

Agilent 16196A/B/C/D Parallel Electrode SMD Test Fixture

Operation and Service Manual

Fourth Edition



Agilent Technologies

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Safety Summary

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

Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

NOTE

16196A/B/C/D comply with INSTALLATION CATEGORY II and POLLUTION DEGREE 2 in IEC61010-1. 16196A/B/C/D are INDOOR USE product.

- Ground The Instrument

To avoid electric shock hazard, the instrument chassis and cabinet must be connected to a safety earth ground by the supplied power cable with earth blade.

- DO NOT Operate In An Explosive Atmosphere

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

- DO NOT Substitute Parts Or Modify Instrument

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

- Dangerous Procedure Warnings

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

Safety Symbol

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



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



Alternating current.



Direct current.



On (Supply).



Off (Supply).



In position of push-button switch.



Out position of push-button switch.



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

WARNING

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

CAUTION

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

NOTE

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

Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies 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 by the calibration facilities of other International Standards Organization members.

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Typeface Conventions

Bold

Boldface type is used when a term is defined. For example: **icons** are symbols.

Italic

Italic type is used for emphasis and for titles of manuals and other publications.

[Hardkey]

Indicates a hardkey labeled “Hardkey.”

Softkey

Indicates a softkey labeled “Softkey.”

[Hardkey] - Softkey1 - Softkey2

Indicates keystrokes **[Hardkey] - Softkey1 - Softkey2**.

| | |
|---|----|
| 1. Installation Guide | |
| Incoming Inspection | 10 |
| Connecting the 16196A/B/C/D to a Measuring Instrument | 15 |
| 2. Product Overview | |
| Product Overview | 18 |
| Functions | 20 |
| Names of Accessories and Functions | 21 |
| 3. Operation | |
| Flow of Measurements | 24 |
| Selecting and Changing the Insulator Assembly | 25 |
| Setting the Electrical Length. | 29 |
| Performing Fixture Compensation | 30 |
| Measuring Open Compensation Data | 30 |
| Measuring Short Compensation Data | 32 |
| Connecting and Measuring DUTs. | 34 |
| Removing the DUT | 34 |
| 4. User Maintenance | |
| Overview. | 38 |
| The Necessity of User Maintenance | 38 |
| User Maintenance Flow | 39 |
| Cleaning | 41 |
| Places Requiring Cleaned | 41 |
| Cleaning Methods | 42 |
| Wear Check. | 44 |
| Example of User Limit Values Setting | 44 |
| Reference Value Acquisition. | 46 |
| Measuring Impedance Shift | 48 |
| Check Sheet | 49 |
| Check Sheet Fill-Out Example | 49 |
| Electrode Wear Check. | 50 |
| Short Plate Wear Check. | 51 |
| Parts Replacement. | 52 |
| Procedure for Replacement. | 52 |
| Check Following Replacement | 52 |
| Assembling Check | 53 |
| Electrode Check | 53 |
| Short Plate Check | 56 |
| 5. Specifications and Supplemental Performance Characteristics | |
| Specifications | 60 |
| Supplemental Performance Characteristics | 61 |
| Additional Error | 61 |
| 6. Service | |
| Replaceable Parts | 68 |

Contents

| | |
|---|----|
| Block Assembly | 68 |
| Cap | 71 |
| Other Parts | 73 |
| Maintenance Kit | 74 |
| 16196U Maintenance Kit | 74 |
| Replacement Procedure | 75 |
| Lower Electrode | 76 |
| Insulator | 78 |
| Upper Electrode | 79 |
| Assembling Check | 81 |
| Method Using Network Analyzer | 81 |

1 Installation Guide

In this chapter, the procedures required from the time the 16196A/B/C/D Parallel Electrode 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 16196A/B/C/D has been checked mechanically and electrically.

The shipment should contain everything listed in Table 1-1 to Table 1-4. If the contents are incomplete or if there is mechanical damage or defect, notify the nearest Agilent Technologies office. If the shipping container is damaged or the cushioning material shows signs of unusual stress, notify the carrier as well as the Agilent Technologies office. Keep the shipping materials for the carrier's inspection.

NOTE

When the equipment is used for the first time following purchase, “Wear Check” should be conducted. This “Wear Check” is required for keeping the measurement accuracy. Refer to “Reference Value Acquisition” on page 46 in “Wear Check” for details.

Figure 1-1 16196A/B/C/D Contents

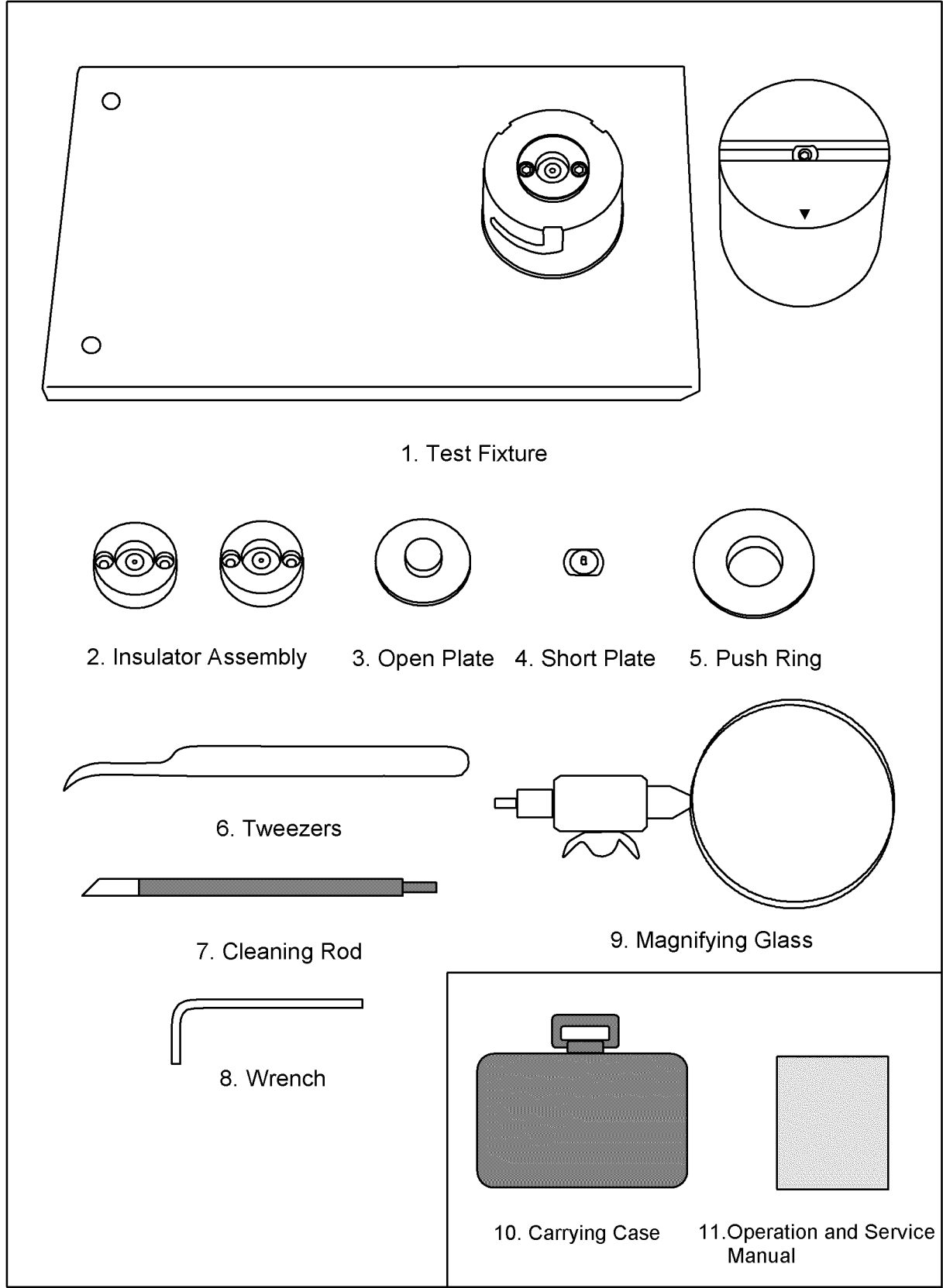


Table 1-1 16196A Package Contents

| No. | Description | Agilent Part No. | Qty. |
|-----|---|------------------|------|
| 1 | 16196A Parallel Electrode SMD Test Fixture | - | 1 |
| - | Insulator Assembly $\phi 1.34$ *1 | 16196-60112 | 1 |
| 2 | Insulator Assembly $\phi 1.14$ | 16196-60113 | 1 |
| 2 | Insulator Assembly $\phi 1.08$ | 16196-60114 | 1 |
| 3 | Open Plate *2 | 16196-29002 | 1 |
| 4 | Short Plate *2 | 16196-29026 | 1 |
| 5 | Push Ring | 16196-24004 | 1 |
| 6 | Tweezers *3 | 8710-2081 | 1 |
| 7 | Cleaning Rod | 5182-7586 | 1 |
| 8 | Wrench | 8710-0909 | 1 |
| 9 | Magnifying Glass *3 | 16193-60002 | 1 |
| 10 | Carrying Case | 16196-60150 | 1 |
| 11 | Operation and Service Manual (This manual) *4 | 16196-90040 | 1 |

*1. Mounted in the Test Fixture when shipped from the factory.

*2. The Open Plate and Short Plate are packed in a single case and shipped.

*3. Furnished with Option 710.

*4. Furnished with Option ABA.

Table 1-2 16196B Package Contents

| No. | Description | Agilent Part No. | Qty. |
|-----|--|------------------|------|
| 1 | 16196B Parallel Electrode SMD Test Fixture | - | 1 |
| - | Insulator Assembly $\phi 0.85$ *1 | 16196-60212 | 1 |
| 2 | Insulator Assembly $\phi 0.75$ | 16196-60213 | 1 |
| 2 | Insulator Assembly $\phi 0.68$ | 16196-60214 | 1 |
| 3 | Open Plate *2 | 16196-29002 | 1 |
| 4 | Short Plate *2 | 16196-29027 | 1 |
| 5 | Push Ring | 16196-24004 | 1 |
| 6 | Tweezers *3 | 8710-2081 | 1 |
| 7 | Cleaning Rod | 5182-7586 | 1 |
| 8 | Wrench | 8710-0909 | 1 |

Table 1-2 16196B Package Contents

| No. | Description | Agilent Part No. | Qty. |
|-----|--|------------------|------|
| 9 | Magnifying Glass ^{*3} | 16193-60002 | 1 |
| 10 | Carrying Case | 16196-60250 | 1 |
| 11 | Operation and Service Manual (This manual) ^{*4} | 16196-90040 | 1 |

*1. Mounted in the Test Fixture when shipped from the factory.

*2. The Open Plate and Short Plate are packed in a single case and shipped.

*3. Furnished with Option 710.

*4. Furnished with Option ABA.

Table 1-3 16196C Package Contents

| No. | Description | Agilent Part No. | Qty. |
|-----|--|------------------|------|
| 1 | 16196C Parallel Electrode SMD Test Fixture | - | 1 |
| - | Insulator Assembly $\phi 0.48$ ^{*1} | 16196-60312 | 1 |
| 3 | Open Plate ^{*2} | 16196-29002 | 1 |
| 4 | Short Plate ^{*2} | 16196-29028 | 1 |
| 5 | Push Ring | 16196-24004 | 1 |
| 6 | Tweezers ^{*3} | 8710-2081 | 1 |
| 7 | Cleaning Rod | 5182-7586 | 1 |
| 8 | Wrench | 8710-0909 | 1 |
| 9 | Magnifying Glass ^{*3} | 16193-60002 | 1 |
| 10 | Carrying Case | 16196-60350 | 1 |
| 11 | Operation and Service Manual (This manual) ^{*4} | 16196-90040 | 1 |

*1. Mounted on the Test Fixture when shipped from the factory.

*2. The Open Plate and Short Plate are packed in a single case and shipped.

*3. Furnished with Option 710.

*4. Furnished with Option ABA.

Table 1-4 16196D Package Contents

| No. | Description | Agilent Part No. | Qty. |
|-----|--|------------------|------|
| 1 | 16196D Parallel Electrode SMD Test Fixture | - | 1 |
| - | Insulator Assembly $\phi 0.30$ ^{*1} | 16196-60414 | 1 |
| 2 | Insulator Assembly $\phi 0.34$ | 16196-60412 | 1 |
| 3 | Open Plate ^{*2} | 16196-29002 | 1 |

Table 1-4 16196D Package Contents

| No. | Description | Agilent Part No. | Qty. |
|-----|--|---------------------------|------|
| 4 | Short Plate ^{*2} | 16196-29030 ^{*3} | 1 |
| 5 | Push Ring | 16196-24004 | 1 |
| 6 | Tweezers ^{*4} | 8710-2081 | 1 |
| 7 | Cleaning Rod | 5182-7586 | 1 |
| 8 | Wrench | 8710-0909 | 1 |
| 9 | Magnifying Glass ^{*4} | 16193-60002 | 1 |
| 10 | Carrying Case | 16196-60450 | 1 |
| 11 | Operation and Service Manual (This manual) ^{*5} | 16196-90040 | 1 |

*1. Mounted in the Test Fixture when shipped from the factory.

*2. The Open Plate and Short Plate are packed in a single case and shipped.

*3. The part number is different from that of the replacement part. When you order it for user maintenance, refer to Table 6-1 on page 69.

*4. Furnished with Option 710.

*5. Furnished with Option ABA.

Connecting the 16196A/B/C/D to a Measuring Instrument

To connect the 16196A/B/C/D Test Fixture to a measuring instrument, it is necessary to use an adapter that fits the measuring instrument.

The 16196A/B/C/D Test Fixture is suitable for use with a high frequency LCR Meter or Impedance Analyzer. Table 1-4 lists the appropriate combination of measuring instrument and adapter.

Table 1-5 Measuring Instruments and Adapters

| Instrument | Adapter |
|---------------------|---|
| 4287A | Test Head + Test Fixture Stand (Furnished with the 4287A) |
| E4991A | Test Head (Furnished with the E4991A) |
| 4291A/B | Test Station + Test Head (Furnished with the 4291A/B) |
| 4286A | Test Head + Test Fixture Stand (Furnished with the 4286A) |
| 4395A ^{*1} | 43961A Impedance Test Adapter |
| 4396B ^{*1} | 43961A Impedance Test Adapter |

^{*1}."Option 010 Impedance Measuring Function" is required.

16196A/B/C/D Test Fixture can be connected to instruments with the 4-terminal pair configuration.

Table 1-6 Measuring Instruments and Adapters

| Instrument | Adapter |
|---|------------------------------------|
| 4294A | 42942A Terminal Adapter |
| 4194A | 41941A + 16099A or 41941B + 16099A |
| 4192A, 4194A, 4263B, 4268A, 4278A, 4279A, 4284A, 4285A | 16085B Terminal Adapter |

Refer to the adapter's manual about the procedure for connecting to the measuring instrument.

NOTE

Some instruments require calibration at the 7-mm connector. Perform calibration at the 7-mm connector before connecting a test fixture. See the operation manual of the instrument for more details.

The general procedure for mounting the Test Fixture on the adapter is as shown below. (For details, see the Manual supplied with each adapter.)

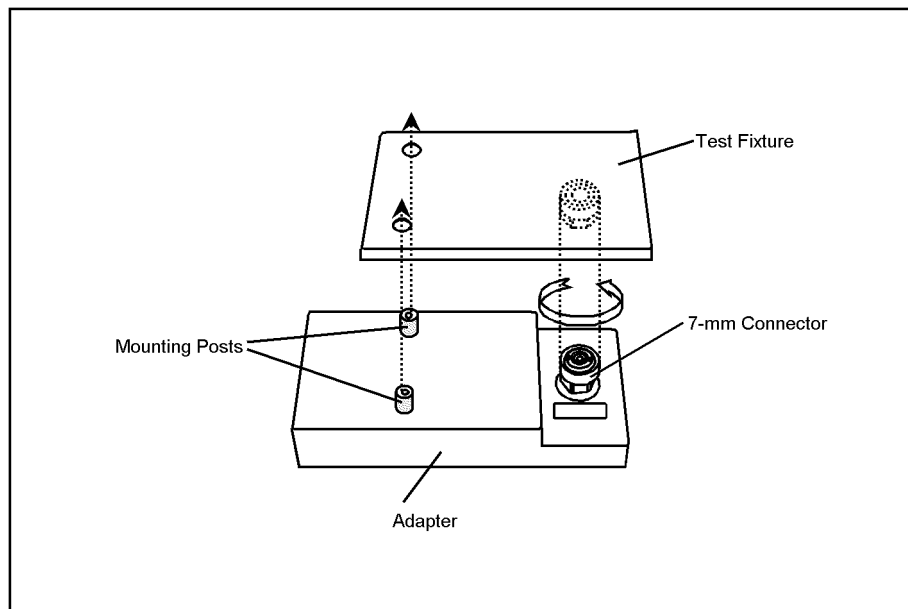
- Step 1.** Turn the adapter's 7-mm connector in the counterclockwise direction when viewed from above and screw the connection sleeve in fully.
- Step 2.** Align the test fixture with the adapter's mount post and 7-mm connector and set it gently in place.
- Step 3.** Turn the adapter's 7-mm connector counterclockwise, connecting the bottom of the test fixture with the connector.

NOTE

To make a firm connection with the test fixture, use the torque wrench (size: 3/4 inch, torque: 12 lb-in, Agilent part number: 8710-1766) to fasten the adapter's 7-mm connector.

Figure 1-2

Installing the Test Fixture



16196abcj0101

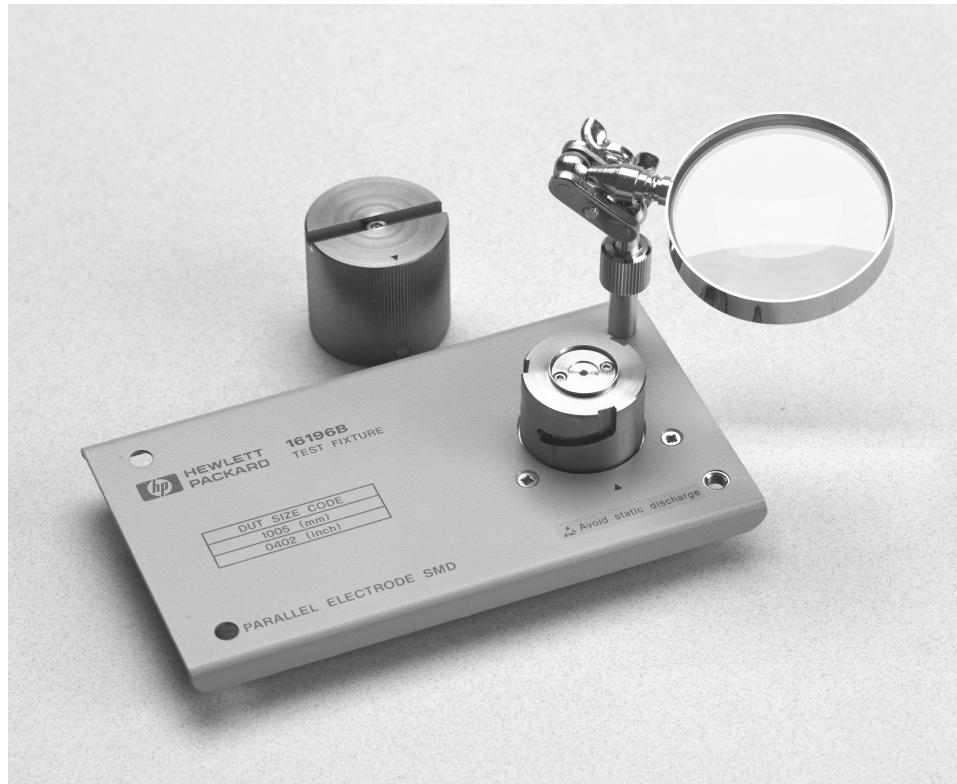
2 Product Overview

Product Overview

The 16196A, 16196B, 16196C, and 16196D are test fixtures for measuring chip components. They enable chip type capacitors, inductors and other components to be measured with high precision and measurement repeatability. The 16196A/B/C/D also is compatible with measuring frequencies up to 3 GHz. The 16196A is for size 1608 parts ^{*1}, the 16196B is for size 1005 parts ^{*1}, the 16196C is for size 0603 parts ^{*1}, and the 16196D is for size 0402 parts ^{*1}.

Figure 2-1

Product Overview (The photograph shows the 16196B.)

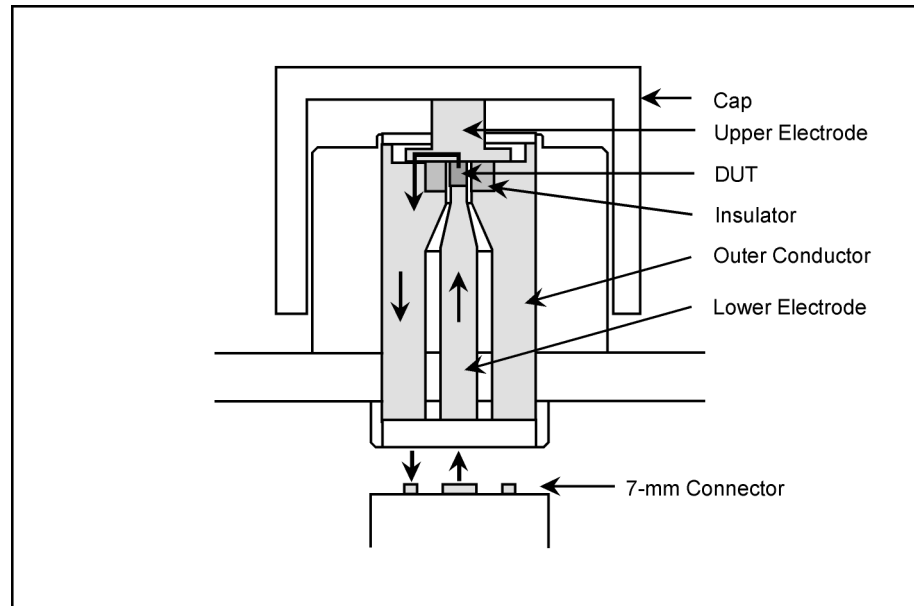


The product appearance is the same for the 16196A, 16196B and 16196C. Only the cap shape for the 16196D is different.

^{*1}. These sizes, 1608, 1005, 0603, and 0402, are all nominal sizes in millimeters.

Figure 2-2

Electrode Structure



After passing through the DUT (Device Under Test), the current flows to the outer conductor via the cap electrode and returns to the outer conductor of the 7-mm connector. Through this structure, the ideal shield structure is formed.

Functions

The names of each part of the 16196A/B/C/D are shown in Figure 2-3.

Figure 2-3

Names of Parts

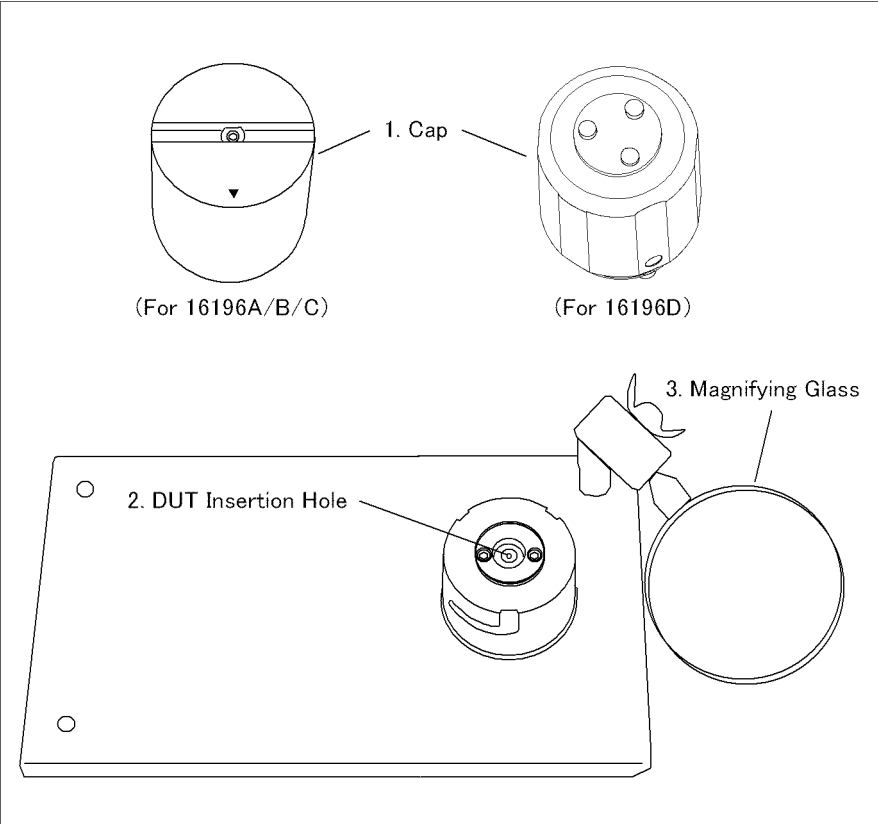


Table 2-1 Names of Parts and Functions

| No. | Name | Function |
|-----|----------------------------------|--|
| 1 | Cap | This is the LOW side electrode. |
| 2 | DUT Insertion Hole | Forms a cylindrical structure made with an insulator and holds the DUT from the sides. |
| 3 | Magnifying Glass ^{*1*2} | Enlarges the DUT and the insulator hole area. |

*1.Furnished with Option 710.

*2.The magnifying glass is packed separately from the 16196A/B/C/D body. Connect it as shown in Figure 2-3.

Names of Accessories and Functions

Figure 2-4

Accessories

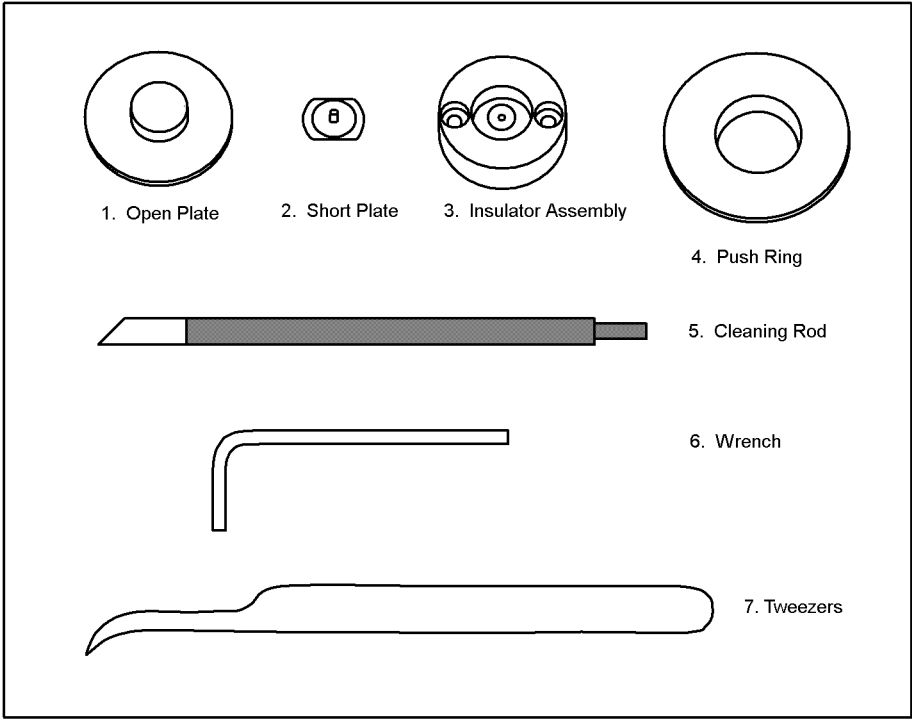


Table 2-2

Names of Accessories and Functions

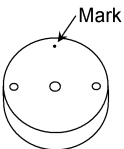
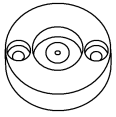
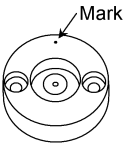
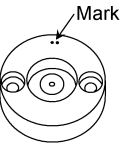
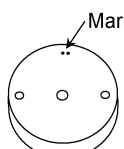
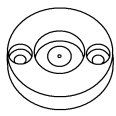
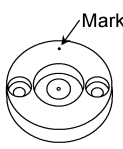
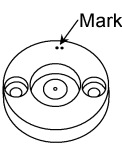
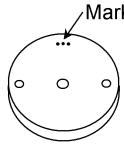
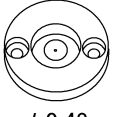
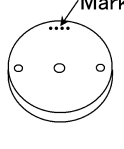

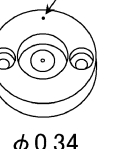
| No. | Name | Function |
|-----|------------------------|--|
| 1 | Open Plate | Used when correcting for an open circuit. |
| 2 | Short Plate | Used when correcting for a short circuit. |
| 3 | Insulator Assembly | Used to change assemblies when measuring DUTs with different shapes. |
| 4 | Push Ring | Supplementary tool used when removing DUTs. |
| 5 | Cleaning Rod | Cleans the electrodes. |
| 6 | Wrench | For removing hex nuts. |
| 7 | Tweezers ^{*1} | Used to handle the open plate, short plate, and DUTs, etc. |

*1. Finished with Option 710.

Insulator Assembly

In order to handle DUTs with differing shapes, the 16196A and 16196B each come with 3 types of insulator assembly, the 16196C comes with 1 insulator assembly, and the 16196D comes with two types of insulator assembly. Each of these insulator assemblies has little marks engraved in them to enable identification of each model and hole diameter. There are marks on the back of the insulator assemblies to identify the model and there are marks on the front to identify the hole diameter.

Insulator Assembly identifications

| Agilent Model No. | Back | Front |
|-------------------|---|--|
| 16196A |  |  ϕ 1.34  ϕ 1.14  ϕ 1.08 |
| 16196B |  |  ϕ 0.85  ϕ 0.75  ϕ 0.68 |
| 16196C |  |  ϕ 0.48 |
| 16196D |  |  ϕ 0.30  ϕ 0.34 |

3 Operation

This chapter describes preparations and fixture compensation when using the 16196A/B/C/D 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 16196A/B/C/D.

1. Selecting and Changing the Insulator Assembly
Select an insulator assembly that is appropriate for the shape of the measured DUT and replace the insulator assembly in the fixture.
2. Setting the Electrical Length
Set the fixture's electrical length in the measuring instrument you will be using.
3. Performing Fixture Compensation
Measure the data for open compensation and measure the data for short compensation. When performing measurements with higher precision, carry out "Fixture compensation for higher precision measurements".
4. Connecting and Measuring the DUT
Connect the DUT and perform measurements.

Settings of the electrical length and fixture compensation differ depending on the measuring instrument used. Refer to the Operation Manual for the measuring instrument that you are using.

NOTE

The 16196A/B/C/D requires frequent wear checks to keep the best measurement accuracy. When the equipment is used for the first time following purchase or part replacement, "Wear Check" should be conducted. Refer to "Wear Check" on page 44 for details.

Selecting and Changing the Insulator Assembly

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

CAUTION

An exclusive type of insulator assembly is supplied with each model. Do not use an insulator assembly from a different model.

Step 1. Select an insulator assembly that is appropriate for the shape of the DUT to be measured.

To take accurate and repeatable measurements, it is necessary for the DUT to be placed in the DUT insertion hole and be stable. For that reason, the 16196A and 16196B each are provided with 3 types of insulator assembly which have DUT insertion holes with different diameters (the 16196C has only one type of insulator assembly, and the 16196D has two types of insulator assembly). Select an insulator assembly that will create the narrowest gap between the DUT and the DUT insertion hole.

Figure 3-1

DUT and DUT Insertion Hole Diameter

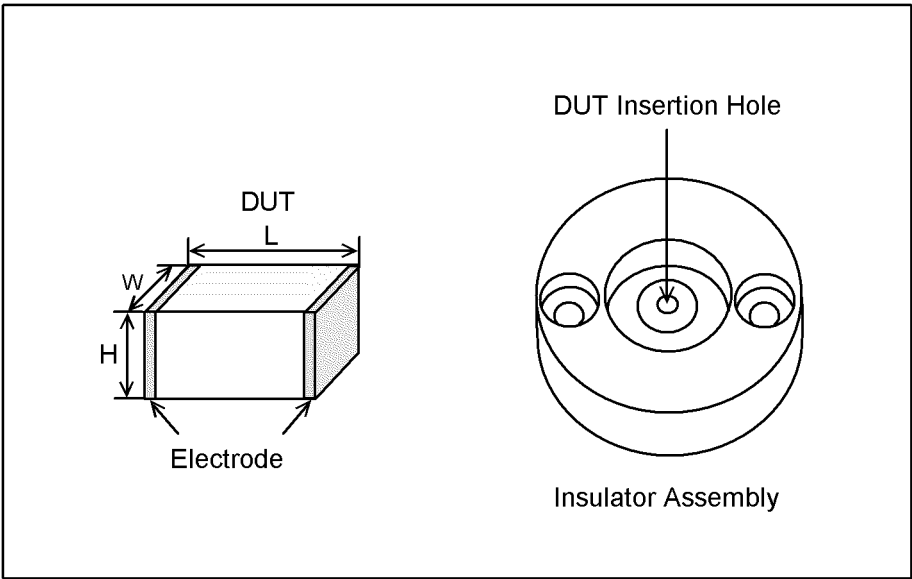


Table 3-1

16196abc0e0311
Insulator Assembly Specifications

| | Insulator Assembly | Example of Corresponding Chip (mm) | | |
|--------|--------------------|------------------------------------|-----------|------------|
| | | Length (L) | Width (W) | Height (H) |
| 16196A | φ1.34 | 1.6 | 0.8 | 0.8 |
| | φ1.14 | 1.6 | 0.8 | 0.6 |
| | φ1.08 | 1.6 | 0.8 | 0.5 |

Table 3-1 **Insulator Assembly Specifications**

| | Insulator Assembly | Example of Corresponding Chip (mm) | | |
|--------|--------------------|------------------------------------|-----------|------------------------------|
| | | Length (L) | Width (W) | Height (H) |
| 16196B | φ0.85 | 1.0 | 0.5 | 0.5 |
| | φ0.75 | 1.0 | 0.5 | 0.35 |
| | φ0.68 | 1.0 | 0.5 | 0.35 |
| 16196C | φ0.48 | 0.6 | 0.3 | 0.3 |
| 16196D | φ0.30 | 0.4 | 0.2 | 0.13 or 0.2 ^{*1} |
| | φ0.34 | 0.4 | 0.2 | 0.2 ^{*1} |

*1. When you measure a 0.4 x 0.2 x 0.2 DUT, first check whether it fits in the φ0.30 insulator assembly. Only if it does not, use the φ0.34 insulator assembly.

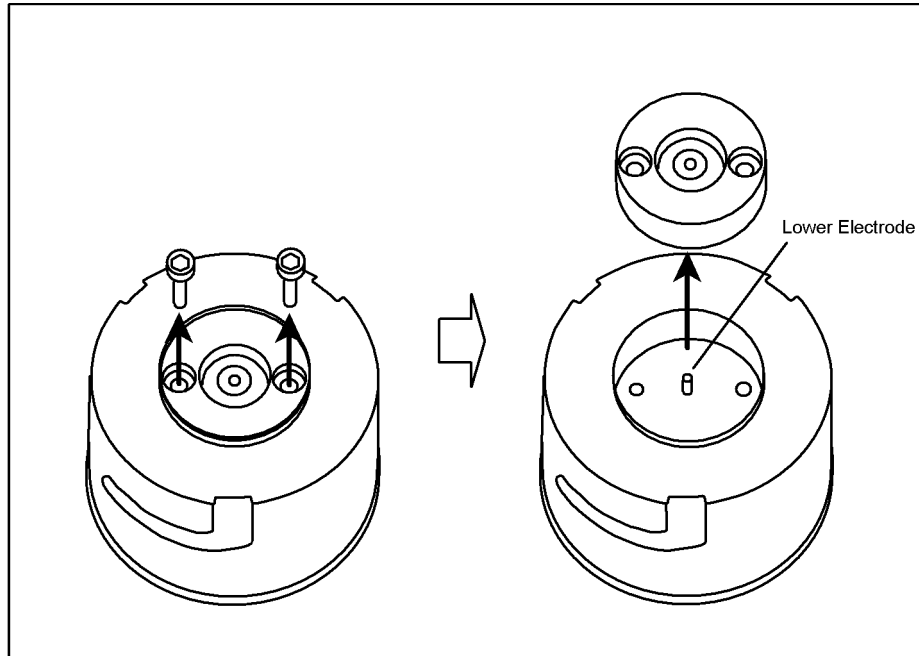
NOTE The number of the insulator assembly doesn't indicate the maximum diameter of the DUT insertion hole that can insert the cylindrical device.

NOTE If the gap between the DUT and the insulator is large, the measurement accuracy and repeatability decrease. Select an insulator assembly that is appropriate for the shape of the DUT to be measured.

- Step 2.** Replace the insulator assembly in the fixture with the selected insulator assembly. Loosen the 2 screws used to fasten the insulator assembly with the hex wrench and take them out, then remove the insulator assembly.

Figure 3-2

Removing the Insulator Assembly



NOTE

If the insulator assembly is difficult to remove, turn the fixture over and remove the insulator assembly by letting it fall out.

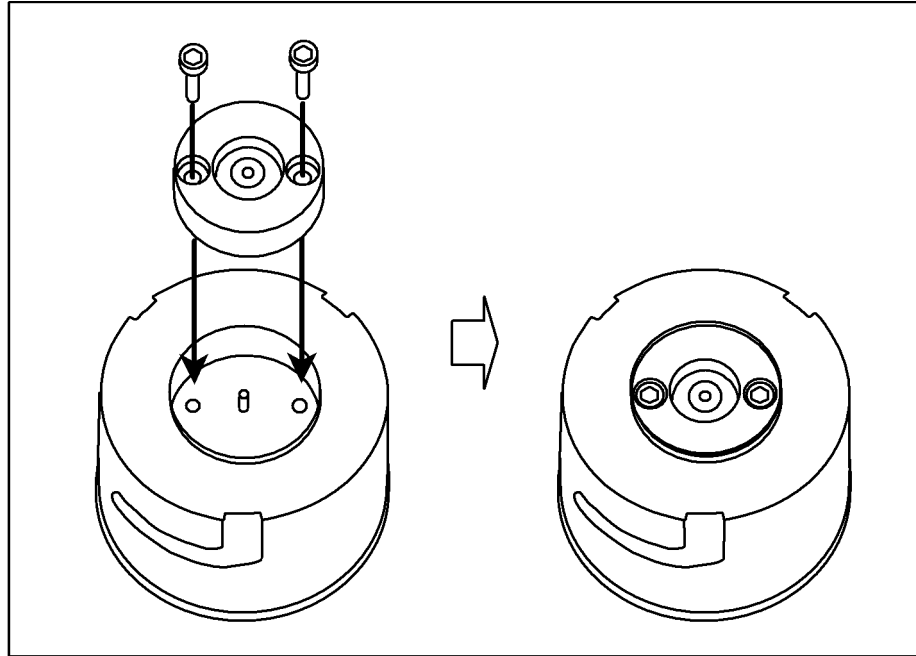
CAUTION

There is danger of the measuring precision and repeatability being adversely affected, and thus do not touch the lower electrode with your hands or damage it in any way.

- Step 3.** Mount the insulator assembly you have selected, and tighten the screws to secure it. Be sure to contact the insulator assembly with the bottom surface securely before tightening the screws.

Figure 3-3

Installing the Insulator Assembly



- Step 4.** Connect the test fixture to the measuring instrument.
Connect the test fixture to the instrument in accordance with “Connecting the 16196A/B/C/D to a Measuring Instrument” on page 15 in Chapter 1.

Setting the Electrical Length

Set the electrical length in the measuring instrument. For the electrical length setting method, see the Operation Manual for the measuring instrument you are using. The electrical lengths for the 16196A/B/C/D are as shown below.

Table 3-2 **Electrical Length**

| Model | Electrical Length [mm] |
|--------|------------------------|
| 16196A | 26.2 |
| 16196B | 26.9 |
| 16196C | 27.1 |
| 16196D | 27.3 |

Performing Fixture Compensation

In order to perform more accurate measurements, before beginning the measurement procedure, it is necessary to compensate the fixture. For the 16196A/B/C/D, perform measurements of the data for open compensation and of the data for short compensation.

NOTE

The 16196A/B/C/D requires frequent wear checks to keep the best measurement accuracy. When the equipment is used for the first time following purchase or part replacement, “Wear Check” should be conducted. Refer to “Wear Check” on page 44 for details.

NOTE

If there are temperature fluctuations which exceed a temperature range of $\pm 5^{\circ}\text{C}$ after fixture compensation has been carried out, then perform fixture compensation again.

Measuring Open Compensation Data

Set the fixture in the open state using the open plate supplied.

Step 1. Remove the cap.

CAUTION

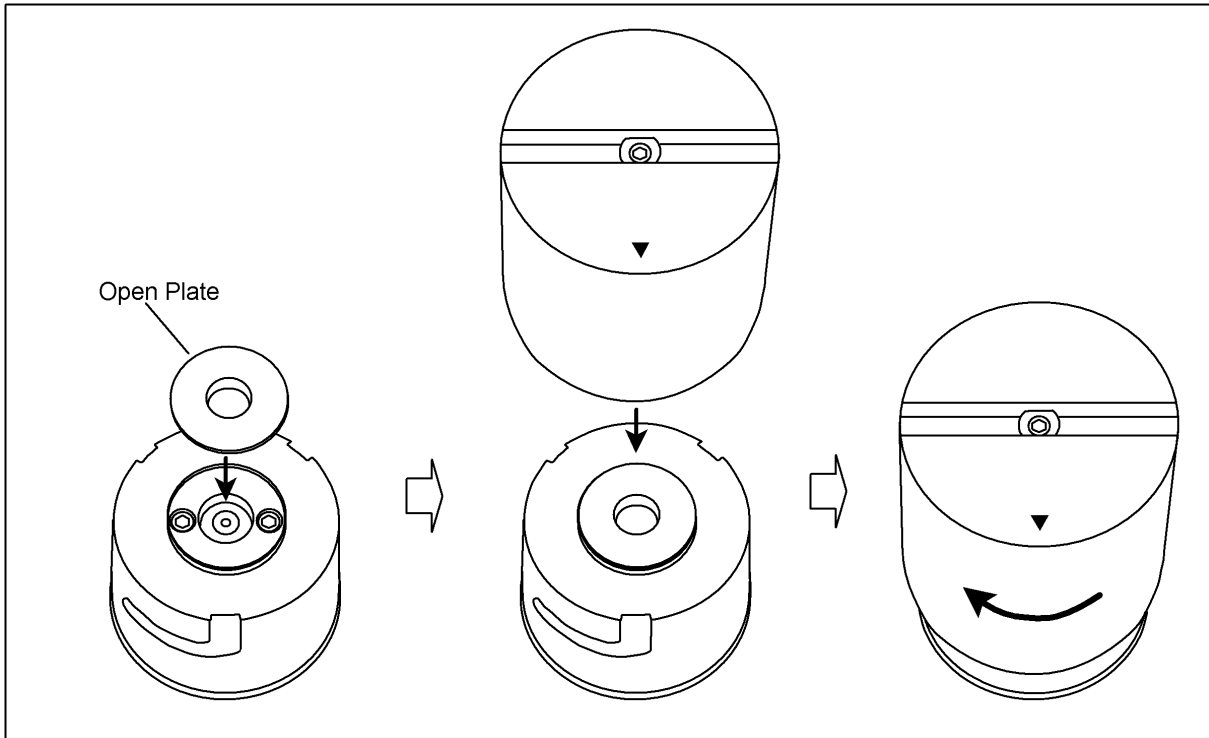
Make sure there is no dirt or other foreign matter in the DUT insertion hole.

Step 2. Using the Tweezers, place the open plate on top of the insulator assembly. Set the open plate with the protruding surface down.

CAUTION

Handle the open plate with Tweezers. If dirt, etc. gets on it, measuring precision and repeatability may be adversely affected.

Figure 3-4 **Setting the Open State Using the Open Plate**



- Step 3.** Fit the cap in place with the mark toward the front, and turn it to the right until it is locked.
- Step 4.** Take measurements of the data for open compensation in accordance with the Operation Manual for the measuring instrument you are using.

Measuring Short Compensation Data

Set the fixture in the short state using the short plate supplied.

Step 1. Remove the cap. Take out the open plate used to measure the open compensation data.

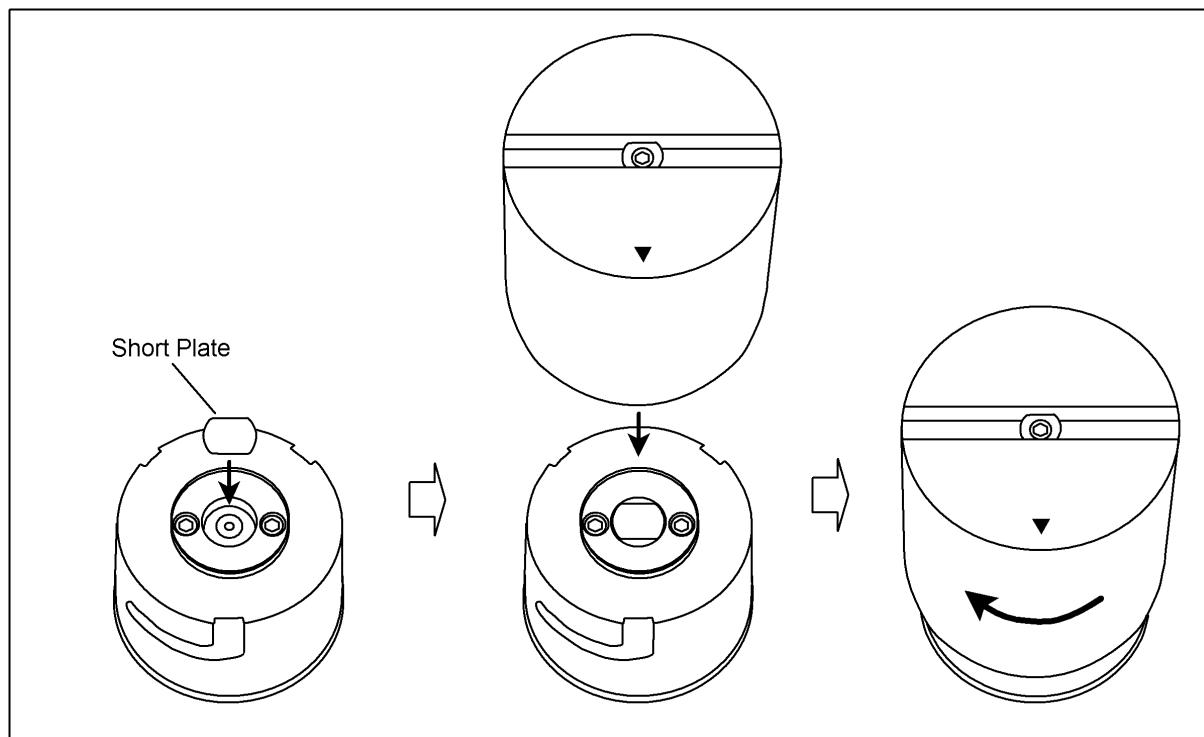
CAUTION Make sure there is no dirt or other foreign matter in the DUT insertion hole.

CAUTION An exclusive type of short plate is supplied with each model. Do not use a short plate from a different model.

Step 2. Place the short plate on the insulator assembly with tweezers. Place the rod-shaped protrusion of the short plate downward, and insert it into the DUT insertion hole.

CAUTION Handle the short plate with Tweezers. If dirt, etc. gets on it, measuring precision and repeatability may be adversely affected.

Figure 3-5 Setting the Short State Using the Short Plate



Step 3. Fit the cap in place with the mark toward the front, and turn it to the right until it is locked.

Step 4. Take measurements of the data for short compensation in accordance with the Operation Manual for the measuring instrument you are using.

NOTE Residual inductance for the Short Plate is as follows.

| Model | Residual Inductance [nH] |
|--------|--------------------------|
| 16196A | 0.43 |
| 16196B | 0.27 |
| 16196C | 0.16 |
| 16196D | 0.11 |

Connecting and Measuring DUTs

Connect DUTs to the electrodes and take measurements.

CAUTION Do not connect a DUT, which has an incompatible size.

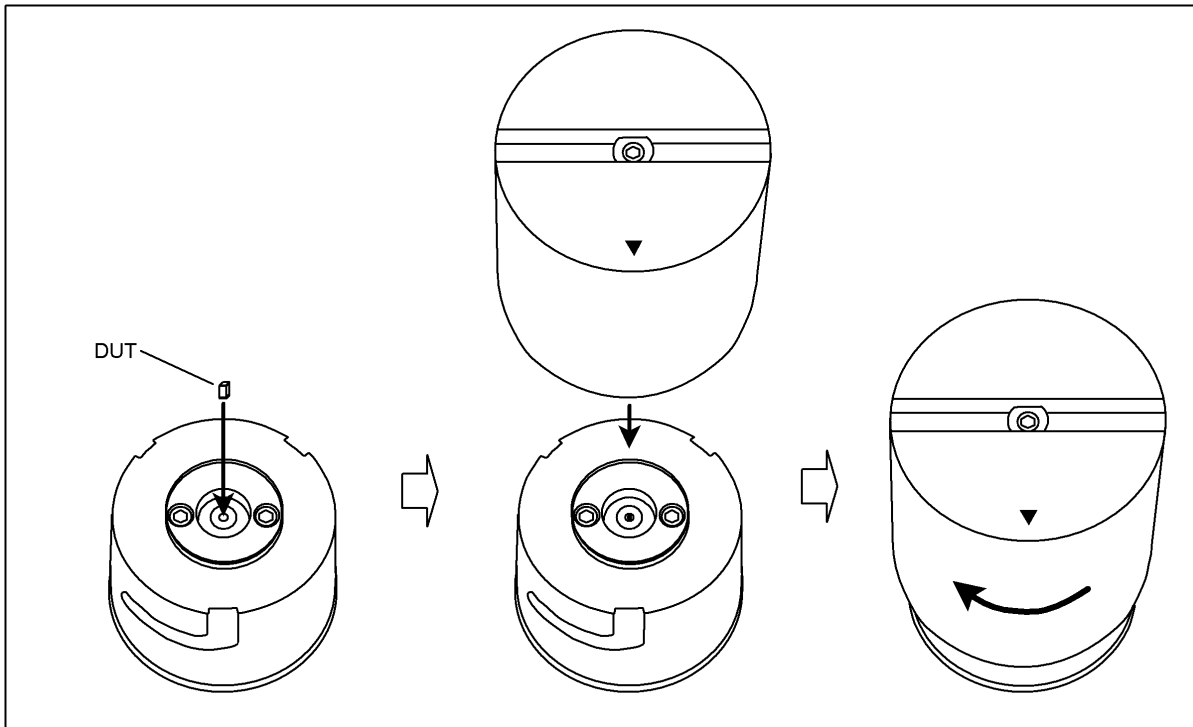
Step 1. Remove the cap.

CAUTION Make sure there is no dirt or other foreign matter in the DUT insertion hole.

Step 2. Insert the DUT into the insulator hole with tweezers.

Use a magnifying glass to check that the DUT is inserted deeply enough into the insulator hole for it to contact the bottom electrode.

Figure 3-6 Connecting a DUT



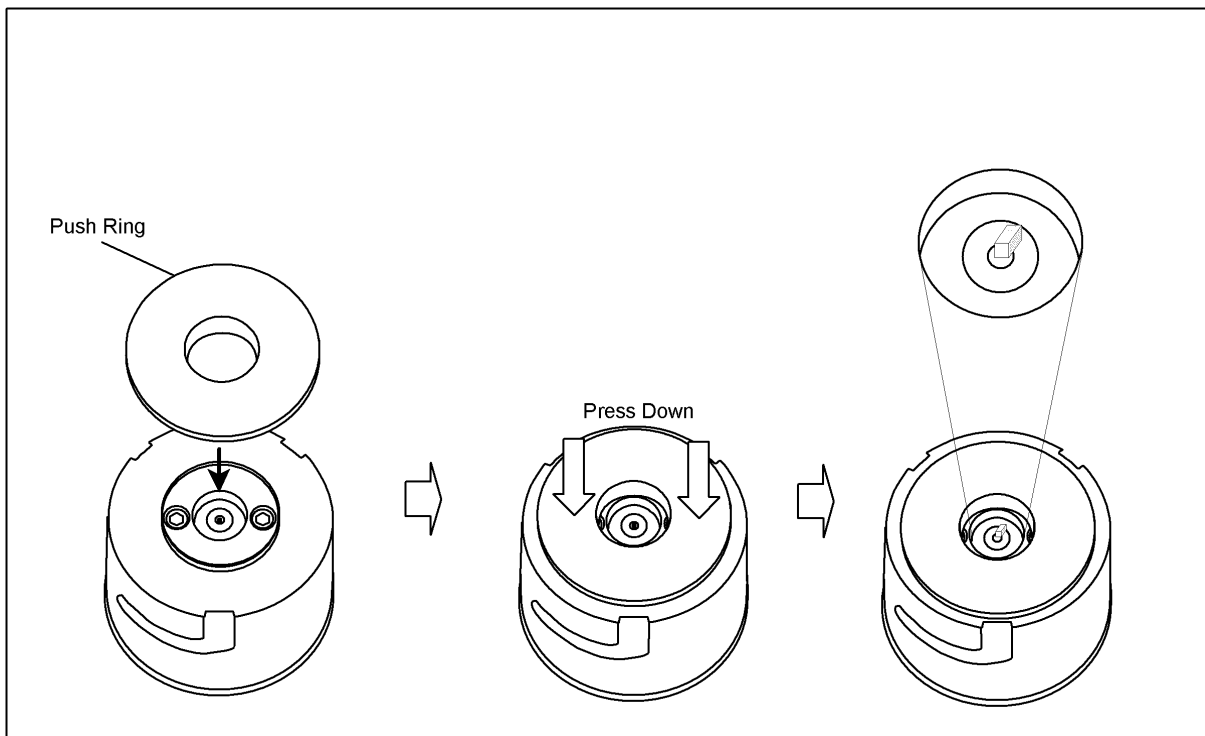
Step 3. Fit the cap in place with the mark toward the front, and turn it to the right until it is locked.

Step 4. Take measurements in accordance with the Operation Manual for the measuring instrument you are using.

Removing the DUT

Use the push ring when removing the DUT.

Figure 3-7 Removing the DUT Using the Push Ring



Press the insulator assembly down using the push ring. When this is done, the lower electrode will push up the DUT and you will be able to remove it. Measurements can also be taken with the push ring placed as is on the insulator assembly.

4 User Maintenance

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 as described in “User Maintenance Flow” on page 39.

Because deterioration of the fixture seriously affects the measurement results when measuring minute values or performing measurements with a high accuracy, proper maintenance of the fixture is particularly important in these cases. Depending on the required measurement performance, it may be necessary to take measures such as establishing more rigorous evaluation standards and perform maintenance more frequently.

The upper and lower electrodes and the short plate are consumable products. These are the fixture construction parts that tend to have the greatest effect on the measurement results. During measurement, solder from the DUT tends to adhere to the upper and lower electrodes, causing gradual deterioration of the electrodes. The short plate part is used for creating a zero-standard during fixture compensation and distortion or contamination of the short plate therefore directly affects the measurement result. Focusing on the upper and lower electrodes and the short plate, this chapter explains the general aspects of user maintenance.

User Maintenance Flow

Figure 4-1 shows the flowchart of the user maintenance. The overview of the each maintenance item is explained below.

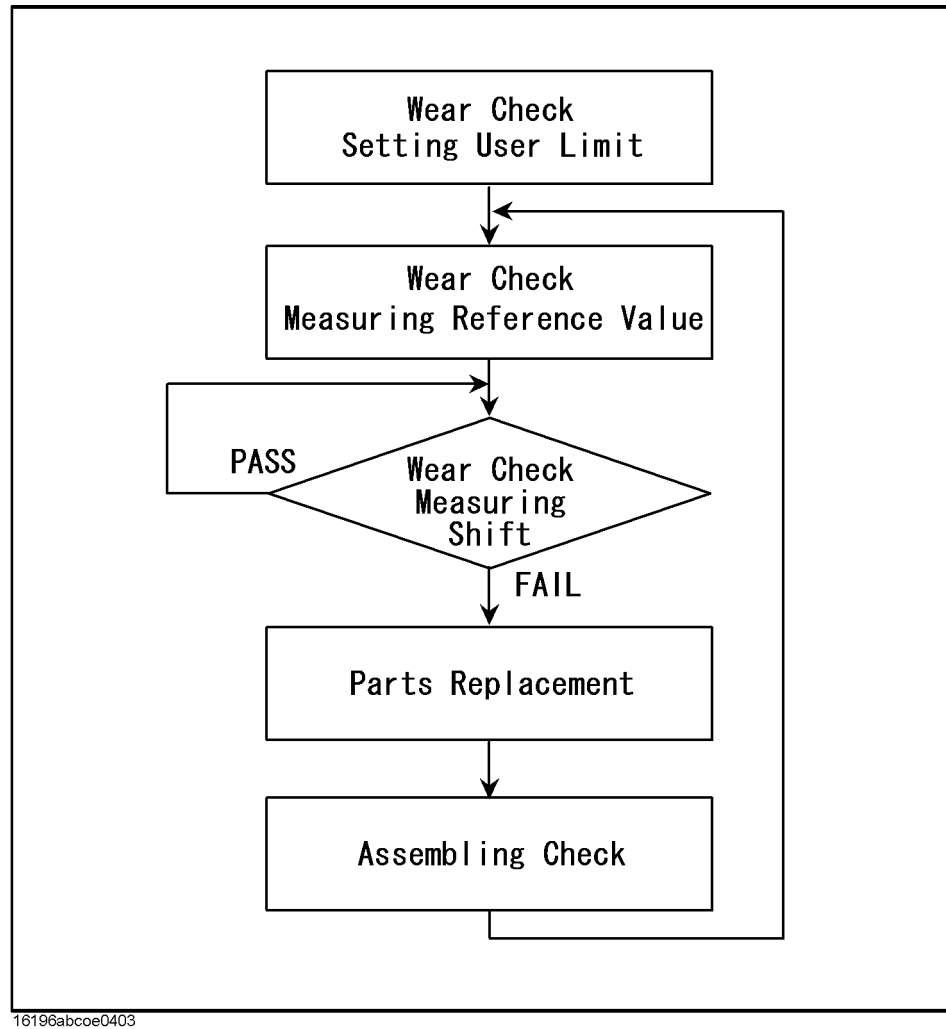
Table 4-1

Maintenance Items

| Item | | Frequency | Item |
|-------------------|---------------------------|--|--|
| Cleaning | | Several times daily | Cleaning of fixture |
| Wear Check | Setting the user limit | When the product is received and when you need | Set the user limit to the required measurement accuracy and the measurement condition. |
| | Measuring reference value | When the product is received and after parts replacement | Measure Ls and Rs of the fixture and set it the reference value |
| | Measuring impedance shift | daily and before fixture compensation | Measure Ls and Rs of the fixture and calculate the shift from the reference value. |
| Parts Replacement | | When the wear check is failed. | Replacement of worn parts |
| Assembling Check | | After parts replacement | Measure Ls and Rs to confirm that the fixture is assembled correctly. |

Figure 4-1

Flowchart of User Maintenance



Cleaning

If the electrodes and insulator assembly become dirty, measuring accuracy and repeatability will decrease. Also, if dirt adheres to the surfaces of the body, it will become impossible to remove the cap smoothly. In order to ensure measurement with high accuracy, be sure to perform cleaning periodically.

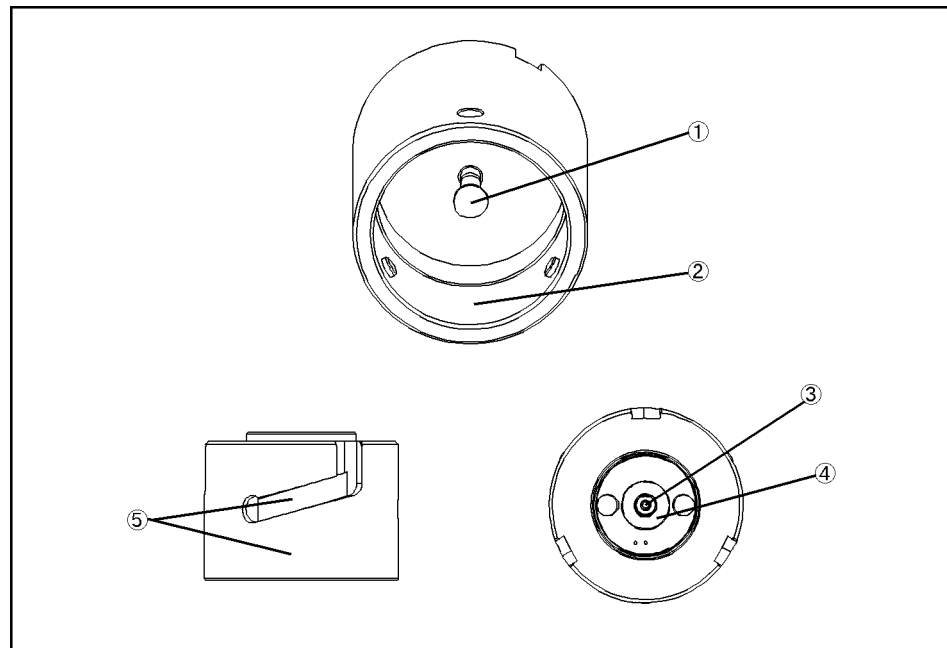
Places Requiring Cleaned

Place, which need to be cleaned, are as follows.

- Upper Electrode (Figure 4-2 (1))
- Cap Inside (Figure 4-2 (2))
- Lower Electrode (Figure 4-2 (3))
- Insulator Assembly recessed part (Figure 4-2 (4))
- Body side surfaces (Figure 4-2 (5))
- Short Plate
- Open Plate

Figure 4-2

Places to be Cleaned



16196abcoj0502

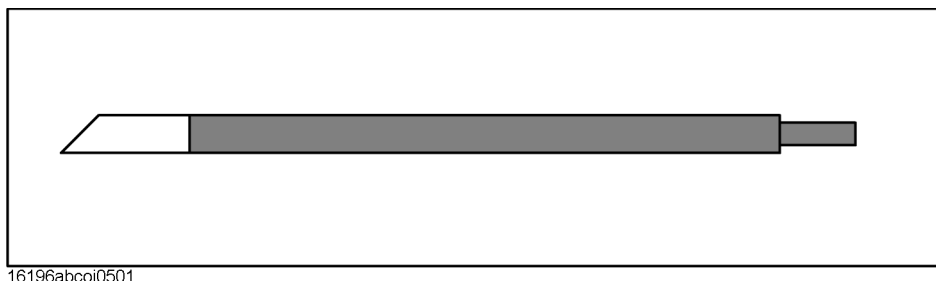
Cleaning Methods

Upper Electrode (Figure 4-2 (1)), Insulator Assembly (Figure 4-2 (4)), Open Plate, Short Plate

Use the Cleaning Rod (Agilent parts number 5182-7586) for the cleaning. Use the white rubber part of the cleaning rod to remove dirt from all contacting surfaces of the above-mentioned parts. Be careful not to scratch or damage the parts when removing the dirt.

Figure 4-3

Cleaning Rod



Dirt tends to adhere to the upper electrode and short plate parts in particular. Meticulous cleaning of these parts is recommended.

| | |
|----------------|---|
| CAUTION | The front of the short plate has a sharp edge, so take adequate precautions when cleaning it. |
|----------------|---|

| | |
|----------------|---|
| CAUTION | Do not use a file or similar object to remove dirt, as this will affect measurement accuracy and repeatability. |
|----------------|---|

| | |
|-------------|--|
| NOTE | If the dirt cannot be removed, replace the part. For replacement method, see the sections "Replaceable Parts" and "Replacement Procedure". |
|-------------|--|

Lower Electrode (Figure 4-2 (3))

Use the Cleaning Rod (Agilent parts number 5182-7586) for the cleaning. First use the push ring to press down the insulator assembly. While maintaining this condition, use the white rubber part of the cleaning rod to remove dirt from the contacting parts of the lower electrode. Be careful not to scratch or damage the parts when removing the dirt.

Dirt tends to adhere to the lower electrode parts in particular. Meticulous cleaning of these parts is recommended.

| | |
|----------------|---|
| CAUTION | Do not use a file or similar object to remove dirt, as this will affect measurement accuracy and repeatability. |
|----------------|---|

| | |
|-------------|--|
| NOTE | If the dirt cannot be removed, replace the part. For replacement method, see the sections "Replaceable Parts" and "Replacement Procedure". |
|-------------|--|

Cap Inside (Figure 4-2 (2)), Body Side Surfaces (Figure 4-2 (5))

Wipe dirt off using a soft cloth, etc.

NOTE

When removing dirt, always be careful to clean so that the electrodes and insulator assembly are not damaged.

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. This check comprises “User Limit Setting”, “Reference Value Acquisition” and “Measuring Impedance Shift”. Using a desired frequency, the impedance (Rs, Ls) of the fixture itself is measured. It is recommended to use a frequency that is also used under the conditions where the fixture is normally used.

Normally, “User Limit Setting” should be conducted under the following circumstances.

- When the equipment is used for the first time following purchase.
- When the required measurement accuracy is changed.

Normally, “Reference Value Acquisition” should be conducted under the following circumstances.

- When the equipment is used for the first time following purchase.
- Following replacement of parts.

Normally, “Measuring Impedance Shift” should be conducted under the following circumstances.

- Once daily and before fixture compensation is performed.

Example of User Limit Values Setting

It is necessary to decide wear check user limit values suitable for the DUT and the demanded measurement accuracy. An example follows below.

To measure the inductors L: 10 nH and Q: 10 at a frequency (f) of 100 MHz with a measurement accuracy degree of 20%;

L: 10 nH

Q: 10

Frequency: 100 MHz

Demanded Accuracy: 20% for both L and Q

Using the above conditions, the inductor’s reactance X and resistance R are determined in the following manner.

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

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

From $Q = X/R = 2\pi fL/R$ we understand that when R changes 20% (100 mΩ) Q should be approximately 20%, and when L changes 20% (2 nH), L and Q both change 20%. Accordingly, in order to measure both L and Q with a measurement accuracy of 20% or less, at least the error of L and R must be less than 2 nH and 120 mΩ, respectively. While remembering that L and R change together and keeping in mind other error factors than the deterioration of the fixture, the respective values should be set to 25% in this example, i.e., 500 pH and 30 mΩ.

CAUTION

Use the same user limit values for “Measuring Impedance Shift”.

NOTE

The above is just an example. The methods to determine the user limit vary with the measurement conditions and the DUT, etc.

NOTE

In actually testing, a part of the effect of electrode wear is cancelled by the SHORT compensation. It is recommended, however, to set the user limit as shown in this example as the deviation from the reference value can be used to deal with all the things affecting the measured values.

Please enter the user limit values in the “Check Sheet” (page 50, page 51). See “Check Sheet Fill-Out Example” on page 49 for an example of how this is done.

Reference Value Acquisition

The impedance (Rs, Ls) of the fixture itself should be measured before deterioration sets in. It is recommended to use a measurement frequency that is used under the conditions where the fixture is normally used.

Normally, the reference value should be measured under the following circumstances.

- When the product is introduced.
- Following replacement of parts.

Required Tools

- 1.5-mm hex wrench (provided accessory)
- Short plate (provided accessory)
- Impedance measuring instrument (with 7-mm connector and calibrated)

Table 4-2 **Setting of Measuring Instrument**

| Measurement Condition | Set Value |
|-----------------------|--|
| Electrical Length | 16196A: 26.2 mm 16196B: 26.9 mm 16196C: 27.1 mm 16196D: 27.3 mm |
| Measurement Parameter | Ls, Rs |
| OSC Level | 500 mV |
| Point Averaging | 32 |

NOTE To make the same settings as given in the above table, refer to the Operation Manual for the measuring instrument.

CAUTION The measuring instrument's fixture compensation function should be set to OFF.

Acquisition Procedure (Electrode Wear Check Reference Value)

- Step 1.** Remove the cap and ensure that nothing is inserted into the fixture.
- Step 2.** Clean the fixture's upper and lower electrodes as described in "Cleaning" on page 41.
- Step 3.** Connect the fixture to the 7-mm connector.
- Step 4.** Place the cap on the fixture body.
- Step 5.** In order to contact the upper electrode and the lower electrode, use the provided hex wrench to turn the screw at the top of the cap approximately 6 turns to the left.

NOTE In case of the 16196D, please omit the step 5.

- Step 6.** Measure Rs and Ls as described in the Operation Manual for the measuring instrument.

- Step 7.** Record the read values as the reference values in the “Check Sheet” (page 50).
- Step 8.** Calculate the upper limit value and the lower limit value from the previously set user limits and the reference values obtained here. Record these in the "Check Sheet".
- Step 9.** Tighten the screw on top of the cap loosened in Step 5.

NOTE In case of the 16196D, please omit the step 9.

Acquisition Procedure (Short Plate Wear Check Reference Value)

- Step 1.** Clean the short plate as described in “Cleaning” on page 41.
- Step 2.** Remove the cap and place the short plate with the protruding surface down on the insulator assembly.
- Step 3.** Place the cap on the fixture body.
- Step 4.** Measure Rs and Ls as described in the Operation Manual for the measuring instrument.
- Step 5.** Record the read values as the reference values in the “Check Sheet” (page 51).
- Step 6.** Calculate the upper limit value and the lower limit value from the previously set user limits and the reference values obtained here. Record these in the "Check Sheet".

Measuring Impedance Shift

Measuring the impedance of the fixture with the upper and lower electrodes in contact should check the electrode wear.

Normally, this check should be conducted under the following circumstances.

- Once daily and before fixture compensation.

Required Tools

- 1.5-mm hex wrench (provided accessory)
- Impedance measuring instrument (with 7-mm connector and calibrated)

CAUTION

The measuring instrument's fixture compensation function should be set to OFF. Also, other settings should be the same as those used for "Reference Value Acquisition".

Procedure (Electrode Wear Check)

- Step 1.** Clean the electrodes as described in "Cleaning" on page 41.
- Step 2.** Set the measuring instrument and measure in the same way as for "Acquisition Procedure (Electrode Wear Check Reference Value)" on page 46.
- Step 3.** Record the Rs and Ls measured values as pass-fail in the "Check Sheet" (page 50).
- Step 4.** If the result is unacceptable, replace both the upper and the lower electrode.

Procedure (Short Plate Wear Check)

- Step 1.** Clean the short plate as described in "Cleaning" on page 41.
- Step 2.** Set the measuring instrument and measure in the same way as for "Acquisition Procedure (Short Plate Wear Check Reference Value)" on page 47.
- Step 3.** Enter the Rs and Ls measured values as pass-fail in the "Check Sheet" (page 51).
- Step 4.** If the result is unacceptable, replace the short plate.

Check Sheet

Check Sheet Fill-Out Example

The following example shows how the check sheet is filled out following electrode wear check. Fill out the sheet in the same manner for short plate wear check.

Electrode Wear Check Fill-Out Example

Table 4-3 Reference Value and User Limit Values Fill-Out Example

| Frequency ^{*1} | Measurement Parameter | Reference Value ^{*2} [a] | User Limit Value ^{*3} [b] | Lower Limit [a-b] | Upper Limit [a+b] |
|-------------------------|-----------------------|-----------------------------------|------------------------------------|-------------------|-------------------|
| 100 MHz | Rs | 90 mΩ | 30 mΩ | 60 mΩ | 120 mΩ |
| | Ls | -290 pH | 500 pH | -790 pH | 210 pH |
| 800 MHz | Rs | 310 mΩ | 40 mΩ | 270 mΩ | 350 mΩ |
| | Ls | -260 pH | 400 pH | -660 pH | 140 pH |

*1. Set by the user as desired.

*2. Record values obtained at the time of “Reference Value Acquisition” on page 46.

*3. See also “Example of User Limit Values Setting” on page 44.

Table 4-4 Check History Fill-Out Example

| Date | Frequency | Measurement parameter | Measured Value | Pass/Fail |
|----------------------|-----------|-----------------------|----------------|--------------------|
| Oct./11/1999 9:30 | 100 MHz | Rs | 100 mΩ | Pass |
| | | Ls | -320 pH | Pass |
| Oct./11/1999 9:35 | 800 MHz | Rs | 345 mΩ | Pass |
| | | Ls | -360 pH | Pass |
| Oct./12/1999 9:30 | 100 MHz | Rs | 105 mΩ | Pass |
| | | Ls | -340 pH | Pass |
| Oct./12/1999 9:35 | 800 MHz | Rs | 355 mΩ | Fail ^{*1} |
| | | Ls | -320 pH | Pass |

*1. When the result is unacceptable, replace the part.

Electrode Wear Check

Table 4-5 Reference Value 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 4-6 Check History

| Date | Frequency | Measurement Parameter | Measured Value | Pass/Fail |
|------|-----------|-----------------------|----------------|-----------|
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
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| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |

Short Plate Wear Check

Table 4-7 Reference Value 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 4-8 Check History

| Date | Frequency | Measurement Parameter | Measured Value | Pass/Fail |
|------|-----------|-----------------------|----------------|-----------|
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
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| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |
| | | Rs | mΩ | |
| | | Ls | pH | |

Parts Replacement

The replacement of parts is explained in the following.

Procedure for Replacement

Refer to “Replaceable Parts” on page 68 and “Replacement Procedure” on page 75 when replacing parts.

A maintenance kit containing 5 pieces is available for replacement of upper and lower electrodes and the short plate. For details, see “Maintenance Kit” on page 74.

Check Following Replacement

Following replacement of parts, it is necessary to confirm that the fixture has been correctly assembled. Please conduct the “Assembling Check” on page 53.

Assembling Check

Following replacement of parts, confirm that the fixture has been correctly assembled. The assembling check consists of “Electrode Check” and “Short Plate Check”, Measure the impedance (Rs, Ls) of both at 100 MHz and 1 GHz.

Normally, this check should be conducted under the following circumstances.

- Following replacement of parts.

Electrode Check

It should be checked whether the fixture is correctly assembled by measuring the impedance (Rs, Ls) of the fixture itself with the upper and lower electrodes in contact.

Required Tools

- 1.5-mm hex wrench (provided accessory)
- Impedance measuring instrument (with 7-mm connector and calibrated)

Table 4-9 **Setting of Measuring Instrument**

| Measurement Condition | Set Value |
|-----------------------|--|
| Electrical Length | 16196A: 26.2 mm 16196B: 26.9 mm 16196C: 27.1 mm 16196D: 27.3 mm |
| Measurement Parameter | Ls, Rs |
| OSC Level | 500 mV |
| Point Averaging | 32 |

NOTE

To make the same settings as given in the above table, refer to the Operation Manual for the measuring instrument.

Procedure

- Step 1.** Remove the cap and ensure that nothing is inserted into the fixture.
- Step 2.** Clean the fixture’s upper and lower electrodes as described in “Cleaning” on page 41.
- Step 3.** Connect the fixture to the 7-mm connector.
- Step 4.** Place the cap on the fixture body.
- Step 5.** In order to contact the upper electrode and the lower electrode, use the provided hex wrench to turn the screw on the top of the cap approximately 6 turns to the left.

NOTE In case of the 16196D, please omit the step 5.

Step 6. Measure Rs and Ls at 100 MHz and 1 GHz in this state.

Step 7. Confirm that the Rs and Ls values are within the limits given in the table below. If the results are outside the limit range, first check the attachment of the upper and lower electrode. If these are correctly attached but the results still remain outside the limit range, the fixture main body may be damaged. In this case, please contact a Agilent Technologies Sales or Service office.

Step 8. Tighten the screw on top of the cap loosened in Step 5.

NOTE In case of the 16196D, please omit the step 8.

Table 4-10 Electrode Check and Limits (16196A)

| Parameter | Frequency | Limit (Absolute value) |
|-----------|-----------|------------------------|
| 100 MHz | Rs | 30 mΩ ~ 150 mΩ |
| | Ls | –500 pH ~ 0 pH |
| 1 GHz | Rs | 100 mΩ ~ 480 mΩ |
| | Ls | –500 pH ~ 0 pH |

Table 4-11 Electrode Check and Limits (16196B)

| Parameter | Frequency | Limit (Absolute value) |
|-----------|-----------|------------------------|
| 100 MHz | Rs | 40 mΩ ~ 160 mΩ |
| | Ls | –400 pH ~ 0 pH |
| 1 GHz | Rs | 120 mΩ ~ 510 mΩ |
| | Ls | –400 pH ~ 0 pH |

Table 4-12 Electrode Check and Limits (16196C)

| Parameter | Frequency | Limit (Absolute value) |
|-----------|-----------|------------------------|
| 100 MHz | Rs | 40 mΩ ~ 170 mΩ |
| | Ls | –300 pH ~ 100 pH |
| 1 GHz | Rs | 120 mΩ ~ 540 mΩ |
| | Ls | –300 pH ~ 100 pH |

Table 4-13 Electrode Check and Limits (16196D)

| Parameter | Frequency | Limit (Absolute value) |
|-----------|-----------|------------------------|
| 100 MHz | Rs | 40 mΩ ~ 250 mΩ |
| | Ls | –300 pH ~ 350 pH |

Table 4-13 Electrode Check and Limits (16196D)

| Parameter | Frequency | Limit (Absolute value) |
|-----------|-----------|------------------------|
| 1 GHz | Rs | 80 mΩ ~ 810 mΩ |
| | Ls | −300 pH ~ 200 pH |

Short Plate Check

Measuring the fixture's impedance with the short plate in place should check the condition of the short plate.

CAUTION

“Short Plate Check” should be performed after the “Electrode Check” has been completed.

Required Tools

- 1.5-mm hex wrench (provided accessory)
- Impedance measuring instrument (with 7-mm connector and calibrated)

Table 4-14 **Setting of Measuring Instrument**

| Measurement condition | Set Value |
|-----------------------|--|
| Electrical Length | 16196A: 26.2 mm 16196B: 26.9 mm 16196C: 27.1 mm 16196D: 27.3 mm |
| Measurement Parameter | Ls, Rs |
| OSC Level | 500 mV |
| Point Averaging | 32 |

NOTE

To make the same settings as given in the above table, refer to the Operation Manual for the measuring instrument.

Procedure

- Step 1.** Clean the short plate as described in “Cleaning” on page 41.
- Step 2.** Remove the cap and place the short plate with the protruding surface down on the insulator assembly.
- Step 3.** Place the cap on the fixture body and fasten it.
- Step 4.** Measure Rs and Ls at 100 MHz and 1 GHz in this condition.
- Step 5.** Confirm that the Rs and Ls values are within the representative values given in the table below. If the results are outside the limit range, please replace the short plate.

Table 4-15 Short Plate Check and Limits (16196A)

| Parameter | Frequency | Limit (Absolute value) |
|-----------|-----------|------------------------|
| 100 MHz | Rs | 30 mΩ ~ 160 mΩ |
| | Ls | 200 pH ~ 800 pH |
| 1 GHz | Rs | 100 mΩ ~ 510 mΩ |
| | Ls | 200 pH ~ 600 pH |

Table 4-16 Short Plate Check and Limits (16196B)

| Parameter | Frequency | Limit (Absolute value) |
|-----------|-----------|------------------------|
| 100 MHz | Rs | 40 mΩ ~ 170 mΩ |
| | Ls | 100 pH ~ 600 pH |
| 1 GHz | Rs | 120 mΩ ~ 540 mΩ |
| | Ls | 100 pH ~ 400 pH |

Table 4-17 Short Plate Check and Limits (16196C)

| Parameter | Frequency | Limit (Absolute value) |
|-----------|-----------|------------------------|
| 100 MHz | Rs | 40 mΩ ~ 180 mΩ |
| | Ls | 100 pH ~ 600 pH |
| 1 GHz | Rs | 120 mΩ ~ 570 mΩ |
| | Ls | 50 pH ~ 350 pH |

Table 4-18 Short Plate Check and Limits (16196D)

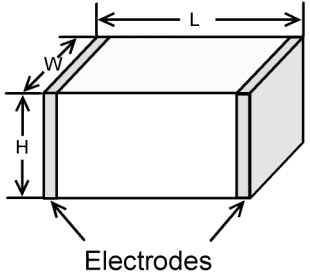
| Parameter | Frequency | Limit (Absolute value) |
|-----------|-----------|------------------------|
| 100 MHz | Rs | 30 mΩ ~ 260 mΩ |
| | Ls | 50 pH ~ 600 pH |
| 1 GHz | Rs | 80 mΩ ~ 860 mΩ |
| | Ls | 0 pH ~ 350 pH |

5

Specifications and Supplemental Performance Characteristics

This chapter provides specifications and supplemental performance characteristics of the 16196A/B/C/D test fixture.

Specifications

| | | |
|---|----------|---|
| Applicable Instruments | | Refer to the Table 1-4,1-5. |
| Applicable DUT Type | | Surface Mount Device with side electrodes. |
|  | Model | Length (L) × Width (W) × Height (H) |
| | 16196A | $(1.6 \pm 0.15) \times (0.8 \pm 0.15) \times (0.4 \text{ to } 0.95) \text{ mm}$ |
| | 16196B | $(1.0 \pm 0.1) \times (0.5 \pm 0.1) \times (0.3 \text{ to } 0.6) \text{ mm}$ |
| | 16196C | $(0.6 \pm 0.03) \times (0.3 \pm 0.03) \times (0.27 \text{ to } 0.33) \text{ mm}$ |
| | 16196D | $(0.4 \pm 0.02) \times (0.2 \pm 0.02) \times (0.11 \text{ to } 0.22) \text{ mm}$ |
| Frequency | | DC to 3 GHz |
| Maximum Voltage | | ± 40V peak max. (AC+DC) |
| Maximum Current | | 5 A |
| 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 | | 78 (D) × 140 (W) × 48 (H) mm (nominal) |
| Weight | | 250g (nominal) |
| | | Model (nominal) |
| | | 16196A 26.2 mm |
| | | 16196B 26.9 mm |
| | | 16196C 27.1 mm |
| | | 16196D 27.3 mm |
| Safety Standards | | 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 |

Supplemental Performance Characteristics

This section provides useful data on the 16196A/B/C/D. These supplemental performance characteristics should not be considered specifications.

Additional Error

Additional errors are calculated as follows.

|Z| Measurement

Additional error for Impedance Z_e [%] 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_o [S] | Test Fixture's Open Repeatability [S] |
| Z_s [Ω] | Test Fixture's Short Repeatability [Ω] |
| Z_x [Ω] | Measured Impedance Value of DUT [Ω] |

| | |
|-------|---|
| Z_s | $(30 + 125 \times f) \times 10^{-3} [\Omega]$ |
| Y_o | $(5 + 40 \times f) \times 10^{-6} [S]$ |
| A | $1 \times f^2 [\%]$ |

where f is frequency (GHz).

D Measurement

Additional error for Dissipation Factor D_e is calculated by using the additional error for Impedance Z_e [%] as follows.

If $D_x \leq 0.1$:

$$D_e = Z_e / 100$$

If $0.1 < D_x \leq 0.5$:

$$D_e = (Z_e / 100) \times (1 + D_x)$$

where D_x is the measured value of D. It is necessary for Z_e 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

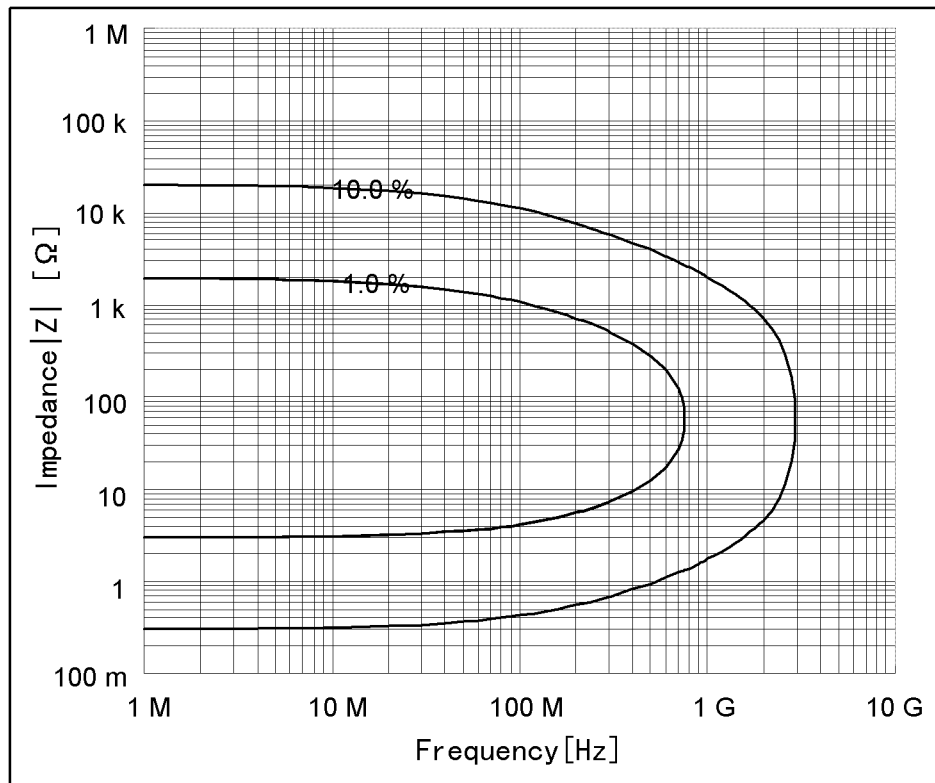
f : measurement signal frequency

Csx : measured value of Cs

Rsx : measured value of Rs .

Figure 5-1

Additional Error for Impedance



Residual Inductance

Residual inductance for the Short Plate is as follows.

| Model | Residual Inductance [nH] |
|--------|--------------------------|
| 16196A | 0.43 |
| 16196B | 0.27 |
| 16196C | 0.16 |
| 16196D | 0.11 |

Applying loading weight to the DUT

The following table shows the factory default of loading weight on the DUT for each model. For the 16196D, the user can replace a part (washer) inside the cap to change it. For the 16196A/B/C, however the loading weight on the DUT cannot be changed.

| Agilent model number | Loading weight to the DUT [gf] |
|----------------------|--------------------------------|
| 16196A/B/C | 400 |
| 16196D | 300 |

Changing the loading weight to the DUT for the 16196D

If the factory default loading weight damages the DUT, replace the part (washer) inside the cap, which changes the spring pressure, to adjust the loading weight on the DUT. Replacement washers must be prepared by users themselves.

NOTE

When the washer is replaced, the specifications and performance of this product are not guaranteed.

Information required to create washers is given below.

Table 5-1

Material and size of the washer

| Material | Outer diameter [mm] | Inner diameter [mm] |
|------------|---------------------|---------------------|
| Polyacetal | φ8.0 to φ12.0 | φ3.2 |

Figure 5-2 Shape of the cap washer

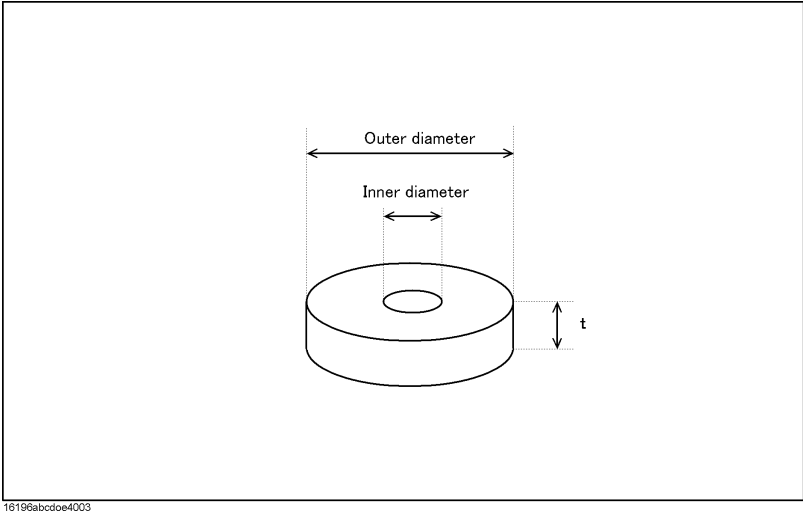


Table 5-2 Relation between washer thickness and loading weight applied to the DUT (design values)

| t [mm] | Loading weight to the DUT:G [gf] |
|--------|----------------------------------|
| 1.0 | 120 |
| 1.5 | 180 |
| 2.0 | 240 |
| 2.5 | 300 |

The loading weight applied to the DUT, G [gf], is obtained by substituting the values of t [mm] into the following equation.

$$G \text{ [gf]} = 119 \times (3.55 + t) - 420$$

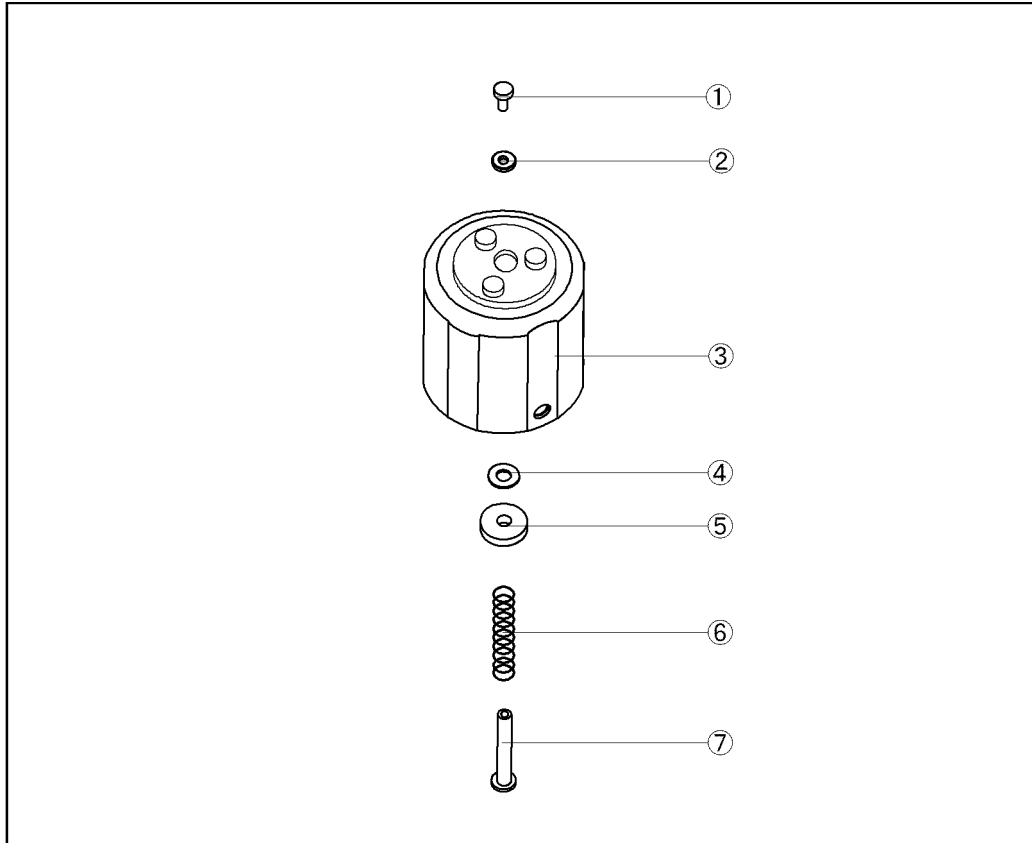
NOTE

If a washer with a thickness (t) of less than 1.0 mm is used, measurement may not be performed accurately.

Replacing the washer inside the cap

The procedure for replacing the washer inside the cap is described below.

Figure 5- 3 Exploded view of the cap



16196abcdoj4005

Replacement procedure

1. Locate a replacement washer.
2. Detach the cap from the fixture.
3. Detach [1] then [2] while holding [7].
4. Detach [3] and [4] from [7].
5. Detach [5] from [7], and replace it with the replacement washer.
6. Attach [4] detached in Step 4 to [7].
7. While protruding [7] from [3], attach [2] detached in Step 3, and tighten [1] with a tightening torque of 0.2 Kgf-cm (0.2 in-lb).
8. Clean [7]. (See “User Maintenance” of the Chapter , “Cleaning.”)

NOTE

Be careful not to bolt inside parts out of the cap when detaching/attaching [1] and [2], because the spring [6] is powerfull.

6 Service

This chapter describes the proper maintenance of the fixture and parts replacement.

Replaceable Parts

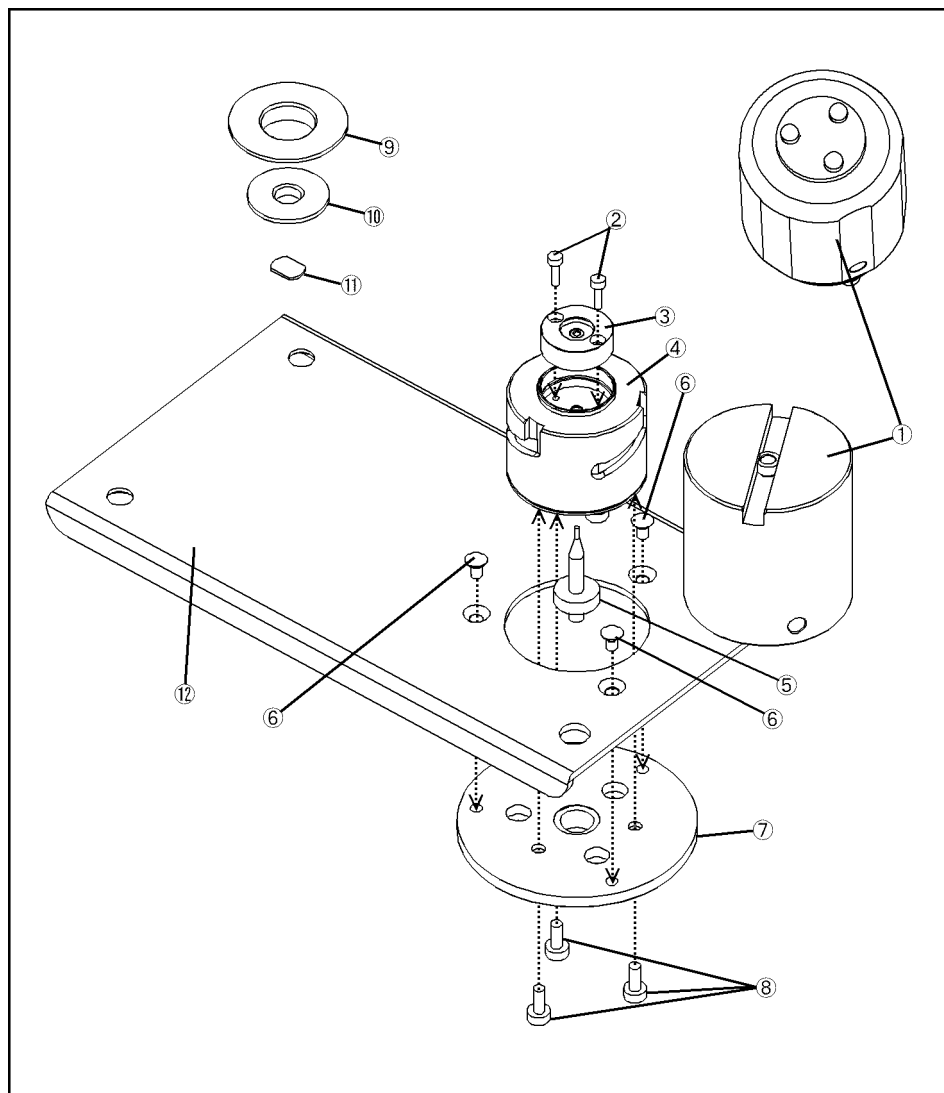
Check the part number by the exploded view below. Do not disassemble the fixture beyond what is shown in this exploded view.

To order parts, specify the Agilent part number. If the part, which is causing problems, is a part that cannot be disassembled, please order the part, which the affected part is, a part of. Sales and Service offices of Agilent Technologies also accept products for repairs.

Block Assembly

Figure 6-1

Block Assembly Exploded View



16196abcdoj4006

Table 6-1 **Replaceable Parts (Block Assembly)**

| Ref. Desig. | Agilent Part No. | Qty. | Description |
|------------------|------------------|------|-------------------------------|
| 1 | 16196-60010 | 1 | Cap Assembly (for 16196A/B/C) |
| | 16196-60020 | 1 | Cap Assembly (for 16196D) |
| 2 | 0515-1044 | 2 | Cap Screw Mach M1.6 |
| 3 | 16196-60112 | 1 | φ1.34 Insulator (for 16196A) |
| | 16196-60113 | 1 | φ1.14 Insulator (for 16196A) |
| | 16196-60114 | 1 | φ1.08 Insulator (for 16196A) |
| | 16196-60212 | 1 | φ0.85 Insulator (for 16196B) |
| | 16196-60213 | 1 | φ0.75 Insulator (for 16196B) |
| | 16196-60214 | 1 | φ0.68 Insulator (for 16196B) |
| | 16196-60312 | 1 | φ0.48 Insulator (for 16196C) |
| | 16196-60412 | 1 | φ0.34 Insulator (for 16196D) |
| | 16196-60414 | 1 | φ0.30 Insulator (for 16196D) |
| 4 | N/A | 1 | Ground Assembly |
| 5 ^{*1} | 16196-60111 | 1 | Lower Electrode (for 16196A) |
| | 16196-60211 | 1 | Lower Electrode (for 16196B) |
| | 16196-60311 | 1 | Lower Electrode (for 16196C) |
| | 16196-60411 | 1 | Lower Electrode (for 16196D) |
| 6 | 0515-0954 | 3 | Screw M-2.5 |
| 7 | 16196-24001 | 1 | Base |
| 8 | 0515-0905 | 3 | Screw M-2.5 |
| 9 | 16196-24004 | 1 | Push Ring |
| 10 | 16196-29002 | 1 | Open Plate |
| 11 ^{*1} | 16196-29026 | 1 | Short Plate (for 16196A) |
| | 16196-29027 | 1 | Short Plate (for 16196B) |
| | 16196-29028 | 1 | Short Plate (for 16196C) |
| | 16196-65101 | 1 | Short Plate (for 16196D) |

Table 6-1 **Replaceable Parts (Block Assembly)**

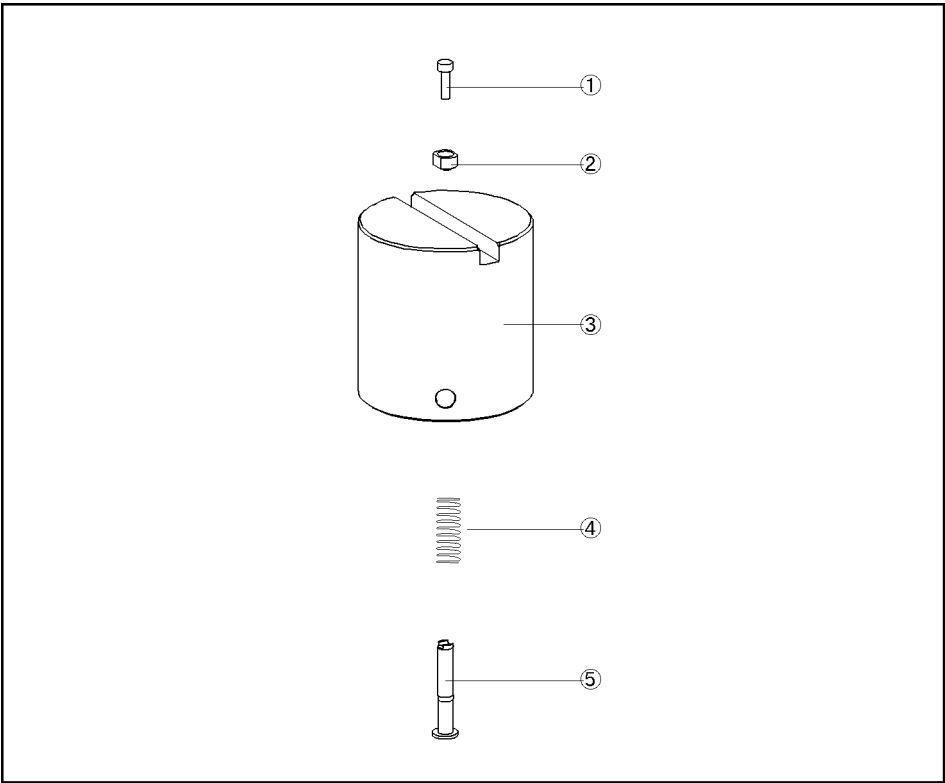
| Ref. Desig. | Agilent Part No. | Qty. | Description |
|-------------|------------------|------|--------------------|
| 12 | 16196-00601 | 1 | Plate (for 16196A) |
| | 16196-00611 | 1 | Plate (for 16196B) |
| | 16196-00621 | 1 | Plate (for 16196C) |
| | 16196-00632 | 1 | Plate (for 16196D) |

*1. Maintenance Kit consisting of 5 replaceable parts is available. Refer to “Maintenance Kit” on page 74 for details.

Cap

Figure 6-2

Cap Exploded View (for 16196A/B/C)



16196abcq0504

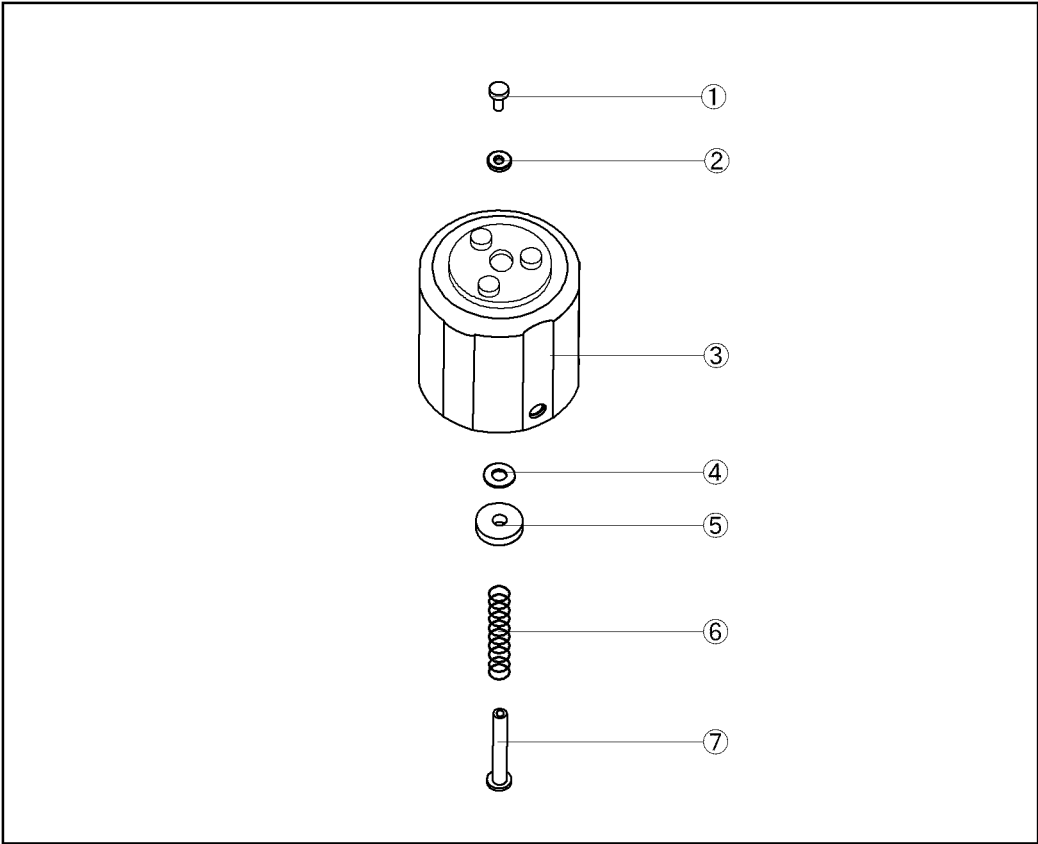
Table 6-2

Replaceable Parts (Cap)

| Ref. Desig. | Agilent Part No. | Qty. | Description |
|-------------|------------------|------|-----------------|
| 1 | 0515-1044 | 1 | Screw Mach M1.6 |
| 2 | 16196-24005 | 1 | Stopper |
| 3 | N/A | 1 | Cap |
| 4 | 1460-2618 | 1 | Spring |
| 5*1 | 16196-23008 | 1 | Upper Electrode |

*1. Maintenance Kit including 5 replaceable parts is available. Refer to “Maintenance Kit” on page 74 for details.

Figure 6-3 Cap Exploded View (for 16196D)



16196abcdoj4005

Table 6-3 Replaceable Parts (Cap)

| Ref. Desig. | Agilent Part No. | Qty. | Description |
|-------------|------------------|------|-----------------|
| 1 | 0515-1077 | 1 | Screw Mach M2 |
| 2 | 3050-2238 | 1 | Washer |
| 3 | N/A | 1 | Cap |
| 4 | 3050-2241 | 1 | Washer |
| 5 | 3050-2239 | 1 | Washer |
| 6 | 1460-2618 | 1 | Spring |
| 7*1 | 16196-23043 | 1 | Upper Electrode |

*1. Maintenance Kit including 5 replaceable parts is available. Refer to “Maintenance Kit” on page 74 for details.

Other Parts

Table 6-4

Replaceable Parts (Other Parts)

| Ref. Desig. | Agilent Part No. | Qty. | Description |
|-------------|------------------|------|-------------------------------|
| 1 | 16196-60150 | 1 | Carrying Case (for 16196A) |
| | 16196-60250 | 1 | Carrying Case (for 16196B) |
| | 16196-60350 | 1 | Carrying Case (for 16196C) |
| | 16196-60450 | 1 | Carrying Case (for 16196D) |
| 2 | 16193-60002 | 2 | Magnifying Glass |
| 3 | 5182-7586 | 1 | Cleaning Rod |
| 4 | 8710-0909 | 1 | Wrench 1.5 mm Hex |
| 5 | 8710-2081 | 1 | Tweezers |
| 6 | 1540-0622 | 1 | Case for OPEN and SHORT plate |
| 7 | 9282-0114 | 1 | Cushion |

Maintenance Kit

The 16196U-maintenance kit is available to provide consumable products and replaceable parts for the 16196A/B/C/D.

16196U Maintenance Kit

The 16196A/B/C/D common option and options for each model separately are available.

Table 6-5 **16196A/B/C Common Option**

| | |
|--------|---|
| Opt010 | Upper Electrode Set for 16196A/B/C (5 pieces) |
|--------|---|

Table 6-6 **16196A Option**

| | |
|--------|---|
| Opt100 | 1608(mm) Short Plate Set (5 pieces) |
| Opt110 | 1608(mm) Lower Electrode Set (5 pieces) |

Table 6-7 **16196B Option**

| | |
|--------|---|
| Opt200 | 1005(mm) Short Plate Set (5 pieces) |
| Opt210 | 1005(mm) Lower Electrode Set (5 pieces) |

Table 6-8 **16196C Option**

| | |
|--------|---|
| Opt300 | 0603(mm) Short Plate Set (5 pieces) |
| Opt310 | 0603(mm) Lower Electrode Set (5 pieces) |

Table 6-9 **16196D Option**

| | |
|--------|---|
| Opt020 | Upper Electrode Set for 16196D (5 pieces) |
| Opt400 | 0402(mm) Short Plate Set (5 pieces) |
| Opt410 | 0402(mm) Lower Electrode Set (5 pieces) |

Replacement Procedure

This section describes the replacement methods for the lower electrode, insulator and upper electrode. After replacing the respective parts, check the operation of the parts with reference to "Operation Check."

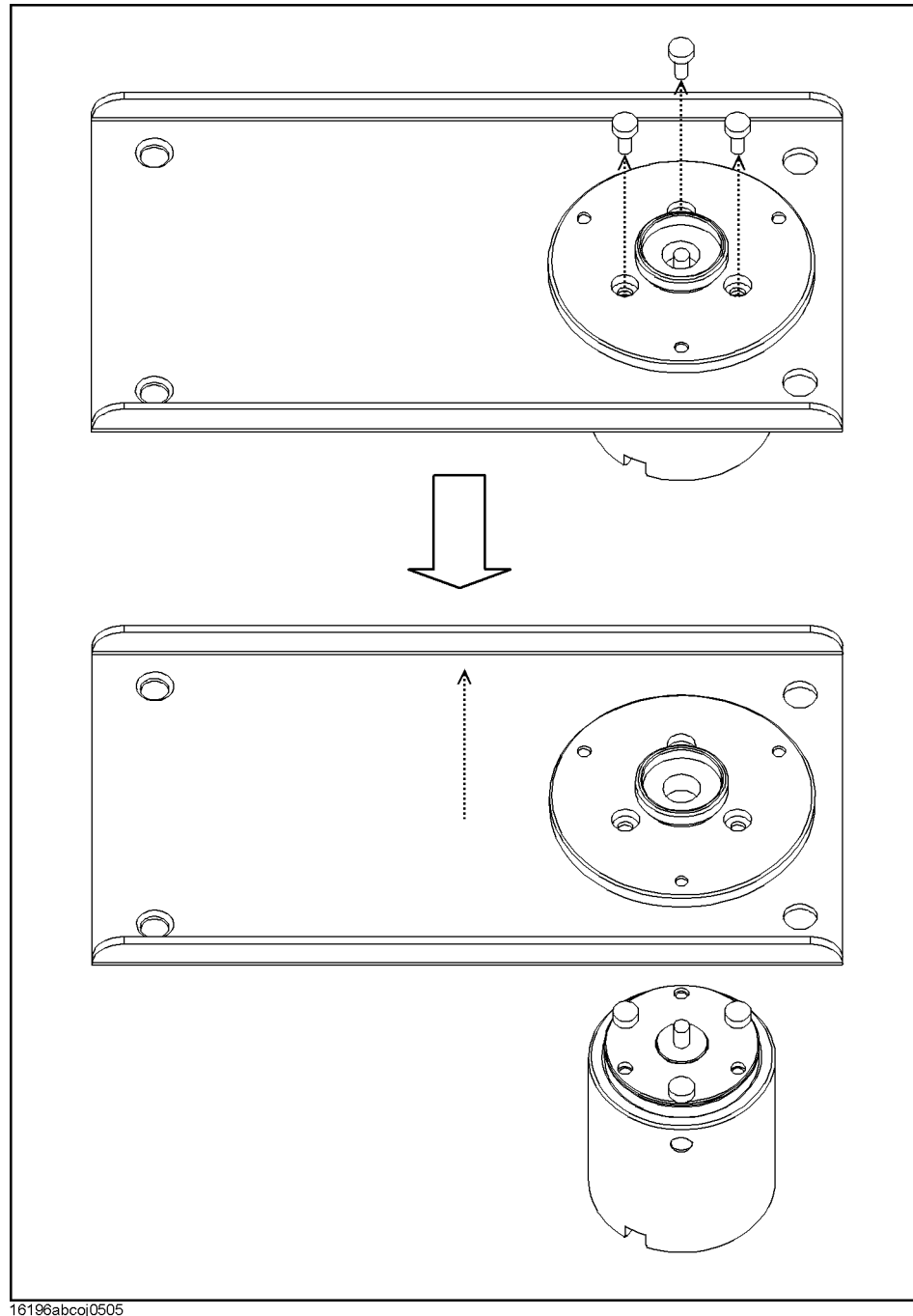
To replace the insulator and upper electrode, the 1.5-mm hex wrench (Agilent Part No. 8710-0909), included with the fixture, is required.

Lower Electrode

1. Prepare the replacement center electrode.
2. Take out the 3 screws from the bottom of the fixture and take out the DUT insert.

Figure 6-4

Removing the Bottom of the Fixture

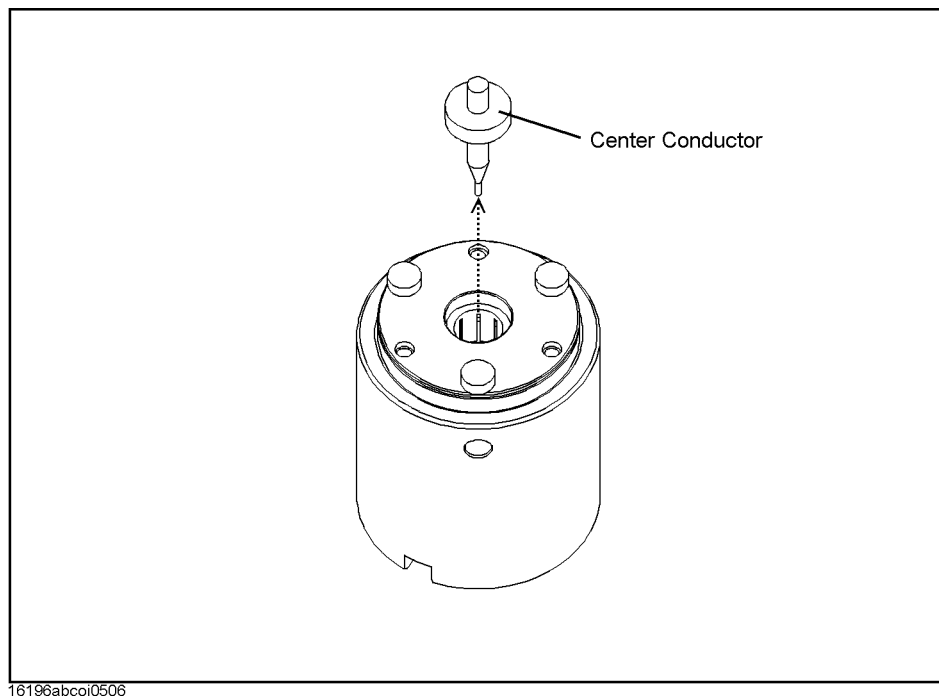


16196abcj0505

3. Remove the lower electrode from the DUT insert.

Figure 6-5

Removing the Lower Electrode



4. Insert the replacement lower electrode in the DUT insert.

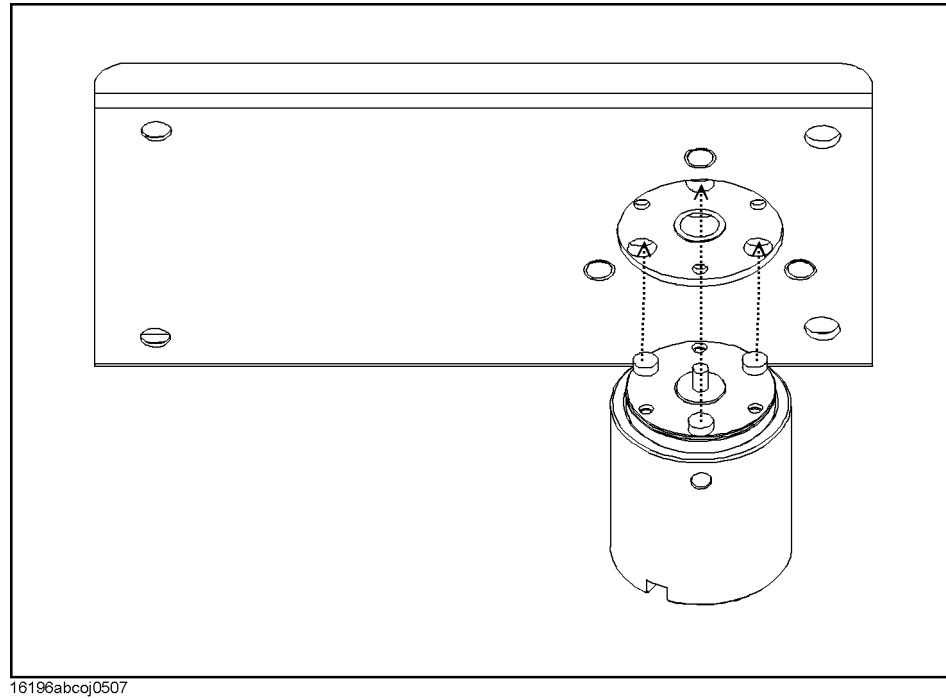
NOTE

The tip of the lower electrode is thin and easily bent. To prevent the tip of the lower electrode from contacting the inside of the DUT insert and being bent, insert the lower electrode vertically against the DUT's bottom surface.

5. Insert the DUT insert in the bottom of the fixture so that the bottom screws settle into the holes in the bottom of the fixture.

Figure 6-6

Mounting the DUT Insert



6. Fasten the DUT insert to the bottom of the fixture using the screws.

Insulator

Replace the insulator with reference to “Selecting and Changing the Insulator Assembly” on page 25.

Upper Electrode

1. Prepare the replacement electrode.
2. Remove the cap from the fixture.
3. Take out the screw from the top of the cap and remove the electrode from the cap.

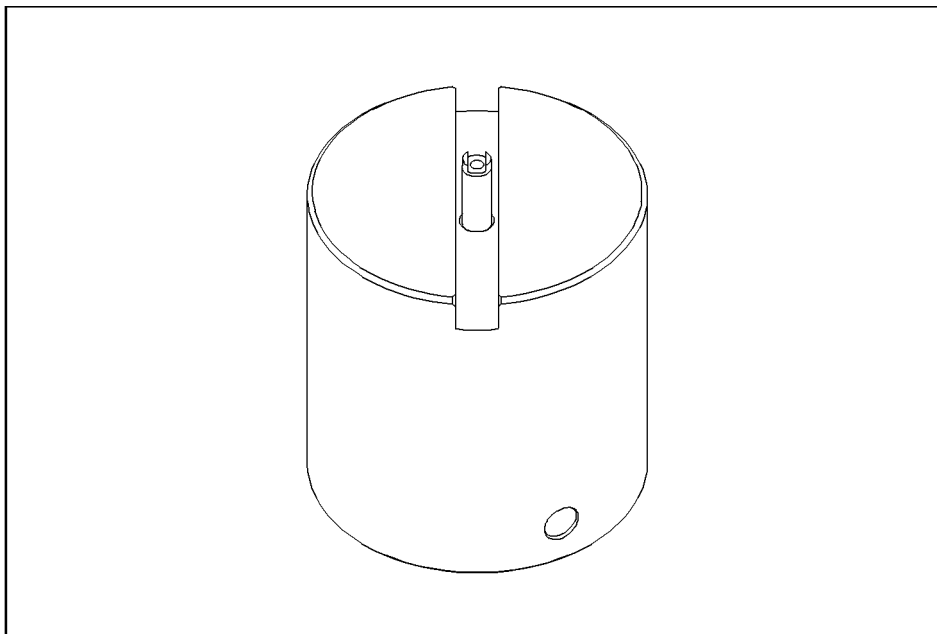
NOTE

In case of the 16196D, take out the screw from the top of the cap while holding the electrode.

4. Take the electrode out of the spring and insert the replacement electrode.
5. Push the electrode in from the bottom of the cap so that the top of the electrode protrudes out of the top of the cap.

Figure 6-7

Electrode Replacement 1



16196abcoj0508

Service Replacement Procedure

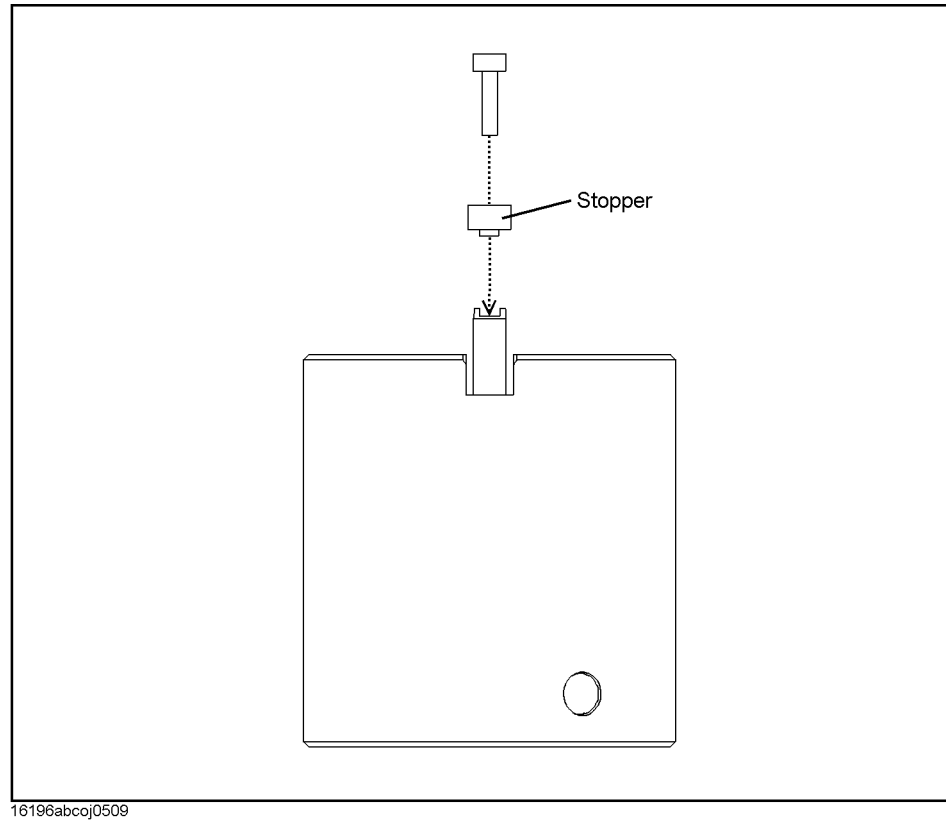
6. Place the stopper removed in step 3 so that the protrusion in the bottom aligns with the indent in the top of the electrode and tighten the screw.

NOTE

In case of the 16196D, while holding the electrode, attach the washer and tighten the screw. The tightening torque is 0.2 Kgf-cm (0.2 in-lb).

Figure 6-8

Electrode Replacement 2



Assembling Check

The assembling check need to be performed following replacement of parts. The impedance measurement instrument or the network analyzer is required for the assembling check. The impedance measurement instrument is more recommendable. Refer to “Assembling Check” on page 53 for the procedure using the impedance measurement instrument.

The assembly check methods with the network analyzer are explained in the following.

NOTE

The network analyzer can be used only for the assembling check. The network analyzer has no function to measure DUT with the 16196A/B/C/D.

Method Using Network Analyzer

Required Tools

- Agilent 8753E
- Open plate
- Short plate

Procedure

Step 1. Conduct S11 full-calibration with the 7-mm connector to be connected to the fixture.

NOTE

For details on the calibration method, see the User’s Guide for the measuring instrument.

Step 2. Connect the fixture to the measuring instrument.

Step 3. Remove the cap and place the open plate on the insulator assembly. Then attach and fasten the cap.

Step 4. Set the measuring instrument as follows.

| Measurement Parameter | Primary:Mag, Secondary:Phase |
|-----------------------|------------------------------|
| Power | −10 dBm |
| IF BW | 100 Hz |
| Point Averaging | 16 |
| Port Extension | 16196A: 26.2 mm |
| | 16196B: 26.9 mm |
| | 16196C: 27.1 mm |
| | 16196D: 27.3 mm |

NOTE

For details on the setting and measurement procedures, see the User’s Manual for the

measuring instrument.

- Step 5.** Take Mag and Phase value readings at 100 MHz and 1 GHz and record the results. Check if the Mag and Phase values are within the typical value ranges shown in the following table.

Table 6-10 Operation Check Typical Values (Open, common for 16196A/B/C/D)

| Parameter | Frequency | Typical Value (Absolute value) |
|-----------|-----------|--------------------------------|
| Mag | 100 MHz | -0.2 ~ 0.2 |
| Mag | 1 GHz | -0.2 ~ 0.2 |
| Phase | 100 MHz | -0.5° ~ 0.5° |
| Phase | 1 GHz | -2.5° ~ 2.5° |

- Step 6.** Remove the open plate, and place the short plate on the insulator assembly. Then attach and fasten the cap.
- Step 7.** Take Mag and Phase value readings at 100 MHz and 1 GHz in this short state and record the results. Check if the Mag and Phase values are within the typical value ranges shown in the following table.

Table 6-11 Operation Check Typical Values (Short, 16196A)

| Parameter | Frequency | Typical Value (Absolute value) |
|-----------|-----------|--------------------------------|
| Mag | 100 MHz | -0.06 ~ -0.01 |
| Mag | 1 GHz | -0.18 ~ -0.03 |
| Phase | 100 MHz | 178° ~ 180° |
| Phase | 1 GHz | 171° ~ 178° |

Table 6-12 Operation Check Typical Values (Short, 16196B)

| Parameter | Frequency | Typical Value (Absolute value) |
|-----------|-----------|--------------------------------|
| Mag | 100 MHz | -0.06 ~ -0.01 |
| Mag | 1 GHz | -0.19 ~ -0.04 |
| Phase | 100 MHz | 179° ~ 180° |
| Phase | 1 GHz | 174° ~ 180° |

Table 6-13 Operation Check Typical Values (Short, 16196C)

| Parameter | Frequency | Typical Value (Absolute value) |
|-----------|-----------|--------------------------------|
| Mag | 100 MHz | -0.07 ~ -0.01 |
| Mag | 1 GHz | -0.20 ~ -0.04 |
| Phase | 100 MHz | 179° ~ 180° |
| Phase | 1 GHz | 174° ~ 180° |

Table 6-14

Operation Check Typical Values (Short, 16196D)

| Parameter | Frequency | Typical Value (Absolute value) |
|-----------|-----------|--------------------------------|
| Mag | 100 MHz | -0.15 ~ 0 |
| Mag | 1 GHz | -0.40 ~ 0 |
| Phase | 100 MHz | 179° ~ 180° |
| Phase | 1 GHz | 174° ~ 180° |

Service
Assembling Check

Numerics

16196A Option, 74
16196A/B/C Common Option, 74
16196B Option, 74
16196C Option, 74
16196D Option, 74
16196U Maintenance Kit, 74
7-mm connector, 16

A

Accessories, 21
adapter, 15
Additional Error, 61
Assembling Check, 53

B

Body Side Surfaces
Cleaning Methods, 43

C

Cap
Cleaning Methods, 43
Functions, 20
Places Requiring Cleaning, 41
Replaceable Parts, 69
Carrying Case
16196A Package Contents, 12
16196B Package Contents, 13
16196C Package Contents, 13
16196D Package Contents, 14
Replaceable Parts, 73
certification, 4
Changes The Spring Pressure, 63
Check Sheet
Fill-Out Example, 49
Cleaning
Methods, 42
Places Requiring, 41
Cleaning Rod
16196A Package Contents, 12
16196B Package Contents, 12
16196C Package Contents, 13
16196D Package Contents, 14
Functions, 21
Replaceable Parts, 73

D

Dimension, 60
Documentation Warranty, 4
DUT
Connecting and Measuring, 34
Removing, 34
DUT Insertion Hole
Functions, 20

E

Electrical Length, 29
Electrode Check, 53
Electrode Structure, 19
Electrode Wear Check
Check Sheet, 50
Fill-Out Example, 49
Procedure, 48
Reference Value Acquisition, 46

F

Fixture Compensation, 30
Frequency
Specifications, 60
Functions, 20

I

Insulator Assembly
16196A Package Contents, 12
16196B Package Contents, 12
16196C Package Contents, 13
16196D Package Contents, 13
Cleaning Methods, 42
Functions, 21
identifications, 22
installing, 28
Places Requiring Cleaning, 41
Removing, 27
Replaceable Parts, 69
Selecting, 25
Specifications, 25

L

Limit
Electrode Check, 54
Limits
Short Plate Check, 57
Lower Electrode
Cleaning Methods, 42
Places Requiring Cleaning, 41
Replaceable Parts, 69
Replacement Procedure, 76
Ls, 47, 48, 54
Electrode Check, 54
Electrode Wear Check, 48
Performance Check Representative Value, 82
Short Plate Check, 56
Short Plate Wear Check, 47, 48

M

Magnifying Glass
16196A Package Contents, 12
16196B Package Contents, 13
16196C Package Contents, 13
16196D Package Contents, 14

Functions, 20
Replaceable Parts, 73
Maintenance Items, 39
Maintenance Kit, 74
Mark, 22
Maximum Current, 60
Maximum Voltage, 60

N

Non Operating Environment, 60

O

Open Compensation, 30
Open Plate
 16196A Package Contents, 12
 16196B Package Contents, 12
 16196C Package Contents, 13
 16196D Package Contents, 13
 Cleaning Methods, 42
 Functions, 21
 Open Compensation, 31
 Places Requiring Cleaning, 41
 Replaceable Parts, 69
Open Repeatability, 61
Operating Environment, 60
Operation and Service Manual
 16196A Package Contents, 12
 16196B Package Contents, 13
 16196C Package Contents, 13
 16196D Package Contents, 14
Opt010
 16196A/B/C Common Option, 74
Opt020
 16196D Option, 74
Opt100
 16196A Option, 74
Opt110
 16196A Option, 74
Opt200
 16196B Option, 74
Opt210
 16196B Option, 74
Opt300
 16196C Option, 74
Opt310
 16196C Option, 74
Opt400
 16196D Option, 74
Opt410
 16196D Option, 74
Option 710
 16196A Package Contents, 12
 16196B Package Contents, 13
 16196C Package Contents, 13
 16196D Package Contents, 14

P

Package Contents
 16196A, 12
 16196B, 12
 16196C, 13
 16196D, 13
Performance Check
 Method Using Network Analyzer, 81
Push Ring
 16196A Package Contents, 12
 16196B Package Contents, 12
 16196C Package Contents, 13
 16196D Package Contents, 14
 Functions, 21
 Removing the DUT, 35
 Replaceable Parts, 69

R

Reference Value
 Electrode Wear Check, 46
Replaceable Parts
 Block Assembly, 69
 Cap, 71, 72
 Other Parts, 73
Residual inductance, 33, 63
Rs, 47, 48, 54
 Electrode Check, 54
 Electrode Wear Check, 48
 Performance Check Representative Value, 82
 Short Plate Check, 56
 Short Plate Wear Check, 47, 48

S

Safety Standards, 60
Short Compensation, 32
Short Plate
 16196A Package Contents, 12
 16196B Package Contents, 12
 16196C Package Contents, 13
 16196D Package Contents, 14
 Cleaning Methods, 42
 Functions, 21
 Places Requiring Cleaning, 41
 Replaceable Parts, 69
 Residual inductance, 33, 63
 Short Compensation, 32
Short Plate Check, 56
Short Plate Wear Check
 Check Sheet, 51
 Reference Value Acquisition, 47
Short Repeatability, 61
Specifications, 60
Supplemental Performance Characteristics, 61

T

Tweezers

16196A Package Contents, 12
16196B Package Contents, 12
16196C Package Contents, 13
16196D Package Contents, 14
Functions, 21
Replaceable Parts, 73

U

Upper Electrode
 Cleaning Methods, 42
 Places Requiring Cleaning, 41
 Replacement Procedure, 79
User Limit Values
 Setting Example, 44

W

Wear Check, 44
Weight, 60
Wrench
 16196A Package Contents, 12
 16196B Package Contents, 12
 16196C Package Contents, 13
 16196D Package Contents, 14
 Functions, 21
 Replaceable Parts, 73