

**Agilent 16089A, B, C Kelvin Clip Leads**

**Agilent 16089D Alligator Clip Leads**

# **Operation and Service Manual**



**Agilent Technologies**

**Agilent Part No. 16089-90020  
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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 which are incorporated at reprint do not cause the date to change.) The manual part number changes when extensive technical changes are incorporated.

November 1991 .....	First Edition (part number: 16089-90000)
January 2000 .....	Second Edition (part number: 16089-90000)
April 2001 .....	Third Edition (part number: 16089-90010)
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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 only 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 injury, always disconnect power and discharge circuits before touching them.

### Do NOT Service or Adjust While Alone

Do *not* attempt internal service or adjustment unless another person, capable of turning off power and 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.

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#### Warning



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

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## Safety Symbols

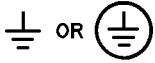
General definitions of safety symbols used on equipment or in manuals.



Instruction manual symbol: the product will be 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.



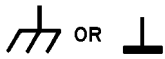
Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective ground terminal. For protection against electrical shock in case of a fault in the instrument. Used with wiring terminals to indicate the terminal which 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 a fault in the instrument. 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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## General Information

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### Introduction

The purpose of this manual is to enable you to use your Agilent 16089A, B, C Kelvin Clip Leads and Agilent 16089D Alligator Clip Leads efficiently and confidently. This manual contains both general and specific information. To use the 16089A, B, C, D to perform a specific function (without having to read the entire manual), follow the directions in “Using the 16089A, B, C, D”.

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### Using the 16089A, B, C, D

The 16089A, B, C, D has been designed to operate specifically with the 4263B LCR Meter.

- To install the 16089A, B, C, D, turn to Chapter 2.
- To operate the 16089A, B, C, D, turn to Chapter 3.
- To order replaceable parts for the 16089A, B, C, D, turn to “Replaceable Parts” in Chapter 4.

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### Product Description

The 16089A, B, C, D has been designed to operate specifically with the following four-terminal-pair type LCR meters and impedance analyzers:

4263B	4284A	4192A
4268A	4285A	4194A
4278A	4288A	4294A

The 16089A, B, C, D make it possible to measure odd-shaped components that cannot be measured with conventional test fixtures. The 16089A, 16089B, and 16089C consist of a direct attachment, four-terminal-pair type test leads that are equipped with two insulated Kelvin clips. Three sizes of Kelvin clips are provided. The 16089A Kelvin Clip Leads is equipped with two large Kelvin clips, the 16089B Kelvin Clip Leads is equipped with middle size clips and the 16089C Kelvin Clip Leads is equipped with small size clips. The 16089D consist of a direct attachment, four-terminal-pair type test leads that are equipped with four alligator clips.

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## Accessories Supplied

The following accessories are supplied with the 16089A, B, C, D:

**Table 1-1. Furnished Accessories**

Description	Part Number	Quantity
Operation and Service Manual	P/N 16089-90010	1

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## Operating and Safety Precautions

### Operating

You need observe only normal precautions in handling and operating the 16089A, B, C, D. 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.

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### Caution



Electrostatic discharge (ESD) can damage the highly sensitive microcircuits in your instrument. ESD damage is most likely to occur as the test leads 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.

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### Service

The voltage levels found in these test leads when used with the intended instruments do not warrant more than normal safety precautions for operator safety. Nevertheless, service should be performed only by qualified personnel.

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## Specifications

This section lists the complete 16089A, B, C, D specifications. These specifications are the performance standards and limits against which the 16089A, B, C, D is tested. When shipped from the factory, the 16089A, B, C, D meets the following specifications:

### Common Specifications for the 16089A, B, C, D

Applicable Instrument	4263B, 4268A 4278A <sup>1</sup> , 4284A <sup>1</sup> , 4285A <sup>1</sup> , 4288A <sup>1</sup> , 4192A <sup>1</sup> , 4194A <sup>1</sup> , 4294A <sup>1</sup>
Maximum dc Bias Voltage	±42 V peak max
Frequency Range	5 Hz to 100 kHz
Operating Temperature	0 to 55°C
Operating Humidity	≤95% RH (@40°C)
Non-operating Temperature	-40 to 70 °C
Non-operating Humidity	≤95% RH (@40°C)
Weight	300 g

<sup>1</sup> Except for the frequency range over 100 kHz.

### Specifications for the 16089A, B, C

Cable Length	0.94 m
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### Specifications for the 16089D

Cable Length	1.3 m
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## Supplemental Performance Characteristics

This section gives 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.

### Supplemental Performance Characteristics of 16089A

■ Applicable DUT size

Diameter of DUT's terminals	≤15 mm
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### Supplemental Performance Characteristics of 16089B

■ Applicable DUT size

Diameter of DUT's terminals	≤7.9 mm
Length of DUT's terminals	≥3 mm

**Supplemental Performance Characteristics of 16089C**

■ Applicable DUT size

- Diameter of DUT's terminals .....  $\leq 1$  mm
- Space between DUT's terminals .....  $\geq 2$  mm
- Length of DUT's terminals .....  $\geq 2$  mm

**Supplemental Performance Characteristics of 16089D**

■ Applicable DUT size

- Diameter of DUT's terminals .....  $\leq 5$  mm

## Preparation for Use

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### Introduction

This chapter explains how to install the Agilent 16089A, B, C Kelvin Clip Leads and Agilent 16089D Alligator Clip Leads. The topics covered include initial inspection, ambient environmental considerations, connecting the test leads for use, and repackaging the test leads for shipment.

---

### Initial Inspection

These test leads have been carefully inspected electrically and mechanically before being shipped from the factory. They should be in perfect physical condition, no scratches, dents or the like, and they should be in perfect electrical condition. Verify this by carefully performing an incoming inspection to check the test lead 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.

1. Inspect the shipping container for damage, and keep the shipping materials until the inspection is completed.
2. Verify that the shipping container contains everything shown in Figure 2-1, Figure 2-2, Figure 2-3, and Figure 2-4 and listed in Table 2-1, Table 2-2, Table 2-3, and Table 2-4.
3. Inspect the exterior of the 16089A, B, C, D for any signs of damage.

## 16089A



**Figure 2-1. 16089A Product Overview**

**Table 2-1. Contents of 16089A**

<b>Description</b>	<b>Agilent Part Number</b>	<b>Quantity</b>
① Kelvin Clip Leads	16089-60001 <sup>1</sup>	1
② Operation and Service Manual <sup>2</sup>	16089-90010	1

1 Agilent internal-only part number.

2 Operation and Service Manual is not shown in Figure 2-1.

## 2-2 Preparation for Use

# 16089B



**Figure 2-2. 16089B Product Overview**

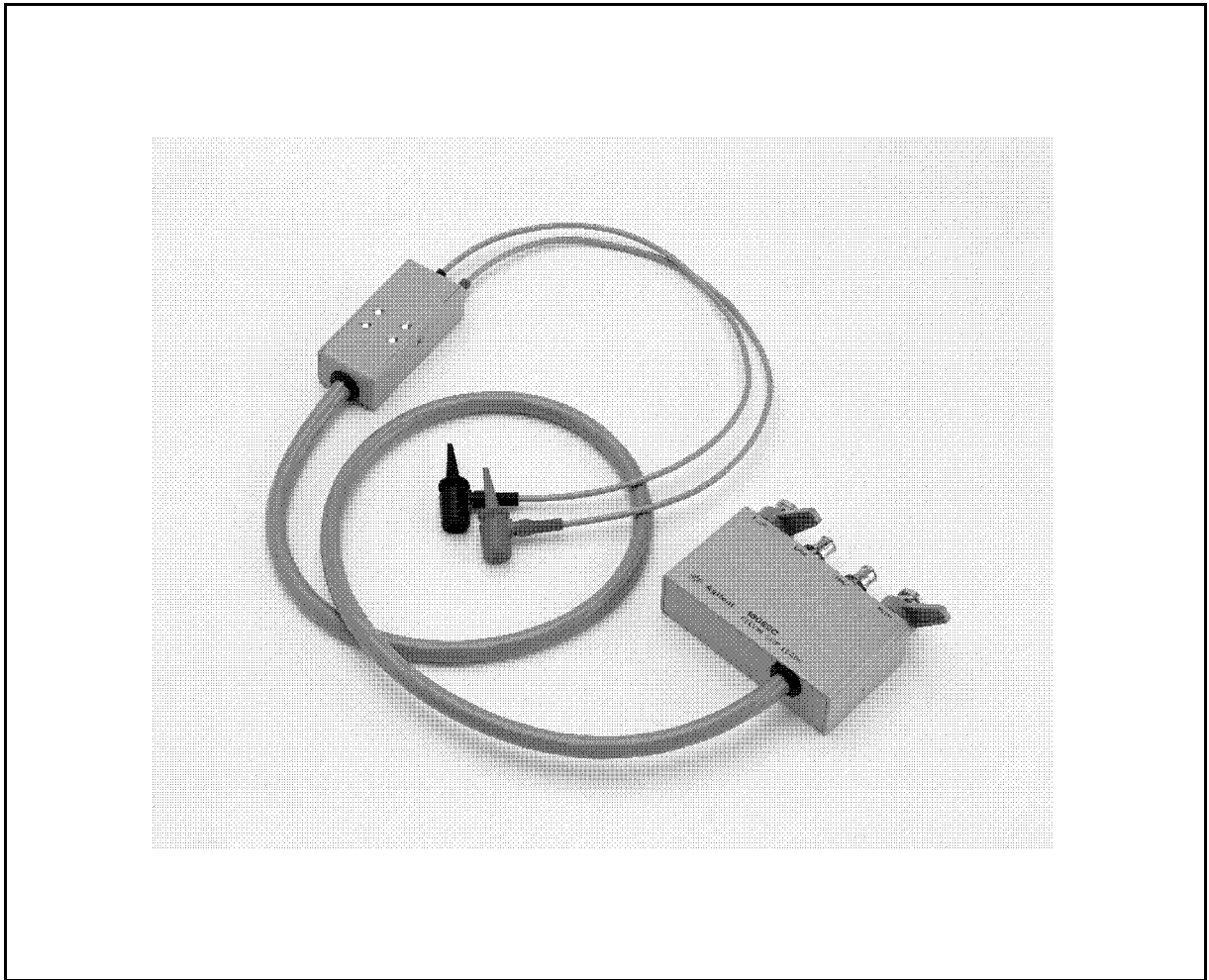
**Table 2-2. Contents of 16089B**

<b>Description</b>	<b>Agilent Part Number</b>	<b>Quantity</b>
① Kelvin Clip Leads	16089-60002 <sup>1</sup>	1
② Operation and Service Manual <sup>2</sup>	16089-90010	1

1 Agilent internal-only part number.

2 Operation and Service Manual is not shown in Figure 2-2.

# 16089C



**Figure 2-3. 16089C Product Overview**

**Table 2-3. Contents of 16089C**

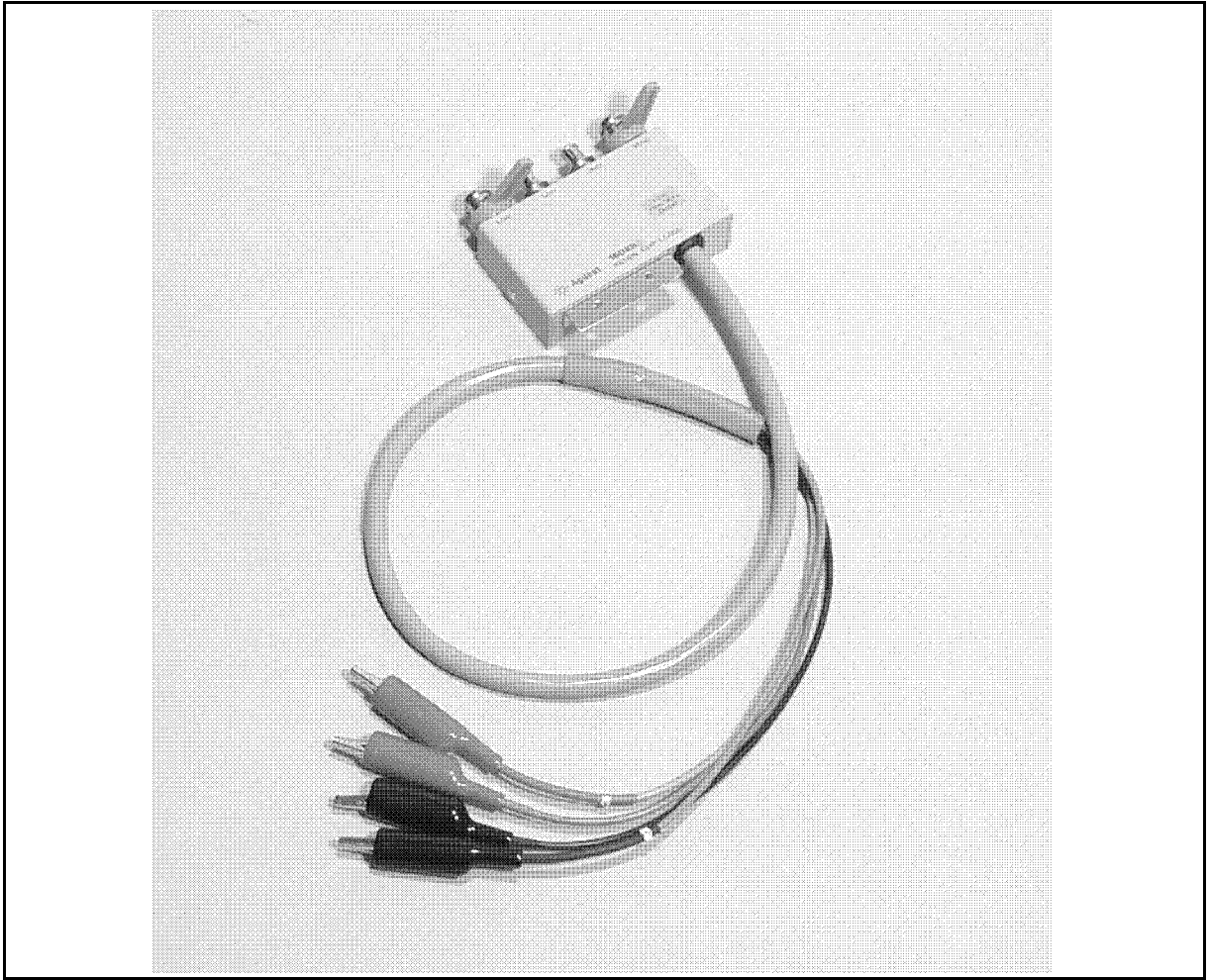
<b>Description</b>	<b>Agilent Part Number</b>	<b>Quantity</b>
① Kelvin Clip Leads	16089-60003 <sup>1</sup>	1
② Operation and Service Manual <sup>2</sup>	16089-90010	1

1 Agilent internal-only part number.

2 Operation and Service Manual is not shown in Figure 2-3.



# 16089D



**Figure 2-4. 16089D Product Overview**

**Table 2-4. Contents of 16089D**

<b>Description</b>	<b>Agilent Part Number</b>	<b>Quantity</b>
① Alligator Clip Leads	16089-60004 <sup>1</sup>	1
② Operation and Service Manual <sup>2</sup>	16089-90010	1

1 Agilent internal-only part number.

2 Operation and Service Manual is not shown in Figure 2-4.

---

## Ambient Environmental Considerations

### Operating and Storage

The 16089A, B, C, D must be operated within an ambient temperature range of 0°C to 55°C and relative humidity up to 95% at 40°C (non-condensing).

The 16089A, B, C, D may be stored within a temperature range of -40°C to +70°, and at a relative humidity of up to 95% at +40°C (non-condensing).

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## Connecting the Test Leads for Use

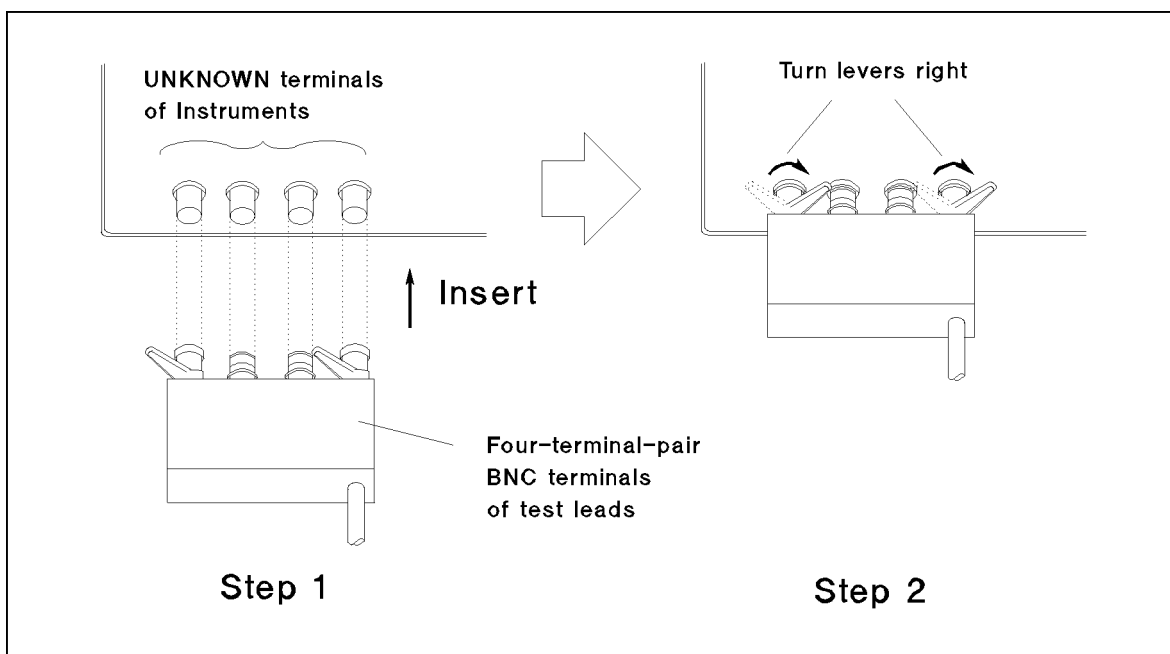


Figure 2-5. Connecting the Test Leads

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## Packaging the Test Leads

If shipment to a Agilent Technologies service center is required, each test lead set should be repackaged using the original factory packaging materials.

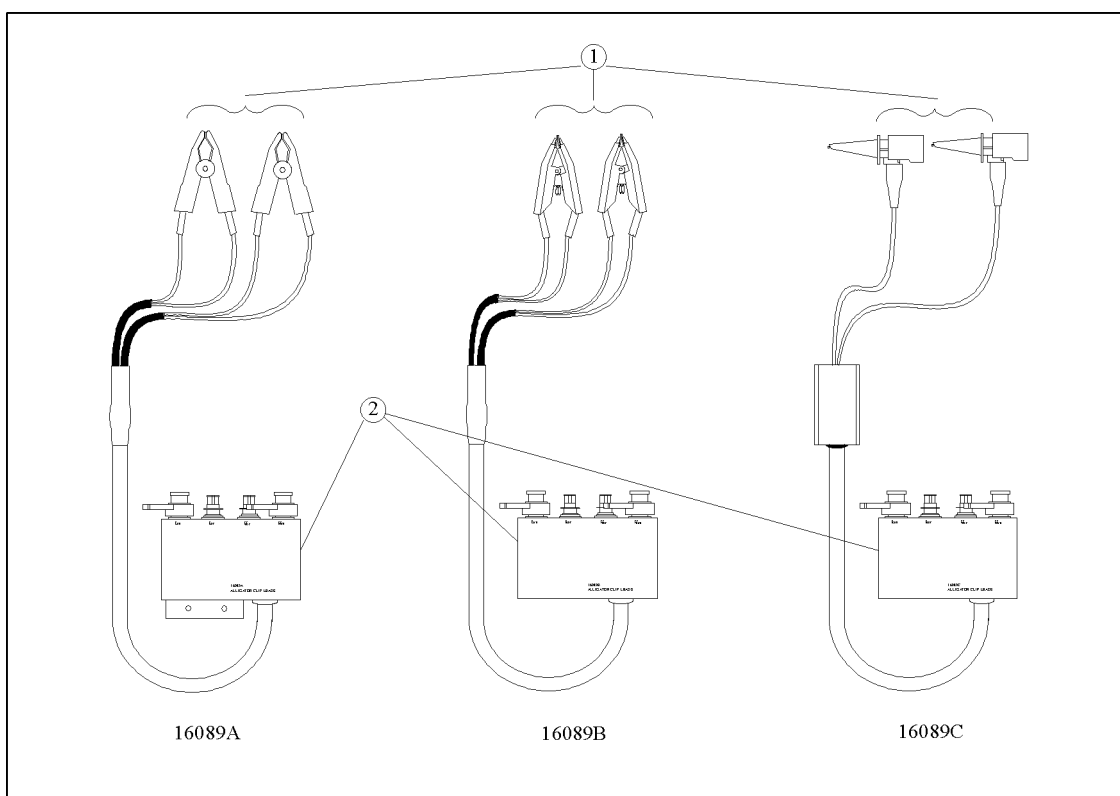
Alternatively, comparable packaging materials may be used. Wrap the test leads in heavy paper and pack in anti-static plastic packing material. Use sufficient shock absorbing material on all sides of the 16089A, B, C, D to provide a thick, firm cushion and to prevent movement. Seal the shipping container securely and mark it *FRAGILE*.

## Operation

### Introduction

This chapter describes using the test leads and compensation techniques for these test leads.

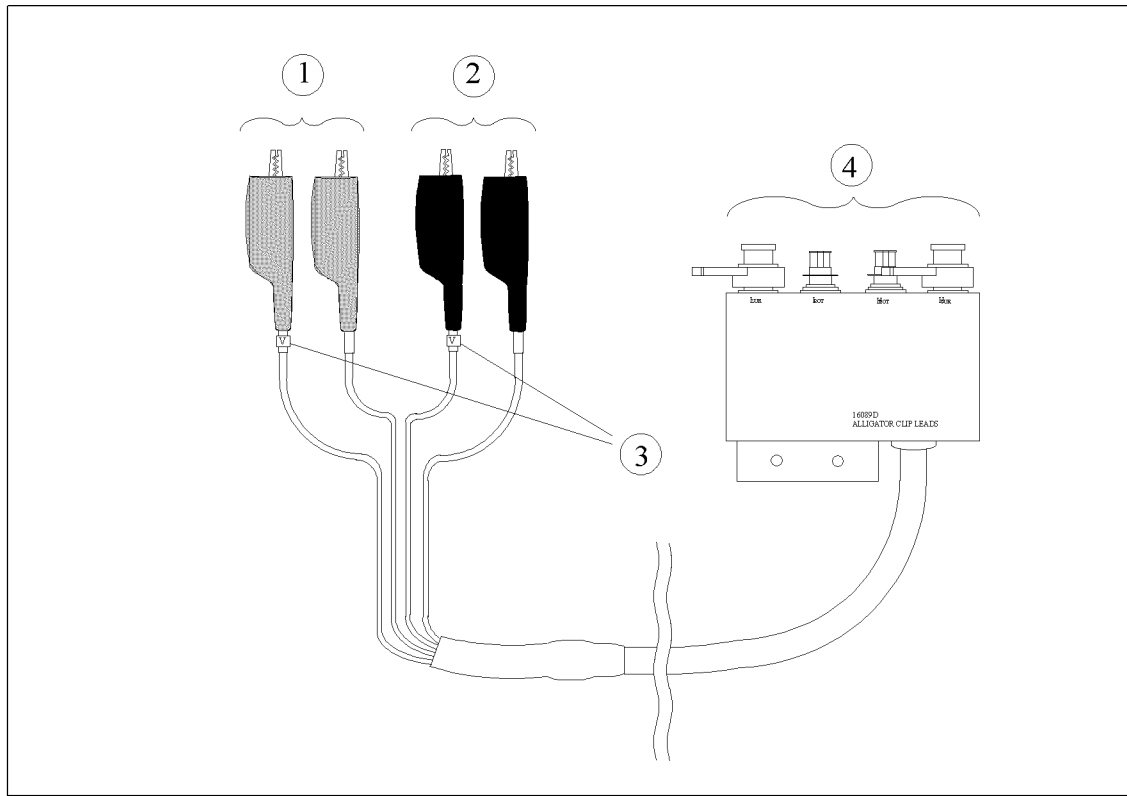
### 16089A, B, C



**Figure 3-1. 16089A, B, C Test Leads Features**

1. *Kelvin Clips*. These are connected to the DUT.
2. *Four-terminal-pair BNC terminals*. These terminals are connected to the UNKNOWN terminals of your measurement instrument.

## 16089D



A9602002

**Figure 3-2. 16089D Test Leads Features**

1. *Alligator Clips (red)*. These are connected to the high terminal of the DUT.
2. *Alligator Clips (black)*. These are connected to the low terminal of the DUT.
3. *V markers*. These show the  $H_{pot}$  and  $L_{pot}$  terminals.
4. *Four-terminal-pair BNC terminals*. These terminals are connected to the UNKNOWN terminals of your instrument.

## OPEN and SHORT Compensation

The 16089A, B, C, D have inherent stray capacitance, residual inductance, and residual resistance that affect the measurement. To cancel the effects caused by these residuals and thus minimize their effect on measurement accuracy, the measurement instrument's OPEN and SHORT compensation capabilities must be used. The procedures are described in the measurement instrument's operation manual.

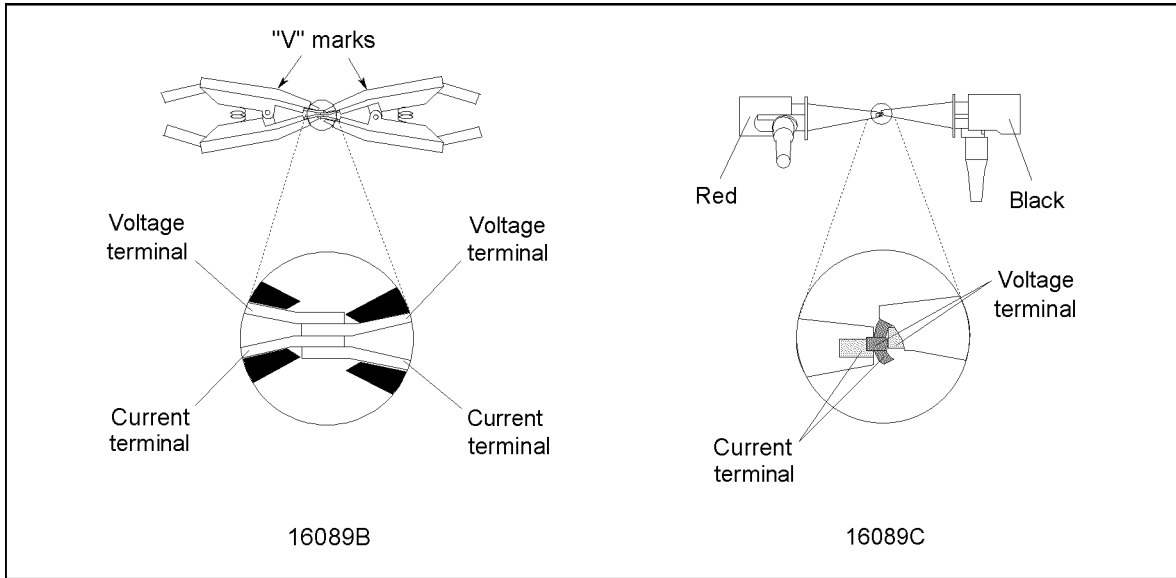


Figure 3-3. Making a Short Condition for the 16089B and 16089C

When you perform SHORT compensation for the 16089A or 16089D, use the furnished short bar as shown in Figure 3-4.

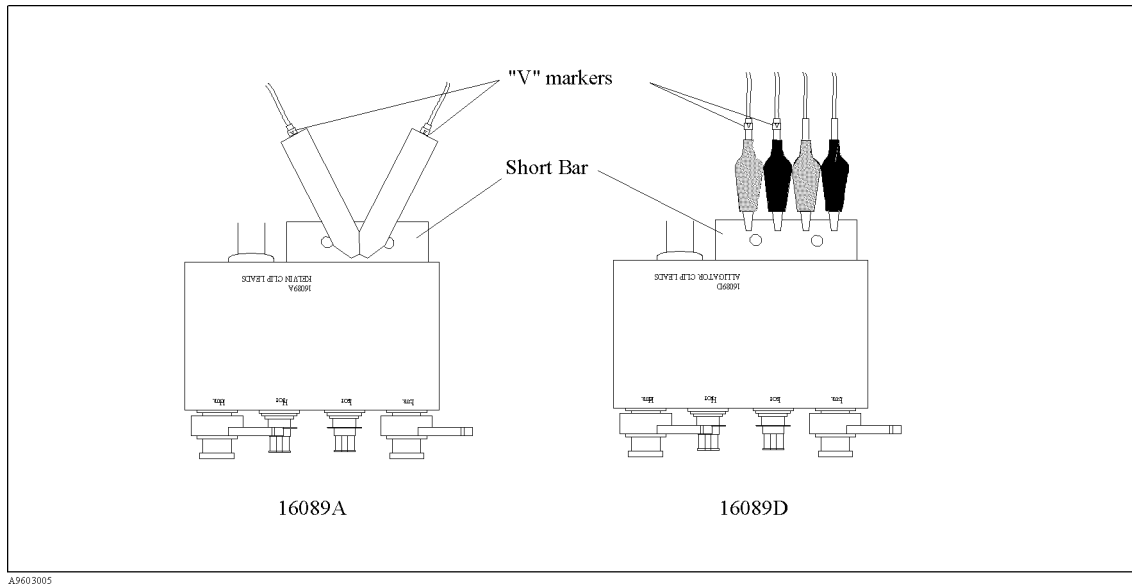


Figure 3-4. Making a Short Condition for the 16089A and 16089D

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**Note**

If the furnished short bar of 16089A or 16089D is corroded, worn or damaged, reverse the position or replace it with a new short bar. To reverse the short bar, remove the 2 screws that fixes the short bar and reverse the position.

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## Operation

Step-by-step instructions on how to make a measurement with the 16089A, B, C, D are:

1. Set the Cable Length setting to 1 m.  
(4192A, 4263B, 4268A, 4278A, 4284A 4285A, 4288A and 4294A only)
2. Connect the test leads of 16089A, B, C, D to the measurement Instrument's UNKNOWN terminals.
3. Perform OPEN and SHORT compensation as described in the measurement instrument's operation manual. Figure 3-3 and Figure 3-4 show how to make short condition for the SHORT compensation.  
(4192A, 4263B, 4268A, 4278A, 4284A 4285A, 4288A and 4294A only)
4. Connect the component to be tested into the test clips.

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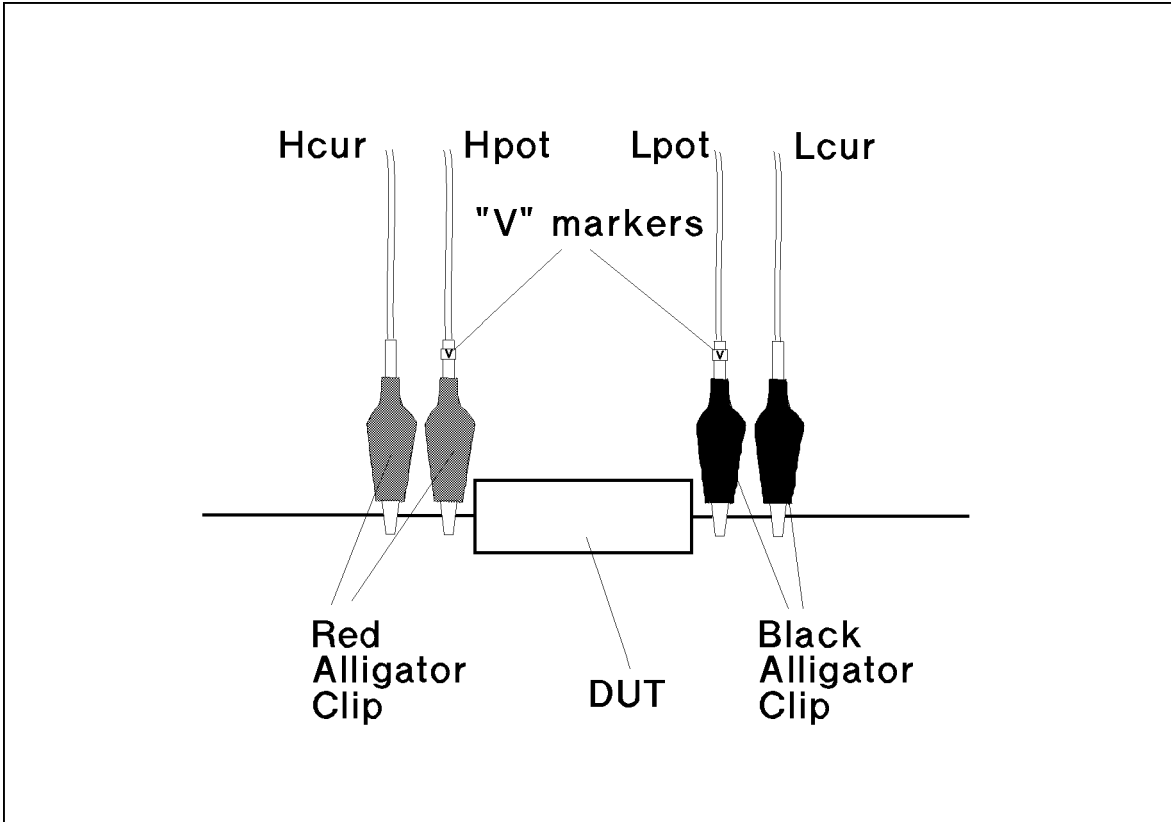
**Note**

When 16089D is used, connect the test clips to the DUT correctly as follows:

- Connect all test clips to the DUT.
- Connect the same color test clips to the same terminal of the DUT.
- Connect the  $H_{pot}$  and  $L_{pot}$  clips (marked "V") closer to the DUT than  $H_{cur}$  and  $L_{cur}$  clips.

Figure 3-5 also shows how to connect a DUT using the alligator clips of the 16089D.

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Figure 3-5. Connecting the DUT to the 16089D





## Service

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### Introduction

This chapter gives replaceable parts information for the 16089A, 16089B, 16089C, and 16089D.

### Replaceable Parts

Table 4-1, Table 4-2, Table 4-3, and Table 4-4 list the replaceable parts for the 16089A, B, C, and D, respectively. Figure 4-1 shows the connection from the cable to the clip assembly of the 16089C. The parts listed can be ordered from your nearest Agilent Technologies office. Ordering information should include the Agilent part number and the quantity required.

#### 16089A Replaceable Parts

**Table 4-1. 16089A Replaceable Parts**

Agilent Part Number	Qty.	Description
16089-60001	1	Test Leads <sup>1</sup>
16089-04001	1	Cover Top
0515-0914	2	Screw Flat Head M3×0.5 L6
16089-60011	2	Large Clip Assembly
7121-2696	2	Wire Marker “V”
16089-01201	1	Short Bar
0515-1550	2	Screw

<sup>1</sup> The whole unit. Agilent internal-only part.

Red and orange cables are screwed on the one Kelvin clip assembly. Gray and black cables are screwed on the other Kelvin clip assembly. Orange and gray cables are marked “V”.

#### 16089B Replaceable Parts

**Table 4-2. 16089B Replaceable Parts**

Agilent Part Number	Qty.	Description
16089-60002	1	Test Leads <sup>1</sup>
16089-04002	1	Cover Top
0515-0914	2	Screw Flat Head M3×0.5 L6
16005-60010	2	Kelvin Clip Assembly

<sup>1</sup> The whole unit. Agilent internal-only part.

On one Kelvin clip, the orange cable is screwed on the “V” marked side, and the red cable is screwed on the non-marked side. On the other Kelvin clip, the gray cable is screwed on the “V” marked side, and the black cable is screwed on the non-marked side.

## 16089C Replaceable Parts

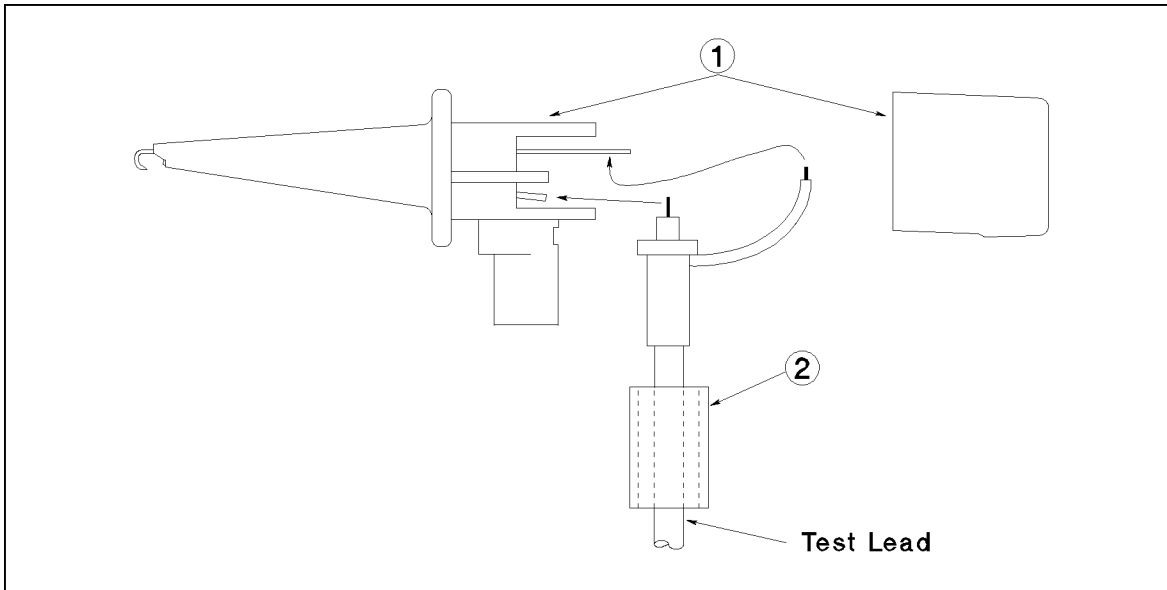
**Table 4-3. 16089C Replaceable Parts**

Reference <sup>1</sup> Designator	Agilent Part Number	Qty.	Description
1	16089-60003	1	Test Leads <sup>2</sup>
	16089-04003	1	Cover Top
	0515-0914	2	Screw Flat Head M3×0.5 L6
	16005-60013	1	Test Clip Assembly Red
	16005-60015	1	Test Clip Assembly Black
2	0890-1809	2 cm	Tube Heat Shrinkable Red
	0890-1808	2 cm	Tube Heat Shrinkable Black

1 Corresponding to designator in Figure 4-1.

2 The whole unit. Agilent internal-only part.

Connection from the cables to the Kelvin clip is shown in Figure 4-1.



A9605001

**Figure 4-1. Kelvin Clip Connections**

## 16089D Replaceable Parts

**Table 4-4. 16089D Replaceable Parts**

<b>Agilent Part Number</b>	<b>Qty.</b>	<b>Description</b>
16089-60004	1	Test Leads <sup>1</sup>
16089-04004	1	Cover Top
0515-0914	2	Screw Flat Head M3×0.5 L6
0340-1085	2	Insulator Alligator Clip Red
0340-1086	2	Insulator Alligator Clip Black
1400-1252	4	Alligator Clip
7121-2696	2	Wire Marker “V”
16089-01201	1	Short Bar
0515-1550	2	Screw

<sup>1</sup> The whole unit. Agilent internal-only part.

Table 4-5 shows the correspondence between the Alligator Clips and the Cables.

**Table 4-5. Clip and Cable Correspondence**

<b>Alligator Clip Color</b>	<b>Cable Color Marker</b>
Red	Orange “V”
Red	Red
Black	Gray “V”
Black	Black



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