Notices

© Keysight Technologies
1993–2017

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Keysight Technologies, Inc. as governed by United States and international copyright laws.

Trademark Acknowledgments

Manual Part Number
16454-90020

Edition
Edition 6, September 2017

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.

Declaration of Conformity

Declarations of Conformity for this product and for other Keysight products may be downloaded from the Web. Go to http://www.keysight.com/go/conformity. You can then search by product number to find the latest Declaration of Conformity.

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.

U.S. Government Rights

Safety Notices

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.

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**
   - Introduction ........................................... 5
   - Product Description .................................. 5
   - Specifications ........................................ 6
   - Supplemental Performance Characteristics ....... 8
     - Typical Measurement Accuracy .................. 8

2. **Initial Inspection**
   - Introduction .......................................... 15
   - Initial Inspection ................................... 15
   - Repackaging the Test Fixture For Shipment ....... 17

3. **Theory on Material Measurement**
   - Magnetic Material Measurement .................. 19
     - Permeability Definition ............................ 19
     - Measurement Principle of Magnetic Material ... 20
     - Structure of 16454A Test Fixture ................. 23

4. **Operation**
   - Connecting the Test Fixture ...................... 25
     - Selecting Fixture and Holder .................... 25
     - Connecting the Test Fixture to the Test Head ... 26
     - Performing SHORT Compensation ................. 28
     - Placing the MUT into the Test Fixture .......... 29

5. **Service**
   - Introduction ........................................... 31
   - Replaceable Parts .................................... 31
   - Functional Test ...................................... 34
     - Fixture Impedance Check .......................... 34
1 General Information

Introduction

This manual contains the following information:

- The specifications of the 16454A (in this chapter).
- Initial inspection of the 16454A (see Chapter 2).
- Ordering replaceable parts for the 16454A (see Chapter 5). For measurement procedures using the 16454A, see the applicable impedance analyzer manual/help.

Product Description

The 16454A is used to measure the permeability of a toroidal core.
Specifications

This section lists the complete 16454A specifications. These specifications are the performance standards and limits against which the 16454A is tested. When shipped from the factory, the 16454A meets the following listed specifications.

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.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable MUT (Material Under Test) Size</td>
<td>See Table 1-1</td>
</tr>
<tr>
<td>Maximum DC Bias Current</td>
<td>±500mA</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>1kHz to 1.0GHz typically</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-55°C to +200°C</td>
</tr>
<tr>
<td>Operating Humidity (at wet bulb temperature &lt;40°C)</td>
<td>Up to 95% RH</td>
</tr>
<tr>
<td>Non-operating Temperature</td>
<td>-55°C to +200°C</td>
</tr>
<tr>
<td>Non-operating Humidity (at wet bulb temperature &lt;65°C)</td>
<td>Up to 90% RH</td>
</tr>
<tr>
<td>Weight</td>
<td></td>
</tr>
<tr>
<td>(Large Test Fixture)</td>
<td>140g typically</td>
</tr>
<tr>
<td>(Small Test Fixture)</td>
<td>120g typically</td>
</tr>
<tr>
<td>Dimension</td>
<td></td>
</tr>
<tr>
<td>(Large Test Fixture)</td>
<td>φ30mm x 35mm H typically</td>
</tr>
<tr>
<td>(Small Test Fixture)</td>
<td>φ24mm x 30mm H typically</td>
</tr>
</tbody>
</table>

Table 1-1

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Small</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>≥ φ3.1mm</td>
<td>≥ φ3.1mm</td>
</tr>
<tr>
<td>c</td>
<td>≤ φ8mm</td>
<td>≤ φ6mm</td>
</tr>
<tr>
<td>h</td>
<td>≤ 3mm</td>
<td>≤ 3mm</td>
</tr>
</tbody>
</table>
Applicable Instruments

E4990A + 42942A (Option E4990A-120 is required)
E4991B with Option E4991B-002
Supplemental Performance Characteristics

This section shows supplemental performance characteristics data. This supplemental performance characteristics is not specification.

Typical Measurement Accuracy

\[
\mu'_r \text{ Accuracy} \left( \frac{\Delta \mu'_r}{\mu'_r} \right)
\]

\[\tan \delta < 0.1\]

\[\begin{align*}
@ f < 1 \text{MHz} & \quad 4 + \frac{25}{F \mu'_r} + \left( \frac{0.1}{F \mu'_r f} \right) & \text{[\%] Typical} \\
@ f \geq 1 \text{MHz} & \quad 4 + \frac{25}{F \mu'_r} + F \mu'_r \left( 1 + \frac{15}{F \mu'_r} \right)^2 f^2 & \text{[\%] Typical}
\end{align*}\]

Loss Tangent Accuracy of \(\mu'_r(\Delta \tan \delta)\)

\[\tan \delta < 0.1\]

\[\begin{align*}
@ f < 1 \text{MHz} & \quad E_a + E_b \quad \text{(Typical)} \\
@ f \geq 1 \text{MHz} & \quad E_a = 0.002 + \frac{0.001}{F \mu'_r f} \quad \text{(Typical)} \\
& \quad E_b = \frac{\Delta \mu'_r \tan \delta}{\mu'_r 100} \quad \text{(Typical)}
\end{align*}\]
General Information
Supplemental Performance Characteristics

Where,

\[ f \] is measurement frequency [GHz]

\[ F = h \ln \frac{c}{b} \] [mm]

\[ h \] is the height of MUT [mm]

\[ b \] is the inner diameter of MUT

\[ c \] is the outer diameter of MUT

\[ \tan \delta \] is the measured value of loss tangent

\[ \mu_{\text{rm}}' \] is the measured value of permeability

<table>
<thead>
<tr>
<th>Conditions of accuracy characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Use the Low Z Test Head for permeability measurement</td>
</tr>
<tr>
<td>• OPEN/SHORT/50Ω calibration must be done. Calibration ON.</td>
</tr>
<tr>
<td>• Averaging (on point) factor is larger than 32 at which calibration is done if Cal points is set to USER DEF.</td>
</tr>
<tr>
<td>• Measurement points are same as the calibration points if Cal point is set to USER DEF.</td>
</tr>
<tr>
<td>• Environment temperature is within ±5°C of temperature at which calibration is done, and within 13°C to 33°C. Beyond this environmental temperature condition, accuracy is twice as bad as specified.</td>
</tr>
</tbody>
</table>
General Information
Supplemental Performance Characteristics

Figure 1-1  Typical Permeability Measurement Accuracy (@F^1=0.5)

Figure 1-2  Typical Permeability Measurement Accuracy (@F^1=3)

1. $F = h \ln \frac{c}{b}$
1. \( F = h \ln \frac{C}{B} \)
Figure 1-5  Typical Permeability Loss Tangent (\(\tan \delta\)) Measurement Accuracy (@F\(^1\)=3)

Figure 1-6  Typical Permeability Loss Tangent (\(\tan \delta\)) Measurement Accuracy (@F\(^1\)=10)

1. \(F = h \ln \frac{c}{b}\)
Figure 1-7  Typical Permeability Measurement Accuracy ($\mu_r$ v.s. Frequency, @F$^1$=0.5)

Figure 1-8  Typical Permeability Measurement Accuracy ($\mu_r$ v.s. Frequency, @F$^1$=3)

1. $F = h \ln\frac{5}{b}$
Figure 1-9 Typical Permeability Measurement Accuracy ($\mu_r$ v.s. Frequency, @$F^1=10$)

1. $F = h \ln \frac{c}{b}$
2 Initial Inspection

Introduction

This chapter contains the following information:

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

Initial Inspection

The magnetic 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 magnetic material 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 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 16454A for any signs of damage.
Table 2-1 16454A Contents

<table>
<thead>
<tr>
<th>Ref /D</th>
<th>Part Number</th>
<th>Qty</th>
<th>Description</th>
<th>RoHS Compliant Replacement Part</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8710-2081</td>
<td>1</td>
<td>Tweezers</td>
<td>8710-2081</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>16454-00601</td>
<td>1</td>
<td>Fixture Holder</td>
<td>16454-00601</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>0515-1050</td>
<td>2</td>
<td>Screw, Hex Recess</td>
<td>0515-1050</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>(not assigned)</td>
<td>1</td>
<td>Test Fixture (Large)</td>
<td>(not assigned)</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>(not assigned)</td>
<td>1</td>
<td>Test Fixture (Small)</td>
<td>(not assigned)</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>16454-25002</td>
<td>1</td>
<td>Holder A</td>
<td>16454-25002</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>16454-25001</td>
<td>1</td>
<td>Holder B</td>
<td>16454-25001</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>16454-25004</td>
<td>1</td>
<td>Holder C (WITHOUT HOLE)</td>
<td>16454-25004</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>16454-25003</td>
<td>1</td>
<td>Holder D (WITH HOLE)</td>
<td>16454-25003</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>1540-0622</td>
<td>1</td>
<td>Holder Case</td>
<td>9300-2603</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>5188-4452</td>
<td>1</td>
<td>Hex Key, 2.5mm Across Flats</td>
<td>5188-4452</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>16454-60101</td>
<td>1</td>
<td>Carrying Case</td>
<td>16454-60101</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>16454-90020</td>
<td>1</td>
<td>Operation and Service Manual</td>
<td>16454-90020</td>
<td>1</td>
</tr>
</tbody>
</table>

1. These parts are not shown in this figure.
2. Only available for option ABA.
Repackaging the Test Fixture For Shipment

If shipment to a Keysight 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 magnetic material test fixture in heavy paper and pack in anti-static plastic packing material. Use sufficient shock absorbing material on all sides of the 16454A to provide a thick, firm cushion and to prevent movement. Seal the shipping container securely and mark it FRAGILE.
Initial Inspection
Repackaging the Test Fixture For Shipment
3 Theory on Material Measurement

This chapter explains the basic principle and the concept of material measurement.

Magnetic Material Measurement

Permeability Definition

Permeability in the alternating-current magnetic field is defined as complex relative permeability ($\mu^*_r$) (See Equation 3-1). The real component of the complex relative permeability ($\mu'_r$) represents the amount of energy stored in the magnetic material from the alternating-current magnetic field. On the other hand, the imaginary component ($\mu''_r$) indicates energy loss to the alternating current magnetic field.

Equation 3-1 Definition of Complex Relative Permeability

$$\mu^*_r = \mu'_r - j\mu''_r$$

As shown in Figure 3-1, complex relative permeability can be expressed in a vector diagram. The loss factor of a magnetic material is expressed as loss tangent ($\tan \delta$), which is the ratio of the imaginary component ($\mu''_r$) to the real component ($\mu'_r$) of the complex relative permeability.

Figure 3-1 Vector Diagram of Complex Relative Permeability and Loss Tangent
Measurement Principle of Magnetic Material

When using a LCR meter or an Impedance Analyzer, the inductance measurement method is employed to measure complex relative permeability. In this method, a DUT (toroidal core) is coiled with a wire and relative permeability is calculated from the measured inductance values. This section explains the measurement principle when using the test fixture, 16454A.

Figure 3-2  Relationship among Current, Magnetic Flux, and Magnetic Flux Density

Generally, the magnetic flux density \( B \) induced by the current flowing in an infinitely long straight wire shown in (a) of Figure 3-2 is expressed as Equation 3-2.

**Equation 3-2**  Magnetic Flux Density Induced by Current Flowing in an Infinitely Long Straight Wire

\[
B = \frac{\mu I}{2\pi r}
\]

On the other hand, the magnetic flux \( \Phi \) induced by current flowing in the closed loop shown in (b) of Figure 3-2 is expressed as Equation 3-3. Note that \( L \) indicates the self-inductance of the closed loop.

**Equation 3-3**  Magnetic Flux Induced by Current in Closed Loop

\[
\Phi = LI
\]

Furthermore, this magnetic flux \( \Phi \) also can be expressed by integrating the magnetic flux density \( B \) throughout the enclosed surface, as shown in Figure 3-2 (See Equation 3-4).

**Equation 3-4**  Relationship between Magnetic Flux and Magnetic Flux Density

\[
\Phi = \int B ds
\]

When a DUT (toroidal core) is mounted in 16454A, an ideal (no magnetic flux leakage) one turn inductor is formed, as shown in Figure 3-3.
The self-inductance of the measurement circuit including the DUT is derived as Equation 3-5 from Equation 3-2, Equation 3-3, Equation 3-4, and the physical shape of 16454A.

**Equation 3-5** Self-Inductance of Measurement Circuit

\[
L = \frac{1}{\mu_0} \int B ds = \int_a^b \int_0^{h_0} \frac{\mu L}{2\pi r} dr dz
\]

By unfolding **Equation 3-5** with \( \mu_0 \) as permeability of free space and \( \mu_r \) as relative permeability of the DUT, **Equation 3-6** can be obtained.

**Equation 3-6** Self Inductance of Measurement Circuit

\[
L = \int_c^e \int_0^{h_0} \frac{\mu_0}{2\pi r} dr dz + \int_b^d \int_0^{h_0} \frac{\mu_0 \mu_r}{2\pi r} dr dz + \int_a^b \int_0^{h_0} \frac{\mu_0}{2\pi r} dr dz + \int_d^c \int_0^{h_0} \frac{\mu_0}{2\pi r} dr dz
\]

By further unfolding **Equation 3-6**, **Equation 3-7** can be obtained.

**Equation 3-7** Self Inductance of Measurement Circuit

\[
L = \frac{h_0}{2\pi} \left\{ (\mu_r - 1)h \ln \frac{c}{b} + h_0 \ln \frac{e}{a} \right\}
\]

By transforming **Equation 3-7** to calculate the relative permeability \( \mu_r \) of the DUT, **Equation 3-8** can be obtained.

**Equation 3-8** Relative Permeability of DUT

\[
\mu_r = \frac{2\pi (L - L_{ss})}{\mu_0 h \ln \frac{c}{b}} + 1
\]

---

Keysight 16454A Magnetic Material Test Fixture
Theory on Material Measurement
Magnetic Material Measurement

L<sub>ss</sub> in Equation 3-9 indicates the self-inductance when a DUT is not mounted in the test fixture.

**Equation 3-9**

Self-Inductance When DUT Is Not Mounted in Test Fixture

\[ L_{ss} = \frac{\mu_0}{2\pi} n_0 \ln \frac{e}{a} \]

**Figure 3-4**

Loss of Magnetic Material

As alternating current causes inductance loss, the self-inductance \( L \) of the measurement circuit is expressed as complex impedance, as shown in Equation 3-12.

**Equation 3-10**

Impedance of Circuit (i)

\[ Z = j\omega L \]

**Equation 3-11**

Complex Impedance of Circuit (ii)

\[ Z^* = R_s + j\omega L^*_s = j\omega \left( \frac{R_s}{j\omega} + L_s \right) \]

**Equation 3-12**

Self-Inductance of Measurement Circuit Expressed as Complex Impedance

\[ L = \frac{Z^*}{j\omega} \]

Substituting “L” from Equation 3-12 to Equation 3-8 yields Equation 3-13.

**Equation 3-13**

Complex Relative Permeability of DUT

\[ \mu_r^* = \frac{2\pi (Z^* - j\omega L_{ss})}{j\omega \mu_0 h \ln \frac{C}{D}} + 1 \]
Structure of 16454A Test Fixture

As shown in Figure 3-5, 16454A has a residual impedance $Z_{\text{res}}^*$.

![Figure 3-5 16454A Residual Impedance](image)

Given the ideal impedance $Z_{\text{ss}}^*$ of the 16454A test fixture with no DUT mounted, the residual impedance $Z_{\text{res}}^*$ can be calculated from the measured impedance $Z_{\text{sm}}^*$ with no DUT mounted in 16454A (in SHORT state).

\[
Z_{\text{res}}^* = Z_{\text{sm}}^* - Z_{\text{ss}}^*
\]

Errors due to residual impedance can be minimized by SHORT compensation. The impedance after error compensation $Z_{\text{comp}}^*$ can be calculated from the measured impedance $Z_{\text{m}}^*$ with a DUT mounted in 16454A, as shown in Equation 3-15.

\[
Z_{\text{comp}}^* = Z_{\text{m}}^* - Z_{\text{res}}^*
\]

Assuming that $Z_{\text{ss}}^*$ consists only of inductance elements ($Z_{\text{ss}}^* = j\omega L_{\text{ss}}$), the complex relative permeability of the DUT can be calculated using Equation 3-13 and compensated impedance, $Z_{\text{comp}}^* = Z^*$, as shown in Equation 3-16.

\[
\mu_r^* = \frac{2\pi(Z_{\text{m}}^* - Z_{\text{sm}}^*)}{j\omega\mu_0 \ln \frac{C}{B}} + 1
\]
4 Operation

Connecting the Test Fixture

Selecting Fixture and Holder

The 16454A consists of two fixtures, a large one and a small one. The applicable MUT size for each fixture is listed in Table 4-1.

Table 4-1 MUT Size for Test Fixtures

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Small</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holder</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>MUT Outer Diameter (mm)</td>
<td>≤ φ8mm</td>
<td>≤ φ6mm</td>
</tr>
<tr>
<td>MUT Inner Diameter (mm)</td>
<td>≥ φ3.1mm</td>
<td>≥ φ3.1mm</td>
</tr>
<tr>
<td>MUT Height (mm)</td>
<td>≤ 3mm</td>
<td>≤ 3mm</td>
</tr>
</tbody>
</table>

Figure 4-1 shows the dimensions of the MUT holder.

Figure 4-1 Dimensions of the MUT Holder
Operation
Connecting the Test Fixture

Connecting the Test Fixture to the Test Head

To connect your fixture to the Test Head, perform the following steps:

1. Turn the APC-70 connector on the test head as shown in Figure 4-2.
2. Verify that the connector sleeve is retracted fully as shown in Figure 4-3.

Figure 4-2

Figure 4-3

3. Secure the test fixture to the fixture holder using the two screws.
4. Connect the connector on the underside of the test fixture to the APC-7 connector on the test head.
5. Secure the fixture holder to the test station using the two screws.
Operation
Connecting the Test Fixture

Figure 4-4 Connecting the Test Fixtures (16454A Small)
Performing SHORT Compensation

The SHORT Compensation corrects for the residual impedance due to the test fixture.

1. Remove the cap of the fixture.

2. Place a MUT holder only in the fixture.

3. Replace the cap by screwing tightly.
Operation
Connecting the Test Fixture

Placing the MUT into the Test Fixture

How to place the MUT on the 16454A is shown below:

1. Remove the cap of the fixture.

2. Place a MUT onto the MUT holder and insert it into the fixture.

3. Replace the cap by screwing tightly.
Operation
Connecting the Test Fixture
Introduction

This chapter gives the service information for the 16454A Magnetic Material Test Fixture.

Serial Number for Non-RoHS 16454A:
“MY43100001 – MY43200586” / “SG43100001 – SG43200586”

Serial Number for RoHS 16454A:
“MY43200587/S43200587 and above”

Replaceable Parts

Table 5-1 identify the supported parts and their respective RoHS compliant replacement support part. Due to limited availability of RoHS compliance station and technical difficulties in RoHS soldering, only parts and support level that do not require RoHS soldering are supported. Replace all defective parts with RoHS compliance part number. The parts listed in this table can be ordered from your nearest Keysight Technologies office. Ordering information should include the Keysight part number and the quantity required.
Service
Replaceable Parts

Table 5-1  Replaceable Parts List

<table>
<thead>
<tr>
<th>Ref /D</th>
<th>Part Number</th>
<th>Qty</th>
<th>Description</th>
<th>RoHS Compliant Replaceable Part</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16454-00601</td>
<td>1</td>
<td>Length Positioning Stage Assembly</td>
<td>16454-00601</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0515-1050</td>
<td>2</td>
<td>Screw, Hex Recess</td>
<td>0515-1050</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>16454-23004</td>
<td>1</td>
<td>Fixture Flange (Large)</td>
<td>16454-23004</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1250-0816</td>
<td>2</td>
<td>Conn-RF Conn</td>
<td>1250-0816</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>16454-23005</td>
<td>1</td>
<td>Center Pin</td>
<td>16454-23005</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>16454-23003</td>
<td>1</td>
<td>Fixture Cap (Large)</td>
<td>16454-23003</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>16454-23002</td>
<td>1</td>
<td>Fixture Flange (Small)</td>
<td>16454-23002</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>16454-23001</td>
<td>1</td>
<td>Fixture Cap (Small)</td>
<td>16454-23001</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>16454-25002</td>
<td>1</td>
<td>Holder A</td>
<td>16454-25002</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>16454-25001</td>
<td>1</td>
<td>Holder B</td>
<td>16454-25001</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>16454-25004</td>
<td>1</td>
<td>Holder C (WITHOUT HOLE)</td>
<td>16454-25004</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>16454-25003</td>
<td>1</td>
<td>Holder D (WITH HOLE)</td>
<td>16454-25003</td>
<td>1</td>
</tr>
</tbody>
</table>
### Table 5-1

#### Replaceable Parts List

<table>
<thead>
<tr>
<th>Ref/D</th>
<th>Part Number</th>
<th>Qty</th>
<th>Description</th>
<th>RoHS Compliant Replaceable Part</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>1540-0622</td>
<td>1</td>
<td>Holder Case</td>
<td>9300-2603</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>5188-4452</td>
<td>1</td>
<td>Hex Key, 2.5mm Across Flats</td>
<td>5188-4452</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>8710-2081</td>
<td>1</td>
<td>Tweezers</td>
<td>8710-2081</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>0470-0013</td>
<td>1</td>
<td>Thread Sealant</td>
<td>0470-0013</td>
<td>1</td>
</tr>
<tr>
<td>-</td>
<td>16454-60101</td>
<td>1</td>
<td>Carrying Case(^1)</td>
<td>16454-60101</td>
<td>1</td>
</tr>
</tbody>
</table>

1. These parts are not shown in this figure.
Functional Test

This section provides the functional test procedure to check the 16454A performance. The functional test can be used for post repair function verification.

Fixture Impedance Check

1. Perform calibration at the APC-7 terminal of the measurement instrument.

2. Place the fixture (small) on the calibrated APC-7 terminal of the measurement instrument.

3. Read $L_s$ and $R_s$ value for each test fixture. The guideline is as follows:

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Frequency</th>
<th>$L_s$</th>
<th>Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>100MHz</td>
<td>1nH ± 0.5nH</td>
<td>$R_s$ &lt;100mΩ</td>
</tr>
<tr>
<td>Large</td>
<td>100MHz</td>
<td>5.5nH ± 2.5nH</td>
<td>$R_s$ &lt;300mΩ</td>
</tr>
</tbody>
</table>