

# Keysight 16198A Bottom Electrode SMD Test Fixture

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## Contents

# 1 Installation Guide

In this chapter, the procedures required from the time the 16198A SMD Test Fixture arrives until its use begins are described.

## Incoming Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the 16198A has been checked mechanically and electrically. The shipment should contain everything listed in contents list in box. If the contents are incomplete or if there is mechanical damage or defect, notify the nearest Keysight Technologies office. If the shipping container is damaged or the cushioning material shows signs of unusual stress, notify the carrier as well as the Keysight Technologies office. Keep the shipping materials for the carrier's inspection.

## Supported Instrument

The 16198A Test Fixture is suitable for use with a E4982A LCR Meter, E4991B Impedance Analyzer and E5061B with option 005.

### NOTE

The compensation for this fixture is not the electrical length compensation which is normally used for the other fixtures. The firmware of supported instruments has a capability to compensate the error factor of fixture with the particular compensation method. Hence, the supported instrument is limited.

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## Selecting and Changing the contact board assembly

Select an contact board assembly that corresponds to the shape of the DUT being measured and replace the contact board assembly in the fixture.

### Procedure

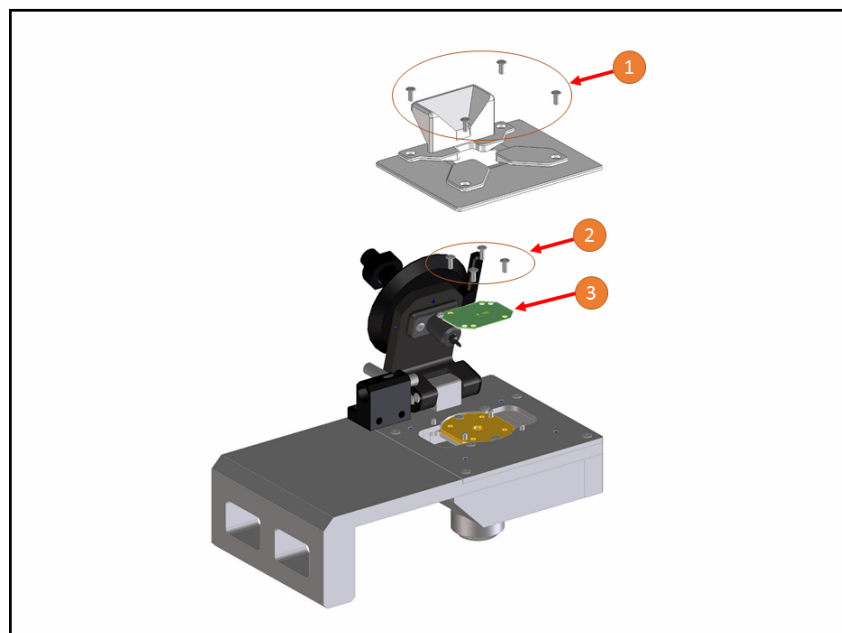
**Step 1.** Confirm if your DUT satisfies the applicable DUT size in [Table 2-2 on page 2-3](#).

**Step 2.** Select an contact board assembly that is appropriate to the shape of the DUT to be measured.

DUT Size	Height	Keysight Parts Number
0201	< 0.15 mm	16198-66601 (70 micrometer)
0201	> 0.12 mm	16198-66602 (100 micrometer)
0402	All	16198-66603 (100 micrometer)

**Step 3.** Loosen the four screws (1 in [Figure 1-1](#)) used to fasten the DUT cover assembly and take them out, then remove the DUT cover assembly.

Figure 1-1 Replacing the contact board assembly



**Step 4.** Loosen the four screws (2 in [Figure 1-1](#)) used to fasten the contact board assembly and take them out, then remove the contact board assembly.

**Step 5.** Replace the contact board assembly in the fixture (3 in [Figure 1-1](#)) with the selected contact board assembly.

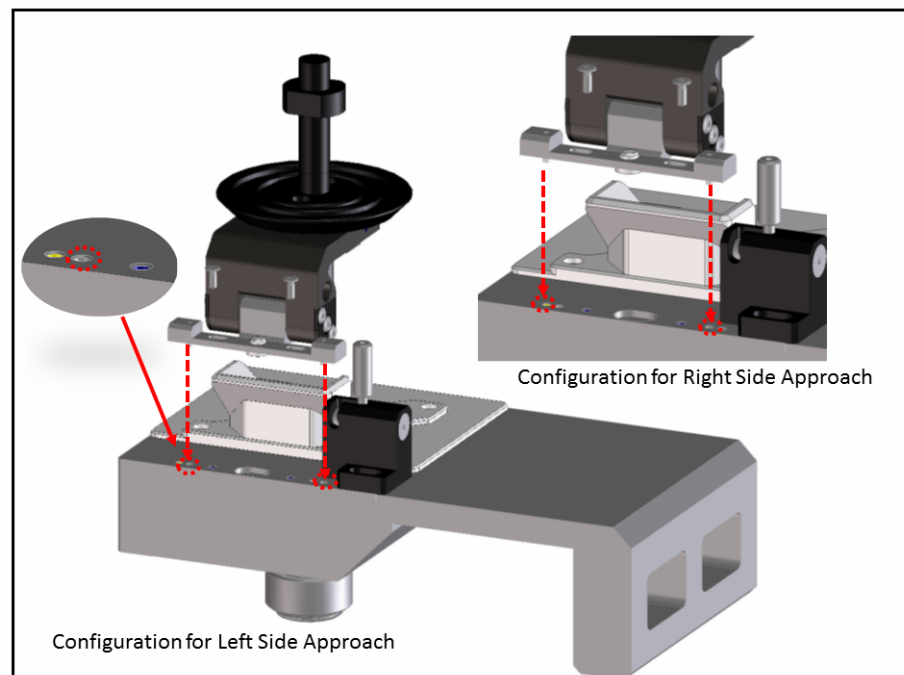
- Step 6.** Tighten the four screws (HEX-Socket M2) used to fasten the contact board assembly. The tightening torque used is 0.17 Nm (1.5 in-lb).
- Step 7.** Tighten the four screws (HEX-Socket M2) used to fasten the DUT cover assembly. The tightening torque used is 0.17 Nm (1.5 in-lb).

## Configuring for Left Side Approach

The following configuration may help to improve the usability.

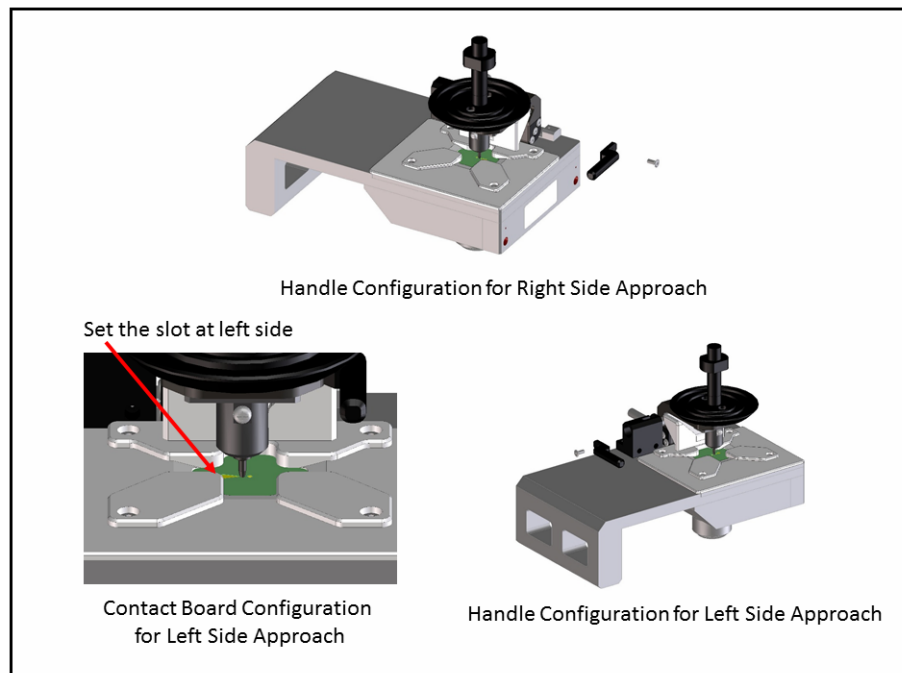
- Step 1.** Remove the two screws used to fasten the loader assembly.
- Step 2.** Replace the position of the loader assembly according to the [Figure 1-2](#)

Figure 1-2 Position of Loader



- Step 3.** Tighten the two screws (HEX-Socket M2) used to fasten the loader assembly. The tightening torque used is 0.17 Nm (1.5 in-lb).
- Step 4.** Remove one of the screw (HEX-Socket M2) used to fasten the handle.
- Step 5.** Replace the position of the handle as shown in [Figure 1-3](#).
- Step 6.** Rotate the connector board assembly position according to the [Figure 1-3](#) so that you can insert the DUT from the left side.

Figure 1-3 Configuration for Left Side Approach



## Connecting the 16198A to a Measuring Instrument

The general procedure for mounting the Test Fixture on the adapter is as shown below.

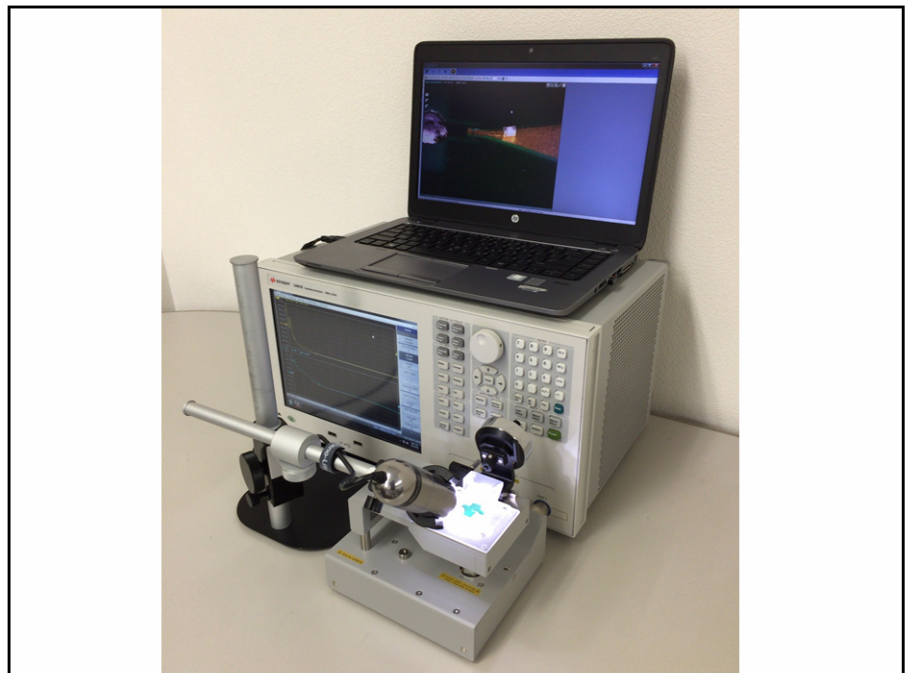
- Step 1.** Execute the calibration at 7-mm connector of the analyzer before the 16198A is connected. Refer to the help manual for the measuring instrument that you are using.
- Step 2.** Turn the adapter's 7-mm connector in the counterclockwise direction when viewed from above and screw the connection sleeve in fully.
- Step 3.** Align the test fixture with the adapter's mount post and 7-mm connector and set it gently in place.
- Step 4.** Turn the adapter's 7-mm connector counterclockwise, connecting the bottom of the test fixture with the connector.

## Instrument Setup

As the DUT is very small, the microscope may be necessary to place the DUT. Prepare your appropriate microscope.



Figure 1-4 E4991B Setup Example with the microscope



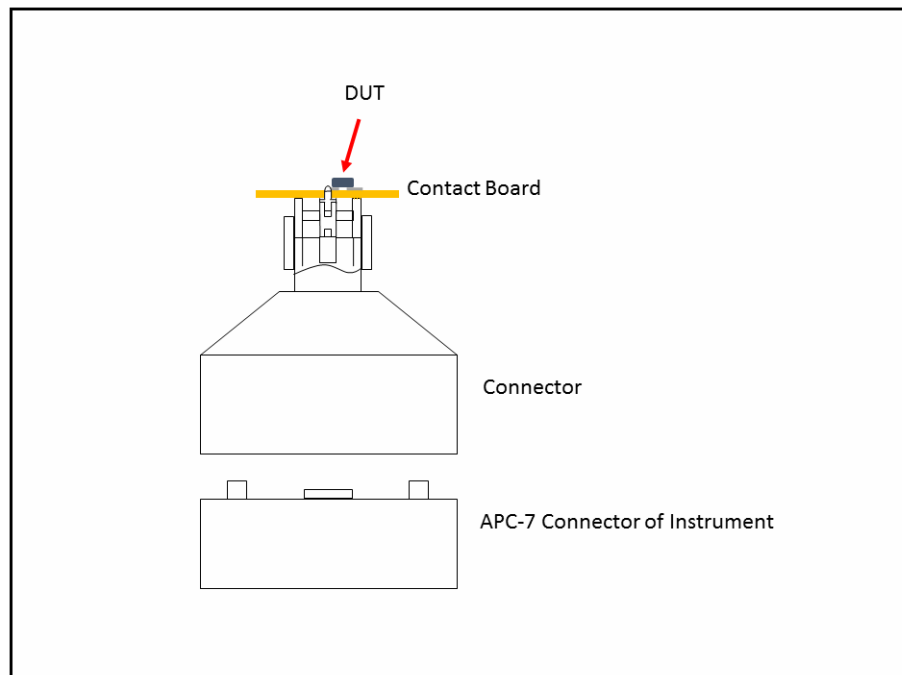
Installation Guide  
Instrument Setup

## 2 Product Overview

### Product Overview

The 16198A is a test fixture for measuring chip components. They enable chip type capacitors, inductors and other components to be measured with high precision and measurement repeatability. The 16198A also is compatible with measuring frequencies up to 3 GHz. The 16198A can measure the DUT size 0402 and 0201 depending on contact board.

Figure 2-1 Electrode Structure



The current from the center conductor flows through the DUT (Device Under Test) after passing the electrode on the contact board and returns to the outer conductor.

Figure 2-2 Name of Parts

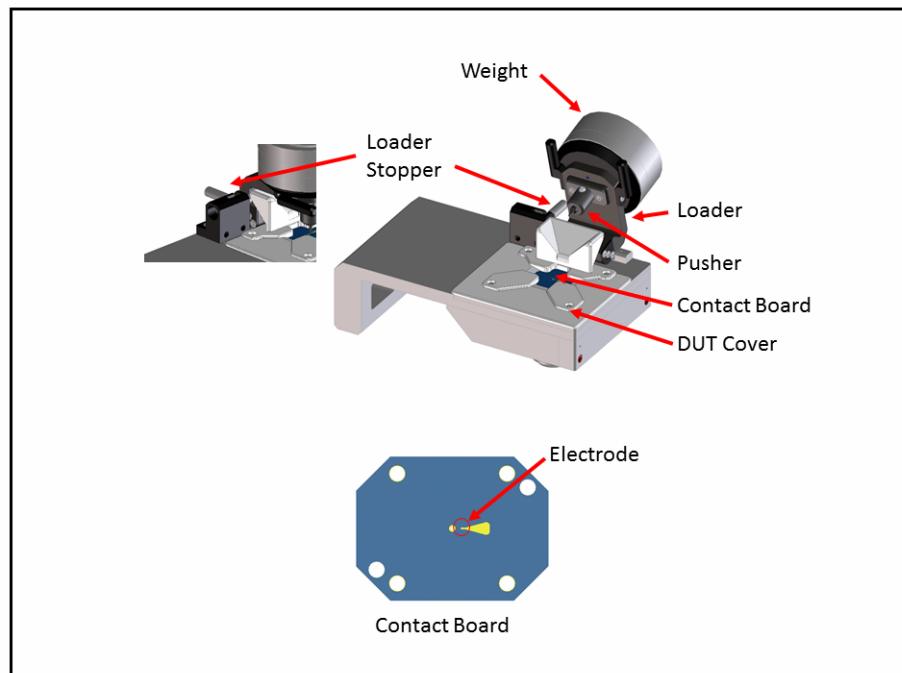


Table 2-1

Names of Parts and Functions

Name	Function
Contact board	Electrode is placed on the surface. Several type of electrodes are available depending on DUT size.
Weight	Weight to control the pressure for DUT contact
Loader	Load and unload the pusher on DUT.
Loader stopper	Hold the position of loader.
Pusher	Push the DUT to the electrode
DUT Cover	Avoid losing the DUT from the contact board

## Specifications and Supplemental Performance Characteristics

### General Information

**Table 2-2**      **General Information**

Description	General information
Applicable DUT Type	Surface Mount Device with bottom electrodes.
Applicable DUT Size	0201: 0.1 to 0.125mm (W) x 0.2mm to 0.25mm (L) x 0.1 to 0.2 mm (H) 0402: 0.18 to 0.22 mm (W) x 0.38 mm to 0.42 mm (L) x 0.11 to 0.22 mm (H)
Frequency	DC to 3 GHz
Maximum Voltage	± 40V peak max. (AC+DC)
Maximum Current	5.0A
Applied temp. of additional error	23±5 °C
Operation Environment	temp. -55 to 85 °C humidity 15% to 95%RH (@ wet bulb temp. < 40 °C )
Storage Environment	temp. -55 to 85 °C humidity 15% to 90%RH (@ wet bulb temp. < 60 °C )
Dimension	145 (W) × 80 (D) × 110 (H) mm
Weight	870g @300gWeight
Safety Standard	IEC 61010-1:2001 / EN 61010-1:2001 Canada: CAN / CSA C22.2 No. 1010.1-92 Installation / overvoltage category II Pollution degree 2 Indoor Use
Range of Weight for pressure	(15) <sup>a</sup> 30 to 330 g
Short bar (0402, 0201)	Short: 0.19 nH
Open offset	0 (@bottom electrode type) to -7.5 fF (@ 5 side electrode type)

a. When the weight holder is removed. (special occasion)

### 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.

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

where A [%] Test Fixture's Proportional Error [%]

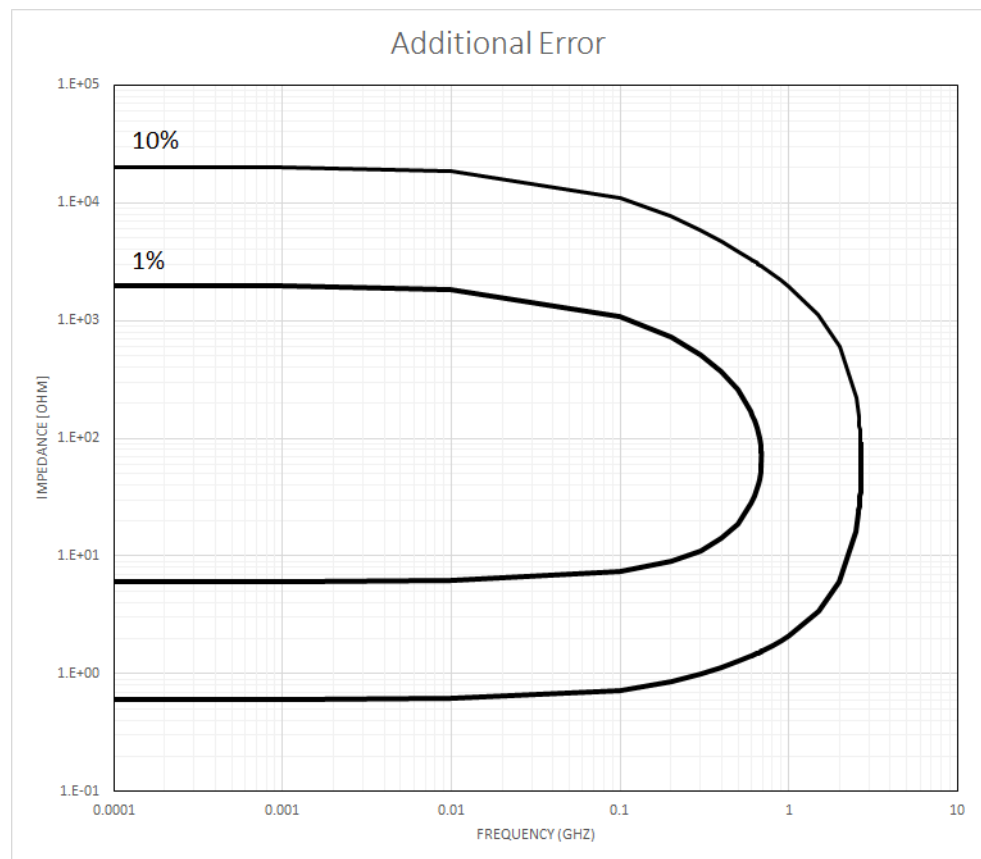
Y<sub>o</sub> [S] Test Fixture's Open Repeatability [S]

Z<sub>s</sub> [Ω] Test Fixture's Short Repeatability [Ω]

Z<sub>x</sub> [Ω] Measured Impedance Value of DUT [Ω]

Error Factor	Formula
Proportional error	$1.2 \times f \text{ (GHz)}^2 [\%]$
Offset Short error	$60 + 125 \times f \text{ (GHz)} [\text{m}\Omega]$
Offset Open error	$5 + 40 \times f \text{ (GHz)} [\mu\text{S}]$

Figure 2-3 Additional Error



## 3 Operation

This chapter describes preparations and fixture compensation when using the 16198A to take measurements as well as DUT connection and measuring methods.

### Flow of Measurements

Follow the steps below when performing measurements of DUTs with the 16198A. Before the measurement, the calibration should be done on the instrument and the fixture should be placed. See [“Connecting the 16198A to a Measuring Instrument” on page 1-4.](#)

#### Procedure

**Step 1.** Selecting the fixture model number in the measuring instrument

Select 16198A from fixture selection softkey in the measuring instrument you will be using.

**Step 2.** Performing Fixture Compensation

Measure the data for open compensation and measure the data for short compensation.

**Step 3.** Connecting and Measuring the DUT

Connect the DUT and perform measurements

Selecting fixture model and fixture compensation differ depending on the measuring instrument used. Refer to the help manual for the measuring instrument that you are using.

### Selecting the fixture model number in the measuring instrument

Select 16198A from fixture selection softkey in the measuring instrument you will be using. Refer to the help manual.

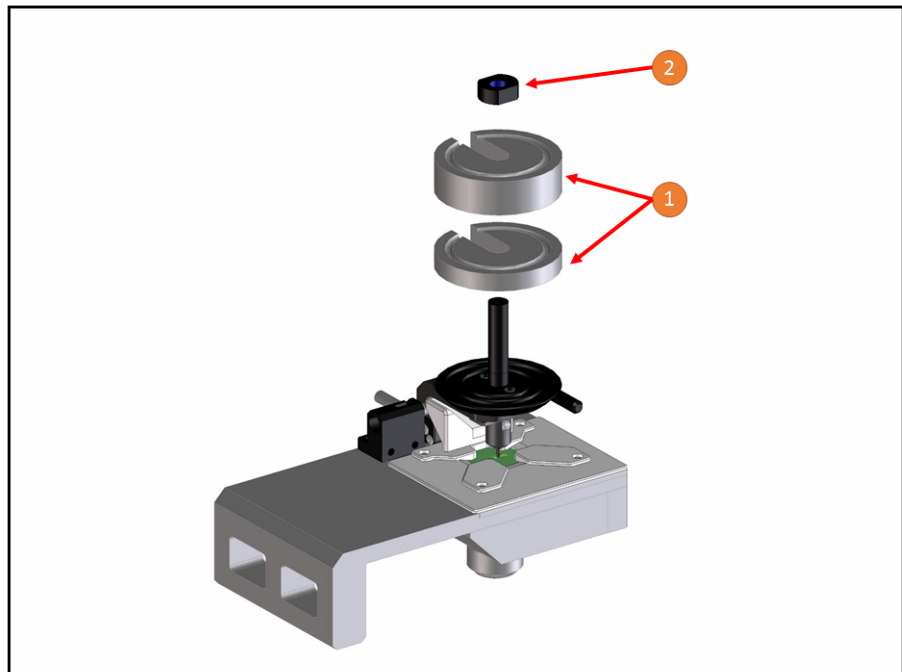
## Performing Fixture Compensation

In order to perform more accurate measurements, before beginning the measurement procedure, it is necessary to compensate the fixture. For the 16198A, perform measurements of the data for open compensation and of the data for short compensation.

### Measuring Short Compensation Data

- Step 1.** Set the required weight as shown in **Figure 3-1, “Setting weight.”** Recommended weight for short bar is 200 to 300 g. The weight below 200 g causes inaccurate measurement.

Figure 3-1 Setting weight



- Step 2.** Place a short bar at the right position on the contact board. The top side of short bar has two lines as shown in **Figure 3-2, “Short bar placement.”**



Figure 3-2 Short bar placement

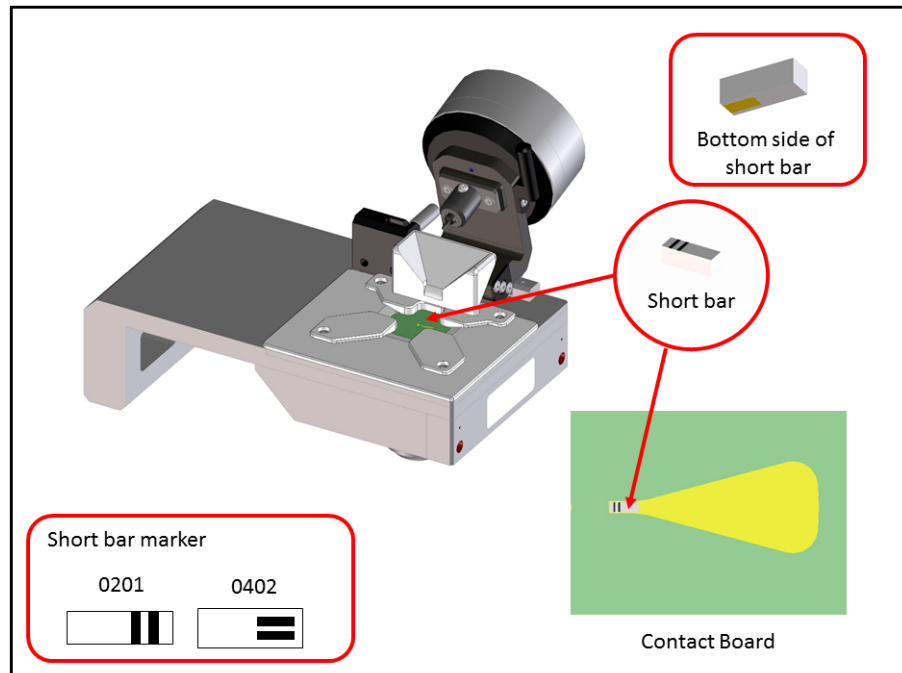
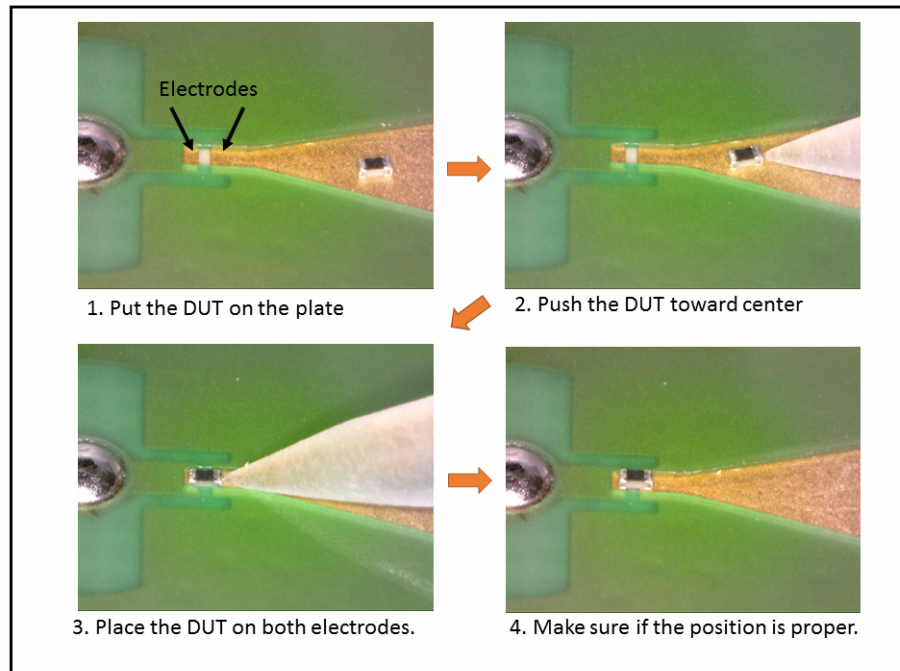
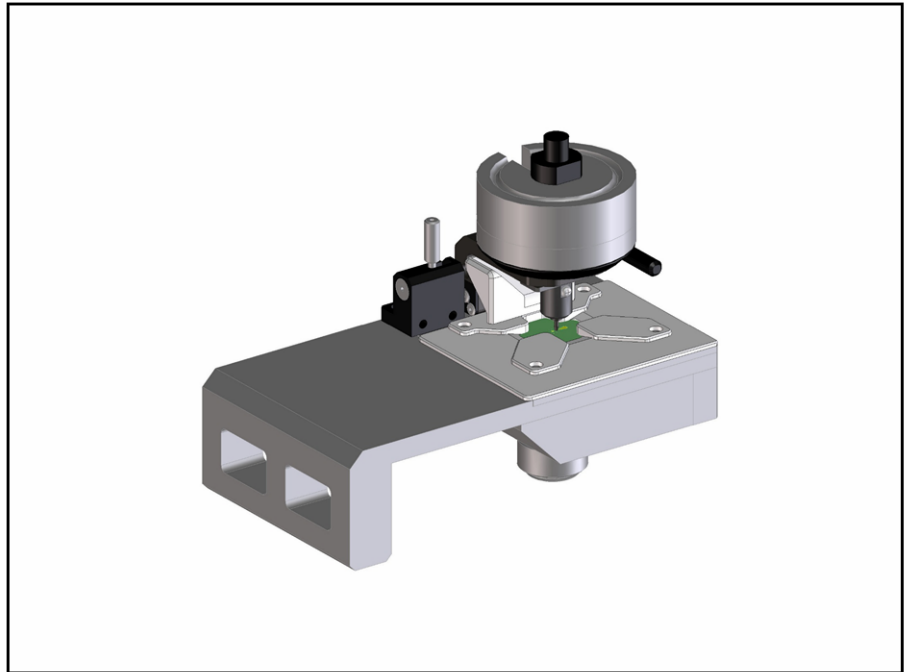


Figure 3-3 Example of DUT/Short bar placement



**Step 3.** Set the fixture in the short state as shown in [Figure 3-4](#), “Close State.”.

Figure 3-4 Close State



**Step 4.** Make sure if the pusher pushes the short bar properly as shown in [Figure 3-6](#), “Pusher.”

Figure 3-5 Pusher Setup

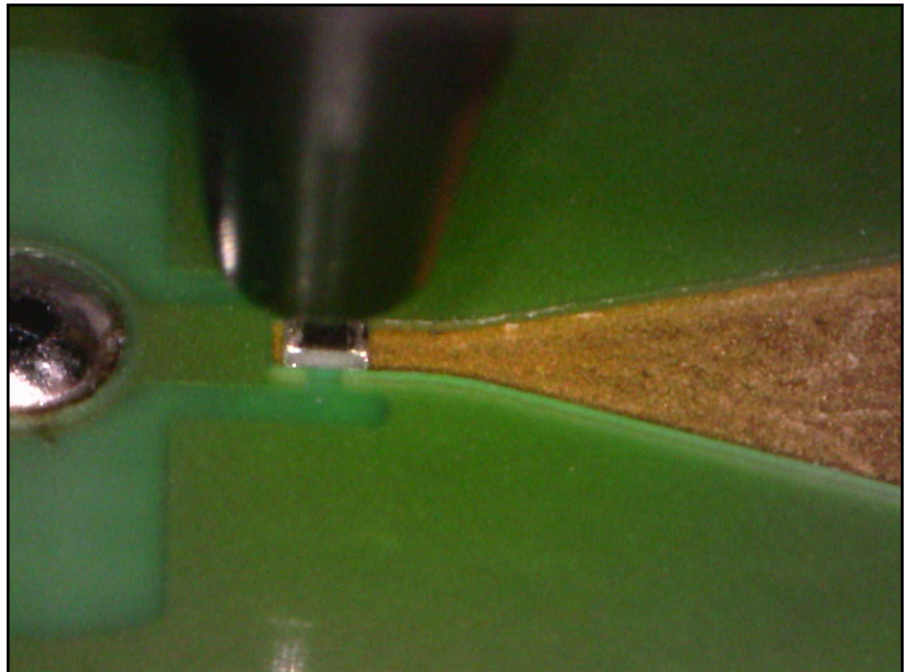
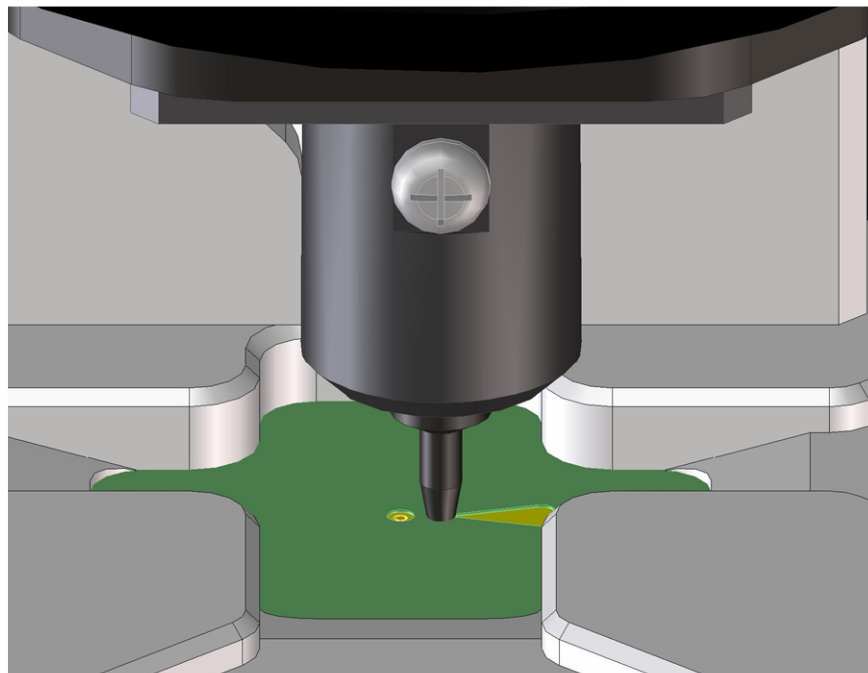


Figure 3-6 Pusher

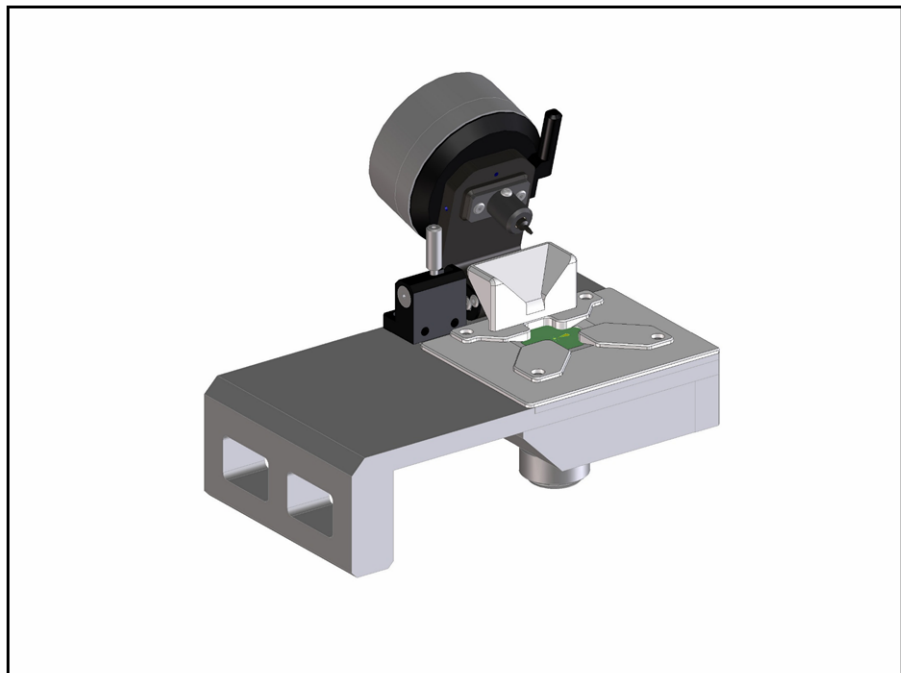


**Step 5.** Take measurements of the data for short compensation in accordance with the Help Manual for the measuring instrument you are using.

#### Measuring Open Compensation Data

**Step 1.** Set the fixture in the open state as shown in [Figure 3-7, “Open State.”](#)

Figure 3-7 Open State



- Step 2.** Take measurements of the data for open compensation in accordance with the Help Manual for the measuring instrument you are using.

### Connecting and Measuring DUT

- Step 1.** Set the required weight for the DUT measurement. The appropriate weight is depending on the DUT. The weight should be enough pressure to make a stable measurement and not make a damage on the DUT.
- Step 2.** Set the DUT on the contact board as shown in [Figure 3-3, “Example of DUT/Short bar placement.”](#)
- Step 3.** Set the fixture in the close state as shown in [Figure 3-4, “Close State.”](#)
- Step 4.** Make sure if the pusher pushes the DUT properly as shown in [Figure 3-6, “Pusher.”](#)
- Step 5.** Take measurements in accordance with the Help Manual for the measuring instrument you are using.

## 4 User Maintenance

This chapter describes the maintenance procedure of 16198A

### Overview

#### The Necessity of User Maintenance

The measurement performance of the fixture decreases slightly each time measurement is repeated. This is due to contamination of the contacting sections by solder, etc. and mechanical wear and distortion caused by repeated use. Consequently, to maintain satisfactory measurement results, it is important to maintain the contacting sections in good condition and take appropriate measures before wear or distortion occurs. To accomplish this it is necessary to monitor the fixture and perform maintenance of the various items.

The contact board and the short bar are consumable products. These are the fixture construction parts that tend to have the greatest effect on the measurement results. Each DUT replacement causes gradual deterioration of the electrodes. The short bar part is used for creating a zero-standard during fixture compensation and distortion or contamination of the short bar therefore directly affects the measurement result. Focusing on the contact board and the short bar, this section explains the general aspects of user maintenance.

## User Maintenance Items

Item	Frequency
Cleaning	Several times daily
Contact board wear check	When the contact board seems to be worn out and measurement result is not accurate.
Short bar wear check	When the short bar seems to be worn out and measurement result is not accurate.
Parts replacement	When the wear check is failed.

## Replacement of Parts with Limited Service Life

**Table 4-1** Estimated Service Life

Item	Estimated Replacement Period
Contact board	600 to 1,200 times DUT replacement
Short bar	1,000 times short bar replacement
Pusher	300,000 times measurement
APC-3.5 Connector	500 times contact board replacement

The Service Life varies depending on the user environment. These data provides typical value.

**Table 4-2** Consumable Parts

Item	Module Number
Contact Board (Guide PCA 0201, 70 micrometer), 1 ea	19198AU-101
Contact Board (Guide PCA 0201, 100 micrometer), 1ea	16198AU-102
Contact Board (Guide PCA 0201, 70 micrometer), 8ea	16198AU-103
Contact Board (Guide PCA 0201, 100 micrometer), 8ea	16198AU-104
Contact Board (Guide PCA 0402, 100 micrometer), 1ea	16198AU-201
Contact Board (Guide PCA 0402, 100 micrometer), 8ea	16198AU-202
Short bar 0201, 5 pc	16198AU-110
Short bar 0402, 5 pc	16198AU-210

## Cleaning

If the contact board and short bar become dirty, measuring accuracy and repeatability will decrease. In order to ensure measurement with high accuracy, be sure to perform cleaning periodically.

Use the furnished Cleaning Rod (Keysight parts number 5182-7586) for the cleaning. Use the white rubber part of the cleaning rod to remove dirt from all contacting surfaces of contact boards and short bar. Be careful not to scratch or damage the parts when removing the dirt.

When the dirt is not removed with the Cleaning Rod, use cotton swab with isopropyl alcohol for the cleaning.

### CAUTION

Do not use Cleaning Rod with alcohol.

## Wear Check

The wear check allows you to obtain an idea about the deterioration of the fixture in order to ensure that the desired measurement accuracy is obtained.

### Open/Short Measurement Check

- Step 1.** Select 16198A from fixture selection softkey in the measuring instrument you will be using. Refer to the help manual.
- Step 2.** Select Ls-Rs as a measurement parameter.
- Step 3.** Set the start and stop frequencies at 10 MHz and 1 GHz, respectively
- Step 4.** Set the 200 to 300 g weight as shown in [Figure 3-1, "Setting weight."](#)
- Step 5.** Place a short bar at the right position on the contact board. The top side of short bar has two lines as shown in [Figure 3-2, "Short bar placement."](#)
- Step 6.** Set the fixture in the short state as shown in [Figure 3-4, "Close State."](#)
- Step 7.** Make sure if the pusher pushes the short bar properly as shown in [Figure 3-6, "Pusher."](#)
- Step 8.** Take measurements of the data for short bar in accordance with the Help Manual for the measuring instrument you are using.
- Step 9.** Set the fixture in the open state as shown in [Figure 3-7, "Open State."](#)
- Step 10.** Remove the short bar from the contact board.
- Step 11.** Take measurements of the data for open state.

Parameter	Frequency	Lower Limit	Upper Limit
Ls (short)	10 MHz	50 pH	1250 pH

Parameter	Frequency	Lower Limit	Upper Limit
Rs (Short)	10 MHz	- 5 mΩ	40 mΩ
Ls (short)	1 GHz	- 50 pH	650 pH
Rs (Short)	1 GHz	- 30 mΩ	575 mΩ
Cp (Open)	10 MHz	-200 fF	200 fF
G (Open)	10 MHz	- 20 μS	20 μS
Cp (Open)	1 GHz	-200 fF	200 fF
G (Open)	1 GHz	-35 μS	70 μS

### Short Repeatability Check

- Step 1.** Select 16198A from fixture selection softkey in the measuring instrument you will be using. Refer to the help manual.
- Step 2.** Select Ls-Rs as a measurement parameter.
- Step 3.** Set the start and stop frequencies at 10 MHz and 1 GHz, respectively
- Step 4.** Set the 200 to 300 g weight as shown in [Figure 3-1, "Setting weight."](#)
- Step 5.** Place a short bar at the right position on the contact board. The top side of short bar has two lines as shown in [Figure 3-2, "Short bar placement."](#)
- Step 6.** Set the fixture in the short state as shown in [Figure 3-4, "Close State."](#)
- Step 7.** Make sure if the pusher pushes the short bar properly as shown in [Figure 3-6, "Pusher."](#)
- Step 8.** Take measurements of the data for short bar in accordance with the Help Manual for the measuring instrument you are using.
- Step 9.** Repeat the step 5 to 8. Remove the short bar once and place it again to measure repeatability.

Parameter	Frequency	Difference between 2 measurements
Rs (Short)	10 MHz	less than 20 mΩ
Rs (Short)	1 GHz	less than 300 mΩ



## Parts Replacement

This section describes about replacement parts.

### Replacement Parts

The following 3 parts are ones the user can replace by them selves. If the other part is broken, send the unit to Keysight service center for repair.

**Table 4-3** Replacement Parts

Item	Module/Part Number
Pusher Unit	16198AU-540
DUT Cover Assy	16198AU-544
Connector APC-3.5	16198AU-545

### Replacement Procedure

#### Pusher Replacement

- Step 1.** Remove the 2 screws used to fasten the pusher ([Figure 4-1](#)).
- Step 2.** Replace the pusher.
- Step 3.** Tighten the 2 screws (HEX-Socket M2) used to fasten the pusher. The tightening torque used is 0.17 Nm (1.5 in-lb).

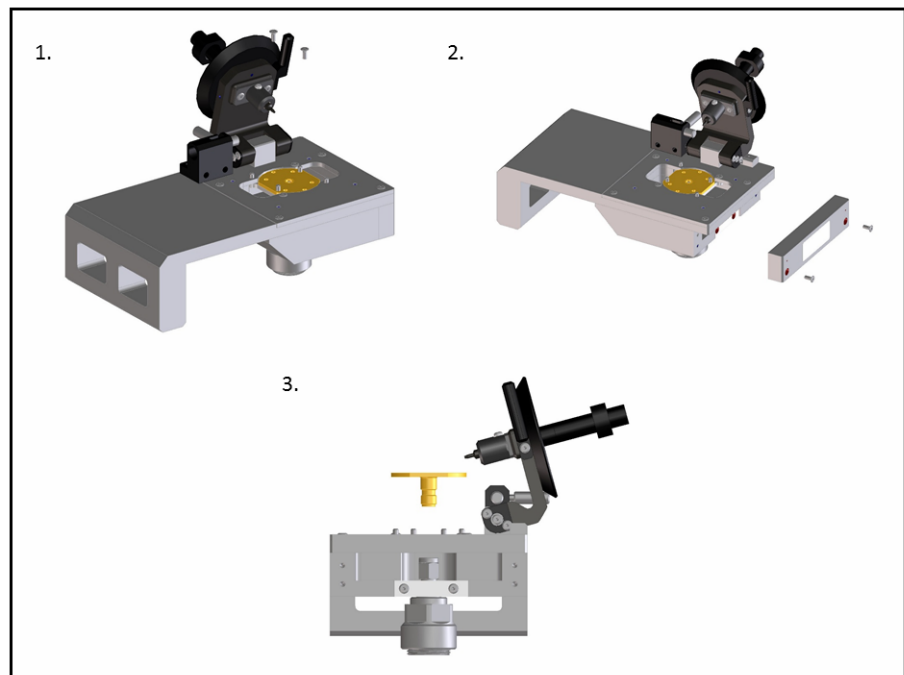
Figure 4-1 Pusher Replacement



#### APC-3.5 Replacement

- Step 1.** Remove the 2 screws (HEX-Socket M2) from the contact board base. (1 in [Figure 4-2](#))
- Step 2.** Remove the side panel by removing the 2 screws (HEX-Socket M2). (2 in [Figure 4-2](#))
- Step 3.** Remove the APC-3.5 connector with loosening nut of 3.5-connection clockwise. (3 in [Figure 4-2](#))
- Step 4.** Mate the positioning hole of new APC-3.5 connector to the positioning pin
- Step 5.** Tighten the APC-3.5 connector to connector board base. The tightening torque used is 0.9 Nm (8 in-lb) and direction is counter clockwise.
- Step 6.** Tighten the 2 screws used to fasten the side panel. The tightening torque used is 0.17 Nm (1.5 in-lb).
- Step 7.** Tighten the 2 screws used to fasten the connector board base. The tightening torque used is 0.17 Nm (1.5 in-lb).

Figure 4-2 APC-3.5 Connector Replacement



User Maintenance  
Parts Replacement

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