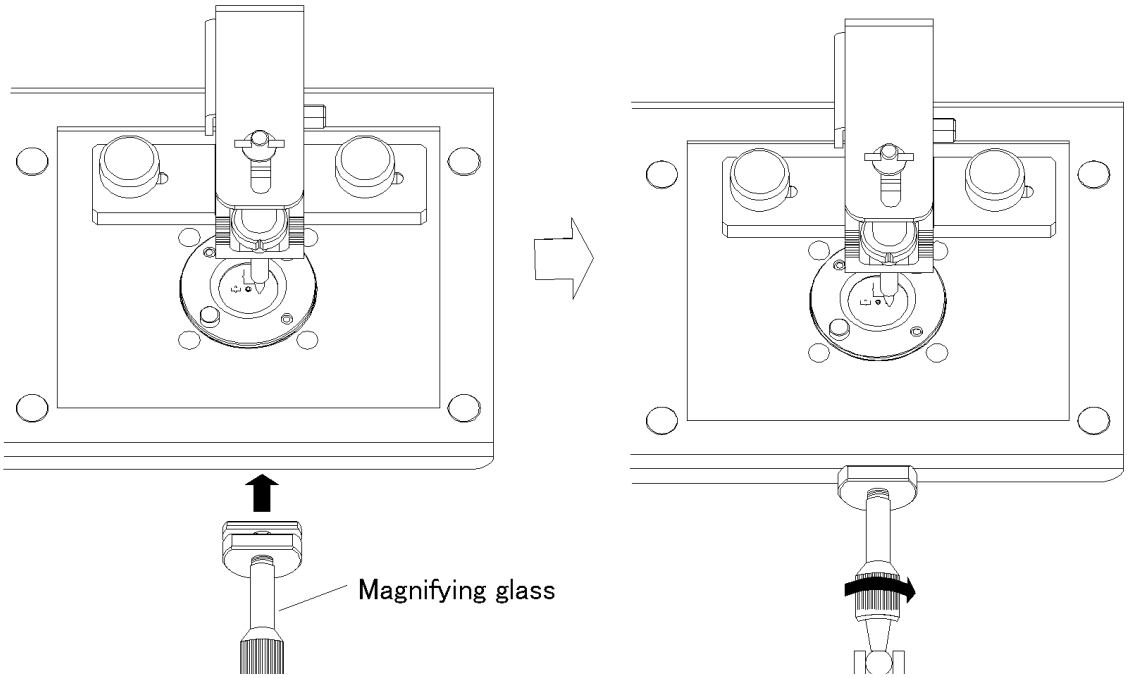
Figure 1-2 Installing the Pressure Unit



Installing the Magnifying Glass

If the magnifying glass is used, install it on the edge of the electrode unit as shown in Figure 1-3.

Figure 1-3 Installing the Magnifying Glass



Storage

Before storing the 16197A, remove the pressure unit from the electrode unit (Figure 1-4) and loosen the pressure adjusting nut on the pressure unit (Figure 1-5). Also remove the magnifying glass, if installed.

Figure 1-4 Removing the Pressure Unit

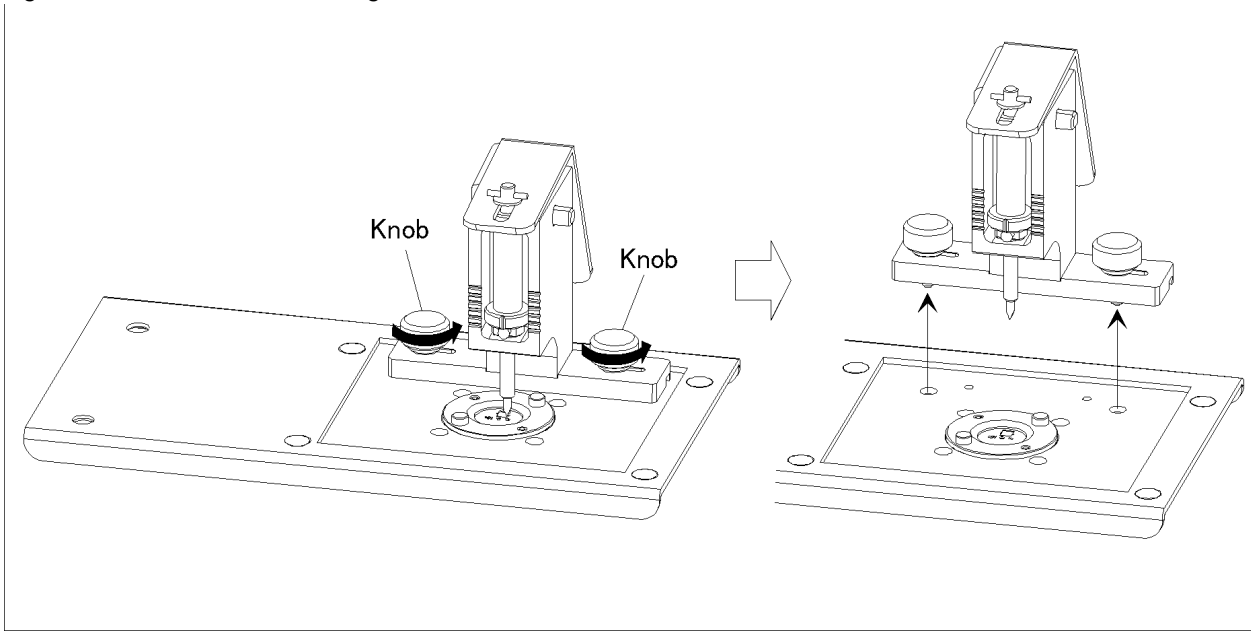
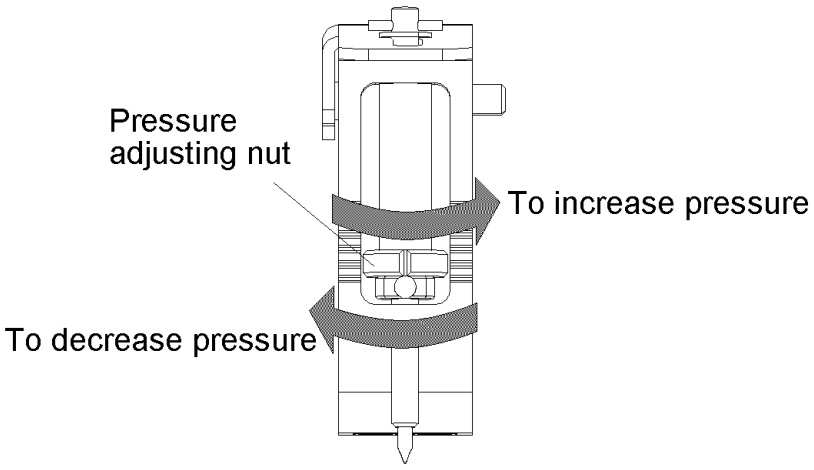


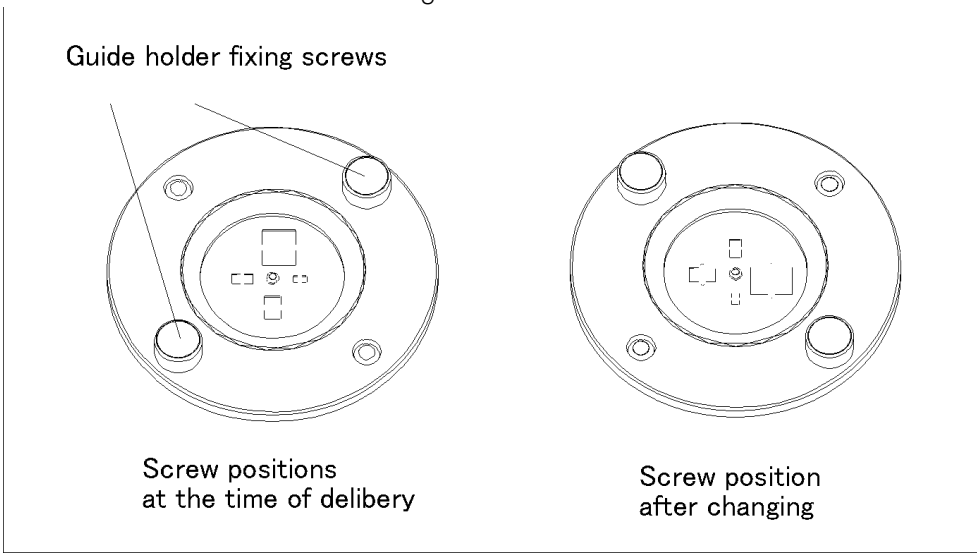
Figure 1-5 Pressure Adjusting Nut



Changing the Positions of the Guide Holder Fixing Screws

If the guide holder fixing screws hamper operation, the positions of these screws can be changed.

Figure 1-6 Positions of the Guide Holder Fixing Screws



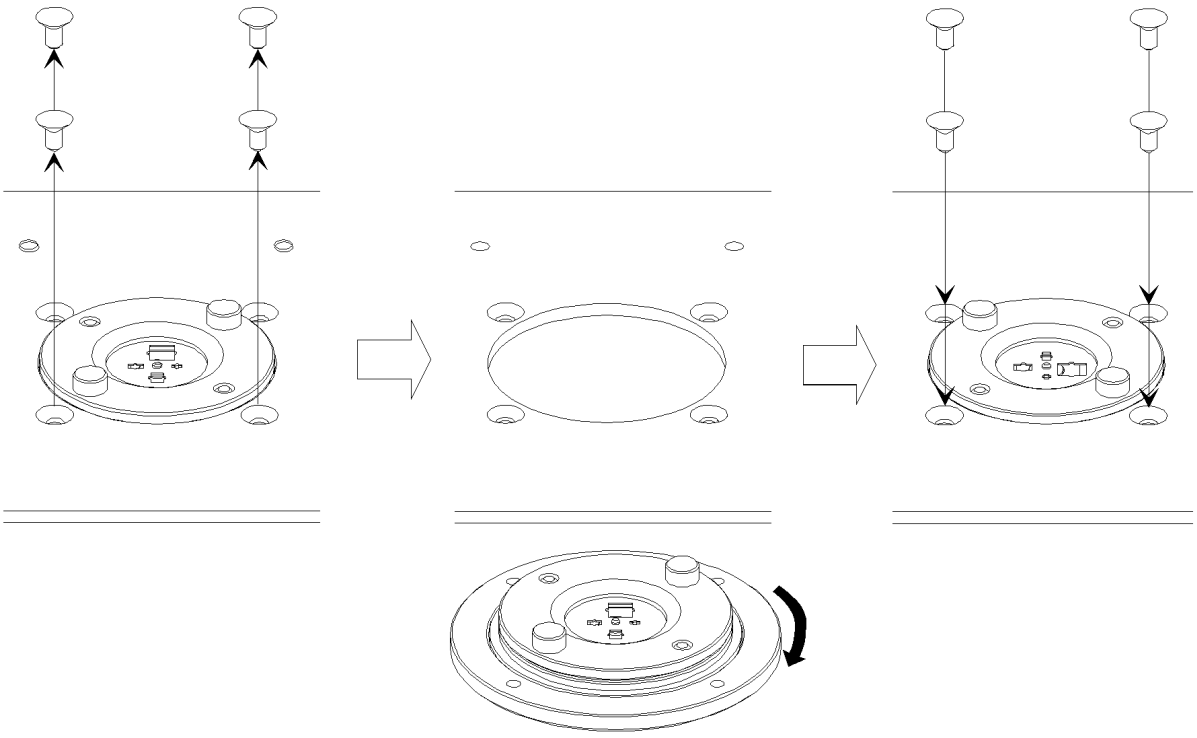
Method for Changing the Positions of the Guide Holder Fixing Screws

Before changing the positions of the fixing screws, remove the pressure unit.

Step 1. Remove the four screws that fix the guide holder flange(Figure 1-7).

Step 2.Rotate the guide holder by 90 degrees together with components fixed on the flange, and again set the guide holder in place (Figure 1-7).

Figure 1-7 Changing the Positions of the Guide Holder Fixing Screws



Connecting the Test Fixture with a Measuring Instrument

Connecting the test fixture 16197A with a measuring instrument requires an adapter suited to the instrument.

The test fixture 16197A is suitable for use with a high-frequency LCR meter or an impedance analyzer. Table 1-2 shows possible adapter combinations.

Table 1-2 Adapter for a Measuring Instrument

Measuring Instrument	Adapter
E4991A	Test head (supplied with the E4991A)
E4991B	Test head (supplied with the E4991B)
E4982A	Test head (supplied with the E4982A), Test Fixture Stand (Opt. 710) and 3.5mm- 7mm Coaxial Adapter (opt.720)
4294A, E4990A-120	42942A terminal adapter
E5061B-3L3/3L4/3L5 with Opt. 005	16201A

The test fixture 16197A can also be connected with any measuring instrument with 4-terminal pair configuration if an appropriate adapter is used.

For the procedure for attaching an adapter, see the Operation Manual for the adapter.

NOTE

Calibration on the 7-mm connector surface may be necessary depending on the type of measuring instrument. In such a case, perform calibration on the 7-mm connector surface before connecting the test fixture with the measuring instrument. For details, see the Operation Manual for the measuring instrument.

Below is the general procedure for attaching an adapter to the test fixture. (For details, see the Operation Manual for each adapter.

Step 1. Rotate the 7mm connector on the adapter counterclockwise as viewed from above to completely retract the connecting sleeve.

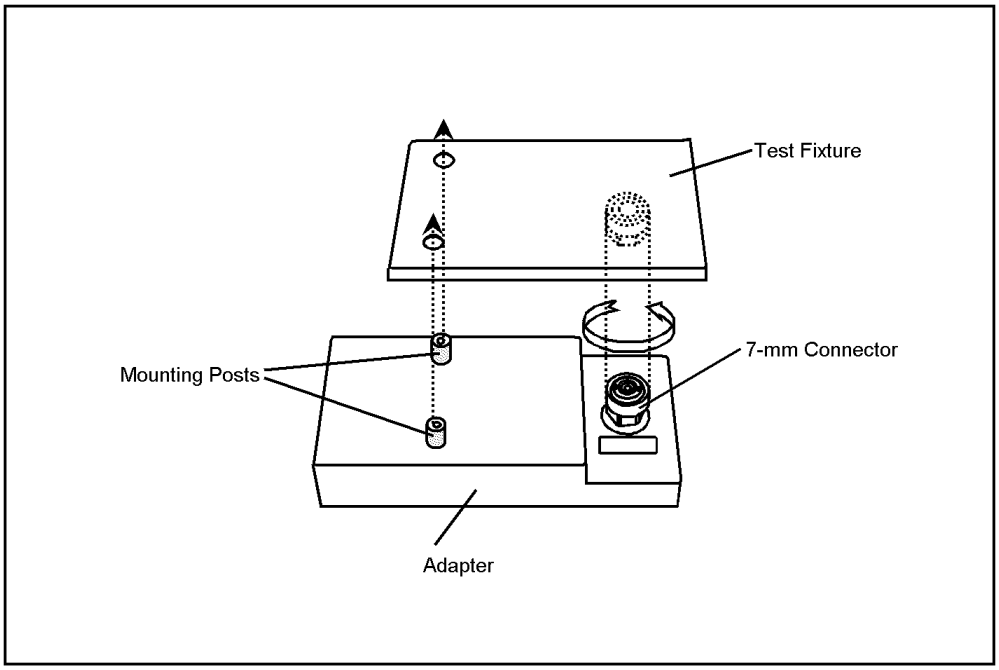
Step 2. Gently place the test fixture onto the adapter, aligning the mounting holes with the mounting posts on the adapter, and the 7mm connector with that on the adapter.

Step 3. Rotate the 7mm connector on the adapter counterclockwise as viewed from above to connect it with the connector on the bottom of the test fixture.

NOTE

Turn the 7-mm connector on the adapter using a 3/4-inch torque wrench with 12 lb-inch torque (Keysight part number: 8710-1766) to firmly connect the test fixture.

Figure 1-8 Installing the Test Fixture



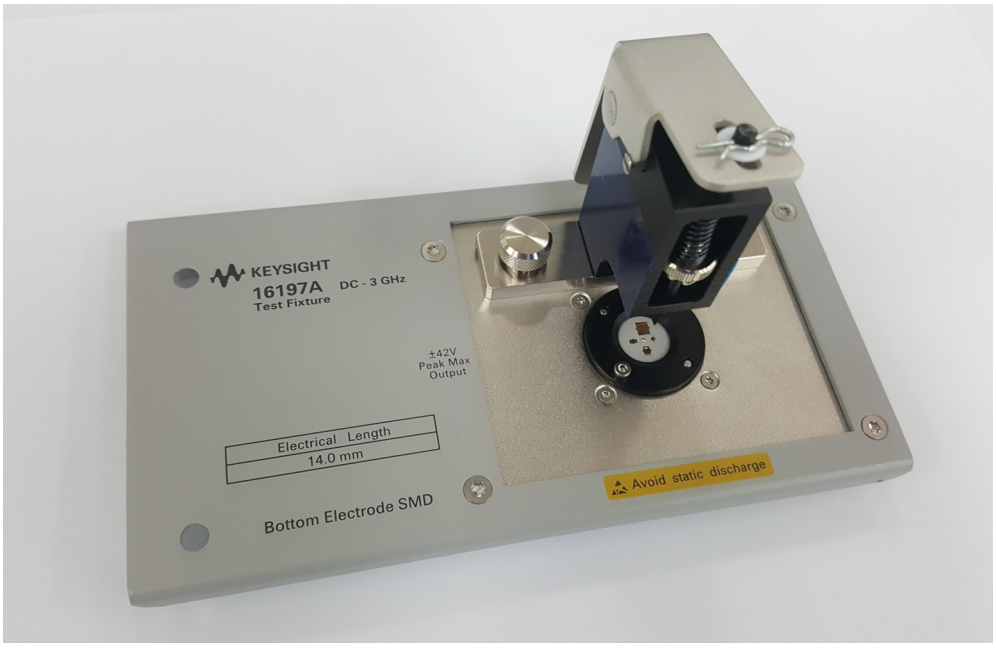
16196abcoj0101

2 Product Description

Product Description

The 16197A is a test fixture for use in measuring bottom-electrode chip components. It enables highly accurate and repeatable measurement of chip-type capacitors, inductors, and other similar components. The 16197A is compatible with measuring frequencies to 3GHz, and can accommodate bottom-electrode chip components of sizes 3225 [1](1210[2]), 3216(1206[2]), 2012[1](0805[2]), 1608[1](0603[2]), and 1005[1](0402[2]). Measurement of chip components of other sizes is possible by preparing appropriate device guides. Measurement of a bottom-electrode chip component of size 0603[1](0201[2]) is also possible using the option.

Figure 2-1 Product Appearance



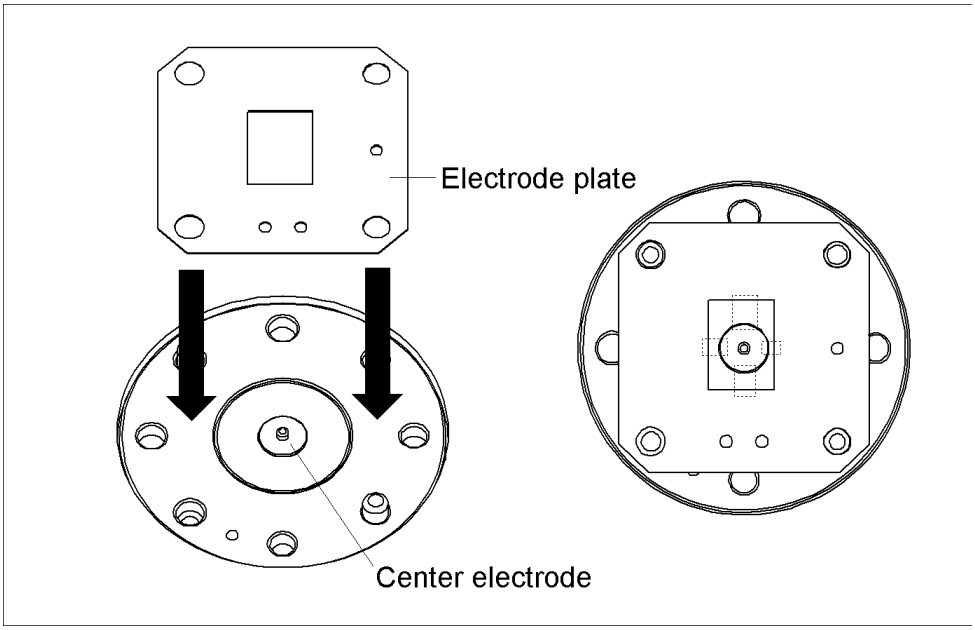
1. EIAJ size
2. EIA size

Mechanism for Connecting a DUT (Device Under Test)

The 16197A uses a device guide and an electrode plate for measuring to various sizes of bottom-electrode SMDs.

The electrode plate is placed onto the center electrode of the electrode unit, producing four different electrode spaces between the center electrode and electrode plate (Figure 2-2).

Figure 2-2 Structure of Electrode (1)



The device guide is placed on the electrode plate to enable each DUT to be positioned in a fixed location (Figure 2-3). Each DUT is set in a frame of the size suitable to the DUT for connecting to the electrode (Figure 2-4).

Product Description

Figure 2-3 Structure of Electrode (2)

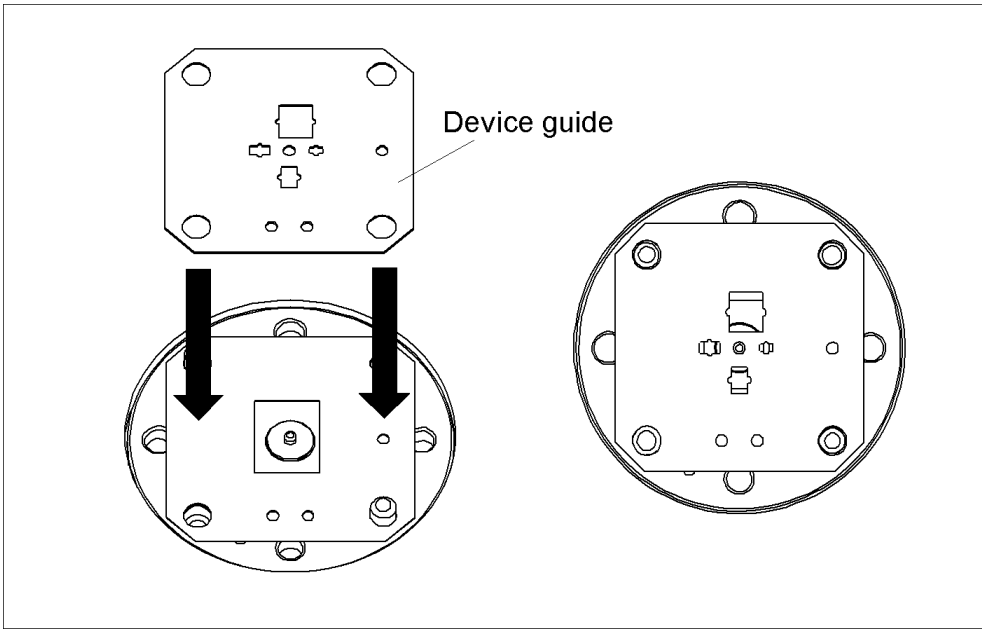
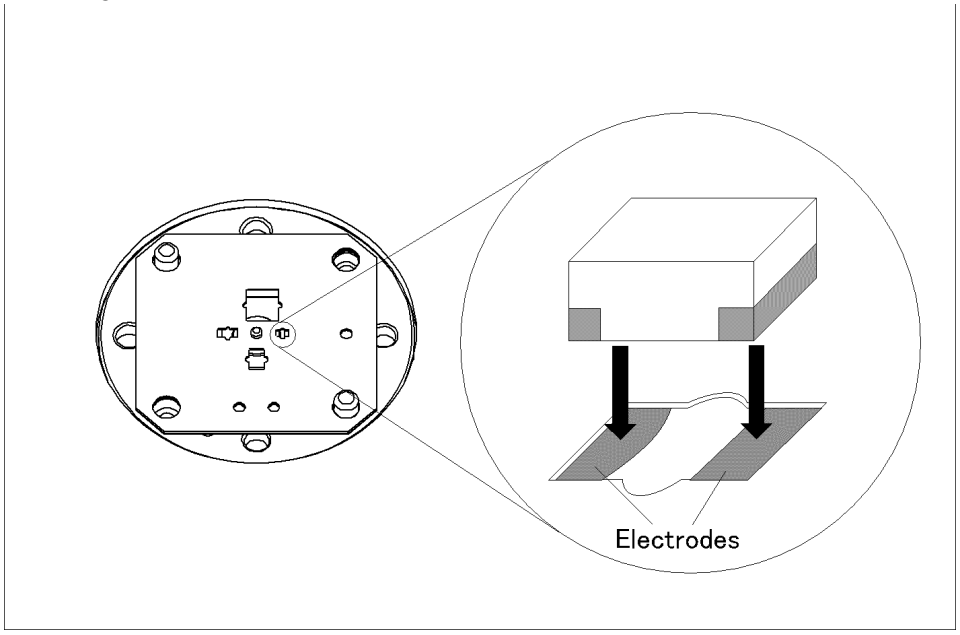
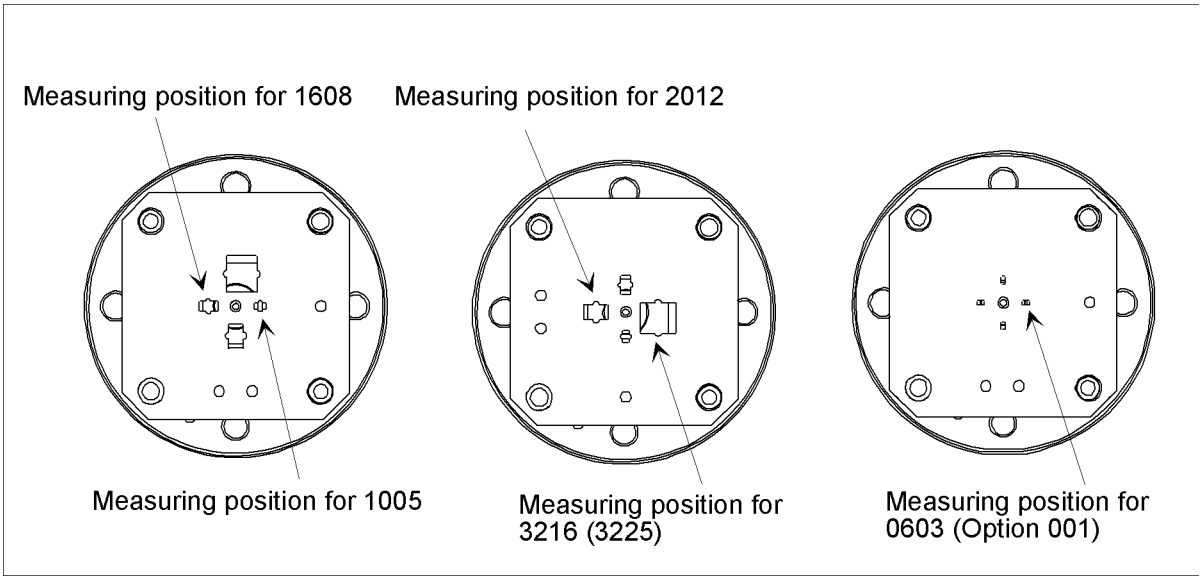


Figure 2-4 Connecting a DUT



The DUT is to be fixed under pressure from the pressure rod. Since the movable range of the pressure rod is limited, either one of the two lateral frames in the device guide can be used as the measuring position (Figure 2-5). Therefore, before connecting a DUT, it may be necessary to change the orientation of the electrode plate and device guide set in place so that the appropriate electrode and device guide frame arrive at the measuring position.

Figure 2-5 Measuring Position for Each Device Size



Names & Functions of Parts

Figure 2-6 shows the part names for the 16197A.

Figure 2-6 Names of Parts

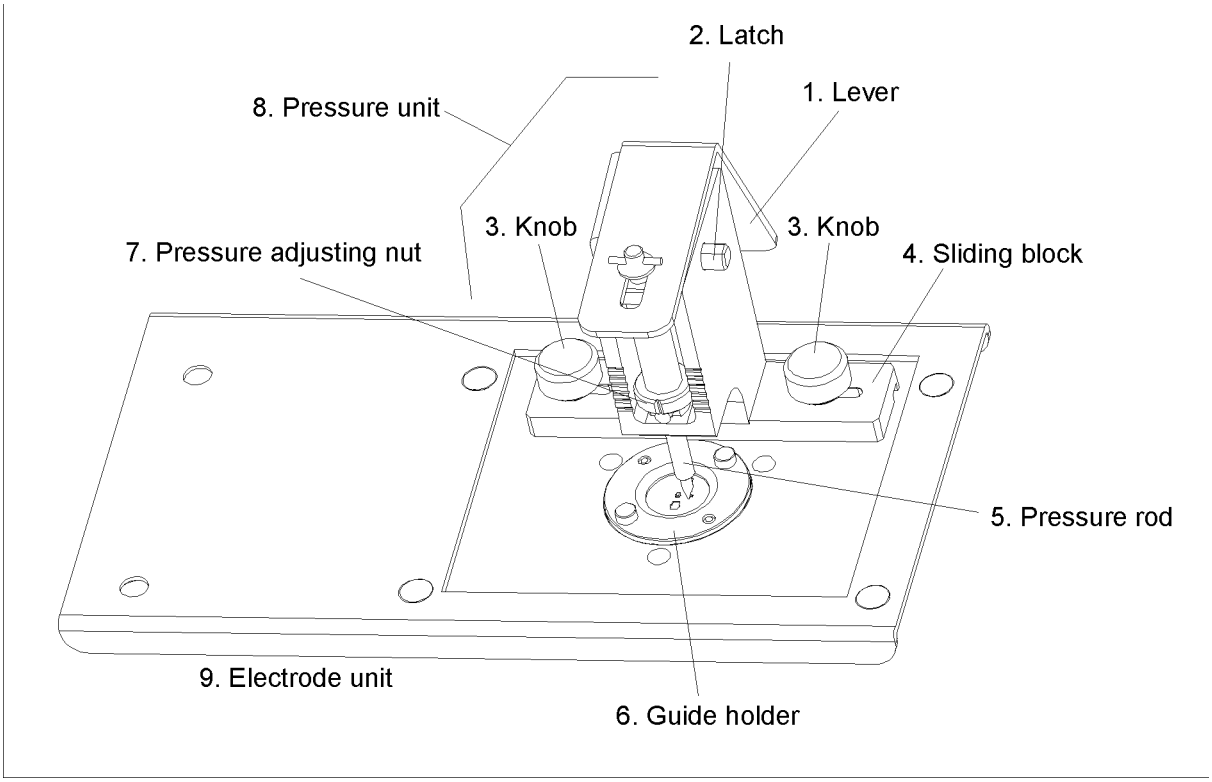


Table 2-1 Names & Functions of Parts

No	Name	Function
1	Lever	Used to raise or lower the pressure rod
2	Latch	Used to fix the lever to retain the pressure rod in its raised position
3	Knob	Used to fix the pressure unit
4	Sliding block	Used to laterally move the pressure unit
5	Pressure rod	Used to fix the DUT by downward pressure during measurement
6	Guide holder	Used to fix the electrode plate and device guide
7	Pressure adjusting nut	Used to adjust the DUT-retaining pressure of the pressure rod
8	Pressure unit	Apparatus to retain the DUT, etc.

Table 2-1 Names & Functions of Parts

No	Name	Function
9	Electrode unit	The electrode section to which the DUT, etc. are connected

Names & Functions of Accessories

Figure 2-7 shows the names of standard accessories of the 16197A, and those of accessories available in Option 001.

Figure 2-7 Accessories

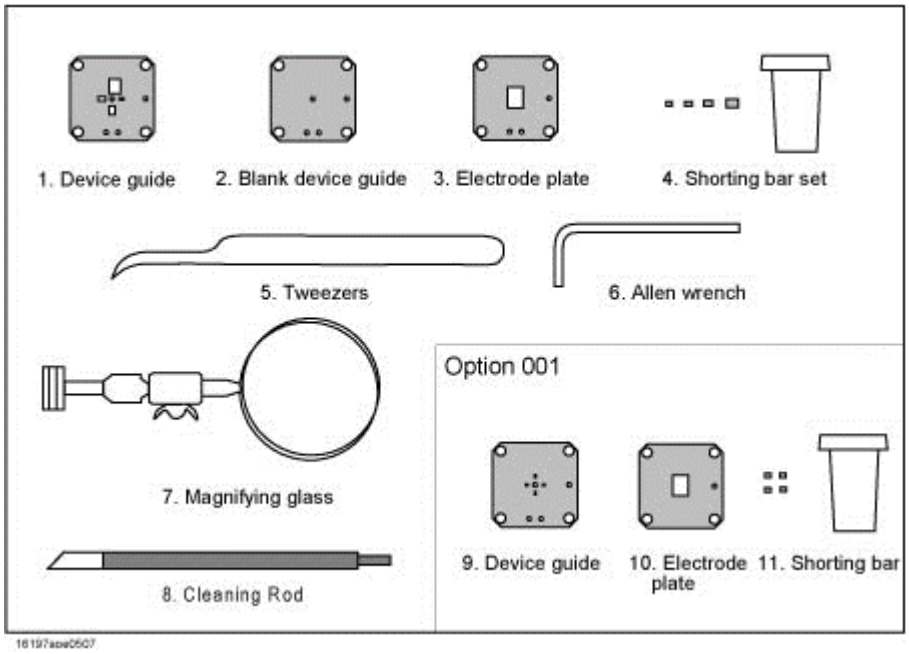


Table 2-2 Names & Functions of Accessories

No	Name	Function
1	Device guide[a]	Used to position the DUT, etc. when connecting it to the electrode
2	Blank device guide	Used to prepare a device guide frame suited to a DUT of a size not fitting any frame in the attached device guide
3	Electrode plate[a]	Used to create various electrode spaces
4	Shorting bar set	Shorting bars in EIA/EIAJ sizes, and a case for storing them. These bars are used during of SHORT compensation.

Table 2-2 Names & Functions of Accessories

No	Name	Function
5	Tweezers	Used to handle shorting bars, the DUT, etc.
6	Allen wrench	Used to tighten/loosen hexagonal nuts
7	Magnifying glass	Used to magnify the view of a connector, electrode, etc.
8	Cleaning rod	Used to clean the electrodes. Refer to “Cleaning Method” on page 45 in Chapter 4.
Option 001		
9	Device guide	Device guide for 0603 devices
10	Electrode plate	Electrode plate for 0603 devices
11	Shorting bar	Shorting bars for 0603 devices, and a case for storing them. These bars are used during SHORT compensation.

a. Delivered attached to the electrode unit

3 Operation

This chapter describes the procedures for measurement preparation, fixture compensation, connection of a DUT, and measurement with the 16197A.

Measurement Flow

To measure a DUT by taking measurements with the 16197A, follow the procedure below.

Step 1. Setting the measuring conditions
Set the measuring conditions for the measuring instrument to be used.

Step 2. Performing calibration
Calibrate the measuring instrument adapters, if necessary.

Step 3. "Setting the Electrical Length" on page 25
Set the electrical length for the measuring instrument, if necessary.

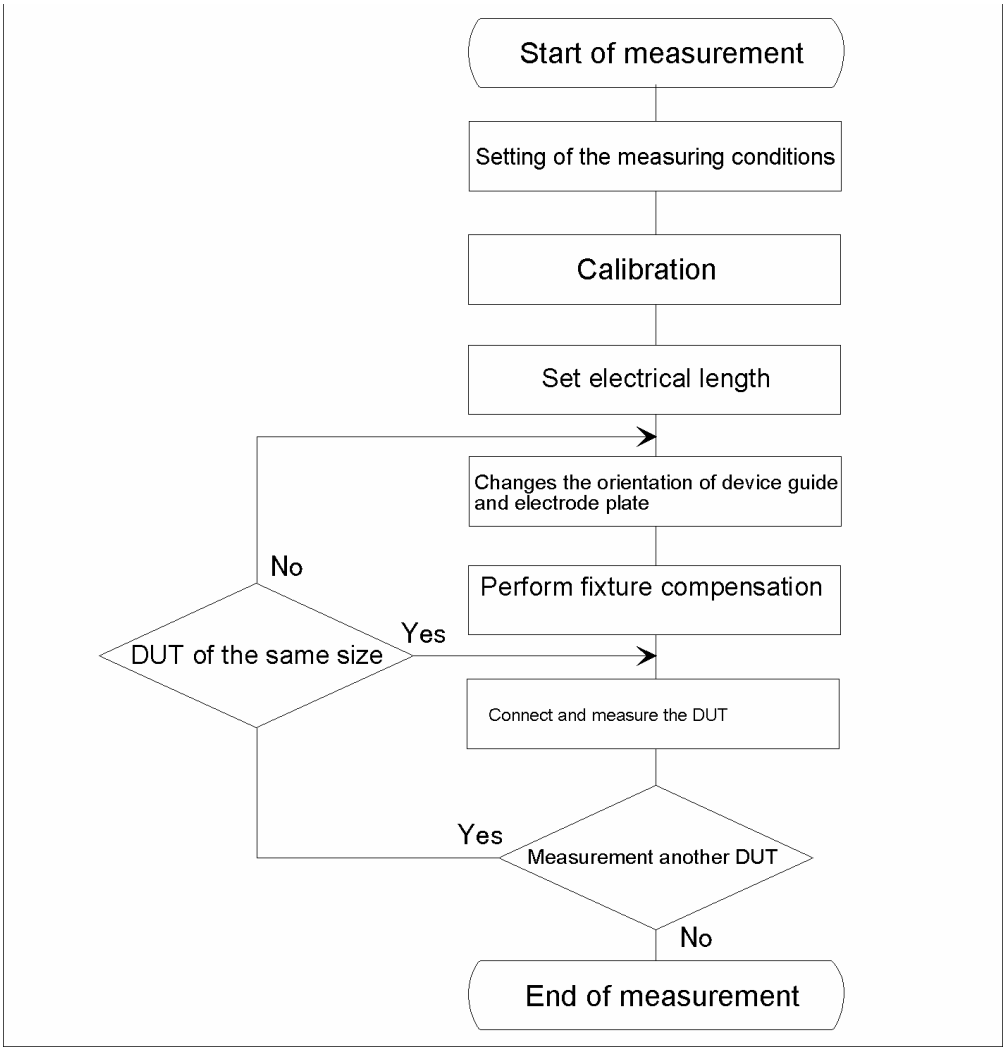
Step 4. "Changing the Orientation of the Device Guide and Electrode Plate" on page 25
Select a device guide frame that fits the configuration of the DUT, and change the orientation of the device guide and electrode plate set on the center electrode, if necessary.

Step 5. "Performing Fixture Compensation" on page 35
Measure the SHORT compensation and OPEN compensation data.

Step 6. "Connecting and Measuring the DUT" on page 40
Connect the DUT to the fixture and perform the measurement.

WARNING The 16197A has the capability for -55°C to +85°C temperature measurement in environmental testing. Use gloves to prevent burns when handling heated parts.

Figure 3-1 Measurement Flow



The calibration methods, electrical length setting, and fixture compensation all differ with the measuring instrument being used. See the operation manual for the measuring instrument to be used.

NOTE

To ensure accurate measurement with the 16197A, it is necessary to perform a deterioration check of the shorting bars. For details, see "Deterioration Check" on page 47

Setting the Electrical Length

Set the electrical length for the measuring instrument, if necessary. For the method of setting the electrical length, see the operation manual for the measuring instrument. The electrical length for the 16197A is as follows:

Model	Electrical length (mm)
16197A	14.00 mm

Changing the Orientation of the Device Guide and Electrode Plate

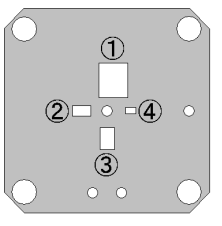
Select a device guide frame suited to the DUT size, and mount the appropriate device guide and electrode plate in the proper orientation so that a suitable frame is located at the measuring position.

Selecting the device guide frame

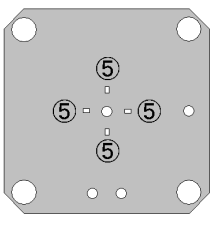
Select a device guide frame suited to the DUT size, with reference to Table 3-1.

Table 3-1 Device Guide Frames and Applicable Device Sizes and Specifications

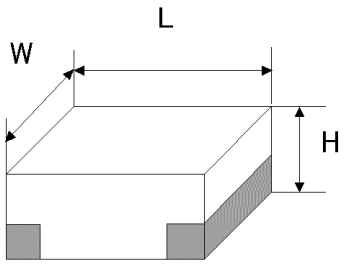
Frame Position	Device Size		Applicable chip size (mm)		
	EIAJ size	EIA size	Length (L)	Width (W)	Height (H)
1	3225	1210	3.2 ± 0.15	2.5 ± 0.15	0.4
	3216	1206	3.2 ± 0.15	1.6 ± 0.15	0.4
2	2012	0805	2.0 ± 0.15	1.25 ± 0.15	0.4
3	1608	0603	1.6 ± 0.15	0.8 ± 0.15	0.4
4	1005	0402	1.0 ± 0.15	0.5 ± 0.15	0.4
5	0603	0201	0.6 ± 0.03	0.3 ± 0.03	0.25



Device guide



Device guide for 0603



NOTE

An excessively large gap between the DUT and device guide frame will result in contact failure between the DUT and electrode, or poor measurement accuracy or repeatability. Be sure to select a device guide frame that fits the DUT configuration.

If the DUT size does not fit any frame in the attached device guide, prepare a suitable frame using the supplied blank device guide. For details, see "Working with Device Guide".

Figure 3-2 Electrode Spacing

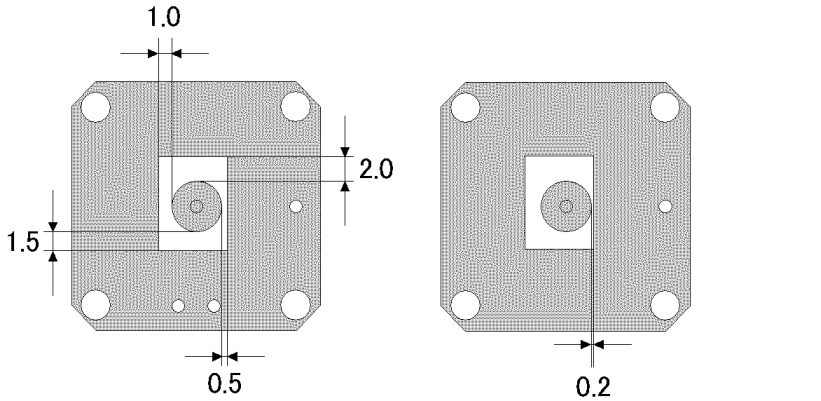
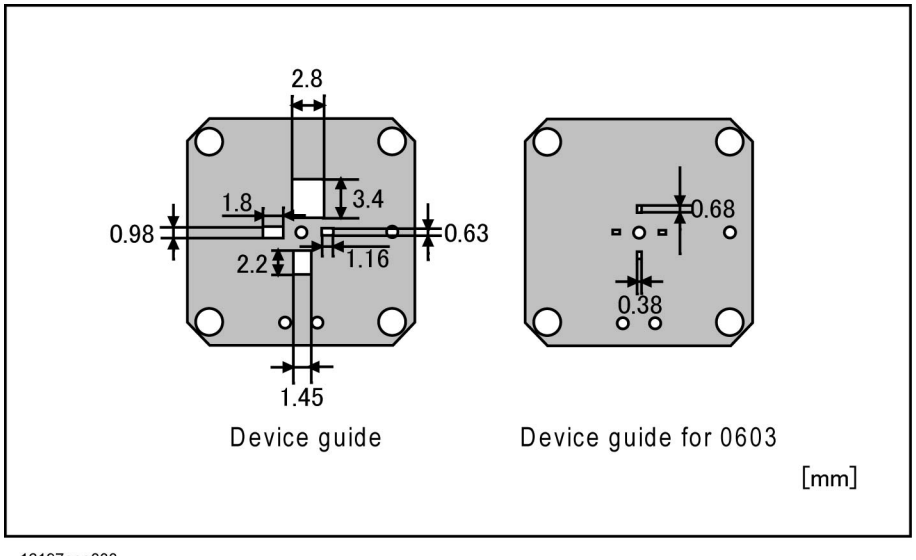
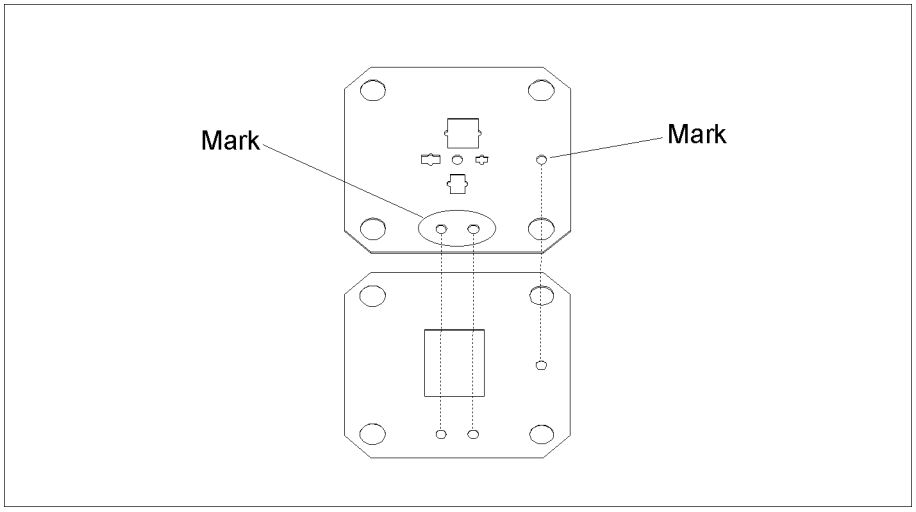


Figure 3-3 Dimension of the Device Guide Frame



CAUTION

Be sure to superpose the device guide onto the electrode plate in the proper orientation and with the correct side facing up. Otherwise, adequate electrode spacing cannot be created. As shown in Figure 3-3 when viewed from above, on the correct face of the device guide there are two marks at positions 90 degrees apart clockwise from a single position. Superpose the device guide onto the electrode plate so that all these marks are aligned with the corresponding marks on the electrode plate. For a 0603 device, correct electrode spacing can be created regardless of whether the mark on the device guide is aligned with the corresponding mark on the electrode plate



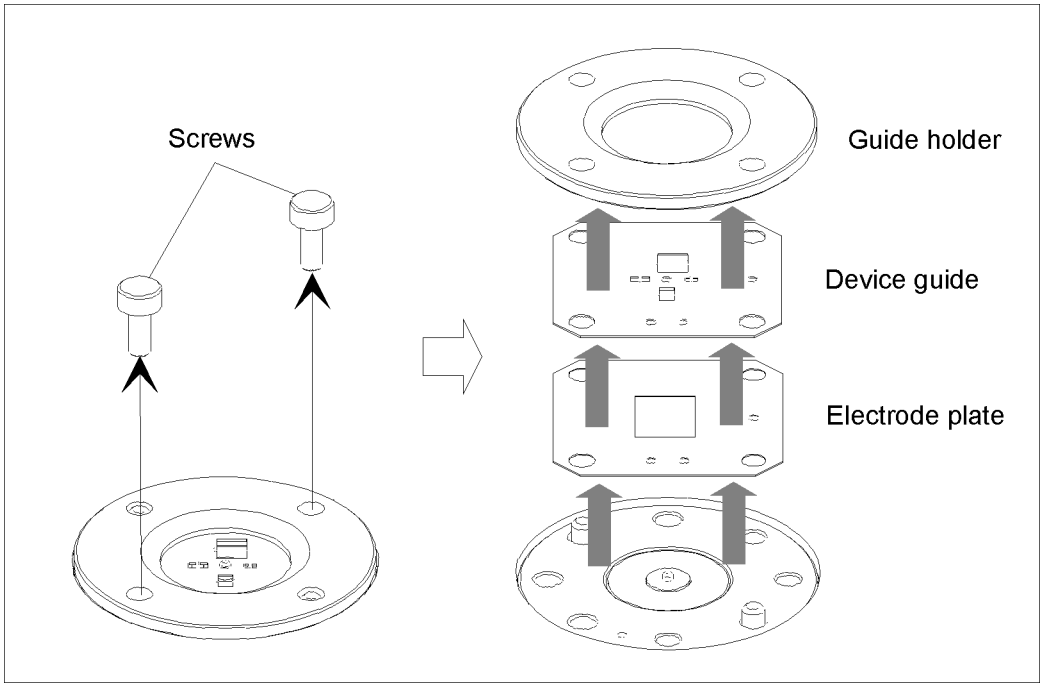
Changing the Orientation of or Replacing the Device Guide and Electrode Plate

Change the orientation of the device guide and electrode plate so that the selected device guide frame is located at the measuring position. For a 0603 device, replace the attached device guide and electrode plate with ones supplied in Option 001.

Step 1. Loosen the knobs on the sliding block, and remove the pressure unit from the electrode unit, referring to Figure 1-4 on page 9

Step 2. Unscrew the screws that fix the guide holder. Then remove the guide holder, device guide, and electrode plate (Figure 3-4)

Figure 3-4 Removing the Device Guide and Electrode Plate



NOTE If it is difficult to take out the electrode plate, turn the electrode unit upside down to remove the plate. Do not use force to take out the electrode plate, otherwise it may be deformed.

Step 3. Mount the device guide and electrode plate so that the selected device guide frame is located at the measuring position. Ensure that the marks on the device guide are aligned with those on the electrode plate (Figure 3-5). For a 0603 DUT, replace the attached device guide and electrode plate with ones supplied in Option 001 (Figure 3-6).

Figure 3-5 Mounting the Device Guide and Electrode Plate

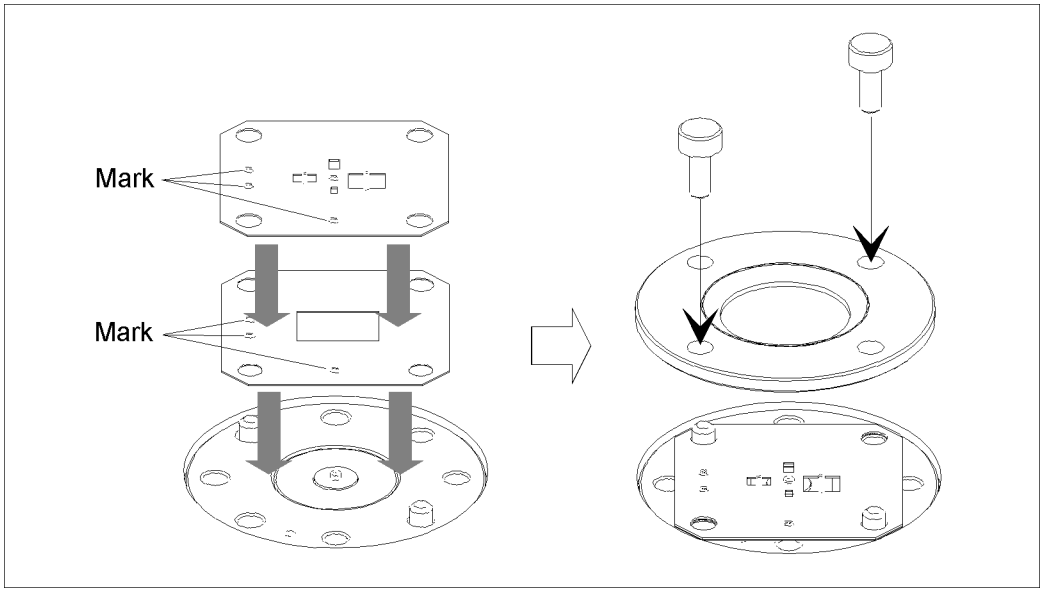
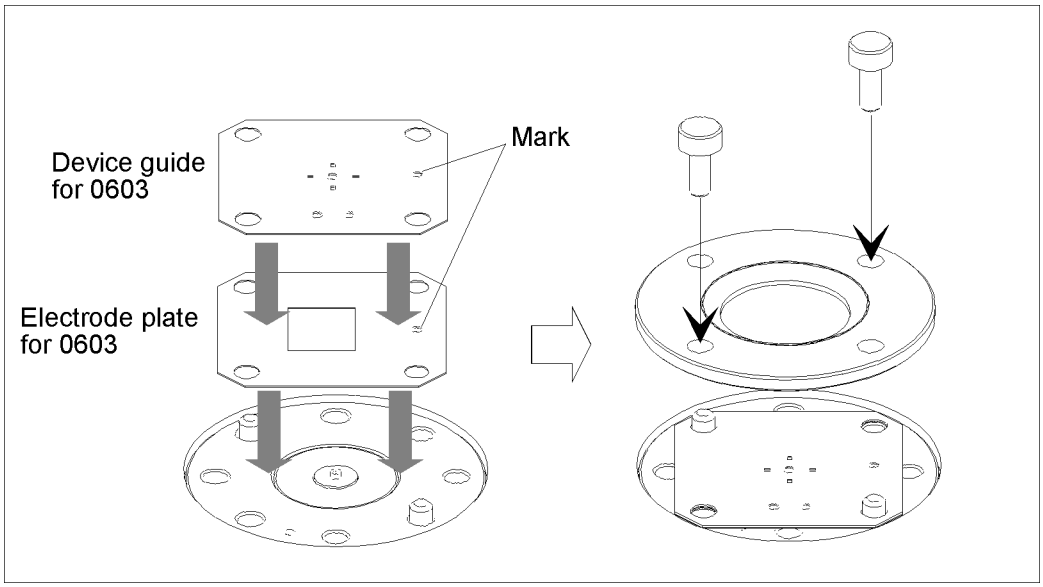


Figure 3-6 Mounting the Device Guide and Electrode Plate 0603



CAUTION Do not touch or damage the center electrode or electrode plate, otherwise measurement accuracy and repeatability may be impaired.

NOTE Be sure to mount the device guide and electrode plate with the correct sides facing up.

Step 4. Install the guide holder, and tighten the screws to secure it.

Step 5. Mount the pressure unit onto the electrode unit according to Figure 1-2 on page 8

Step 6. Connect the test fixture with the measuring instrument.
Connect the test fixture with the measuring instrument according to "Connecting the Test Fixture with a Measuring Instrument" on page 13 in Chapter 1.

Working with Device Guide

To measure a DUT whose size does not fit any frame in the attached device guide, it is necessary to prepare a suitable device guide frame. Prepare a frame with reference to the dimensions of the blank device guide shown in Figure 3-7 and the electrode positioning shown in Figure 3-8.

Reference Data for Preparing a Device Guide Frame

Figure 3-7 Dimensional Drawing of a Blank Device Guide

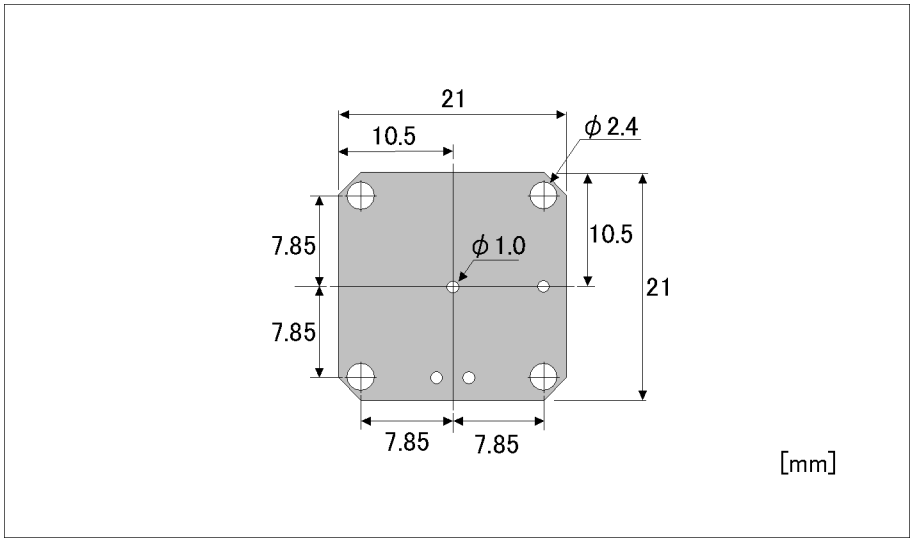
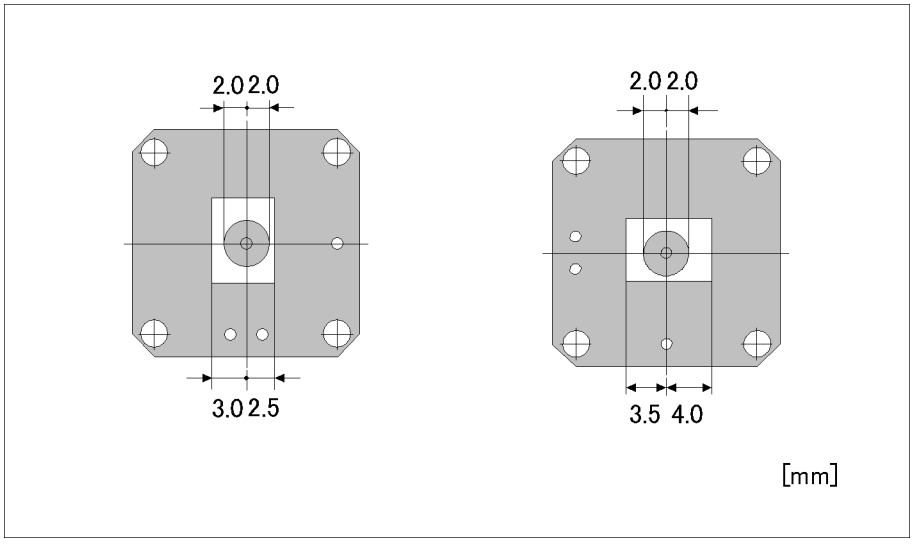
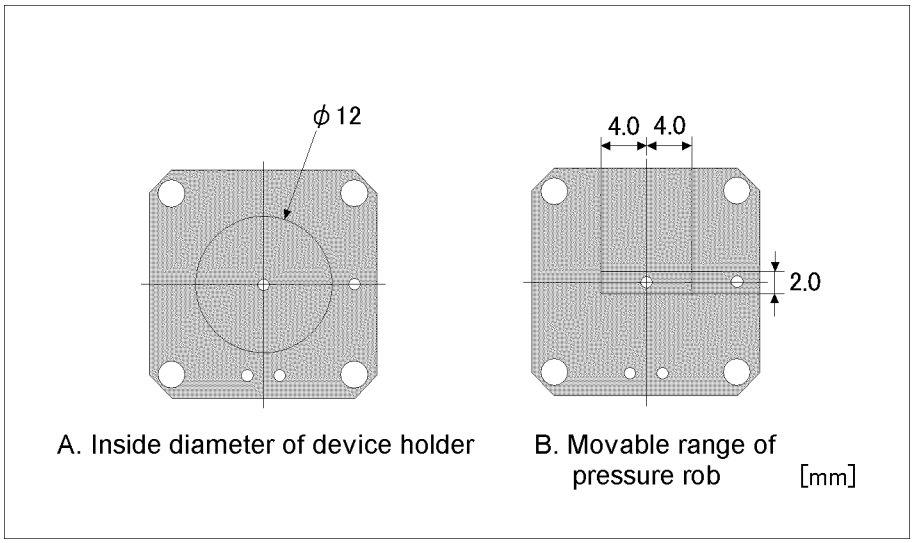


Figure 3-8 Electrode Positioning



A guide holder is placed onto the device guide. Figure 3-9-A shows the inside diameter of the guide holder. Figure Figure 3-9-B shows the movable range of the pressure rod.

Figure 3-9 Inside Diameter of Guide Holder & Movable Range of Pressure Rod



Determine the position of the frame to be prepared, keeping in mind the following requirements:

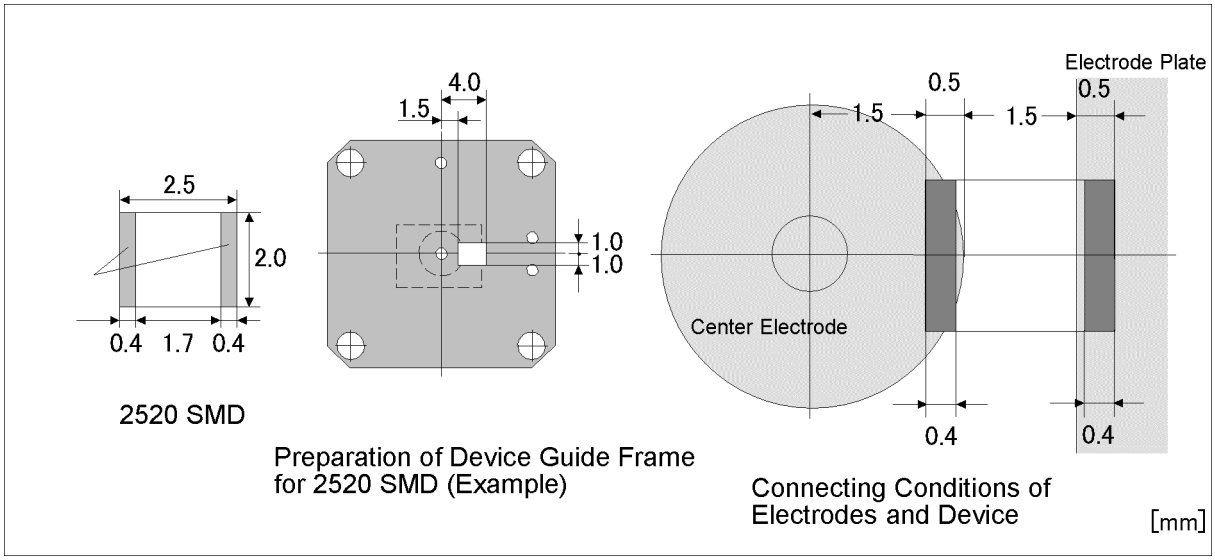
- The electrode of the DUT must maintain equal contact with both the center electrode and electrode plate.
- The electrode of the DUT must have a large contact area, and the electrode space between the center electrode and electrode plate must be as large as possible.
- The pressure rod must be able to press the center of the DUT to stabilize the DUT during measurement.

Example of Preparing the Device Guide

Preparing the Device Guide for a 2520 SMD

The figure below shown an example of preparation for a device guide for a 2520 SMD. For a 2520 SMD, the measuring position for a 2012 device is used (electrode space: 1.5mm).

Figure 3-10 Example of Preparation of Device Guide for 2520 SMD

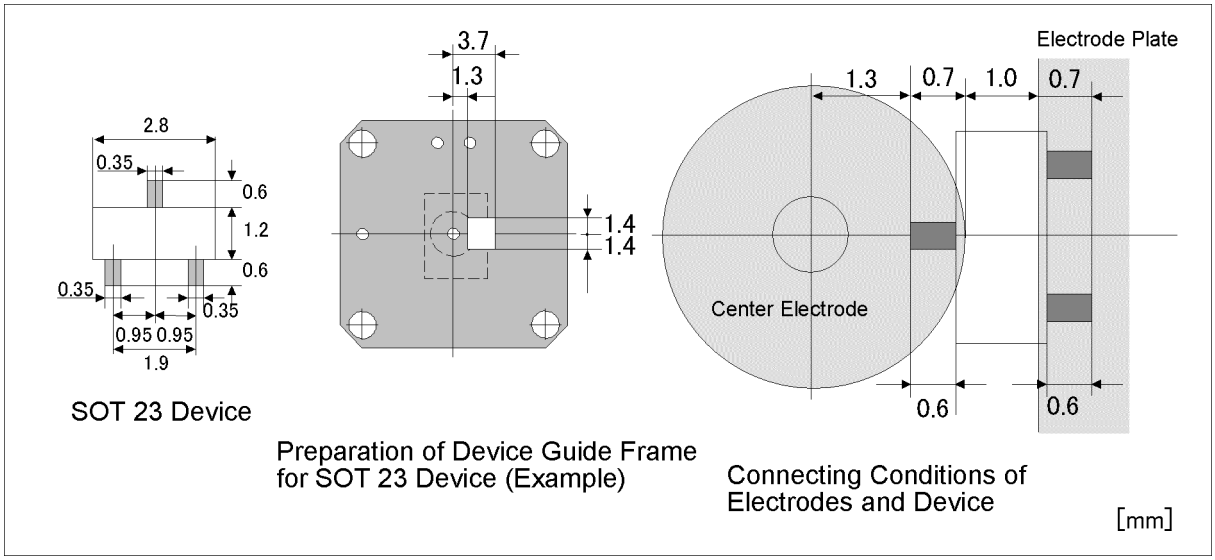


Prepare the frame at the position shown inFigure 3-10 This position is within the movable range of the pressure rod (4 mm on each lateral side from the center). In a frame at this position, the electrodes on both lateral sides of the DUT can be placed in equal contact by 0.4-mm width with the center electrode and the electrode plate.

Example of Preparing the Device Guide for an SOT 23 Device (Case Style 287)

The figure below shows an example of preparing a device guide for an SOT 23 device. For an SOT 23 device, the measuring position for a 1608 device is used (electrode space: 1.0 mm).

Figure 3-11 Example of Preparing the Device Guide for an SOT 23 Device (Case Style 287)



Prepare a frame at the position shown in Figure 3-11. In a frame at this position, the electrodes on both lateral sides of the DUT can be placed in equal contact by 0.6-mm width with the center electrode and the electrode plate.

Example of Preparing a Simple Device Guide

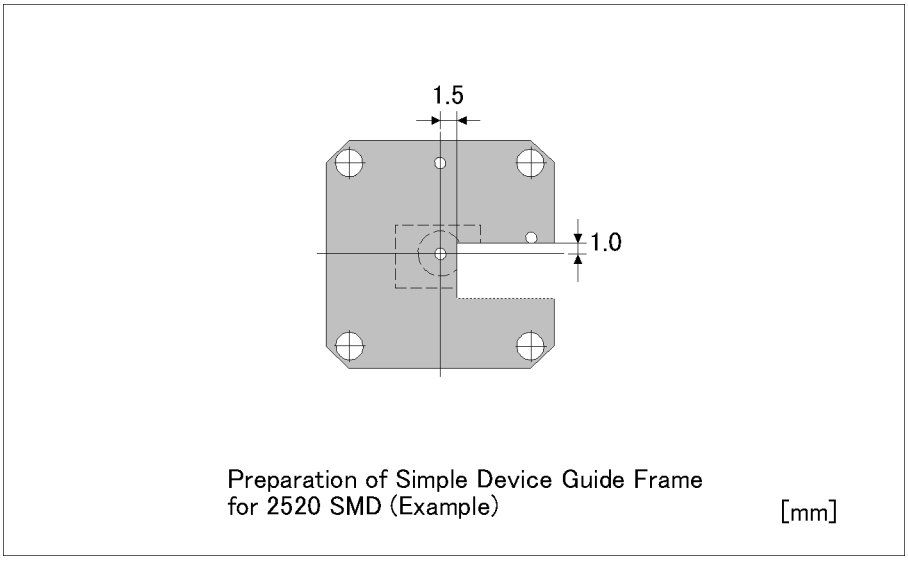
In order to prepare the device guide more easily, there is a method that involves precisely cutting only the 2 sides that position the device over the electrodes. Do not cut the corner hole which mounts the device guide.

CAUTION The measurement accuracy when using this method is not guaranteed.

Preparing the Simple Device Guide for a 2520 SMD

The position which places the 2520 SMD is same as Figure 3-10. Cut the 2 sides precisely which fixes the device position as shown in Figure 3-12.

Figure 3-12 Example of Preparing the Simple Device Guide for a 2520 SMD



Performing Fixture Compensation

To ensure accurate measurement, it is necessary to perform fixture compensation before measurement. For the 16197A, measure the SHORT compensation and OPEN compensation data. If the DUT size or the measuring position is changed, perform fixture compensation again.

NOTE If a temperature change greater than ± 5°C occurs after fixture compensation, perform the fixture compensation from the beginning.

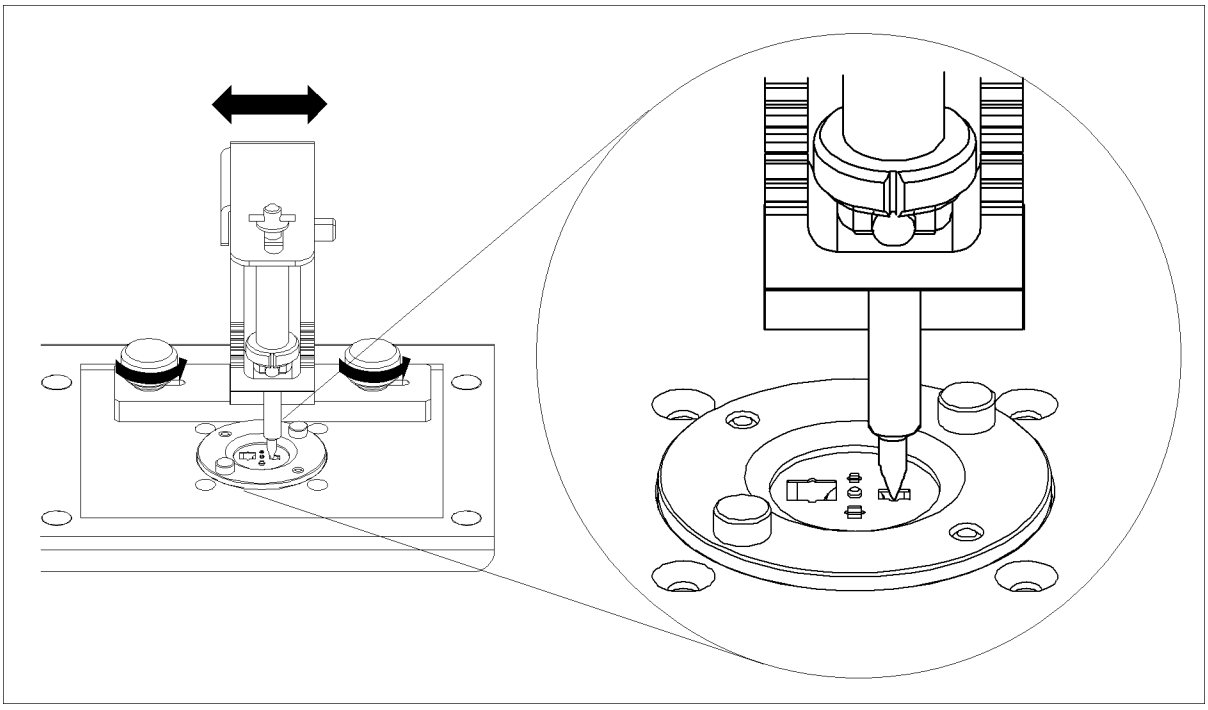
Measuring the SHORT Compensation Data

With the fixture SHORT state using a supplied shorting bar, measure the SHORT compensation data.

Step 1. Rotate the pressure adjusting nut to adjust the pressure on the pressure rod to the same value as used for measurement.

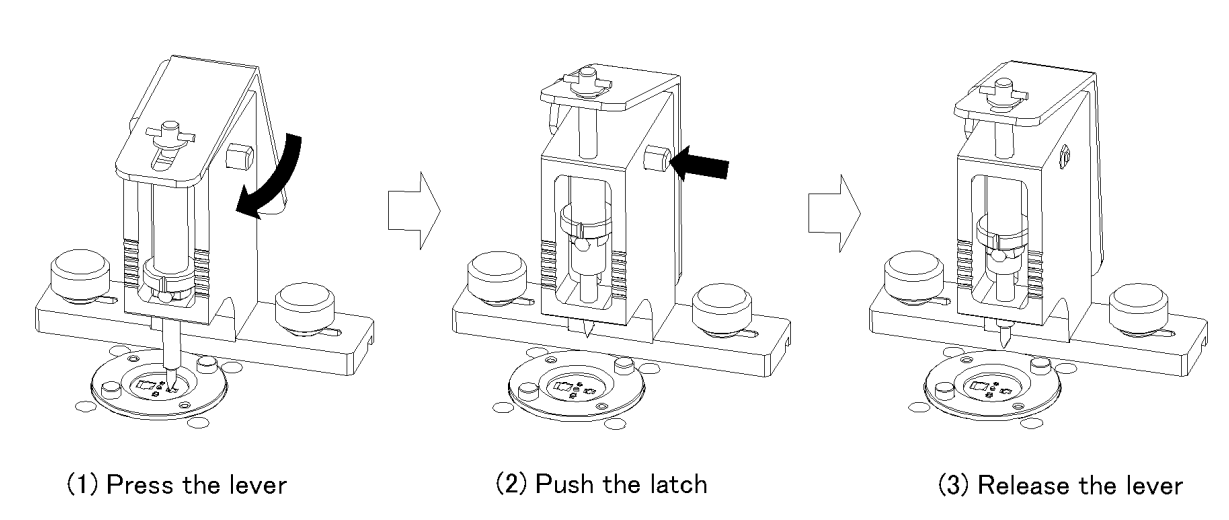
Step 2. Loosen the knobs on the sliding block, and adjust the position of the pressure unit so that the end of the pressure rod is located at the center of the device guide frame where the shorting bar will be placed (Figure 3-13).

Figure 3-13 Adjusting the Pressure Unit Position



Step 3. Press the lever to the limit (Figure 3-14,1). With the lever pressed, push in the latch (Figure 3-14,2), and then release the lever (Figure 3-14,3). The pressure rod is then fixed at its raised position.

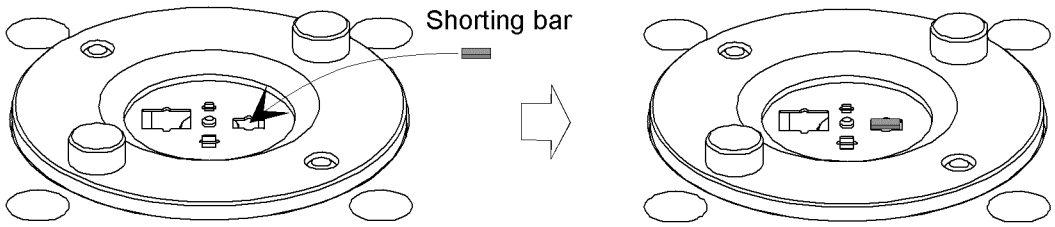
Figure 3-14 Raising the Pressure Rod



Step 4. Using tweezers, place an appropriate shorting bar on the electrode along the device guide frame.

CAUTION Each shorting bar is made exclusively for a particular device size. Do not use a shorting bar of the wrong size.

Figure 3-15 Connecting the Shorting Bar



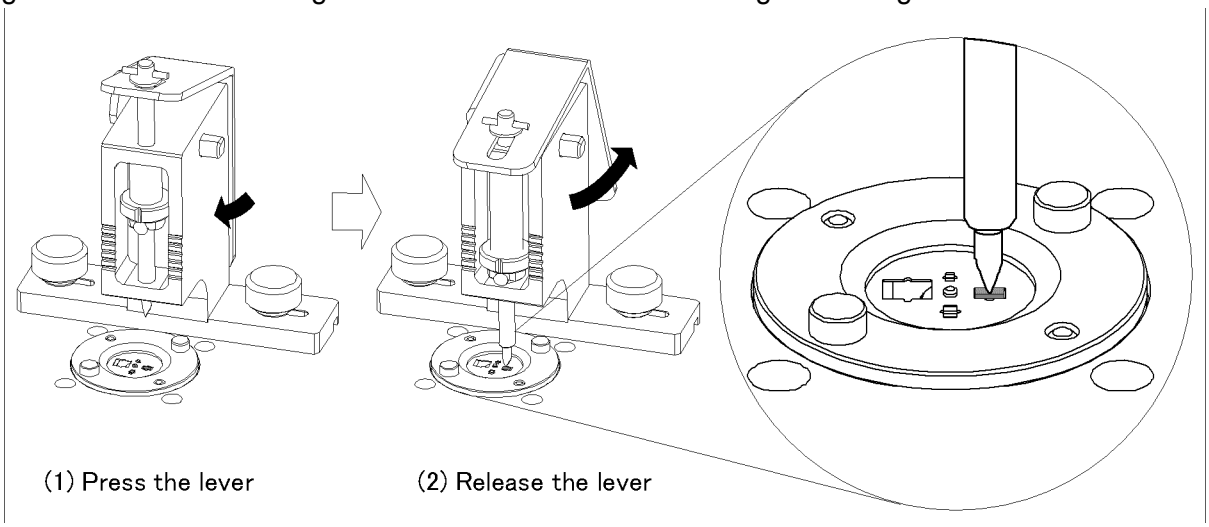
CAUTION Handle each shorting bar with tweezers, taking care not to soil it. A soiled shorting bar may impair measurement accuracy and repeatability.

NOTE Take care so that the correct face of the shorting bar is placed in contact with the electrode.

NOTE Shorting bars can wear out. Therefore, each time before using a shorting bar, measure and compare its resistance with that of a new shorting bar. For details, see "Operation Check" on page 69

Step 5. Press the lever; the latch is disengaged (Figure 3-16,1). Slowly release the lever to lower the pressure rod (Figure 3-16,2).

Figure 3-16 Setting the Fixture for SHORT State Using a Shorting Bar

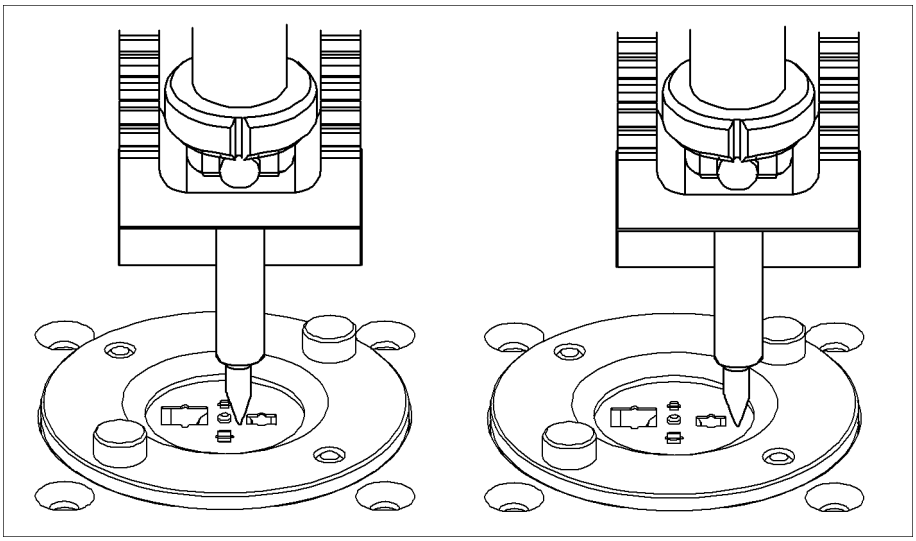


NOTE Adjust the position of the pressure unit in advance so that a shorting bar can be pressed at its center by the end of the pressure rod.

Step 6. Measure the SHORT compensation data according to the operation manual for the measuring instrument to be used.

NOTE When measurement is not being done, lower the pressure rod so it rests on an unoccupied area of the device guide.

Figure 3-17 Standby Position of the Pressure Road



NOTE

Confirm that the end of the pressure rod is not deformed. Replace the rod if deformed. For the replacement part, see “Replaceable Parts” on page 61.

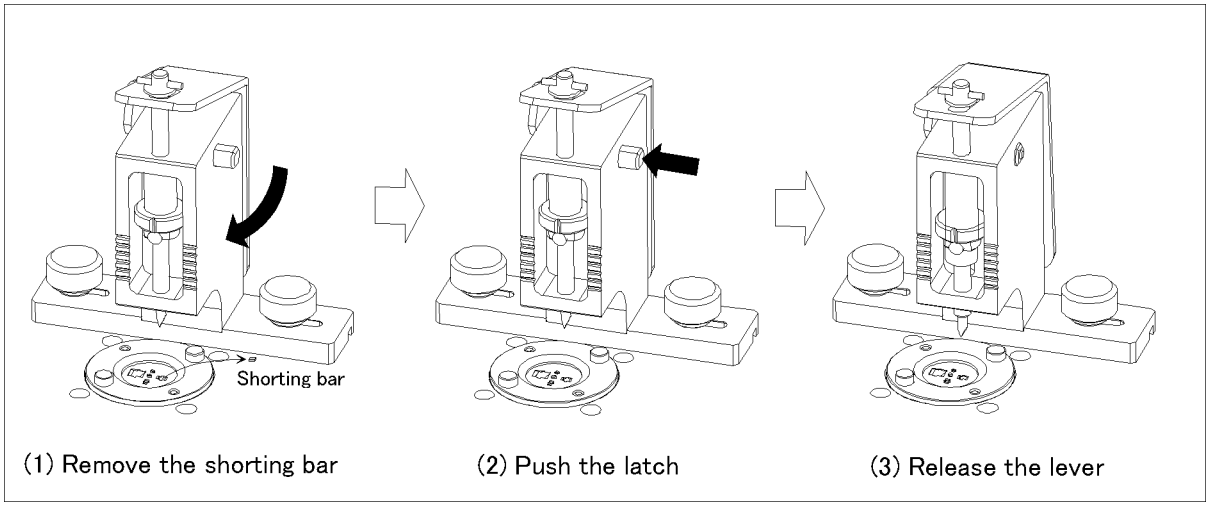
Measuring OPEN Compensation Data

With the fixture in an OPEN state, measure the OPEN compensation data.

Step 7. Press the lever to raise the pressure rod, and remove the shorting bar used to measure the SHORT compensation data (Figure 3-18,1).

Step 8. Press the lever to raise the pressure rod (Figure 3-18,2), and push the latch to secure the pressure rod in its raised position (Figure 3-18,3).

Figure 3-18 Setting the Fixture for OPEN State



Step 9. Measure OPEN compensation data according to the operation manual for the measuring instrument to be used.

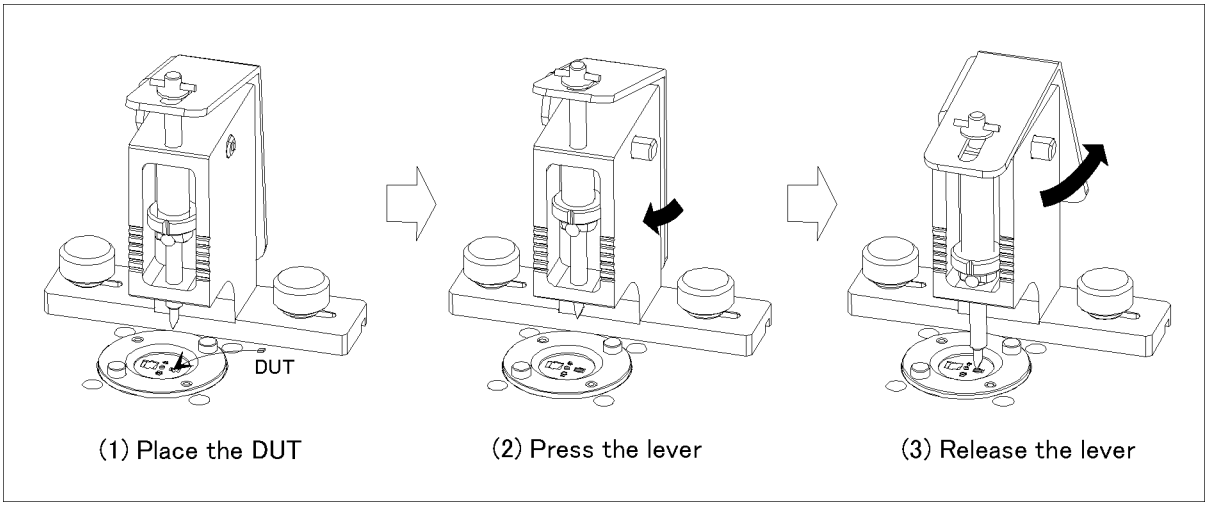
Connecting and Measuring the DUT

Connect the DUT with the electrode, and carry out the measurement.

Step 1. Place the DUT on the electrode in an appropriate device guide frame (Figure 3-19,1).

Step 2. Press the lever to disengage the latch (Figure 3-19,2), and slowly release the lever to lower the pressure rod (Figure 3-19,3).

Figure 3-19 Connecting the DUT

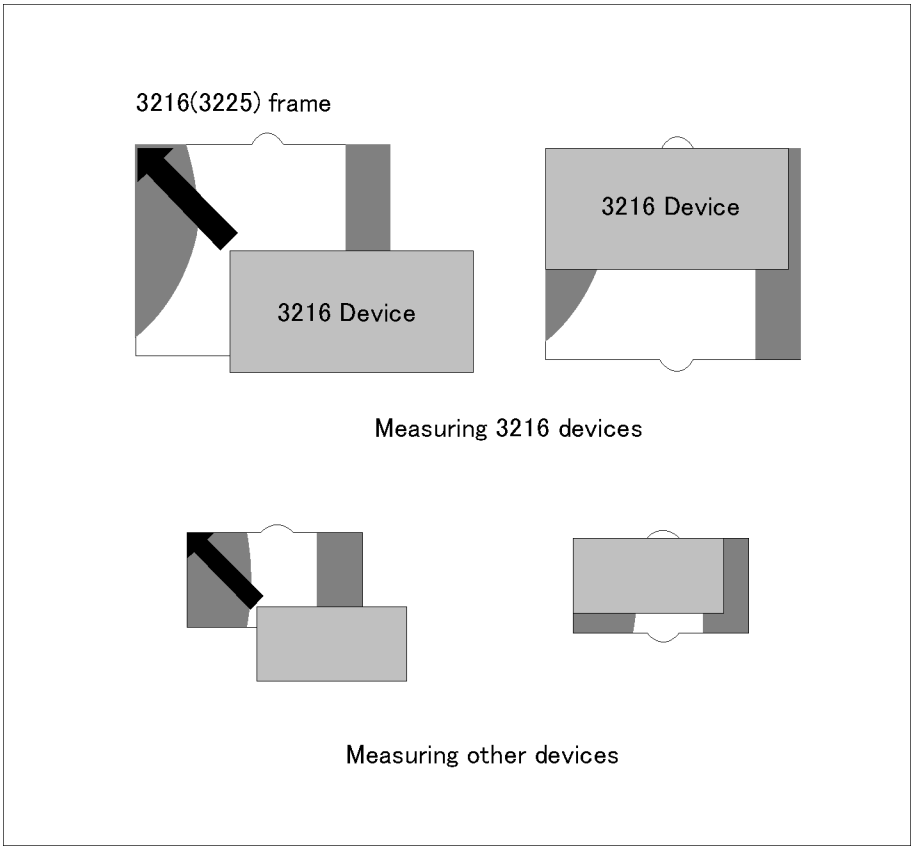


Step 3. Perform the measurement according to the operation manual for the measuring instrument to be used.

CAUTION The DUT may become hot during measurement. If the temperature of the DUT rises, the end of the pressure rod may be deformed. If this occurs, decrease the pressure on the pressure rod to prevent deformation of the end of the rod.

NOTE To ensure accurate and repeatable measurements, place the DUT alongside a fixed edge of each device guide frame. Testing a 3216 DUT, for instance, uses the 3216/3225 frame. Since this frame is dimensioned to fit with a 3225 device, some clearance remains in the frame if it is used for a 3216 DUT. Therefore, it is necessary to place the DUT alongside a fixed edge of the frame.

Figure 3-20 DUT Position in the Device Guide Frame



4 User Maintenance

This chapter describes the operations to perform before starting measurement, and the procedures necessary to ensure accurate measurements.

Description

Necessity of User Maintenance

Through repeated use, the fixture's measuring performance will gradually deteriorate over time due to smearing on the contact faces from solder buildup, and to mechanical wear and deformation of the contact faces themselves. To continually achieve optimal measurement results, it is important to keep the contact faces in good condition and take appropriate action before such wear or deformation occurs. Therefore, the fixture should be properly cared for by implementing each of the maintenance items shown in Table 4-1.

Table 4-1 Maintenance Items

Name	Frequency of implementation	Contents	Target parts
Cleaning	Several times a day	Cleaning the fixture	Entire fixture
Electrode deterioration check	Before using the fixture for the first time after delivery/ After replacement of parts	Acquisition of reference values[a]	Center electrode, Electrode plate
	Once a day/Before fixture compensation	Determining the deviation from reference values[a]	Center electrode, Electrode plate

Table 4-1 Maintenance Items

Name	Frequency of implementation	Contents	Target parts
Replacement of parts	When deterioration check result is unacceptable	Changing the orientation of the contact assembly, or replacement of parts	Center electrode, Electrode plate
			Shorting bar
Assembly check	After replacement of parts	Evaluation of absolute Ls and Rs values	Center electrode, Electrode plate
			Shorting bar

a. For details, see “Acquiring Reference Values” on page 48.

Maintenance of the fixture is important especially to ensure fine or highly accurate measurement, since deteriorated measurement performance of the fixture has a significant effect on the measurement results. Depending on the required measurement performance, it may be necessary to increase the frequency of maintenance and/or adopt more strict criteria for each maintenance item.

The electrodes and shorting bars are consumable. Of all the fixture components, these parts are most likely to affect the measurement results. The electrodes tend to deteriorate gradually since they can easily be smeared with solder transferred from the DUT during measurements. Because shorting bars are used to determine the zero reference for fixture compensation, smeared or deformed shorting bars can directly influence measurement results. This chapter describes the general user maintenance requirements, focusing primarily on the electrodes and shorting bars.

Cleaning

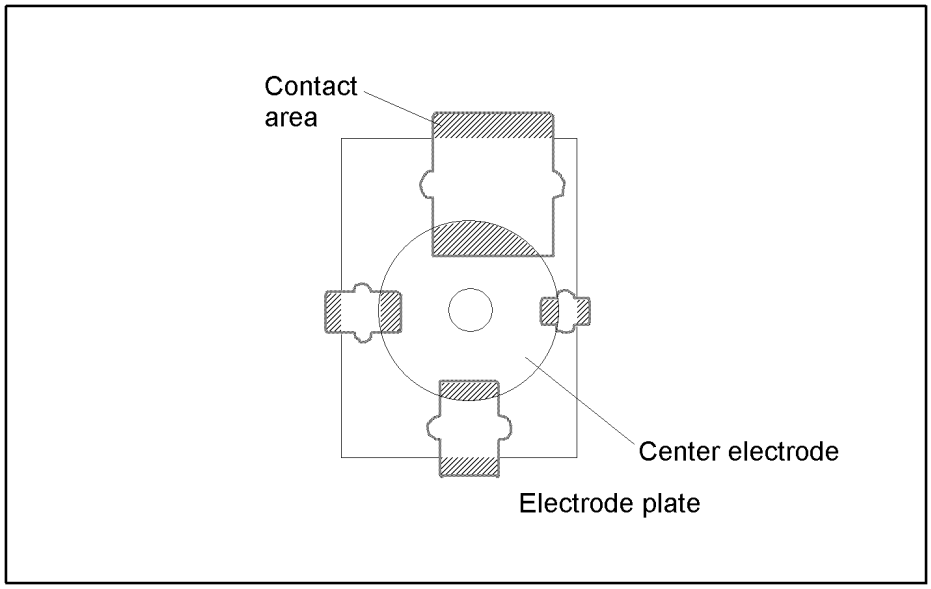
Smeared electrodes result in poor measurement accuracy and repeatability. Periodically clean the electrodes to ensure accurate measurements.

Areas Requiring Cleaning

The following areas require cleaning.

- The area of the center electrode that will be in contact with the electrode of the DUT
- The area of the electrode plate that will be in contact with the electrode of the DUT

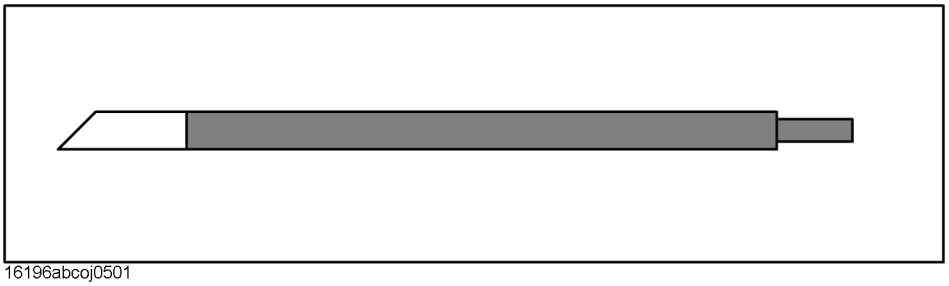
Figure 4-1 Areas Requiring Cleaning



Cleaning Method

Use a cleaning rod (Keysight part number: 5182-7586) to clean the electrodes. Remove smears on the above-mentioned contact area by wiping with the white rubber portion of the cleaning rod. Take care not to damage the electrode parts.

Figure 4-2 Cleaning Rod



CAUTION Do not file off the smears; filing part surfaces may cause poor measurement accuracy or repeatability.

NOTE If smears cannot be removed, replace the part. For the replacement method, see “Changing the Orientation of or Replacing the Contact Assembly” on page 67

Deterioration Check

A deterioration check must be performed to determine the state of deterioration of the fixture and to confirm whether the fixture is providing the required measurement accuracy. The deterioration check comprises three operations: “Setting user limit values,” “Acquiring Reference Values”“Electrode Deterioration Check”. In the deterioration check, the impedance values (Rs, Ls) of the fixture itself are measured at a discretionary frequency. It is recommended to use the frequency at which the fixture is normally used.

Perform “Setting user limit values” in the following cases:

– When using the fixture for the first time after delivery

– When changing the required measurement accuracy

Perform “Acquiring Reference Values” in the following cases:

– When using the fixture for the first time after delivery

– After replacing parts

Perform “Electrode Deterioration Check” in the following cases:

– Once a day, and before conducting fixture compensation

Example Settings of User Limit Values

User limit values for the deterioration check should be set appropriately according to the type of DUT, required measurement accuracy, and so on. Example settings of user limit values are shown below.

To evaluate an inductor (L:10nH, Q:10) at a frequency (f) of 100 MHz with a measurement accuracy of around 20%:

L:	10nH
Q:	10
Frequency:	100MHz
Required measurement accuracy:	20% for both L and Q

The reactance X and resistance R of the inductor under the above-mentioned conditions can be obtained as follows:

$$R = X/Q = 0.6\Omega$$

$$X = 2\pi fL = 6\Omega$$

Therefore, $Q = X/R = (2\pi fL)/R$. Accordingly, if R fluctuates by 20% (120 mΩ), Q will change by about 20%; and if L fluctuates by 20% (2 nH), both L and Q will change by about 20%. In other words, to measure L and Q at an accuracy of 20% or less error, errors in L and R must be 2 nH and 120 mΩ at the most, respectively. Considering that both L and R may fluctuate, and allowing for possible causes of error other than a deteriorated fixture, the errors must be set smaller than the above-mentioned values. For the present example, with the error set at 25% for both L and R, the user limit values for L and R are set at 500 pH and 30 mΩ, respectively.

NOTE Note that the above settings are just an example. Actually, user limit values should be varied depending on the measuring conditions and type of DUT.

NOTE In actual measurement, some of the effect of electrode deterioration is canceled by SHORT compensation. However, it is recommended to set user limit values on the assumption that deviations from the reference values affect the entire measurement results, as shown in the above example.

Record the user limit values in the "Check Sheet" on page 51. For the method of recording, see "Example Entry in Check Sheet" on page 51.

Acquiring Reference Values

To obtain reference values, measure the impedance (Rs, Ls) of the fixture before deterioration. It is recommended to take measurements at a frequency at which the fixture is normally used. It is necessary to obtain reference values using electrodes and shorting bars for all sizes of DUTs that will be subject to actual measurement.

"Acquiring reference values" is necessary in the following cases:

- When using the fixture for the first time after delivery
- After replacement of parts

Necessary equipment

- Shorting bars (supplied as accessories)
- Impedance measuring instrument (calibrated at the 7mm connector end)

CAUTION Set the fixture compensation for the measuring instrument to OFF.

CAUTION Check that each shorting bar is not deformed or stained.

Procedure for Acquiring Reference Values for the Electrode Deterioration Check

Step 1. Clean each electrode and shorting bar using the method described in “Cleaning” on page 45.

Step 2. At the actual DUT measurement position, connect an appropriate shorting bar with the electrode to set the fixture for the SHORT state (See Figure 3-16 on page 37).

Step 3. Measure Rs and Ls according to the Operation and Service Manual for the measuring instrument.

Step 4. Record the Rs and Ls readings as reference values in the “Check Sheet” on page 51

Step 5. From the reference values and the user limit values determined in the preceding section, calculate the upper and lower limit values, and record them in the Check Sheet.

Electrode Deterioration Check

Measure the impedance of the fixture in the SHORT state to check for electrode deterioration. Use a shorting bar suited to the size of the actual DUT.

The electrode deterioration check is necessary in the following cases:

– Once a day, and before conducting fixture compensation

Necessary equipment

– Shorting bars (supplied as accessories)
– Impedance measuring instrument (calibrated at the 7-mm connector end)

CAUTION Set the fixture compensation of the measuring instrument to OFF. Set all other functions to the same states according to “Acquiring Reference Values”

Electrode Deterioration Check Procedure

Step 1. Clean each electrode and shoring bar using the method described in “Cleaning” on page 45.

Step 2. Perform the measurement, with the measuring instrument set for the same conditions as mentioned in “Procedure for Acquiring Reference Values for the Electrode Deterioration Check” on page 49.

Step 3. Record the Rs and Ls readings, as well as their acceptability, in the “Check Sheet” on page 51.

Step 4. If the results are unacceptable, replace the center electrode or the electrode plate.

CAUTION By changing the orientation of the contact assembly, it is possible to take measurements using an unused clean area of the center electrode. For details, see “Changing the Orientation of or Replacing the Contact Assembly” on page 67

CAUTION An electrode deterioration check using a deformed or stained shorting bar may produce unacceptable check results. Replace the shorting bar if it is deformed or if it cannot be cleaned.

Check Sheet

Example Entry in Check Sheet

The following tables shown an example entry of electrode deterioration check results in the Check Sheet.

Example Entry of Electrode Deterioration Check Results

DUT Size 2012

Table 4-2 Example Entry of Reference Values and User Limit Values

Frequency[a]	Measurement parameter	Reference value [a][b]	User limit value [b][c]	Lower limit [a-b]	Upper limit [a+b]
100 MHz	Rs	40 mΩ	30 mΩ	10 mΩ	70 mΩ
	Ls	2.34 nH	0.5 nH	1.84 nH	2.84 nH
800 MHz	Rs	220 mΩ	40 mΩ	180 mΩ	260 mΩ
	Ls	2.32 nH	0.4 nH	1.92 nH	2.72 nH

a. User's discretionary value
b. Enter the values obtained in section "Acquiring Reference Values" on page 48
c. For entry, see "Example Settings of User Limit Values" on page 47

Table 4-3 Example Entry of Checking History

Date/ Time	Frequency	Measurement parameter	Measurement value	Acceptability	Set position of pressure adjusting nut
2000/ 10/11 9:30	100 MHz	Rs	50 mW	O	
		Ls	2.5 nH	O	
2000/ 10/11 9:35	800 MHz	Rs	250 mW	O	
		Ls	2.6 nH	O	
2000/ 10/12 9:30	100 MHz	Rs	55 mW	O	
		Ls	2.6 nH	O	
2000/ 10/12 9:35	800 MHz	Rs	285 mW	X[a]	
		Ls	2.7 nH	O	

a. Replace parts if check results are not acceptable.

Electrode Deterioration Check

DUT size _____

Table 4-4 Reference Values and User Limit Values

Frequency	Measurement parameter	Reference value [a]	User limit value [b]	Lower limit [a-b]	Upper limit [a+b]
	Rs	mΩ	mΩ	mΩ	mΩ
	Ls	pH	pH	pH	pH
	Rs	mΩ	mΩ	mΩ	mΩ
	Ls	pH	pH	pH	pH

Table 4-5 Checking History

Date/Time	Frequency	Measurement parameter	Measurement value	Acceptability	Set position of pressure adjusting nut
		Rs	mΩ		
		Ls	pH		
		Rs	mΩ		
		Ls	pH		
		Rs	mΩ		
		Ls	pH		
		Rs	mΩ		
		Ls	pH		
		Rs	mΩ		
		Ls	pH		
		Rs	mΩ		
		Ls	pH		
		Rs	mΩ		
		Ls	pH		
		Rs	mΩ		
		Ls	pH		
		Rs	mΩ		
		Ls	pH		

Assembly Check

Each time after replacing a part, conduct an assembly check to confirm that the fixture has been assembled properly. The procedure for performing an assembly check is identical with that for an operation check. For the procedure, see “Operation Check” on page 69

5 Specifications and Supplemental Performance Characteristics

This chapter provides specifications and supplemental performance characteristics of the 16197A test fixture.

Definitions

Specification (spec):	Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

Supplemental Information is intended to provide information useful in applying the instrument, but that is not covered by the product warranty. The information is denoted as typical, or nominal.

Typical (typ.):	Expected performance of an average unit which does not include guardbands.
Nominal (nom.):	A general, descriptive term that does not imply a level of performance.

Specifications

Applicable Instruments		Refer to the **Table 1-2** and Table 1-3 on page 13
Applicable DUT Type		Surface Mount Device with bottom electrodes.
Applicable DUT Size		Model — Length (L) × Width (W) × Height (H) 3225 — (3.2 ± 0.15) × (2.5 ± 0.15) × (≥0.4) mm 3216 — (3.2 ± 0.15) × (1.6 ± 0.15) × (≥ 0.4) mm 2012 — (2.0 ± 0.1) × (1.25 ± 0.1) × (≥0.4) mm 1608 — (1.6 ± 0.15) × (0.8 ± 0.15) × (≥ 0.4) mm 1005 — (1.0 ± 0.03) × (0.3 ± 0.03) × (≥0.4) mm 0603 — (0.6 ± 0.03) × (0.3 ± 0.03) × (≥ 0.25) mm
Frequency		DC to 3 GHz
Maximum Voltage		± 42V peak max. (AC+DC)
Maximum Current		5A
Operating Environment	temp.	-55°C to +85°C
	humidity	15% to 95%RH (@ wet bulb temp. < 40°C)
Non Operating Environment	temp.	-55°C to +85°C
	humidity	≤90% RH (@ wet bulb temp. <65°C)
Dimension		Approximately 160 (W) x 86 (D) x 70 (H) mm (nom.)
Weight		Approximately 300 g (nom.)
Safety Standards		EN61010-1:2001 IEC61010-1:2001 CAN/CSA C22.2 No.61010-1-12 INSTALLATION CATEGORY I POLLUTION DEGREE 2 INDOOR USE

Supplemental Performance Characteristics

This section provides useful data on the 16197A. These supplemental performance characteristics should not be considered specifications.

Additional Error

Additional errors are calculated as follows.

|Z| Measurement

Additional error for Impedance Ze [%] is calculated by substituting the values in the table below into the following equation.

$Ze\ [\%] = \pm \{A + (Zs/Zx + Yo \times Zx) \times 100\}$

where

A [%]	Test Fixture's Proportional Error [%]
Yo [S]	Test Fixture's Open Repeatability [S]
Zs [Ω]	Test Fixture's Short Repeatability [Ω]
Zx [Ω]	Measured Impedance Value of DUT [Ω]

Zs	$(30 + 150 \times f) \times 10^{-3}$[W]
Yo	$(2 + 30 \times f) \times 10^{-6}$[S]
A	$1.2 \times f^{2}$ [%]

where f is frequency (GHz)

D Measurement

Additional error for Dissipation Factor De is calculated by using the additional error for Impedance Ze [%] 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 Rse[%] of the Rs measurement is calculated by using the additional error for Impedance Ze [%] 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.

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

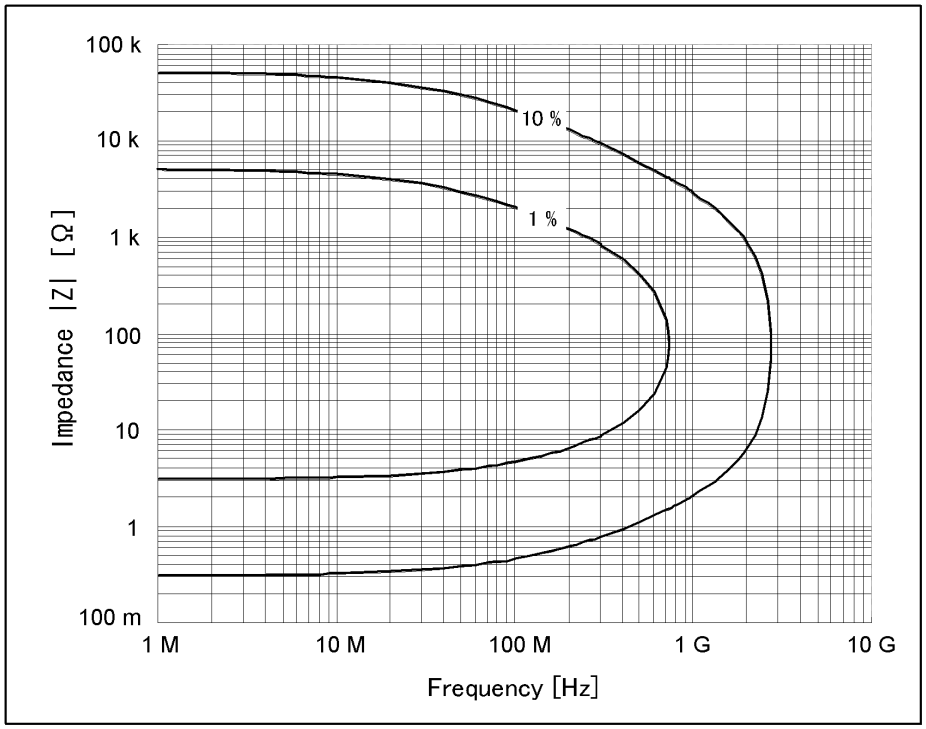
where

f: measurement signal frequency

Csx: measured value of Cs

Rsx: measured value of Rs

Figure 5-1 Additional Error for Impedance



Residual Inductance of the Shorting Bar

The usual method to compensate the test fixture's residual inductance is to let SHORT = 0H. In this method, the measurement result is the relative value of the measured impedance to the shorting bar's impedance. The short bar's residual inductance as a result of its size and shape is not estimated.

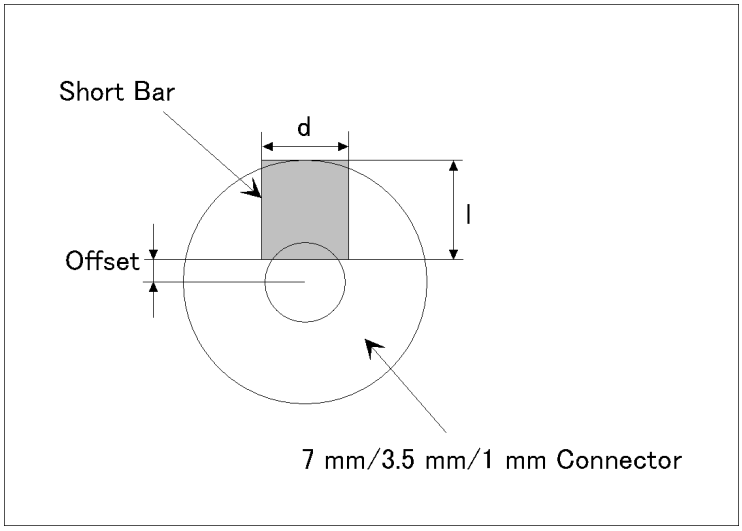
On the other hand, there is a definition method to let SHORT = x H. In this method, the measurement result is the absolute value of the device's impedance. The short bar's residual inductance as a result of its size and shape is estimated under specific conditions and is used as a reference value. This method, is useful for devices with values which are close to the short conditions of the measurement system.

The reference inductance values presented Table 5-1 were simulated as the relative difference to a disk-type 0 W termination on either the 7mm or the 3.5mm connector. The measurement of these short bars under other conditions than shown below cannot reproduce the reference inductance values.

Table 5-1 Residual Inductance (Typical)

Shorting Bar Set	1 [mm]	d [mm]	h [mm]	Offset [mm]	Connector	Inductance (Typical)
0.6 x 0.3 x 0.3	0.6	0.3	0.3	0.0585	1 mm	0.1nH
1.0 x 0.5 x 0.5	1.0	0.5	0.5	0.75	3.5 mm	0.5 nH
1.6 x 0.8 x 0.8	1.6	0.8	0.8	0.45	3.5 mm	0.4 nH
2.0 x 1.2 x 0.8	2.0	1.2	0.8	1.5	7 mm	0.9 nH
3.2 x 1.6 x 0.8	3.2	1.6	0.8	0.9	7 mm	0.8 nH

Figure 5-2 Simulation Setup



6 Service

This chapter describes the replaceable parts of the fixture, and the method for replacing parts.

Replaceable Parts

The support parts for RoHS and non-RoHS compliance 16197A Bottom Electrode SMD Test Fixture with the exploded views and tables shown below. Due to limited availability of RoHS compliance station and technical difficulties in RoHS soldering, only parts and support level that do not require RoHS soldering are supported. Replace all defective parts with RoHS compliance part number. Do not disassemble each unit into smaller components than shown in these exploded views. If a defective part to be replaced is part of a component that cannot be disassembled, place an order for the entire component. Defective parts or components may be sent to Keysight Technologies local sales/service office for repair.

Perform "Operation Check" in 16197A Operation and Service Manual each time a part is replaced.

Pressure Unit

Figure 6-1 Exploded View of Pressure Unit Assembly

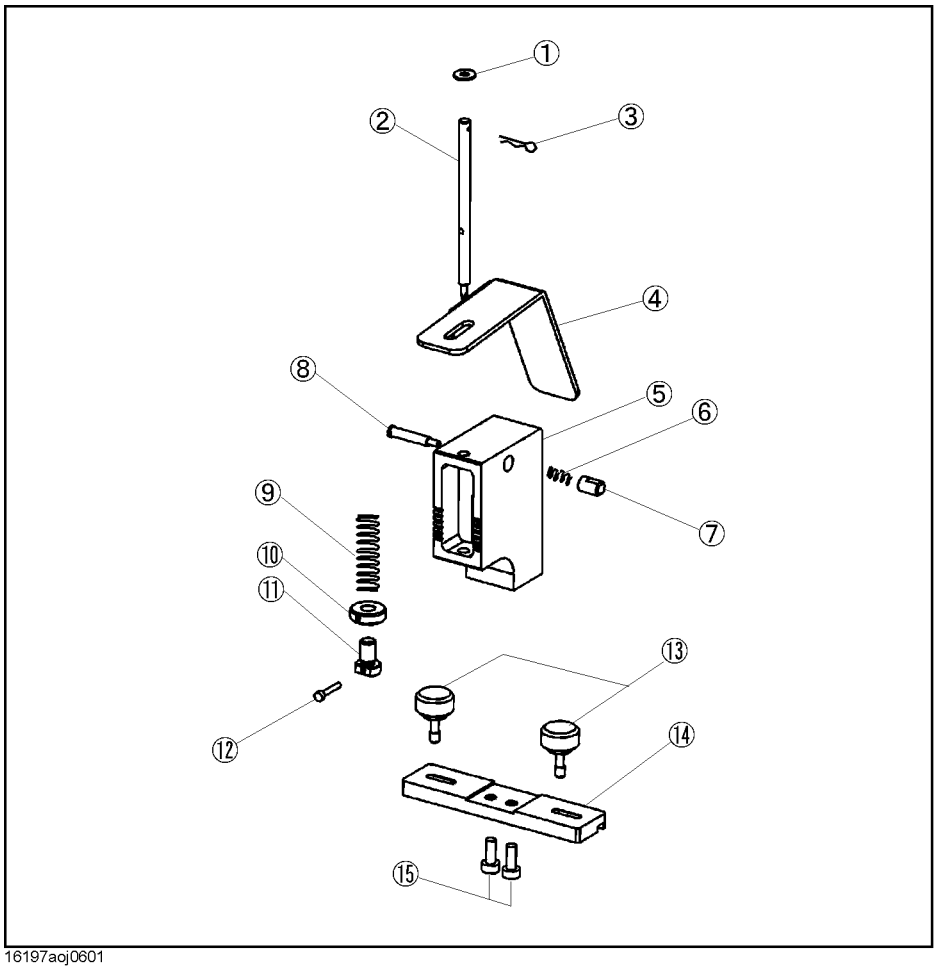


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Table 6-1 Replaceable Parts (Pressure Unit)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
1	3050-1138	Washer	1	3050-1138	Washer	1
2	16197-25002	Pressure rod	1	16197-25002	Pressure rod	1
3	1480-1093	R-pin	1	1480-1240	R-pin	1
4	16197-05001	Lever	1	16197-05001	Lever	1
5	N/A	Pressure unit	1	N/A	Pressure unit	1

Table 6-1 Replaceable Parts (Pressure Unit)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
6	1460-2662	Spring	1	1460-2662	Spring	1
7	16197-23003	Shaft	1	16197-23003	Shaft	1
8	16197-23004	Shaft	1	16197-23004	Shaft	1
9	1460-2663	Spring	1	1460-2663	Spring	1
10	16197-24004	Pressure adjusting nut	1	16197-24004	Pressure adjusting nut	1
11	16197-24005	Screw	1	16197-24005	Screw	1
12	0515-1185	Screw	1	0515-1185	Screw	1
13	16197-24003	Knob	2	16197-24003	Knob	2
14	N/A	Sliding block	1	N/A	Sliding block	1
15	0515-1550	Screw M3	2	0515-0372	Screw M3	2

Electrode Unit

Figure 6-2 Exploded View of Electrode Unit Assembly

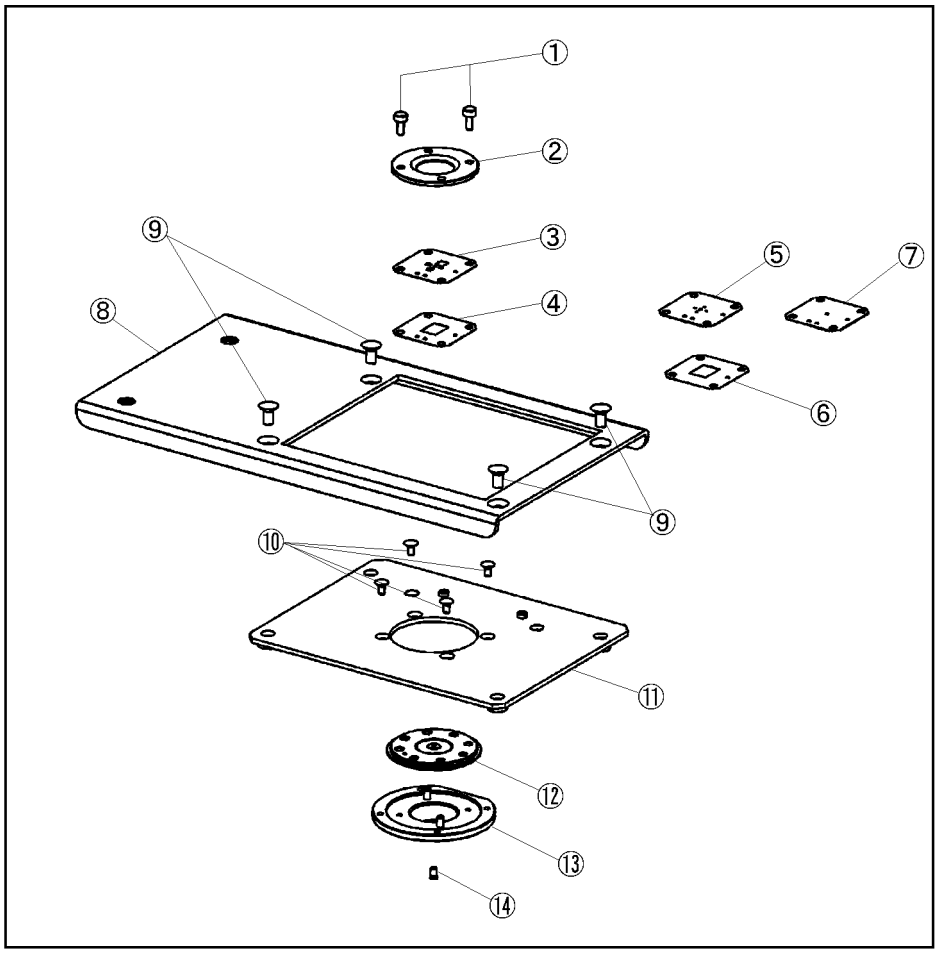

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Table 6-2 Replaceable Parts (Electrode Unit)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
1	0515-1077	Screw M-2.0	2	0515-1077	Screw M-2.0	2
2	16197-25004	Guide holder	1	16197-25004	Guide holder	1
3	16197-25005	Device guide	1	16197-25005	Device guide	1
4	16197-00603	Electrode plate	1	16197-00603	Electrode plate	1

Table 6-2 Replaceable Parts (Electrode Unit)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
5	16197-25007	Device guide (for Option 001)	1	16197-25007	Device guide (for Option 001)	1
6	16197-00604	Electrode plate (for Option 001)	1	16197-00604	Electrode plate (for Option 001)	1
7	16197-25006	Device guide (blank)	1	16197-25006	Device guide (blank)	1
8	16197-00601	Plate	1	16197-00601	Plate	1
9	0515-0914	Screw M3 x 0.5	4	0515-1946	Screw M3 x 0.5	4
10	0515-0952	Screw M2 x 0.4	4	0515-2151	Screw M2 x 0.4	4
11	N/A	Plate	1	N/A	Plate	1
12	16197-60001	Contact assembly (including contact center)	1	16197-60001	Contact assembly (including contact center)	1
13	16197-24001	Flange	1	16197-24001	Flange	1
14	1250-0907	Contact center	1	1250-0907	Contact center	1

Other Parts

Table 6-3 Replaceable Parts (Other Parts)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
1	16191-29005	Shorting bar 1.0 x 0.5	1	16191-29005	Shorting bar 1.0 x 0.5	1
2	16191-29006	Shorting bar 1.6 x 0.8	1	16191-29006	Shorting bar 1.6 x 0.8	1

Table 6-3 Replaceable Parts (Other Parts)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
3	16191-29007	Shorting bar 2.0 x 1.2	1	16191-29007	Shorting bar 2.0 x 1.2	1
4	16191-29008	Shorting bar 3.2 x 1.6	1	16191-29008	Shorting bar 3.2 x 1.6	1
5	16197-29001	Shorting bar (for Option Kit 001)	1	16197-29001	Shorting bar (for Option Kit 001)	1
6	8710-2081	Tweezers	1	8710-2081	Tweezers	1
7	8710-0909	Allen wrench	1	8710-0909	Allen wrench	1
8	16193-60002	Magnifying glass	1	16193-60002	Magnifying glass	1
9	16197-60050	Carrying case	1	16197-60060	Carrying case	1

Changing the Orientation of or Replacing the Contact Assembly

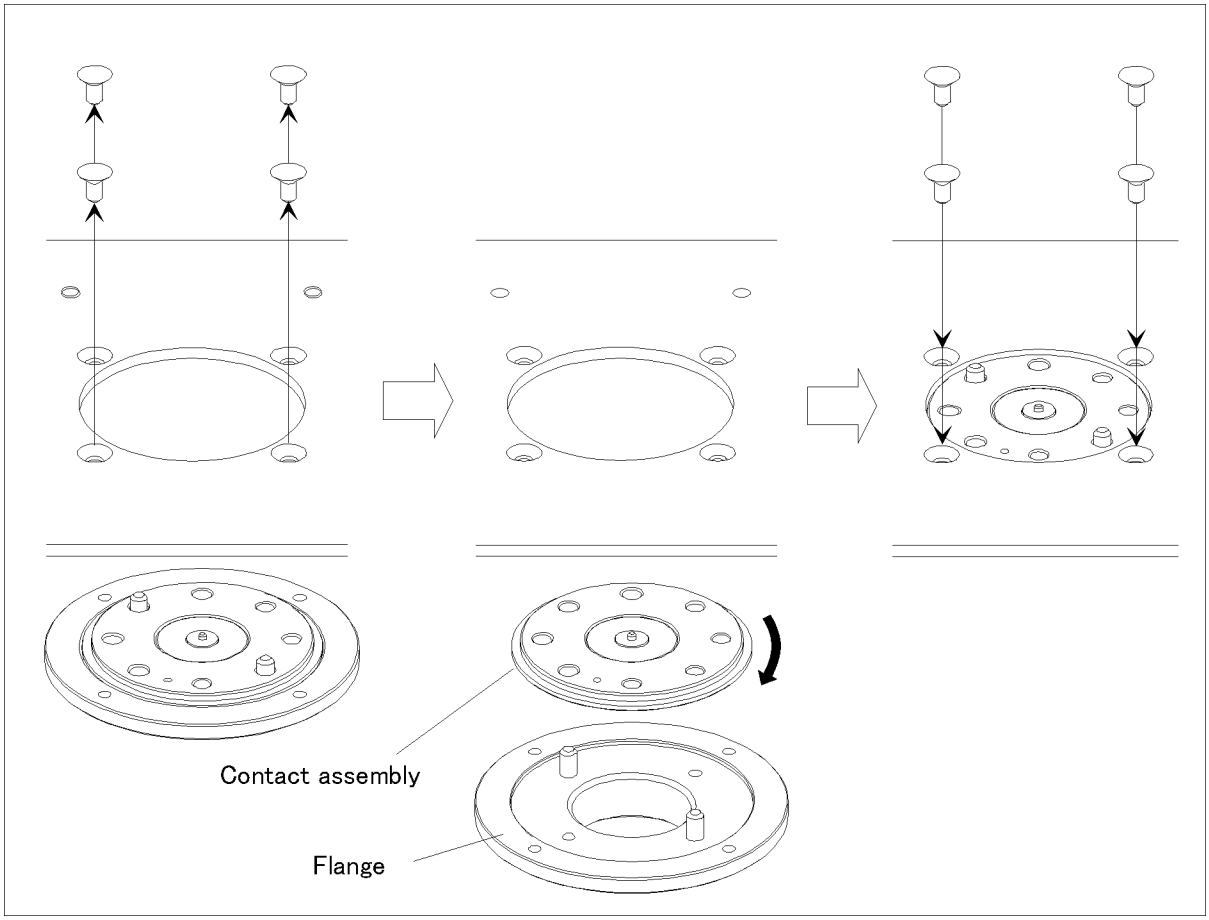
If the center electrode of the contact assembly is smeared, an unused clean area of the center electrode can be used simply by changing the orientation of the contact assembly. This section describes the method for changing the orientation of or replacing the contact assembly.

To change the contact assembly orientation or replace the contact assembly, it is necessary to use a 1.5-mm Allen wrench (Keysight part number: 8710-0909) and a Phillips screwdriver.

Procedure for Changing the Orientation of or Replacing the Contact Assembly

1. Take off the guide holder, and remove the device guide and electrode plate. (See to Figure 3-4 on page 28).
2. Remove the four screws from the upper side of the fixture, and then remove the contact assembly and flange.

Figure 6-3 Removing the Contact Assembly



3. Rotate the contact assembly and set it in place so that a clean area of the center electrode is at the measuring position.
4. Install the flange, and tighten the screws.
5. Install the device guide and electrode plate. Then mount the guide holder and secure it with the screws.

Operation Check

This section describes the operation check method. Be sure to perform the operation check after each time a part is replaced.

Open Impedance Check

Conduct an Open impedance check with the fixture set for the OPEN state.

Necessary equipment

- Shorting bars (supplied as accessories)
- Impedance measuring instrument (calibrated at the 7-mm connector end)

NOTE If a measuring instrument other than the 4291B is to be used, make the equivalent settings according to the Operation and Service Manual for the instrument to be used.

Step 1. Prepare a measuring instrument calibrated at the 7-mm connector end. Connect the test fixture with this instrument.

Step 2. Set the fixture for the OPEN state, at the DUT measuring position (see Figure 3-18 on page 38).

Step 3. Make the settings for the 4291B as follows.

Table 6-4 Settings for the Measuring Instrument (Keysight 4291B)

Measuring Condition	Setting
Measurement parameter	Cp
Start frequency	100MHz
Stop frequency	1GHz
OSC Level	0.5V
Number of points	2
Point averaging factor	16
Points averaging	ON

Step 4. Under these conditions, measure Cp at 100 MHz and 1 GHz separately.

Step 5. Confirm that the Cp value is within the typical range shown in Table 6-5.

Table 6-5 OPEN Impedance Check: Typical

Parameter	Frequency	Typical (Absolute value)
Cp	100MHz	700 fF ± 400 fF
Cp	1GHz	700 fF ± 400 fF

Short Impedance Check

Upon completion of the open impedance check, carry out a short impedance check with the fixture set for the SHORT state.

Step 1. At the DUT measuring position, connect an appropriate shorting bar with the electrode to secure the fixture for the SHORT state. (See Figure 3-16 on page 37).

Step 2. Make the settings for the 4291B as follow.

Table 6-6 Settings for the Measuring Instrument (Keysight 4291B)

Measuring Condition	Setting
Measurement parameter	Ls
Start frequency	100MHz
Stop frequency	1GHz
OSC Level	0.5V
Number of points	2
Point averaging factor	16
Points averaging	ON

Step 3. Under this condition, measure Ls at 100MHz and 1GHz, separately.

Step 4. Confirm that the Ls value is within the typical range shown in Table 6-7

Table 6-7 SHORT Impedance Check: Typical

Parameter	Frequency	Typical (Absolute value)
Ls	100MHz	2.3nH ± 1nH [a]
Ls	1GHz	2.3nH ± 1nH[a]

a. The values given above are common to shorting bars of all sizes.

Short-impedance Measurement Repeatability Check

Repeat short impedance measurement to check for the repeatability of measurement.

Step 1. Upon completion of the short impedance check, disconnect the shorting bar and connect it again with the electrode.

Step 2. Under the same measuring conditions as given above, measure Ls again at 100MHz and 1GHz, separately.

Step 3. Confirm that the Ls value is within the typical range shown in Table 6-7.

Step 4. Obtain the difference between the first and second Ls measurements.

Step 5. Confirm that the variation in measurements is within the typical range shown in Table 6-8.

Table 6-8 SHORT Impedance Check: Typical

Parameter	Frequency	Typical (Difference)
Ls	100MHz	± 45pH
Ls	1GHz	± 45pH

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