Keysight 16452A Liquid Test Fixture

Operation and
Service Manual

Notices

Trademark Acknowledgments

Manual Part Number

16452-90000

Edition

Edition 6 January 2019

Printed in Malaysia

Published by:

Keysight Technologies International Japan G.K,
1-3-3 Higashikawasaki-cho
Chuo-ku
Kobe-shi, Hyogo, Japan

Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT WILL CONTROL.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

U.S. Government Rights

The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at http://www.keysight.com/find/sweula The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Table of Contents

1 General Information

The purpose of this manual is to enable you to use your 16452A Liquid Test Fixture efficiently and confidently.

Manual Summary

This manual contains the following:

- The Specifications of the 16452A (see this chapter)
- Inspecting the 16452A (see Chapter 2)
- Operating the 16452A (see Chapter 3)
- Ordering replaceable parts for the 16452A (see Chapter 4)

Product Description

The 16452A Liquid Test Fixture provides accurate dielectric constant and impedance measurements of liquid materials. This fixture allows you to make frequency swept measurements or temperature coefficient measurements that precisely characterize liquid materials.

NOTE **16452A is not capable of measuring salt or ionic solutions or other liquids with bulk conductivity due to the electrode polarization phenomenon.**

KEYSIGHT TECHNOLOGIES

Applicable Instrument

The 16452A has been designed to operate specifically with the LCR meters/impedance analyzers with 4 terminal pair.

Accessories

Furnished Accessories

See Table 2-1 for the accessories supplied with the 16452A.

Recommended Measurement Cables[1]

You need a 4-terminal BNC cable to connect the 16452A and your measurement instrument. For this purpose, Keysight Technologies recommends using the following cables.

For the temperature range of 0 to +55°C	16048A Test leads
For the temperature range of -20 to +125°C	16048G/H + 1250-2375

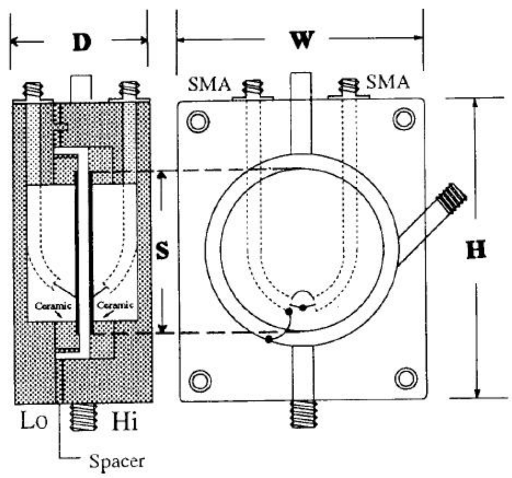
1. These cables are not furnished with the 16452A. Order according to your measurement requirements.

Specifications

This section lists the complete 16452A specifications. These specifications are the performance standards and limits against which the 16452A is tested. When shipped from the factory, the16452A meets the following specifications:

Electrode Size (S)	ϕ38±0.5 (mm)
Dimension	85 (H) x 85 (W) x 37 (D)(mm)
Weight	1.4 kg
Maximum Operating Voltage	30 Vrms

Figure 1-1 Electrode Size of the 16452A (section view)



Operating Frequency	20 Hz to 30 MHz

The operating frequency differs according to the instrument that the 16452A is used with.

Materials

Test fixture body (electrodes, spacers, liquid inlet and outlet)

Nickel-plated cobal (Fe 54%, Co 17%, Ni 29%)

Insulator	Ceramic (alumina Al_2O_3)
O-ring	Viton (Fluoro rubber)
Insulator soldering	Silver-copper and gold-copper

The typical corrosive characteristics of these materials are shown in Appendix A.

Operating Temperature	-20 to +125°C

The measurement cable's operating temperature is:

16048A	0 to +55°C
16048G/H + 1250-2375	-20 to +150°C

Non-Operating Temperature	-40 to 70°C

Supplemental Performance Characteristics

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

Electrode gap repeatability (Screw torque: 15 kgf·cm)	100 Hz to 15 MHz
Assembly repeatability	See Table 1-1
Temperature repeatability (@23°C to 125°C)	See Table 1-1
Necessary liquid volume	See Table 1-1
Air Capacitance Value (@23°C ± 5°C, 1MHz)	See Table 1-1

Table 1-1 Typical Data

Spacer thickness	1.3mm	1.5mm	2.0mm	3.0mm
Electrode gap assembly repeatability	0.3mm±12μm	0.5mm±12μm	1.0mm±12μm	2.0mm±12μm
Electrode gap temperature repeatability	0.3mm±2μm	0.5mm±2μm	1.0mm±2μm	2.0mm±2μm
Necessary liquid volume	3.4ml	3.8ml	4.8ml	6.8ml
Air capacitance value	34.9pF±25%	21.2pF±15%	10.9pF±10%	5.5pF±10%

Short residual (when using the furnished shorting plate with a 1.3mm spacer)

Ls (equivalent series inductance)	20nH
Rs (equivalent series resistance)	0.5Ω
Temperature expansion coefficient	≤ ±300ppm/°C

Additional impedance measurement

In the following measurement,

- The SHORT compensation is done.

- The calculation is done using the capacitive measurement method (see "Capacitive Measurement Method" on page 34).
- The measurement instrument is LCR Meter/Impedance Analyzer with 4 terminal pair.
- The relative dielectric constant is $1 < |\dot{\varepsilon}_r| < 500$

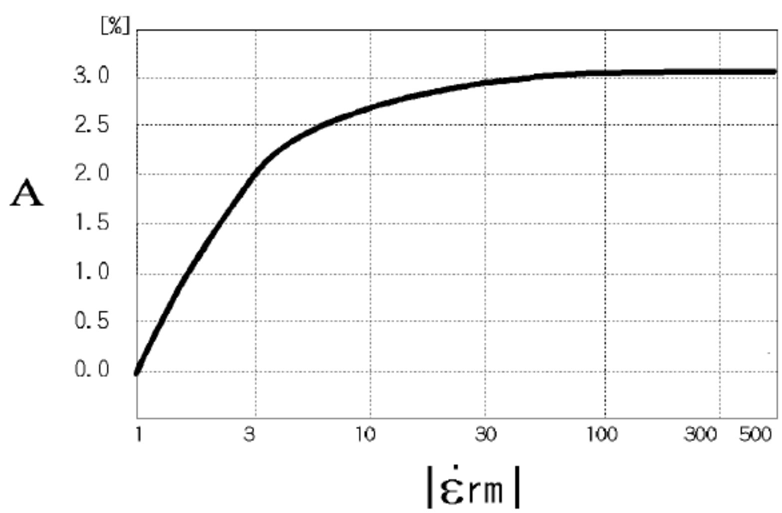
The fixture error[1] is defined by:

Error = A + B [%] (See Figure 1-4)

Where,

A	:Obtained from Figure 1-2
B	:Obtained from Figure 1-3

Figure 1-2 Fixture Error (A)



1. The measurement accuracy is a complex function of the measurement instrument accuracy and the fixture error.

Figure 1-3 Fixture Error (B)

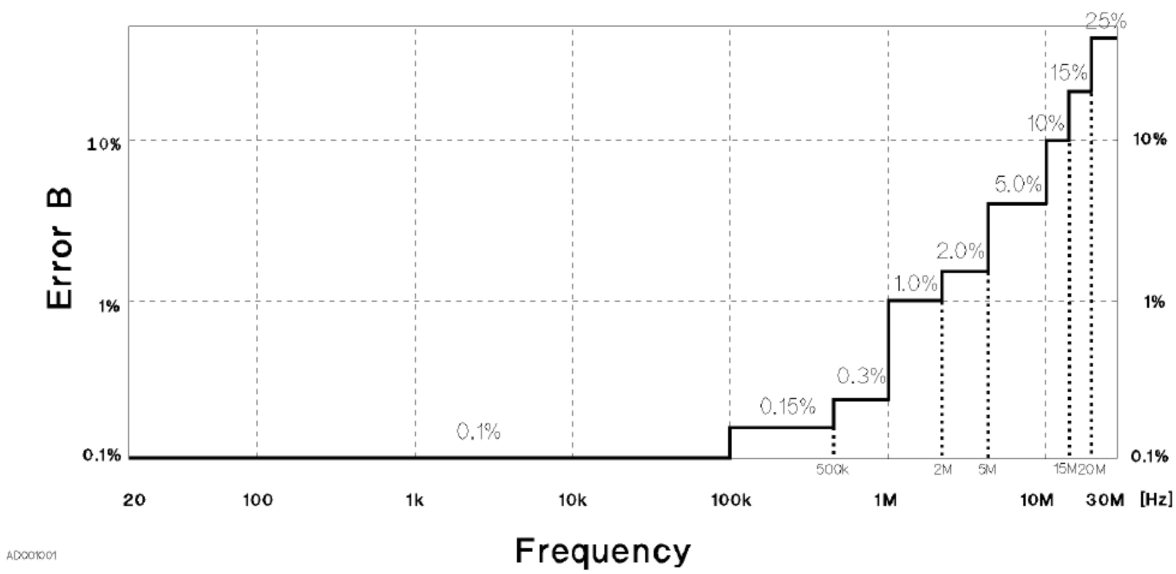
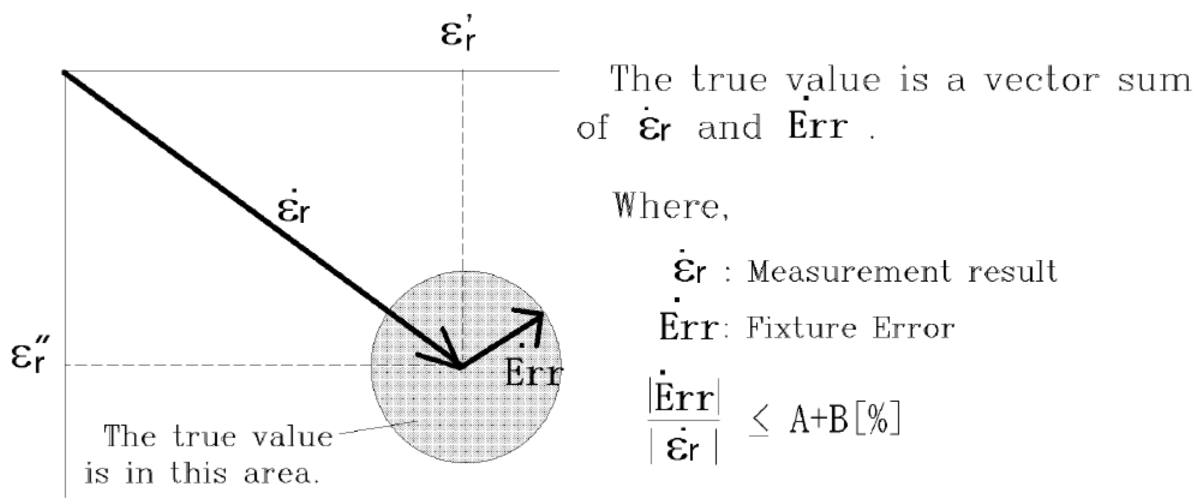


Figure 1-4 Fixture Error (A+B)



2 Initial Inspection

Introduction

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

- Inspect the shipping container for damage. Keep the shipping materials until the inspection is completed.
- Verify that the shipping container contains everything shown in Figure 2-1 and listed in Table 2-1.
- Inspect the exterior of the 16452A for any signs of damage.

Product Overview

Figure 2-1 16452A Product Overview

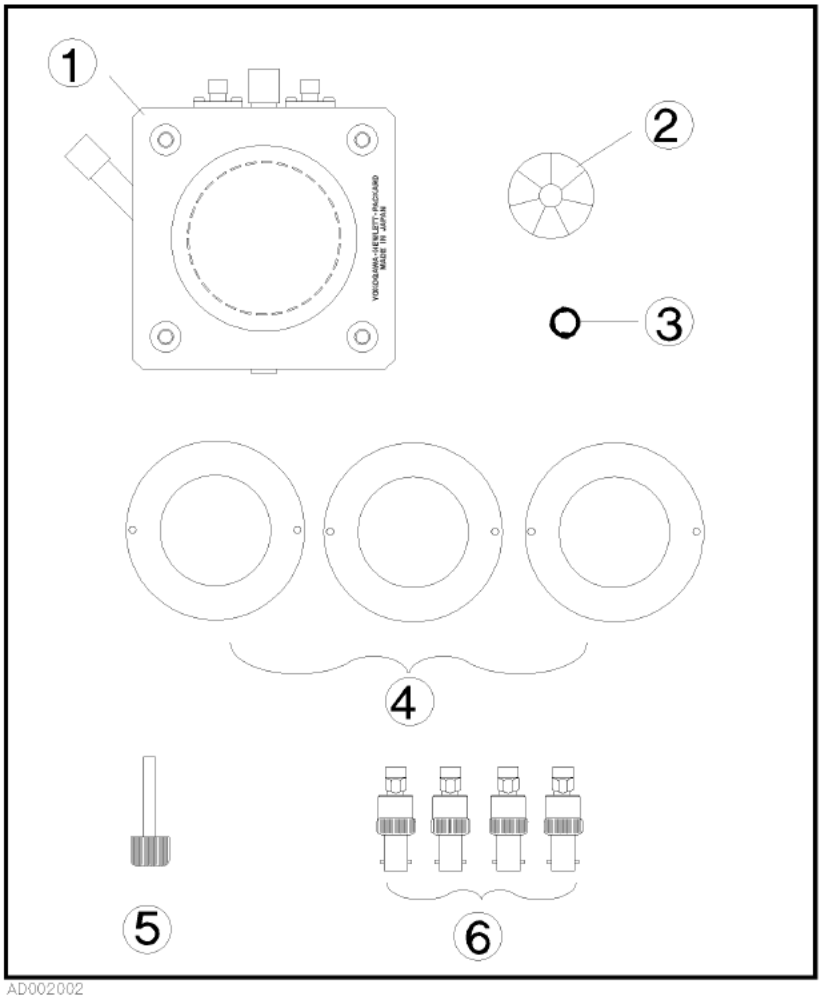


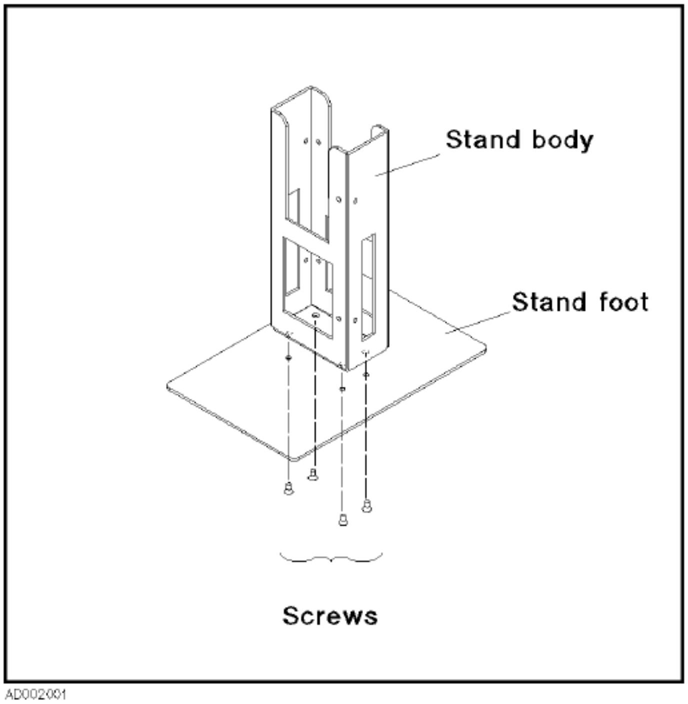
Table 2-1 **Contents**

Reference Designator	Description	Part Number	Quantity
1	Liquid test fixture	16452A	1
	O-ring for electrodes[1]	0905-1275	2
2	Shorting plate	16092-08010	1
3	O-ring for liquid outlet	0905-1277	1
4	Spacer		
	1.3mm (thickness)/ 0.3 mm (gap)[2]	16452-00601	1
	1.5mm (thickness)/ 0.5 mm (gap)	16452-00602	1
	2.0mm (thickness)/ 1.0 mm (gap)	16452-00603	1
	3.0mm (thickness)/ 2.0 mm (gap)	16452-00604	1
5	lid of liquid outlet	16452-24002	1
6	SMA-BNC adapter	1250-1200	4
-	Waterproof cap for BNC connector[3]	1252-5831	4
-	Carrying Case[4]	16452-60111	1
-	Operation and Service Manual[4]	16452-90000	1
-	Fixture stand[5]		
	Stand body	_[6]	1
	Screw for stand	0515-0914	4
	Stand foot	16452-00611	1

1. The O-rings are assembled in the 16452A.
2. The 1.3mm spacer is assembled in the 16452A.
3. The cap is on the SMA-BNC adapter.
4. The carrying case and the Operation and Service Manual are not shown in the Figure 2-1.
5. The fixture stand is shown in Figure 2-2. Assemble it as shown in the figure.
6. The stand body is assembled using the two angle irons (16452-01201) and the four screws (0515-0914).

If you ordered a measurement cable (16048A, or 116048G/H + 1250-2375), check that the cable is included.

Figure 2-2 Assembling the Fixture Stand



Repackaging the Test Fixture For Shipment

If shipment to aKeysight Technologies service center is required, each test fixture should be repackaged using the original factory packaging materials.

If this material is not available, comparable packaging materials may be used. Wrap the liquid test fixture in heavy paper and pack in anti-static plastic packing material. Use sufficient shock absorbing material on all sides of the 16452A to provide a thick, firm cushion and to prevent movement. Seal the shipping container securely and mark it *FRAGILE*.

3 Operation

Introduction

This chapter describes how to measure the dielectric constant ($\boldsymbol{\varepsilon}$) of the liquid using the 16452A.

- The standard measurement sequence is shown in this chapter.
- Some instructions for the temperature measurement are provided at the back of the chapter.

Measurement Sequence

Relative permittivity ($\boldsymbol{\varepsilon}_r$) can be calculated from the ratio of the capacitance of a material to that of air (nearly equal to that of a vacuum). The standard measurement sequence is as follows:

1. Prepare the test fixture for use.
2. Connect the test fixture.
3. Check the SHORT residual.
4. Set the instrument for capacitance measurement.
5. Do a SHORT compensation.
6. Do the air capacitance (C_o) measurement.
7. Do the liquid capacitance and resistance (C_p, R_p) measurement.
8. Drain the liquid (after measurement)
9. Do the data processing- Calculate dielectric parameter from measurement data.

Measurement Requirements

To do the measurement, the following items are required:

- 16452A Liquid Test Fixture
- Fixture stand (furnished with the 16452A)
- SMA-BNC adapter (furnished with the 16452A)
- Measurement cable (16048A or 16048G/H + 1250-2375)
- 1.3 mm spacer for the SHORT compensation (furnished with the 16452A)
- Shorting plate for the SHORT compensation (furnished with the 16452A)
- A spacer (choose one of the furnished four spacers)
- Measurement instrument (LCR Meter/Impedance analyzer with 4 terminal pair)
- Liquid under test (enough for the spacer you are using)

In addition, the following items are useful:

- For washing the 16452A, a brush, detergent, cloth, etc.
- For high temperature measurements, gloves to prevent scalding.

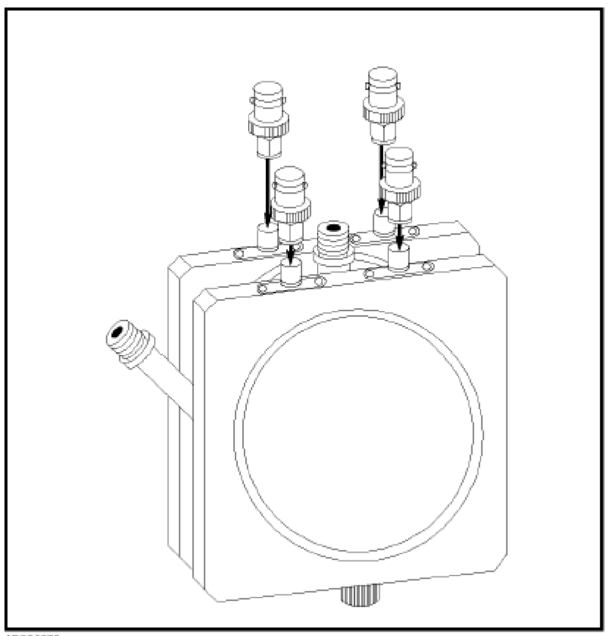
Preparation of Test Fixture for Use

Before connecting the test fixture, you must connect the SMA-BNC adapters to the 16452A terminals. Also, the spacer and shorting plate must be set between the electrodes for the SHORT compensation. The 16452A can be separated into High and Low electrodes to make it possible to set the spacer and the shorting plate. The test fixture's electrodes are easier to clean if you separate the electrodes.

Connecting the SMA-BNC Adapters to the 16452A

Connect the SMA-BNC Adapters to the 16452A SMA-terminals as shown in Figure 3-1. The waterproof caps for the BNC connector should be on when washing the electrodes.

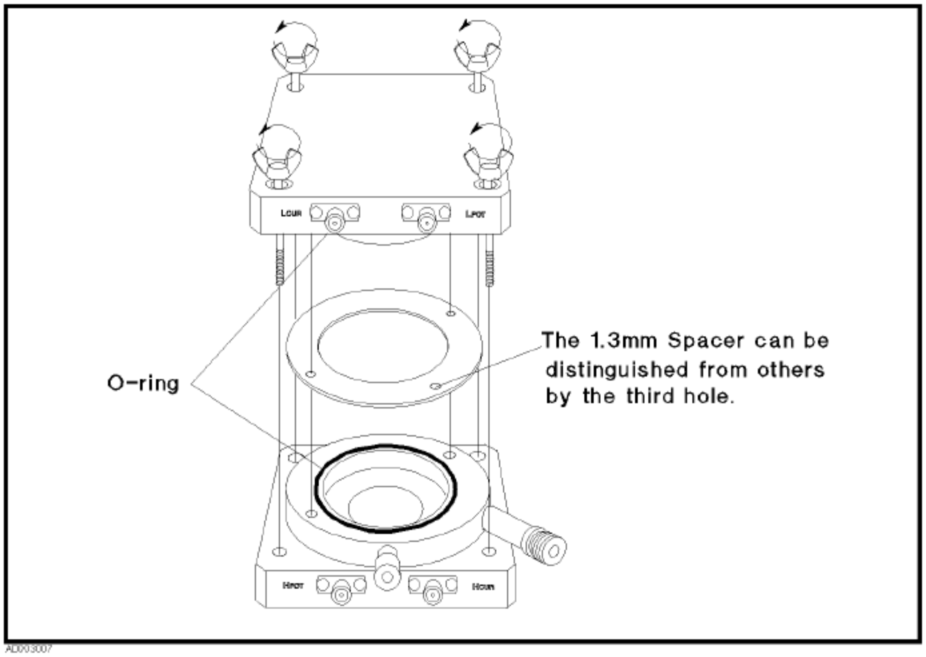
Figure 3-1 Connecting the SMA-BNC Adapter



Separating the Test Fixture into High and Low Electrodes

Separate the test fixture as shown in Figure 3-2.

Figure 3-2 Separating the Test Fixture into High and Low Electrodes



Cleaning and Drying the Electrodes

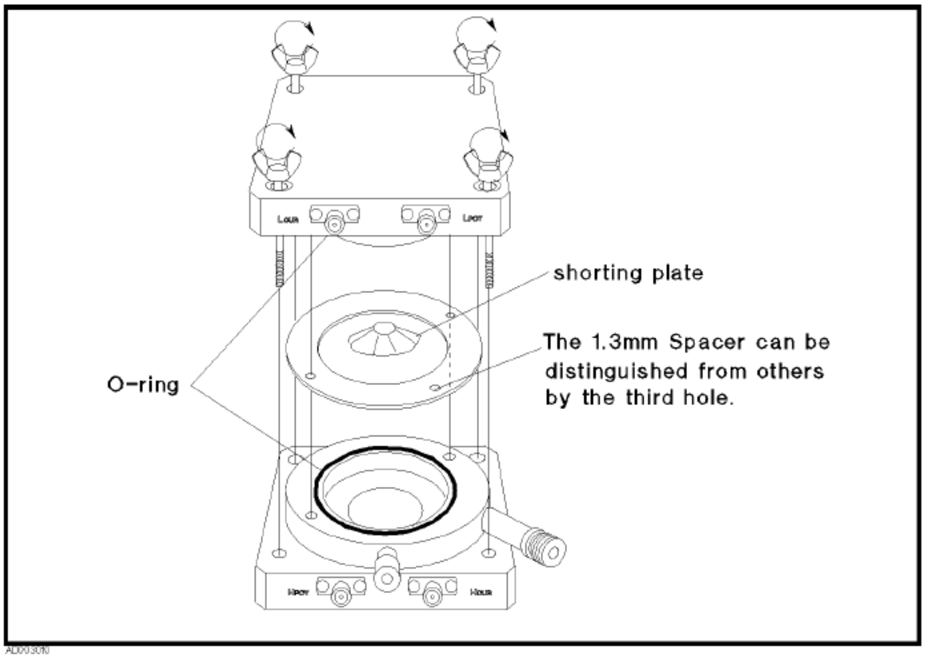
To get a better measurement, the 16452A electrodes must be cleaned after using. If the 16452A's electrodes are smeared, wash and dry them thoroughly before assembling. Any impurities deposited on the electrode will affect the measurement.

CAUTION Do not use a detergent that corrodes the test fixture. For a list of the materials that are corrosive to the test fixtures, see Appendix A.

Assembling the Test Fixture

Set the 1.3 mm spacer (electrode distance is 0.3mm) and the shorting plate as required. Then assemble the 16452A as shown in Figure 3-3.

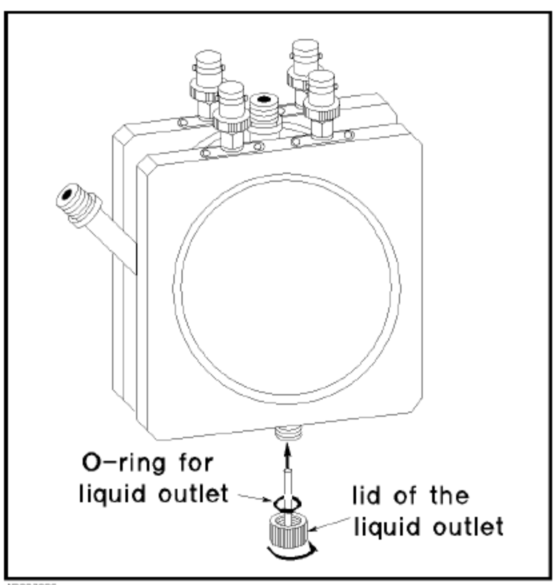
Figure 3-3 Assembling the Test Fixture for a SHORT compensation



Putting the Lid On the Liquid Outlet

Put the lid on the liquid outlet as shown in Figure 3-4.

Figure 3-4 Putting the Lid On



Connecting the Test Fixture

Use a 4-terminal-pair BNC cable to connect the 16452A and your measurement instrument. Keysight Technologies recommends using the following cables:

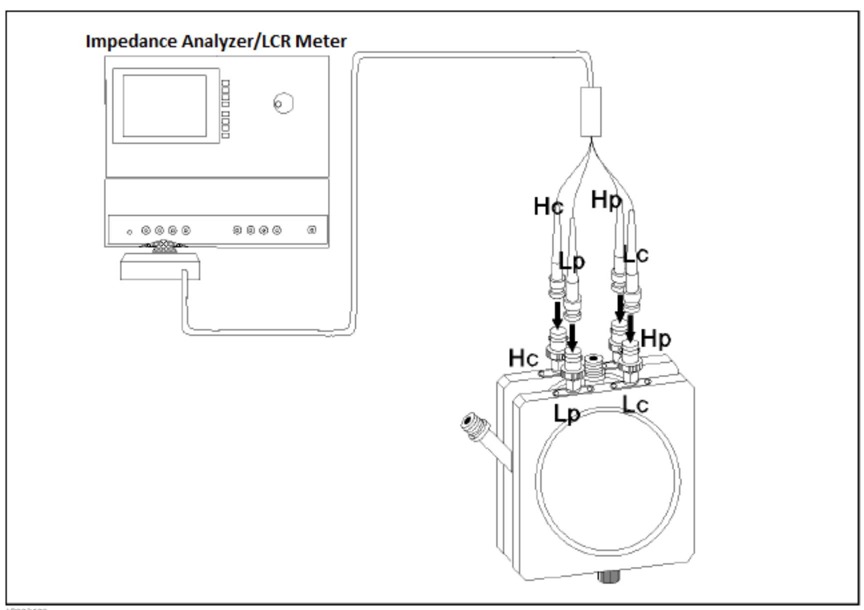
For the temperature range of 0 to +55ºC	16048A Test leads
For the temperature range of -20 to +125ºC	16048G/H + 1250-2375 Test leads

Select the cable that matches your measurement.

Procedure

1. Set the cable length to 1m. For the setting, please refer to your measurement instrument.
2. Take the BNC adapter caps off and connect the test fixture to the unknown terminal using the cables (Lp: L_{POT}, Lc: C_{CUR}, Hp: H_{POT}, Hc: H_{CUR}).

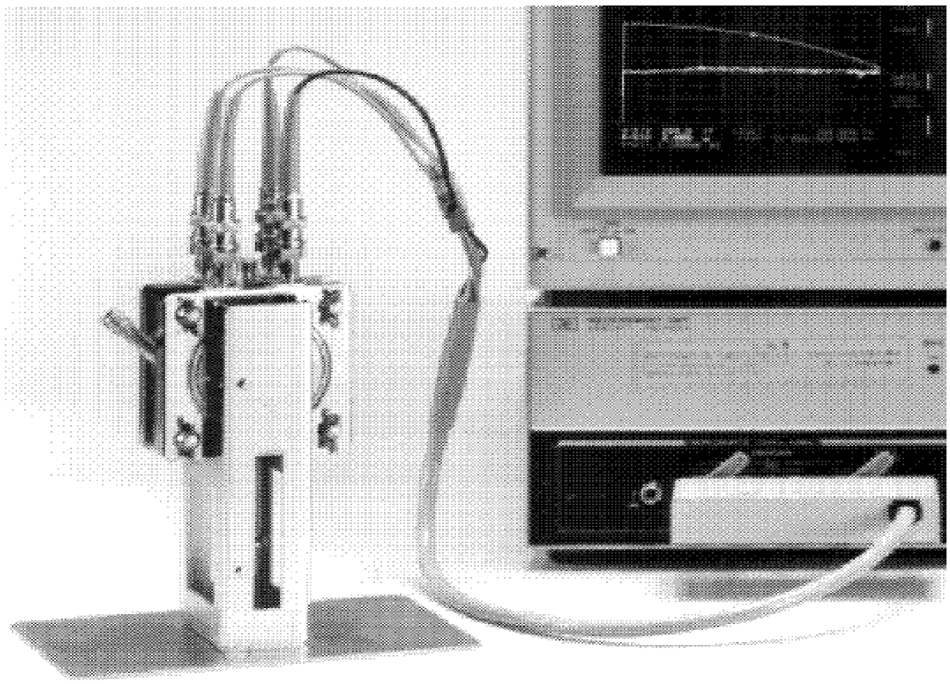
Figure 3-5 Connecting the Test Fixture



Fixture Stand Usage

The fixture stand sets the test fixture stable and upright as required during the measurement.

Figure 3-6 **Fixture Stand Usage**



Checking the SHORT Residual

Before using the test fixture, you should check its electrical performance. You can confirm its performance by checking the SHORT residual. The SHORT residual must be measured with the compensation function OFF because the compensation cancels the SHORT residual.

Procedure

1. Set the compensation function OFF (OPEN, SHORT and LOAD, depend on your measurement instrument).
2. Select the measurement parameter "Ls-Rs"
3. Check the SHORT residual value at 1MHz is in the following range:

   $Ls < 20nH$

   $Rs < 0.5\Omega$

For the measurement setting, please refer to your measurement instrument.

If the SHORT Residual is Out of Range

1. Check the connection of the test fixture and the measurement cable. Also, check the shorting plate connection.
   - Is the spacer width in the 16452A 1.3mm?
   - Does the shorting plate contact to both high and low electrodes?
   - Are the electrodes clean and free from rust?
2. If the problem cannot be corrected, please contact the nearest Keysight Technologies sales office.

Setting the Instrument for Capacitance Measurement

To measure the dielectric constant (**ε**), the test fixture uses a capacitance-measurement method.This is done by measuring C_p (parallel equivalent capacitance) and R_p (parallel equivalent resistance) and then calculating the dielectric constant (**ε**) and the dielectric loss (tan **δ**).

Procedure

1. Select the measurement parameter "Cp-Rp":
2. Select the other settings depending on each application.

For the setting, please refer to your measurement instrument.

Performing a SHORT Compensation

Confirm that the 1.3 mm spacer and the shorting plate are set as specified in the “Preparation of Test Fixture for Use” on page 21.

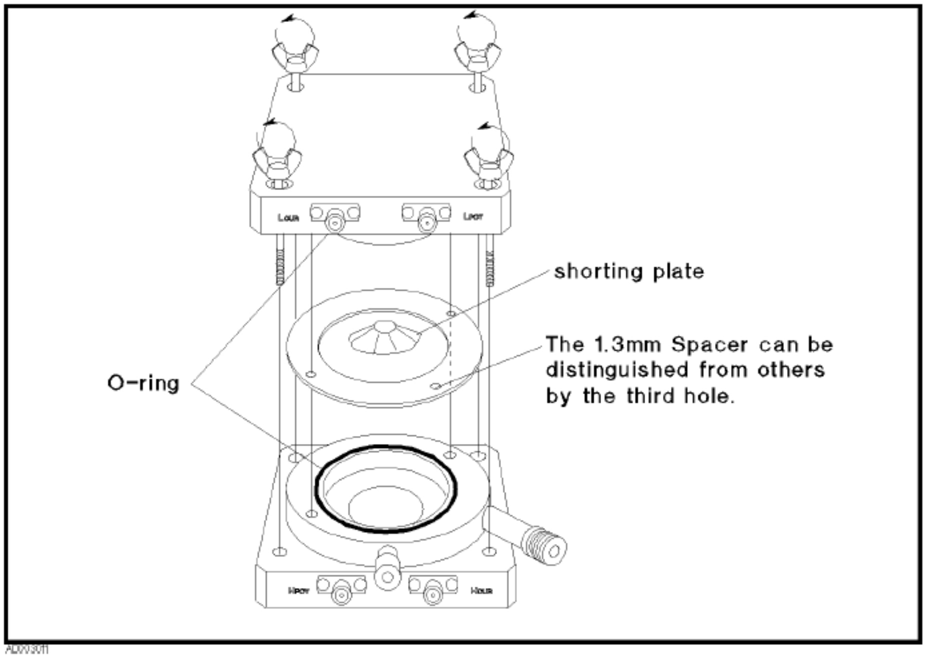
For the measurement setting, please refer to your measurement instrument.

NOTE The OPEN and LOAD compensations are not required for the 16452A.

Air Capacitance (C_0) Measurement

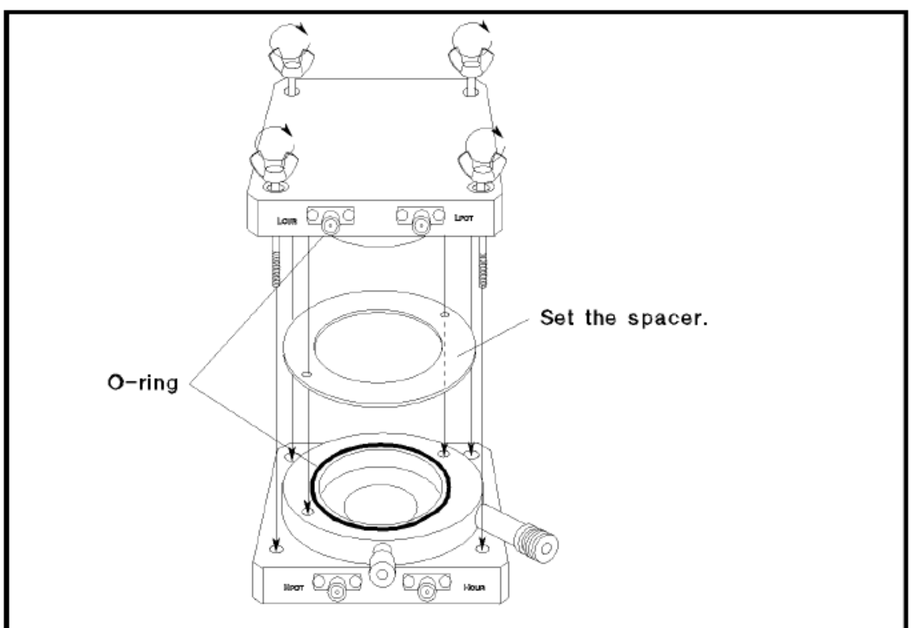
1. Separate the test fixture as shown in Figure 3-7.

Figure 3-7 Separating the Test Fixture into High and Low Electrodes



2. Remove the shorting plate and select the spacer that is to be used to measure the liquid. Then assemble the test fixture.

Figure 3-8 Test Fixture Assemble for Measurement



3. Measure the air capacitance value (C_0) and record the measurement data. The data is used to calculate the dielectric parameter.

NOTE

Compare the measured value with the value in the "Supplemental Performance Characteristics" on page 9.

If the value is not correct, check the following:

- Was the spacer correctly chosen and set?
- Are the O-rings set correctly?
- Are the high and low electrodes put tightly together?

Then perform the measurement procedure again.

Liquid Capacitance and Resistance (C_p, R_p) Measurement

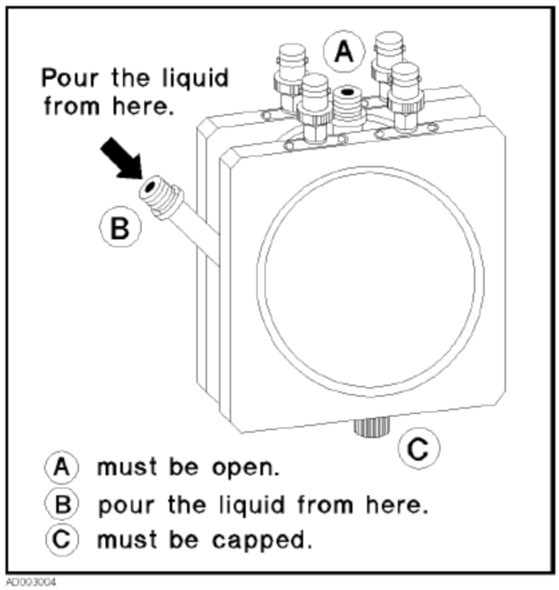
WARNING

Be careful when dealing with liquids (especially volatile and/or flammable liquid such as oil or organic solvents) that can cause an accident. Accidents such as an explosion, ignition, emission of poison gas, scalding (by heat or chemicals), and so on, are possible.

To prevent any accidents, establish a strict process for the measurements. (For example, using appropriate ventilation, a gas mask, and gloves.)

1. Pour the liquid under test into the 16452A until the liquid fills tube
   Pour the liquid gently so that air does not get mixed in with the liquid.

Figure 3-9 Poring the Liquid under Test



WARNING

When you pour the liquid, be careful that the liquid does not leak from the test fixture.

- An 16452A assembled in the wrong manner (for example, lack of the O-rings or the spacer) will cause liquid leakage. Assemble the 16452A again if leakage is found.

If the problem cannot be corrected, please contact the nearest Keysight Technologies sales office.

WARNING

DO NOT enclose the liquid in the 16452A. Carburetion of the liquid enclosed in the 16452A can cause an explosion of the 16452A.

2. Measure the capacitance and equivalent parallel resistance value (C_p, R_p) of the liquid under test and record the measurement data. The data is used to calculate the dielectric parameter.

WARNING

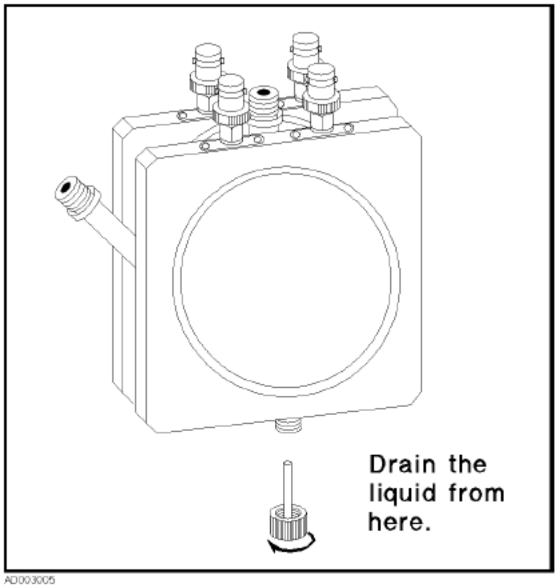
DO NOT apply a dc test signal to the 16452A. The dc signal can cause electrolysis of the liquid.

When you use the 16452A in a thermostatic chamber or an oil tank, see the "Performing Temperature Measurements" on page 36 procedure.

Drain the Liquid (After Measurement)

1. Turn the lid of the liquid outlet and take it o. Drain the liquid (Figure 3-10).

Figure 3-10 Taking the Lid Off



2. Wash and dry the test fixture.

Data Processing- Calculate Dielectric Parameter from Measurement Data

The dielectric parameter (**ε**) is calculated from the following equation.

$$\dot{\varepsilon}_r = \alpha\left(\frac{C_p}{C_o} - j\frac{1}{\omega C_o R_p}\right) \tag{1}$$

Ⓑ

Where,

α	Correction coefficient (see next page)
$\dot{\varepsilon}_r$	Relative dielectric constant (complex)
C_p	Liquid capacitance (measurement data)
C_o	Air capacitance (measurement data)
R_p	Equivalent parallel resistance (measurement data)
ω	Angular frequency (ω=2πf)
f	Frequency

Measurement Theory

The relative dielectric constant indicates the energy value of a material in an electric field. It is represented as a complex quantity. The relative dielectric constant ($\dot{\varepsilon}_r$) is defined as the ratio of the material's dielectric constant ($\dot{\varepsilon}$) to that of a vacuum (ε_0 = 8:854 x 10^{-12}).

$$\dot{\varepsilon}_r = \frac{\dot{\varepsilon}}{\varepsilon_o}$$

Also,

$$\dot{\varepsilon}_r = \varepsilon'_r - j\varepsilon''_r \tag{2}$$

Loss tangent

$$\tan\delta = \frac{\varepsilon''_r}{\varepsilon'_r}$$

Where,

ε'_r	Relative dielectric constant
ε''_r	Dielectric loss

The 16452A and Keysight impedance analyzer/LCR meter use the “Capacitive Method” for obtaining relative permittivity by measuring the capacitance of a material that is sandwiched between parallel electrodes.

Capacitive Measurement Method

The dielectric coefficient (ε'_r) and loss (ε''_r) can be calculated from the capacitance and electrode dimensions.

$$\varepsilon'_r = \frac{t \times C_p}{A \times \varepsilon_o}$$

$$\varepsilon''_r = \frac{\sigma}{\omega \times \varepsilon_o}$$

(Where, the conductivity $\sigma = \frac{t}{A \times R_p}$, A is area of electrode, t is gap between electrodes.)

The dielectric constant of a vacuum (ε_0) is calculated from the capacitance of the vacuum (Approximately equal to air capacitance C_0).

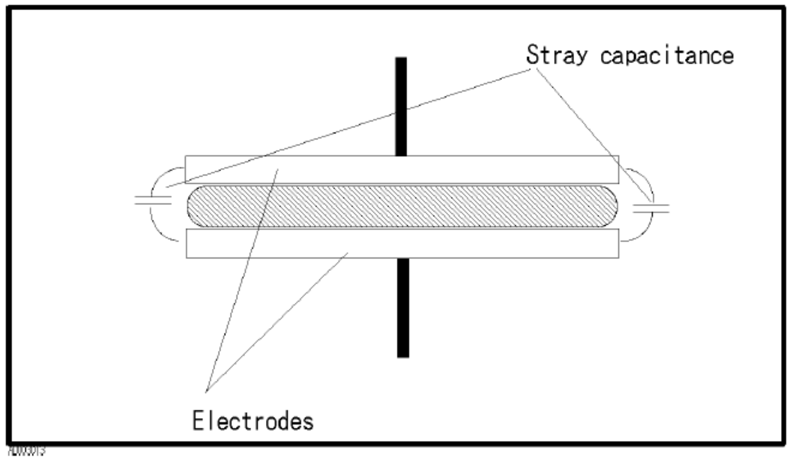
$$\varepsilon_o = \frac{t \times C_o}{A}$$

Therefore, the equation (2) can be rewritten in the same form as equation (1), when α=1.

Correction Coefficient

The measured data (C_p, C_o) contains the stray capacitance, which alters by the dielectric constant.

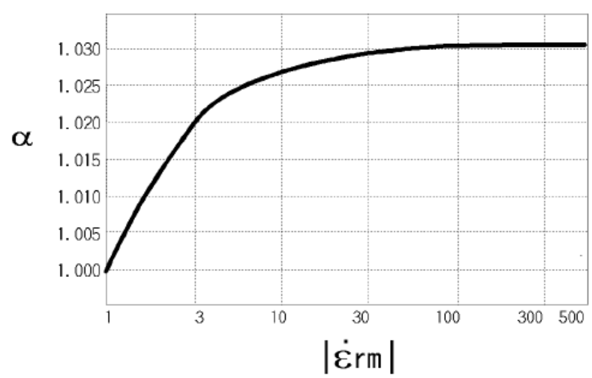
Figure 3-11 Stray Capacitance



The stray capacitance can be canceled by multiplying the correction coefficient (**α**), as shown in equation (1). The value of **α** is calculated by following equation.

$$\alpha = \frac{100|\dot{\varepsilon}_{rm}|}{97.0442|\dot{\varepsilon}_{rm}| + 2.9558}$$

Figure 3-12 **Correction Coefficient**



Where, $\dot{\varepsilon}_{rm}$ is the right side of equation (1), enclosed by ( ).

$$\dot{\varepsilon}_{rm} = \frac{C_p}{C_o} - j\frac{1}{\omega C_o R_p}$$

Therefore,

$$|\dot{\varepsilon}_{rm}| = \sqrt{\frac{C_p^2}{C_o^2} + \frac{1}{(\omega C_o R_p)^2}}$$

Performing Temperature Measurements

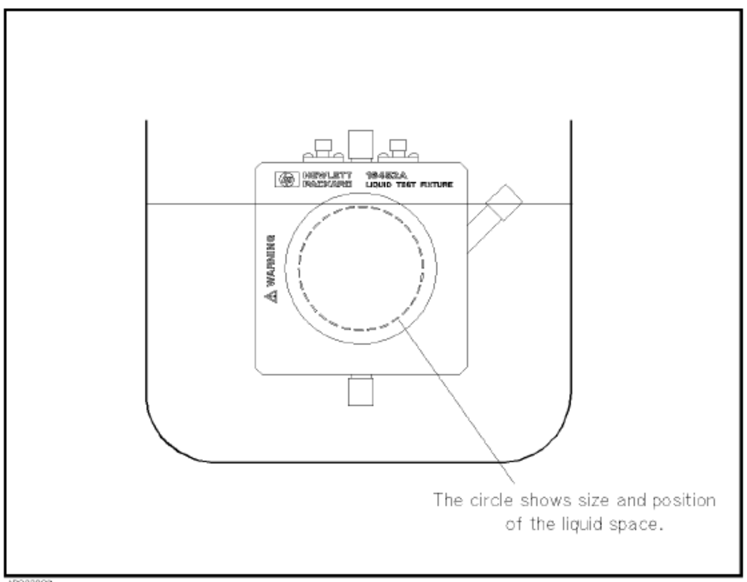
The following information is provided for users who use the 16452A in a thermostatic chamber or an oil tank.

- The 16452A is specified to operate in the temperature range of -20 to 125°C. You should be aware not only of the heat resisting property of the 16452A, but also that of the measurement cable. The heat resisting properties of the Keysight Technologies-recommended cables are:

0 to +55°C	16048A
-20 to +150°C	16048G/H + 1250-2375

- When you use the thermocouple to monitor the inside temperature of the test fixture, be careful not to short the electrodes.
- When you use the 16452A in an oil tank, soak the whole circle shown in Figure 3-13 (the circle shows the size and position of the liquid space of the 16452A).

Figure 3-13 Soaking the 16452A in the Oil Tank



WARNING **DO NOT touch the heated test fixture, cable, and fixture stand with your naked hand. Use gloves to prevent scalding.**

4 Service

Introduction

This chapter covers assembly replacement and troubleshooting information.

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

Assembly Replacement

Table 4-1, Table 4-2, and Table 4-3 list the support parts for RoHS and non-RoHS compliance 16452A Liquid Test Fixture. All the listed items are changed at RoHS conversion. Due to limited availability of RoHS compliance station and technical difficulties in RoHS soldering, only parts and support level that do not require RoHS soldering are supported. For RoHS Compliant Upper Level Assembly Replacement Part, if multiple parts are replaced by a common higher assembly part, only order ONE part of the higher level common assembly. If the original support part (Non-RoHS Compliant Replacement Part is obsolete, replaced the part by a higher common RoHS Compliant assembly part. The parts listed can be ordered from your nearest Keysight Technologies Office. Ordering information must include the Keysight part number and the required quantity.

Serial Number for Non-RoHS 16452A:
JP44100001 – JP44299999/MY44100001 – MY44200319/
SG44100001 – SG44200319

Serial Number for RoHS 16452A:
MY44200320 and above/SG44200320 and above

Figure 4-1 16452A Replaceable Parts (Major Parts)

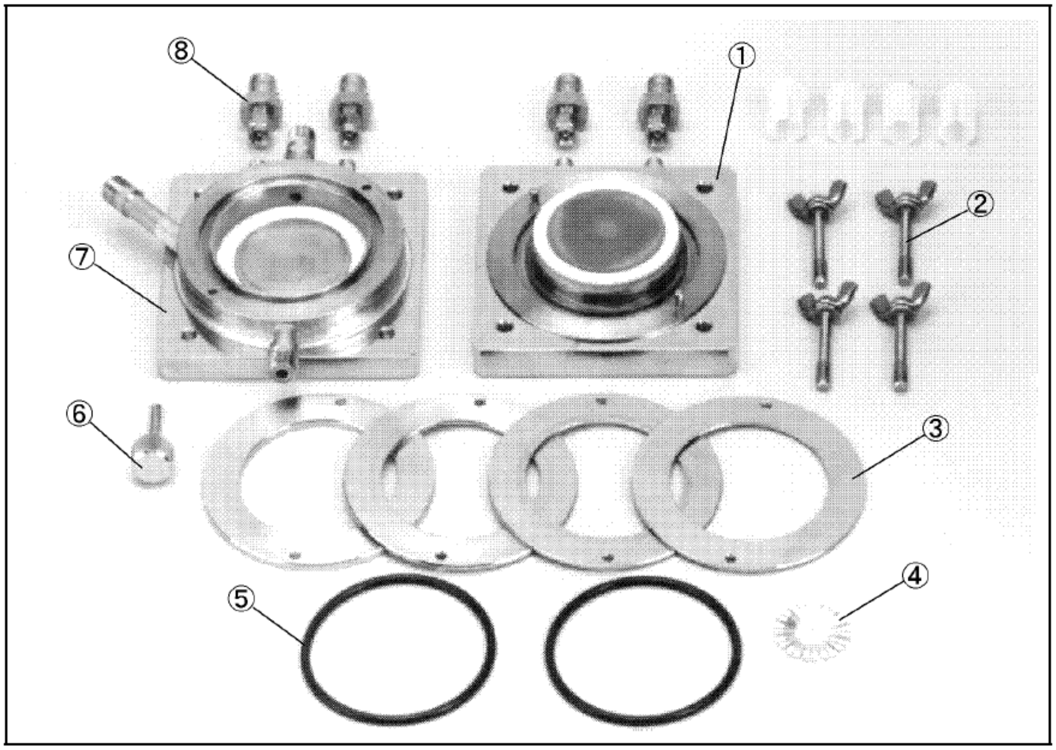


Table 4-1 Replaceable Parts (Major Parts)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
1	16452-60002	Low Electrode Assembly	1	16452-60002	Low Electrode Assembly	1
2	16452-24001	Screw	4	16452-24001	Screw	
3	16452-00601	Spacer, 1.3mm (thickness) / 0.3mm (gap)	1	16452-00601	Spacer, 1.3mm (thickness) / 0.3mm (gap)	1
	16452-00602	Spacer, 1.5mm (thickness) / 0.5mm (gap)	1	16452-00602	Spacer, 1.5mm (thickness) / 0.5mm (gap)	1
	16452-00603	Spacer, 2.0mm (thickness) / 1.0mm (gap)	1	16452-00603	Spacer, 2.0mm (thickness) / 1.0mm (gap)	1
	16452-00604	Spacer, 3.0mm (thickness) / 2.0mm (gap)	1	16452-00604	Spacer, 3.0mm (thickness) / 2.0mm (gap)	1

Table 4-1 Replaceable Parts (Major Parts)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
4	16092-08010	Shorting Plate	1	16092-08010	Shorting Plate	1
5	0905-1275	O Ring	2	0905-1275	O Ring	2
6	16452-24002	Lid of Liquid Outlet	1	16452-24002	Lid of Liquid Outlet	1
	0905-1277	O Ring for Lid	1	0905-1277	O Ring for Lid	1
7	16452-60001	High Electrode Assembly	1	16452-60001	High Electrode Assembly	1
8	1250-1200	SMA(m)-BNC(f) Adapter	4	1250-1200	SMA(m)-BNC(f) Adapter	4

Table 4-2 Replaceable Parts (Other Parts)

Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
16452-04001	Round Cover for Back of the Electrode	2	16452-60001/ 16452-60002	High Electrode Assembly/ Low Electrode Assembly	1
0905-1276	Washer, Teflon	2	16452-60001/ 16452-60002	High Electrode Assembly/ Low Electrode Assembly	1
0515-0994	Spacer	8	16452-60001/ 16452-60002	High Electrode Assembly/ Low Electrode Assembly	1
1252-5831	Waterproof Cap for BNC Connector	4	1252-5831	Waterproof Cap for BNC Connector	4
16452-01201	Angle Iron for the Stand	2	16452-01201	Angle Iron for the Stand	2

Table 4-2 Replaceable Parts (Other Parts)

Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
16452-00611	Plate for the Stand Foot	1	16452-00611	Plate for the Stand Foot	1
0515-0914	M3 Screw for the Stand	8	0515-0914	M3 Screw for the Stand	8
16452-60101	Carrying Case	1	16452-60111	Carrying Case	1
16452-90000	Operation and Service Manual	1	16452-90000	Operation and Service Manual	1

Electrode Assembly

Figure 4-2 16452A Replaceable Parts (Around SMA Connector)

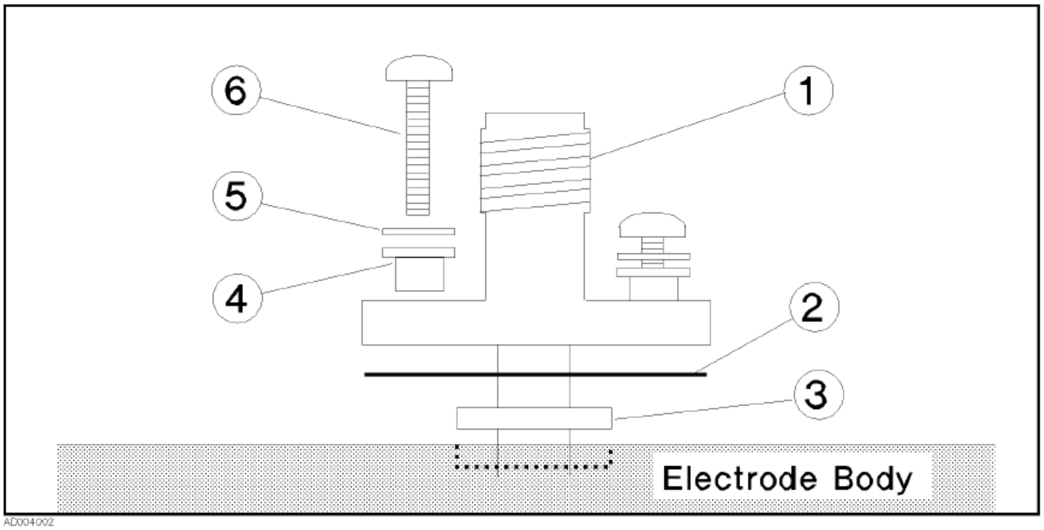


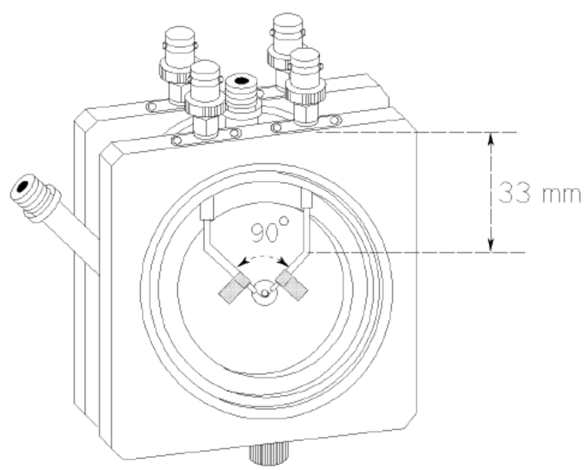
Table 4-3 16452A Replaceable Parts (Around SMA Connector)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
1	16452-61603	SMA Cable Assembly for High Electrode	2	16452-60001	High Electrode Assembly	1
	16452-61602	SMA Cable Assembly for Low Electrode	2	16452-60002	Low Electrode Assembly	1
2	16452-25001	Insulator	4	16452-60001/ 16452-60002	High Electrode Assembly/ Low Electrode Assembly	1
3	16452-29001	O Ring	4	16452-60001/ 16452-60002	High Electrode Assembly/ Low Electrode Assembly	1
4	16452-25002	Insulator	8	16452-60001/ 16452-60002	High Electrode Assembly/ Low Electrode Assembly	1

Table 4-3 16452A Replaceable Parts (Around SMA Connector)

Ref /D	Part Number	Description	Qty	RoHS Compliant Replacement Part	Description	Qty
5	2190-0654	Washer, M2	8	16452-60001/ 16452-60002	High Electrode Assembly/ Low Electrode Assembly	1
6	0515-0976	Screw, M2	8	16452-60001/ 16452-60002	High Electrode Assembly/ Low Electrode Assembly	1

Figure 4-3 Inside of the Electrode Assembly



Assembling Procedure for Electrode

See Figure 4-2 and Table 4-3 for the reference designators.

1. Pass the SMA cable assembly (1) through the insulator (2) and the O ring (3).
2. Insert the cable into the electrode body, and connect it using the insulators (4), the washers (5) and the screws (6).
3. Bend the semi-rigid cable at 33 mm from the top face of the electrode body as described in Figure 4-3, and set the angle between the semi-rigid cables close to 90º.
4. Solder the semi-rigid cables to the center pin of the electrode.

5. Solder the shield of the cable to the copper round plate using solder wick.

Troubleshooting

When the short residual resistance is out of the limit, check the fixture connection, the shorting plate, and the surface of the electrodes. If the surface of the electrode is damaged, electrode assembly replacement is required for restoring proper electrical performance.

When the short residual inductance is out of the limit, check the angle of the semi-rigid cables in back of the electrode assemblies. The angle should be close to 90º. Also check the shield of the semi-rigid cables are connected only at the copper round plate.

CAUTION **Do not polish the surface with powder to protect the electrode.**

A: Liquids that Corrode the Test Fixture

The appendix A provides information about the liquids that corrode the test fixture.

The liquid under test directly contacts the following materials:

- Nickel - the test fixture body (electrodes, spacers, liquid inlet and outlet).
- Ceramic (alumina Al2O3) – the insulator around the electrodes.
- Rubber (Fluoro rubber) - the O-rings.
- Silver copper and gold copper - the insulator soldering

Do not use the test fixture with liquids that corrode these materials. Typical corrosive liquids for each material are listed in the following sections.

WARNING **Do not apply DC test signal (or low-frequency test signal) to electrolyte solutions (ionic solutions) such as salt. The DC signal (or low-frequency signal) can cause electrolysis reaction of the liquid.**

Nickel Corrosive Liquid

Corrosive liquid	Little-corrosive liquid	Non-corrosive liquid
acid oxidant and salt oxidant	hydrochloric acid (HCl)	alkali salt
For example,	sulfuric acid (H_2SO_4)	
nitric acid (HNO_3)	organic acid	
nitrous acid (HNO_2)		
ferric chloride ($FeCl_3$)		
cupric chloride ($CuCl_2$)		
mercuric chloride ($HgCl_2$)		
acetic acid (CH_3CO_2H)[a]		
formic acid (HCO_2H)[a]		
citric acid ($HO_2CC(OH)(CO_2H)_2.H_2O$)[a]		

a. The measurement accuracy is a complex function of the measurement instrument accuracy and the fixture error.

Ceramic (alumina: Al_2O_3) Corrosive Liquid

Aqueous solution of fluoride corrodes the ceramic.

Viton (Fluoro rubber) Corrosive Liquid

Ketone and ester corrode the Vition.

Silver-copper and gold-copper

Strong acid liquid corrodes silver copper and gold copper.

Edition 6 January 2019

16452-90000
www.keysight.com