

Agilent 16453A Dielectric Material Test Fixture
Specification and Service Manual



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Fourth Edition

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Manual Printing History

The manual printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates that are incorporated at reprint do not cause the date to change.) The manual part number changes when extensive technical changes are incorporated.

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Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific **WARNINGS** given elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument.

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

DO NOT Operate In An Explosive Atmosphere

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

Keep Away From Live Circuits

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT Service Or Adjust Alone

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT Substitute Parts Or Modify Instrument

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

Dangerous Procedure Warnings

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

Warning



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

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

Operating Precaution

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

Caution



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

Never touch the test clip contacts.

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

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 to the calibration facilities of other International Standards Organization members.

Warranty

This Agilent Technologies instrument product is warranted against defects in material and workmanship for a period of one year from the date of shipment, except that in the case of certain components listed in *Instrument Specifications* of this manual, the warranty shall be for the specified period. During the warranty period, Agilent Technologies will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Agilent Technologies. Buyer shall prepay shipping charges to Agilent Technologies and Agilent Technologies shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Agilent Technologies from another country.

Agilent Technologies warrants that its software and firmware designated by Agilent Technologies for use with an instrument will execute its programming instruction when properly installed on that instrument. Agilent Technologies does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

Limitation Of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

No other warranty is expressed or implied. Agilent Technologies specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Exclusive Remedies

The remedies provided herein are buyer's sole and exclusive remedies. Agilent Technologies shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products.

For any assistance, contact your nearest Agilent Technologies Sales and Service Office. Addresses are provided at the back of this manual.

Safety Symbols

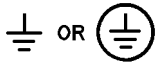
General definitions of safety symbols used on equipment or in manuals.



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



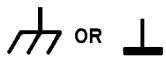
Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



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



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



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



Alternating current (power line).



Direct current (power line).



Alternating or direct current (power line).

Warning



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

Caution



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

Note



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

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viii

Contents

1. General Information	
Introduction	1-1
Product Description	1-1
Applicable Instrument	1-1
Specifications	1-2
2. Initial Inspection	
Introduction	2-1
Initial Inspection	2-1
Repackaging the Test Fixture For Shipment	2-2
3. Service	
Introduction	3-1
Replaceable Parts	3-1
Parts Replacement Procedures	3-4
Removal Procedure	3-4
Replacement Procedure	3-5
Functional Test	3-6

Tables

1-1. Applicable Dielectric Material Size Using with 16453A	1-2
2-1. 16453A Contents	2-2
3-1. Replaceable Parts List (Upper Part)	3-2
3-2. Replaceable Parts List (Lower Part)	3-3
3-3. Replaceable Parts List (Misc.)	3-4
3-4. Fixture Impedance Check Guideline	3-6

General Information

Introduction

This manual contains the following information:

- The specifications of the 16453A (in this chapter).
- Initial inspection of the 16453A (see Chapter 2).
- Ordering replaceable parts for the 16453A (see Chapter 3).

For measurement procedures using the 16453A, see the *4291A RF Impedance/Material Analyzer User's Guide*.

Product Description

The 16453A is a fixture for measuring the permittivity of dielectric materials.

Applicable Instrument

The 16453A has been designed to operate specifically with the 4291A RF Impedance/Material Analyzer equipped with the Option 002 (which provides the permittivity measurement function for dielectric material).

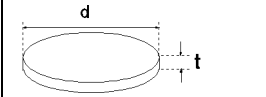
Specifications

This section lists the complete 16453A specifications. These specifications are the performance standards and limits against which the 16453A is tested. When shipped from the factory, the 16453A meets the following listed specifications. For the specifications when used with the 4291A, see the *4291A RF Impedance/Material Analyzer Operating Manual Set*.

Specifications describe the instrument's warranted performance over the temperature range of 0°C to 55°C (except as noted). Supplemental characteristics are intended to provide information that is useful in applying the instrument by giving non-warranted performance parameters. These are denoted as *typical, typically, nominal* or *approximate*.

Applicable MUT (Material Under Test) Size	See Table 1-1
Maximum DC Bias Voltage	± 40 V
Frequency Range	1 MHz to 1.0 GHz typically
Relative Permittivity of Load	$\epsilon_r' = 2.1$ typically
.....	$\epsilon_r'' = 0$ typically
Operating Temperature	-55°C to +200°C
Operating Humidity (@ wet bulb temperature <40°C)	Up to 95% RH
Non-operating Temperature	-55°C to +200°C
Non-operating Humidity (@ wet bulb temperature <65°C)	Up to 90% RH
Weight	600 g typically
Dimension	130 mm H × 50 mm W × 60 mm D typically

Table 1-1. Applicable Dielectric Material Size Using with 16453A

	$0.3 \text{ mm} \leq t \leq 3 \text{ mm}$ $d \geq \phi 15 \text{ mm}$
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Initial Inspection

Introduction

This chapter contains the following information:

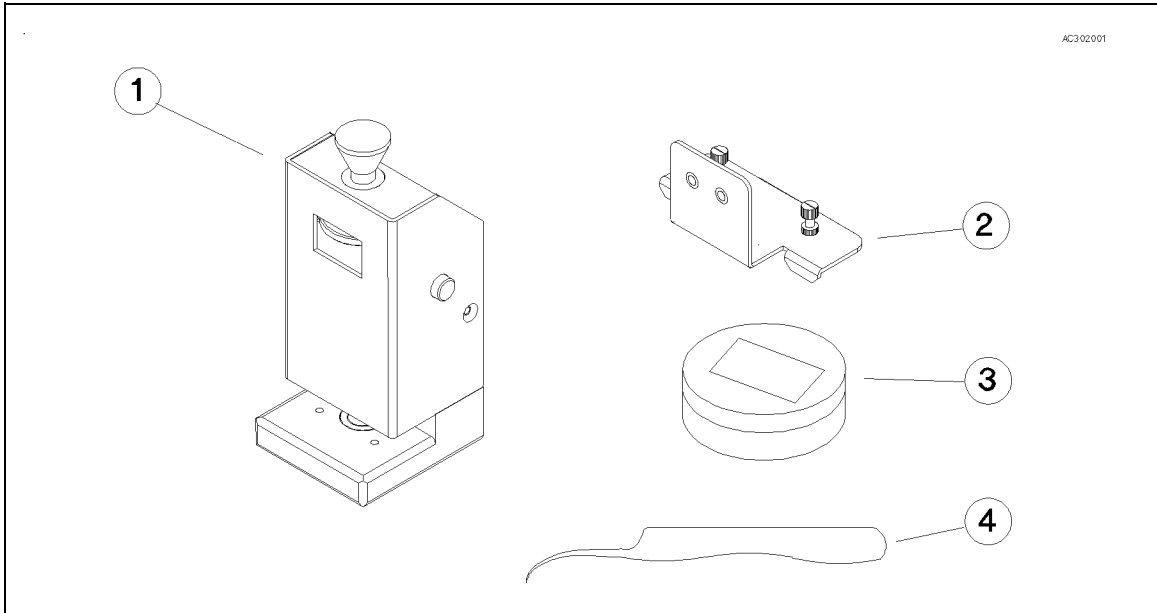
- Initial inspection.
- Repackaging the test fixture for shipment.

Initial Inspection

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

- Inspect the shipping container for damage. Keep the shipping materials until the inspection is completed.
- Verify that the shipping container contains everything listed in Table 2-1.
- Inspect the exterior of the 16453A for any signs of damage.

Table 2-1. 16453A Contents



Reference Designator	Description	Agilent Part Number	Quantity
1	Main Assembly	Not Assigned	1
2	Fixture Holder	16453-01213	1
3	Load ¹	16453-60021	1
4	Tweezers	8710-2081	1
—	Carrying Case ²	16453-60011	1
—	Specification and Service Manual ²	16453-90000	1

1 Consists of load plate, case, and thickness label.

2 These parts are not shown in this figure.

Note



The load thickness value is written on the case of the load. This value is required to perform 4291A load compensation.

Repackaging the Test Fixture For Shipment

If shipment to a Agilent 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 dielectric material test fixture in heavy paper and pack in anti-static plastic packing material. Use sufficient shock absorbing material on all sides of the 16453A to provide a thick, firm cushion and to prevent movement. Seal the shipping container securely and mark it *FRAGILE*.

Service

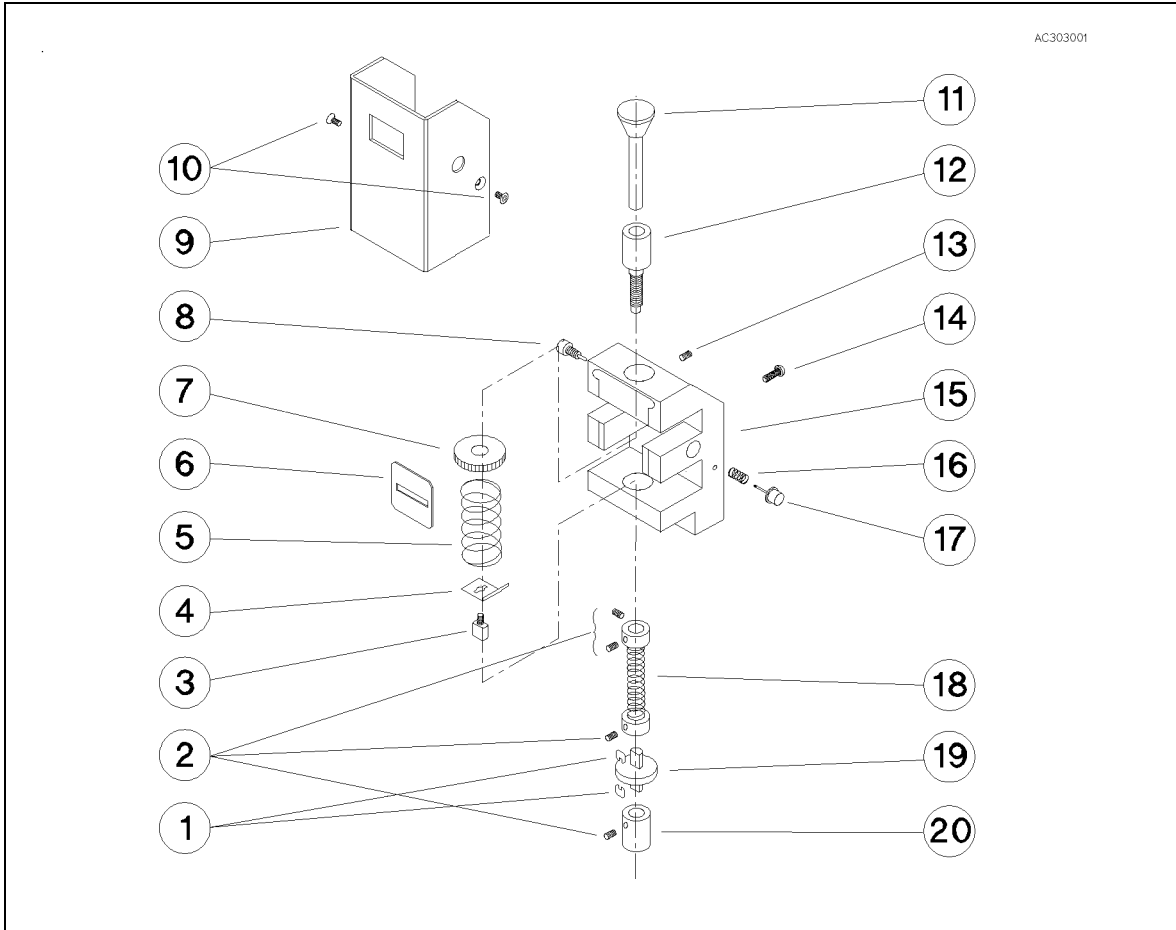
Introduction

This chapter provides service information for the 16453A Dielectric Material Test Fixture.

Replaceable Parts

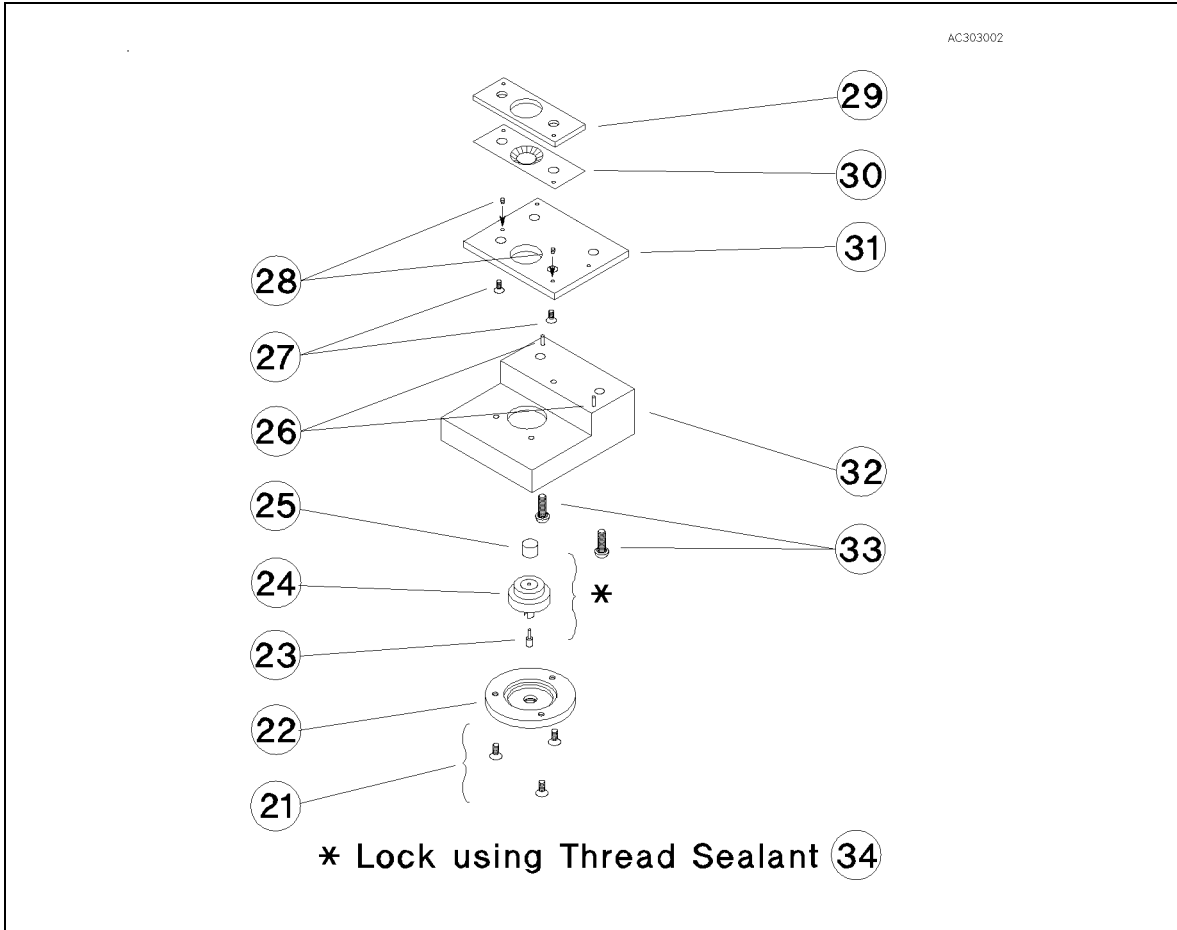
Table 3-1, Table 3-2, and Table 3-3 identify the replaceable parts. The parts listed in these tables can be ordered from your nearest Agilent Technologies office. Ordering information should include the Agilent Part number and the quantity required.

Table 3-1. Replaceable Parts List (Upper Part)



Reference Designator	Agilent Part Number	Qty.	Description
1	16190-09001	2	Plate
2	3030-0007	4	Screw SET4-40
3	16453-23004	1	Screw
4	16453-01215	1	Latch Plate
5	1460-2384	1	Spring
6	16453-01211	1	Plate
7	16453-23003	1	Dial
8	16453-24003	1	Screw
9	16453-04001	1	Cover
10	0515-0914	2	Screw M3 L6
11	16453-23001	1	Knob Shaft
12	16453-23002	1	Sleeve
13	3030-0285	1	Screw SET6-32
14	0515-1551	1	Screw M3 L10
15	16453-20011	1	Deck
16	1460-2385	1	Spring
17	16453-24004	1	Latch Button
18	16453-29001	1	Spring
19	16453-25001	1	Insulator
20	16453-24015	1	Electrode

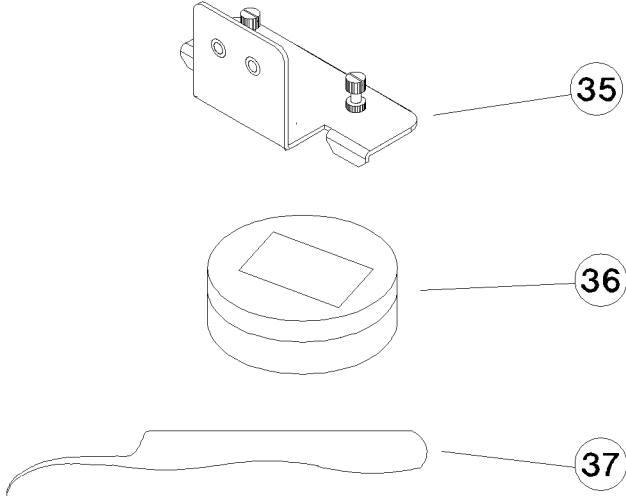
Table 3-2. Replaceable Parts List (Lower Part)



Reference Designator	Agilent Part Number	Qty.	Description
21	0515-0914	3	Screw M3 L6
22	16453-24011	1	Flange
23	1250-0816	1	Contact
24	16453-60001	1	Bead Assembly
25	16453-24018	1	Electrode
26	1480-0739	2	Spring Pin
27	0515-0914	2	Screw M3 L6
28	16092-21010	2	Pin
29	16453-01212	1	Plate
30	16453-08001	1	Spring
31	16453-01214	1	Plate
32	16453-20012	1	Base
33	0515-0868	2	Screw M4 L16
34	0470-0013	1	Thread Sealant

Table 3-3. Replaceable Parts List (Misc.)

AC303003



Reference Designator	Agilent Part Number	Qty.	Description
35	16453-01213	1	Angle Plate
36	16453-60021	1	Load ¹
37	8710-2081	1	Tweezers
—	16453-60011	1	Carrying Case ²
—	16453-90000	1	Specification and Service Manual ²

¹ Consists of load plate, case, and thickness label.

² These parts are not shown in this figure.

Parts Replacement Procedures

This section provides removal and replacement procedures for the 16453A.

Note



In this section, numbers quoted by “ ” correspond to Reference Designators in the Replaceable Parts Lists (Table 3-1, Table 3-2, and Table 3-3).

Removal Procedure

Cover Removal

1. Release latch button “17” by pulling up knob “11” if it is latched.
2. Remove two screws “10” on the sides of cover “9.”
3. Loosen screw “14” on the back of the main assembly until the button can be pushed into the cover.
4. Remove cover “9” carefully while preventing the button from popping out.

5. Remove plate “6.”
6. Remove button “17” and spring “16.”
7. Detach the lower part from the upper part by removing the two “33” screws from the bottom of the assembly.

Lower Part Disassembly

8. Remove plate “31.”
9. Remove plate “29” and spring “30” by removing the two “27” screws from plate “31.”
10. Remove flange “22” by removing the three “21” screws from base “32.”
11. Unscrew electrode “25” using pliers because contact “23” and electrode “25” are locked with thread sealant.

Note Contact “23” and electrode “25” are not reusable after disassembly.



Upper Part Disassembly

12. Disassemble spring “18”, insulator “19”, and electrode “20” by loosening the four “2” hex screws.
13. Unscrew “3” using a slot screwdriver and remove latch plate “4” and spring “5.”
14. Remove dial “7.”
15. Detach knob shaft “11” by removing screw “8.”
16. Detach sleeve “12” by loosening hex screw “13.”

Replacement Procedure

Reverse the “Removal Procedure.”

Note Contact “23” and electrode “25” should be locked with a drop of thread sealant “34” when assembling them.



Functional Test

This section provides the functional test procedure to check the 16453A's performance. The functional test can be used for post repair function verification.

Fixture Impedance Check

1. Perform the 4291A calibration with the High Impedance Test Head. (Refer to *4291A RF Impedance/Material Analyzer User's Guide*.)
2. Place the fixture on the calibrated APC-7[®] terminal of the 4291A RF Impedance/Material Analyzer.
3. Set the 4291A Point Average to 10 by pressing (Bw/Avg), POINT AVG FACTOR, (1), (0), (x1), POINT AVG on OFF (then the label changes to POINT AVG ON off).
4. Set sub markers to each frequency point in Table 3-4.
5. Press the latch button while pulling up the knob so that the knob is latched.
6. Read Cp and G values for each frequency by marker list function. Verify they meet the open guidelines in Table 3-4.
7. Pull up the knob and release the latch button. Press down on the knob so that the upper and the lower electrodes are making contact.
8. Read Ls and Rs values for each frequency by marker list function. Verify they meet the short guidelines in Table 3-4.

Table 3-4. Fixture Impedance Check Guideline

Freq.	Open		Short	
	Cp	G	Ls	Rs
10 MHz	3±1 pF	≤ 5.1 μS	7±3 nH	≤ 2.0 Ω
100 MHz	3±1 pF	≤ 15 μS	7±3 nH	≤ 6.3 Ω
200 MHz	3±1 pF	≤ 45 μS	7±3 nH	≤ 8.9 Ω
300 MHz	3±1 pF	≤ 95 μS	7±3 nH	≤ 11 Ω
500 MHz	3±1 pF	≤ 250 μS	7±3 nH	≤ 14 Ω
800 MHz	3±1 pF	≤ 640 μS	7±3 nH	≤ 18 Ω
1 GHz	3±1 pF	≤ 1000 μS	7±3 nH	≤ 20 Ω