

**HP 16088B Test Fixture**  
**Operation Manual**



**HP Part No. 16088-90010**  
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**Edition 3**  
**E0692**

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## 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.

June 1992 ... Edition 3

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## General Information

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### Introduction

This operating note provides information to operate and maintain the HP 16088B Test Fixture. The HP 16088B Test Fixture is shown in Figure 1-1.

This test fixture is designed for testing electronic devices (Device Under Test or DUT). Before you measure the characteristics of a device, set the proper socket module in the test fixture and wire the terminals of the panel to the terminals of the socket.

This test fixture has a total of thirteen channels: four Source Monitor Unit (SMU) channels, two High Current Unit (HCU) channels, two High Voltage Unit (HVU), two Voltage Source (VS) channels, two Voltage Monitor (VM) channels, and one Ground Unit (GNDU) channel. For information about each channels, see "Specifications".

If your test fixture has the optional module selector, you can select between the SMU, HCU, or HVU as the unit to be connected to the DUT without having to manually change the connections.

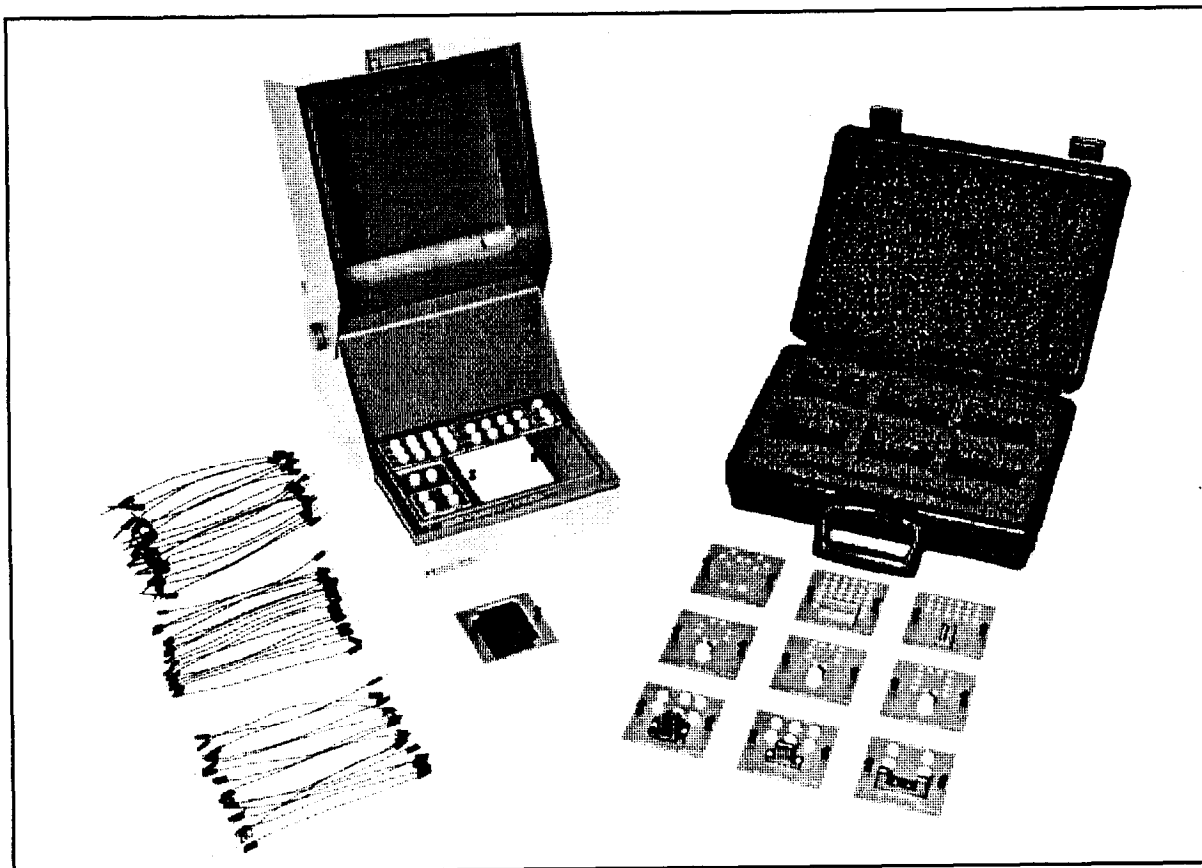


Figure 1-1. The HP 16088B Test Fixture and Accessories

## Furnished Accessories

The test fixture comes with the following accessories:

- Carrying case for socket modules
- Fifteen miniature banana – miniature banana connection cables
- Fifteen miniature banana – pin plug connection cables
- Fifteen miniature banana – miniature clip connection cables
- Blank Teflon™ board
- Universal socket module
- Ten connection pins
- Operating Note

## Options

Table 1-1 lists the options available for the HP 16088B Test Fixture.

**Table 1-1. Options for HP 16088B**

| Option Number | Description                                                         | HP Part Number |
|---------------|---------------------------------------------------------------------|----------------|
| 001           | Adds five connection cables (miniature banana – miniature banana)   | 16088-61001    |
| 002           | Adds five connection cables (miniature banana – pin plug)           | 16088-61002    |
| 003           | Adds five connection cables (miniature banana – miniature clip)     | 16088-61003    |
| 010           | Adds three socket modules for power devices                         | —              |
| 020           | Adds six socket modules for low power devices and a carrying case   | —              |
| 030           | Adds an extra universal socket module and ten extra connection pins | —              |
| 031           | Adds ten extra connection pins                                      | —              |
| 300           | Adds module selector                                                | —              |

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## Specifications

This paragraph provides specifications of the HP 16088B Test Fixture. Table 1-2 shows the maximum current and voltage for the test fixture.

**Table 1-2.**  
**Maximum Current and Voltage for the Test Fixture**

| Channel | Maximum Voltage | Maximum Current |
|---------|-----------------|-----------------|
| SMU     | 200 V           | 1 A             |
| HCU     | 10 V            | 10 A            |
| HVU     | 1000 V          | 10 mA           |
| VS      | 40 V            | 100 mA          |
| VM      | 40 V            | —               |

## Function

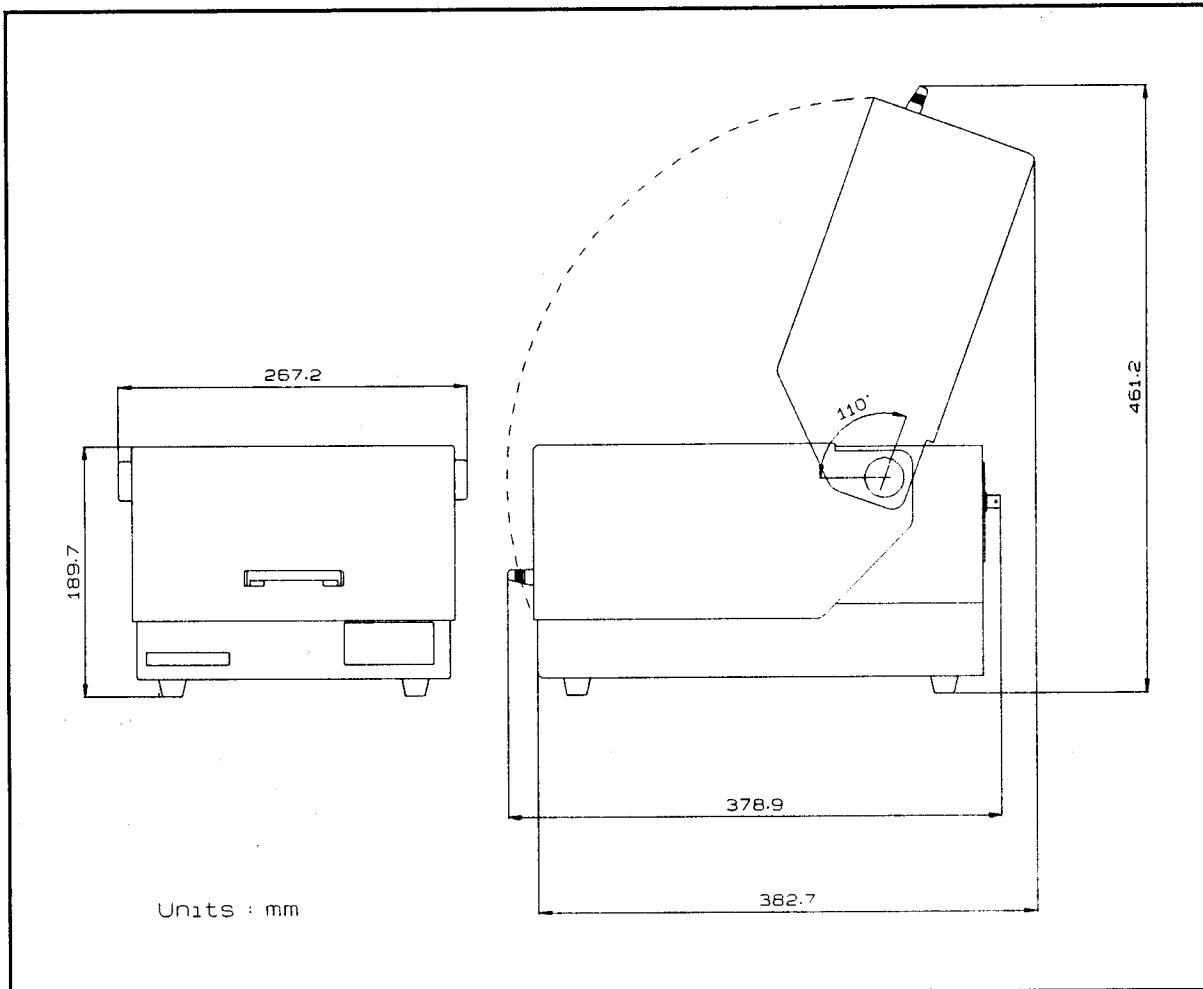
This test fixture lets you test various shaped electric devices. The test fixture has four SMU channels, two HCU channels, two VS channels, two VM channels, two HVU, channels, and a GNDU channel. Kelvin connections can be measured with the test fixture. The lid of the test fixture shields the Device Under Test (DUT) from electrostatic interference and light effects. The interlock (INTLK) terminal is a safety feature on the fixture that prevents users from receiving an electric shock during measurements. If the optional Module Selector is added, you can select from the SMU, HCU, or HVU as the channel that is connected to the DUT.

## Physical Characteristics

|           |                               |
|-----------|-------------------------------|
| Dimension | See Figure 1-2.               |
| Weight    | Approximately 7 lbs or 3.2 kg |
| Color     | French Gray                   |

## Operating Environment

|                              |                                   |
|------------------------------|-----------------------------------|
| Operating Temperature range: | 5° to 40° C; 41° to 104° F        |
| Operating Humidity range:    | 5 to 80% RH no condensation       |
| Storage Temperature range:   | −40° to 70° C; −40° to 158° F     |
| Storage Humidity range:      | ≤ 90% RH at 65° C no condensation |
| Maximum Tilt Angle:          | 20°                               |



**Figure 1-2. Dimensions of the HP 16088B Test Fixture**

---

## Supplemental Performance Characteristics

### Test Fixture

The following reference data is specified at  $23 \pm 5^\circ \text{C}$  ( $73 \pm 9^\circ \text{F}$ ) and 50% relative humidity.

#### ■ SMU channel

|                                                                  |                          |
|------------------------------------------------------------------|--------------------------|
| Leakage Current (force/sense $\longleftrightarrow$ common)       | : 10 pA maximum at 200 V |
| Stray Capacitance (force/sense $\longleftrightarrow$ common)     | : 15 pF maximum          |
| Stray Capacitance (force/sense $\longleftrightarrow$ other SMUs) | : 3 pF typical           |
| Residual Resistance (force)                                      | : 60 m $\Omega$ typical  |
| Residual Resistance (sense)                                      | : 60 m $\Omega$ typical  |
| Guard Capacitance (force/sense $\longleftrightarrow$ guard)      | : 70 pF maximum          |

#### ■ HCU channel

|                                                                |                         |
|----------------------------------------------------------------|-------------------------|
| Leakage Current (high-force $\longleftrightarrow$ low-force)   | : 1 nA maximum at 10 V  |
| Leakage Current (high-sense $\longleftrightarrow$ low-sense)   | : 1 nA maximum at 10 V  |
| Stray Capacitance (high-force $\longleftrightarrow$ low-force) | : 300 pF maximum        |
| Stray Capacitance (high-sense $\longleftrightarrow$ low-sense) | : 100 pF maximum        |
| Residual Resistance (high-force or low-force)                  | : 35 m $\Omega$ typical |
| Residual Resistance (high-sense or low-sense)                  | : 60 m $\Omega$ typical |

#### ■ HVU channel

|                                                             |                          |
|-------------------------------------------------------------|--------------------------|
| Leakage Current (force $\longleftrightarrow$ common)        | : 10 pA typical at 200 V |
| Stray Capacitance (force $\longleftrightarrow$ common)      | : 15 pF typical          |
| Stray Capacitance (force $\longleftrightarrow$ other SMUs)  | : 3 pF typical           |
| Residual Resistance                                         | : 300 m $\Omega$ typical |
| Guard Capacitance (force/sense $\longleftrightarrow$ guard) | : 40 pF maximum          |

#### ■ VS or VM channel

|                     |                         |
|---------------------|-------------------------|
| Residual Resistance | : 70 m $\Omega$ typical |
|---------------------|-------------------------|

#### ■ GNDU channel

|                             |                         |
|-----------------------------|-------------------------|
| Residual Resistance (force) | : 40 m $\Omega$ typical |
| Residual Resistance (sense) | : 40 m $\Omega$ typical |

■ Selectable SMU channel (option 300 only)

|                                                                 |                          |
|-----------------------------------------------------------------|--------------------------|
| Leakage Current (force/sense $\longleftrightarrow$ common)      | : 15 pA typical at 200 V |
| Stray Capacitance (force/sense $\longleftrightarrow$ common)    | : 15 pF typical          |
| Stray Capacitance (force/sense $\longleftrightarrow$ other SMU) | : 3 pF typical           |
| Residual Resistance (force)                                     | : 300 m $\Omega$ typical |
| Residual Resistance (sense)                                     | : 400 m $\Omega$ typical |
| Guard Capacitance (force/sense $\longleftrightarrow$ guard)     | : 60 pF typical          |
| Resistance (channel is off)                                     | 100 G $\Omega$ typical   |

■ Selectable HCU channel (option 300 only)

|                                                                |                          |
|----------------------------------------------------------------|--------------------------|
| Leakage Current (high-force $\longleftrightarrow$ low-force)   | : 1 nA maximum at 10 V   |
| Leakage Current (high-sense $\longleftrightarrow$ low-sense)   | : 1 nA maximum at 10 V   |
| Stray Capacitance (high-force $\longleftrightarrow$ low-force) | : 400 pF typical         |
| Stray Capacitance (high-sense $\longleftrightarrow$ low-sense) | : 200 pF typical         |
| Residual Resistance (high-force)                               | : 70 m $\Omega$ typical  |
| Residual Resistance (low-force)                                | : 35 m $\Omega$ typical  |
| Residual Resistance (high-sense)                               | : 160 m $\Omega$ typical |
| Residual Resistance (low-sense)                                | : 60 m $\Omega$ typical  |
| Resistance (channel is off)                                    | : 100 G $\Omega$ typical |

■ Selectable HVU channel (option 300 only)

|                                                            |                          |
|------------------------------------------------------------|--------------------------|
| Leakage Current (force $\longleftrightarrow$ common)       | : 15 pA typical at 200 V |
| Stray Capacitance (force $\longleftrightarrow$ common)     | : 15 pF typical          |
| Stray Capacitance (force $\longleftrightarrow$ other SMUs) | : 3 pF typical           |
| Residual Resistance                                        | : 500 m $\Omega$ typical |
| Guard Capacitance (force $\longleftrightarrow$ guard)      | : 60 pF typical          |
| Resistance (channel off)                                   | : 100 G $\Omega$ typical |

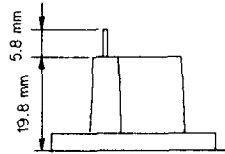
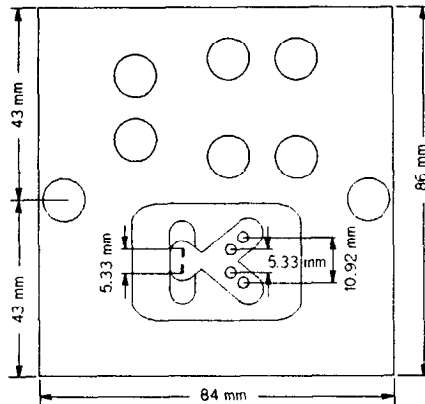
## Accessories

### ■ Socket Module Set for Power Devices

The socket module set includes sockets for three types of power devices: in-line package, TO-package, and axial lead. These socket modules are designed for a high current unit with Kelvin connections.

A description of each socket module follows:

#### □ TO- Package (TO-3 or TO-66)



HP Part Number: 16088-60007

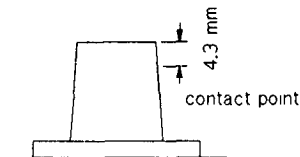
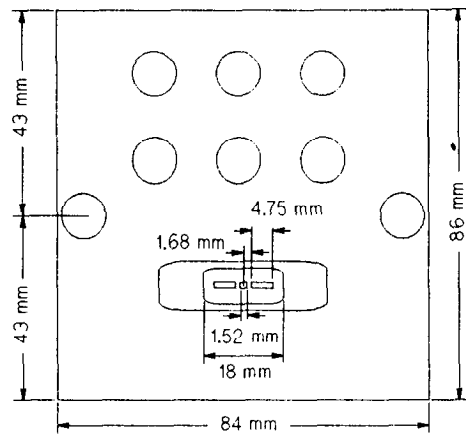
This socket module is installed with an TO-3 or TO-66 package socket for Kelvin connections.

Reference data

Maximum voltage: 1000 V

Residual Resistance: 20 mΩ typical

#### □ In-line Package (3-pin)



HP Part Number: 16088-60008

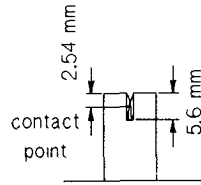
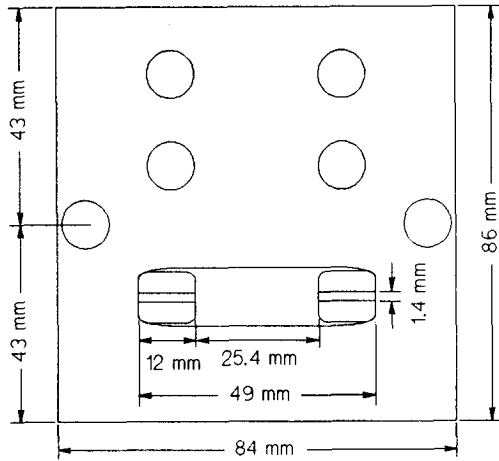
This socket module is installed with an in-line package socket for Kelvin connections.

Reference Data

Maximum Voltage: 1000 V

Residual Resistance: 20 mΩ typical

## □ Axial Lead Package



HP Part Number: 16088-60009

This socket module is installed with an axial lead package socket for Kelvin connections.

### Reference Data

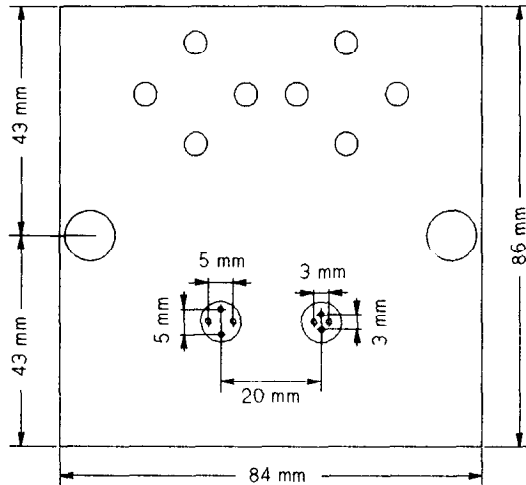
Maximum Voltage: 1000 V

Residual Resistance: 20 m $\Omega$  typical

## ■ Socket Module Set for Low Power Devices

This socket module set includes sockets for six types of power device: TO-packages (4-pin), dual-in-line packages (28-pin), dual-in-line packages (18-pin), TO-packages (8-pin), TO-packages (10-pin), and TO-packages (12-pin). These socket modules are not designed for Kelvin connections.

### □ TO-Packages (4-pin)

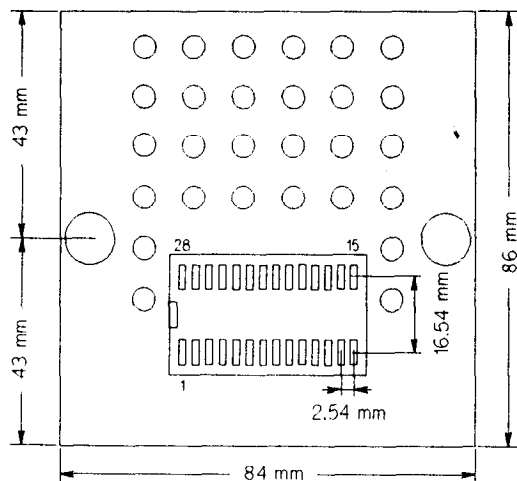


HP Part Number: 16088-60001

This socket module is installed with two transistor sockets for measurement of three lead or four lead bipolar transistors and FETs.

Maximum Voltage: 200 V

### □ Dual-In-Line Packages (28-pin)

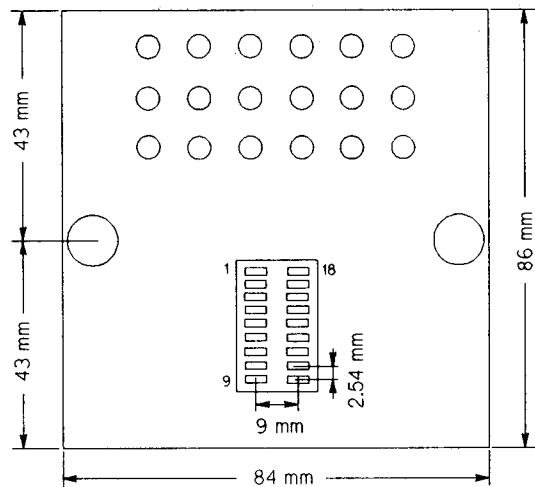


HP Part Number: 16088-60002

This socket module is installed with a 28-pin dual-in-line socket.

Maximum Voltage: 230 V

□ Dual-In-Line Package (18-pin)

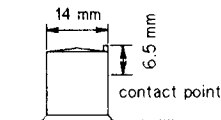
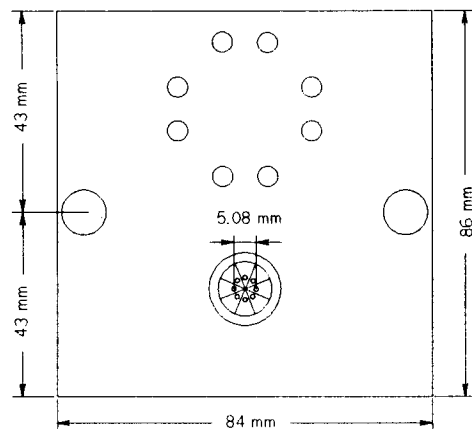


HP Part Number: 16088-60003

This socket module is installed with an 18-pin dual-in-line socket.

Maximum Voltage: 230 V

□ TO-Package (8-pin)

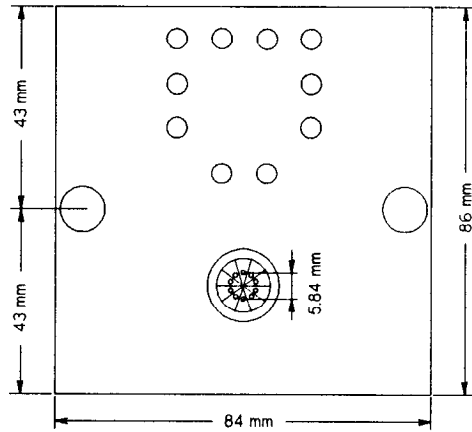


HP Part Number: 16088-60004

This socket module is for measurements of 8-pin package devices.

Maximum Voltage: 230 V

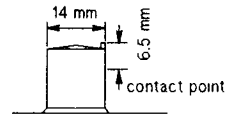
□ TO-Package (10-pin)



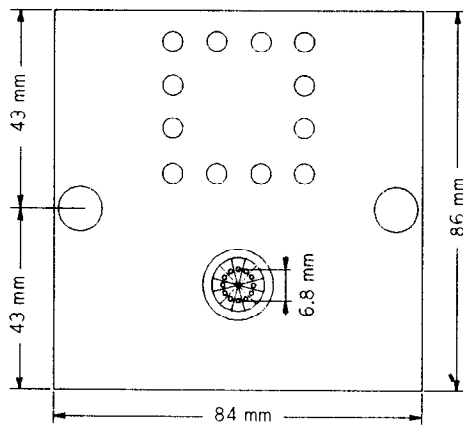
HP Part Number: 16088-60005

This socket module is for measurements of 10-pin package devices.

Maximum Voltage: 230 V



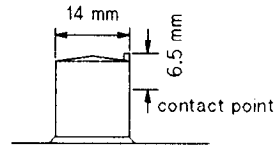
□ TO-Package (12-pin)



HP Part Number: 16088-60006

This socket module is for measurements of 12-pin TO- package devices.

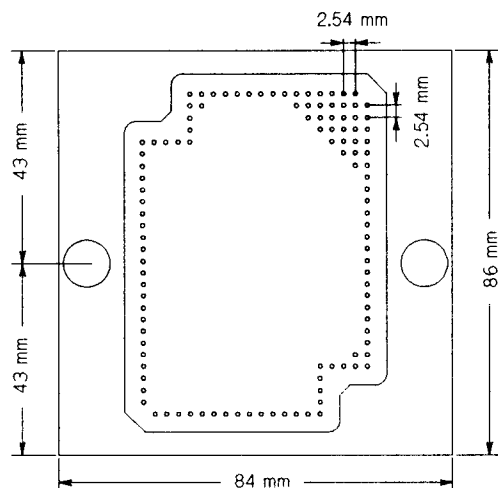
Maximum Voltage: 230 V



## ■ Universal Socket Module and Blank Teflon Board

A universal socket module and a blank Teflon board are furnished with the test fixture.

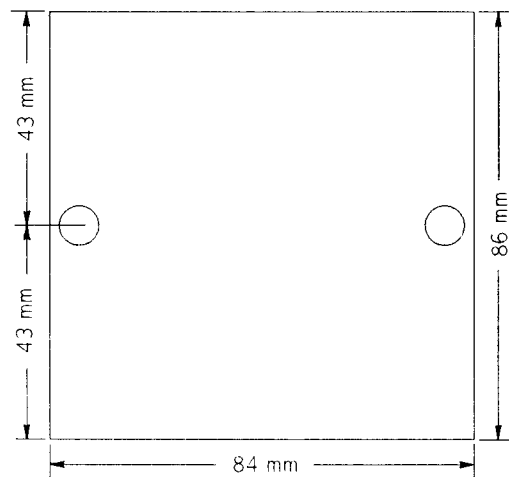
### □ Universal Socket Module



HP Part Number: 16088-60010

This socket module is for measurement of virtually any device--component, DIP IC, or small-scale circuit.

### □ Blank Teflon Board



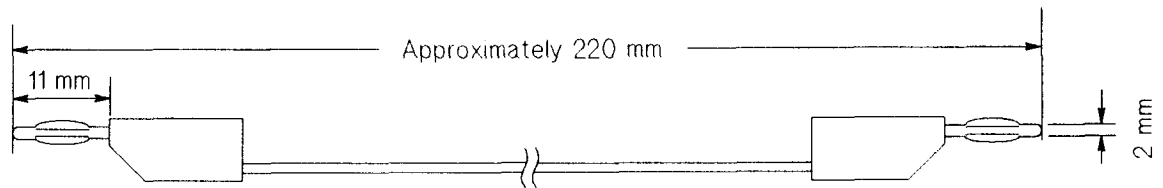
HP Part Number: 16058-60004

This insulation board with minimal leakage current is for extremely low current measurements.

## ■ Connection Cable Sets

Three types of connection cables are provided as follows:

### □ Miniature Banana - Miniature Banana



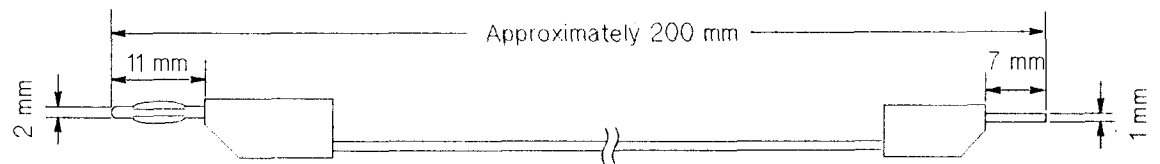
HP Part Number: 16088-61001

This connection cable set has five miniature banana-miniature banana connection cables.

Reference data

Residual Resistance: 20 m $\Omega$  typical

### □ Miniature Banana - Pin Plug



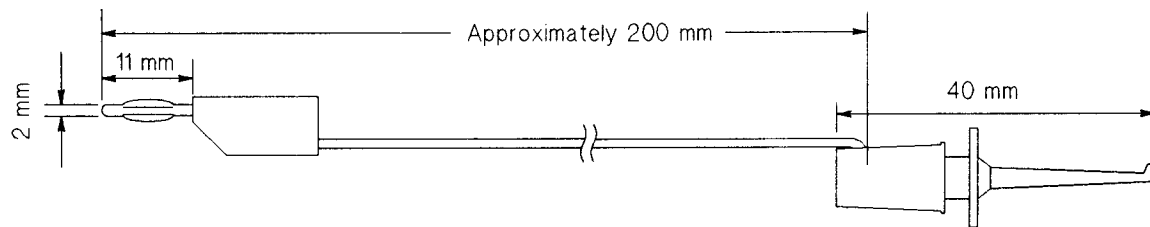
HP Part Number: 16088-61002

This connection cable set has five miniature banana-pin plug connection cables.

Reference data

Residual Resistance: 20 m $\Omega$  typical

#### □ Miniature Banana - Miniature Clip



HP Part Number: 16088-61003

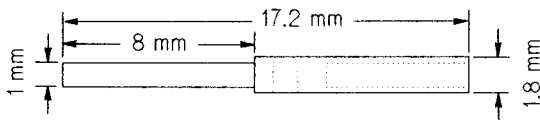
This connection cable set has five miniature banana-miniature clip connection cables.

Reference data

Residual Resistance: 20 m $\Omega$  typical

#### ■ Connection Pin Set

HP Part Number: 16088-60013



This connection pin is used with a universal socket module. A set includes ten connection pins.

#### ■ Carrying Case

The carrying case can hold up to six socket modules, a blank Teflon board, and connection cables. The HP part number of the carrying case is 16088-60100. Refer to Figure 1-1.

## Operation

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### Introduction

This chapter provides information for operating the test fixture.

First of all, select the proper environment to execute the measurements. Place the test fixture on a flat surface. The test fixture is contained in an electromagnetic shelter, but Hewlett-Packard recommends that the measurement is performed in as noiseless environment as possible for more stable and accurate measurement results.

The electric devices are placed into the provided socket modules in the test fixture, and their dc characteristics are measured by Source Monitors.

For electrical devices that don't fit into any of the pre-formed socket modules, make the connections between the device and the necessary terminals directly using the miniature clip connection cables and the blank Teflon board. You can also use the universal socket module for uniquely shaped electrical devices.

The optional module selector lets you select between the SMU, HCU, or HVU as the unit to be connected to the DUT without having to manually change the connections.

This section covers the following topics:

- Attaching a socket module into the test fixture.
- Mounting and wiring the DUT on the socket module.

---

#### Warning



**Be sure to use the interlock (INTLK) terminal and HVU OUTPUT ON/OFF STATUS terminal to prevent electric shock.**

---

#### Warning



**Do not operate the test fixture while the HVU OUTPUT ON/OFF STATUS indicator is lit. Dangerous voltages of up to 1000 V may be present on the connection between the source monitor and the DUT.**

---

#### Note



After setting up the test fixture and DUT, confirm that the connections are correct. Shut the fixture lid to short the interlock (INTLK) terminal.

---

#### Caution



**Do not remove or attach the DUT in the test fixture when voltage or current is present in the test fixture due to possible damage to the instrument or the DUT.**

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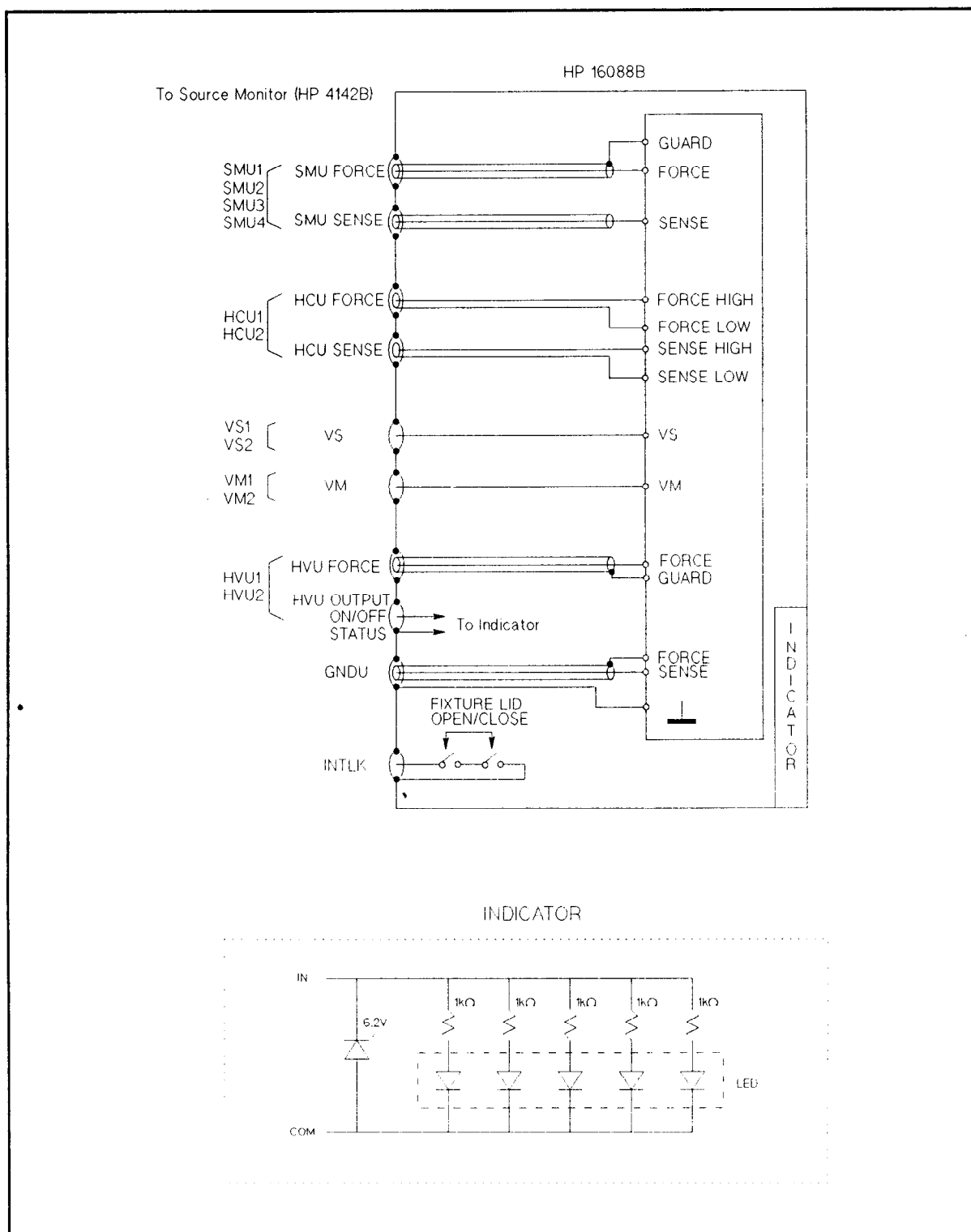
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**Caution**

Do not touch any metal surface that is in the circuit path. Oil, perspiration, and dirt prevent good electric contact and degrade measurement accuracy.

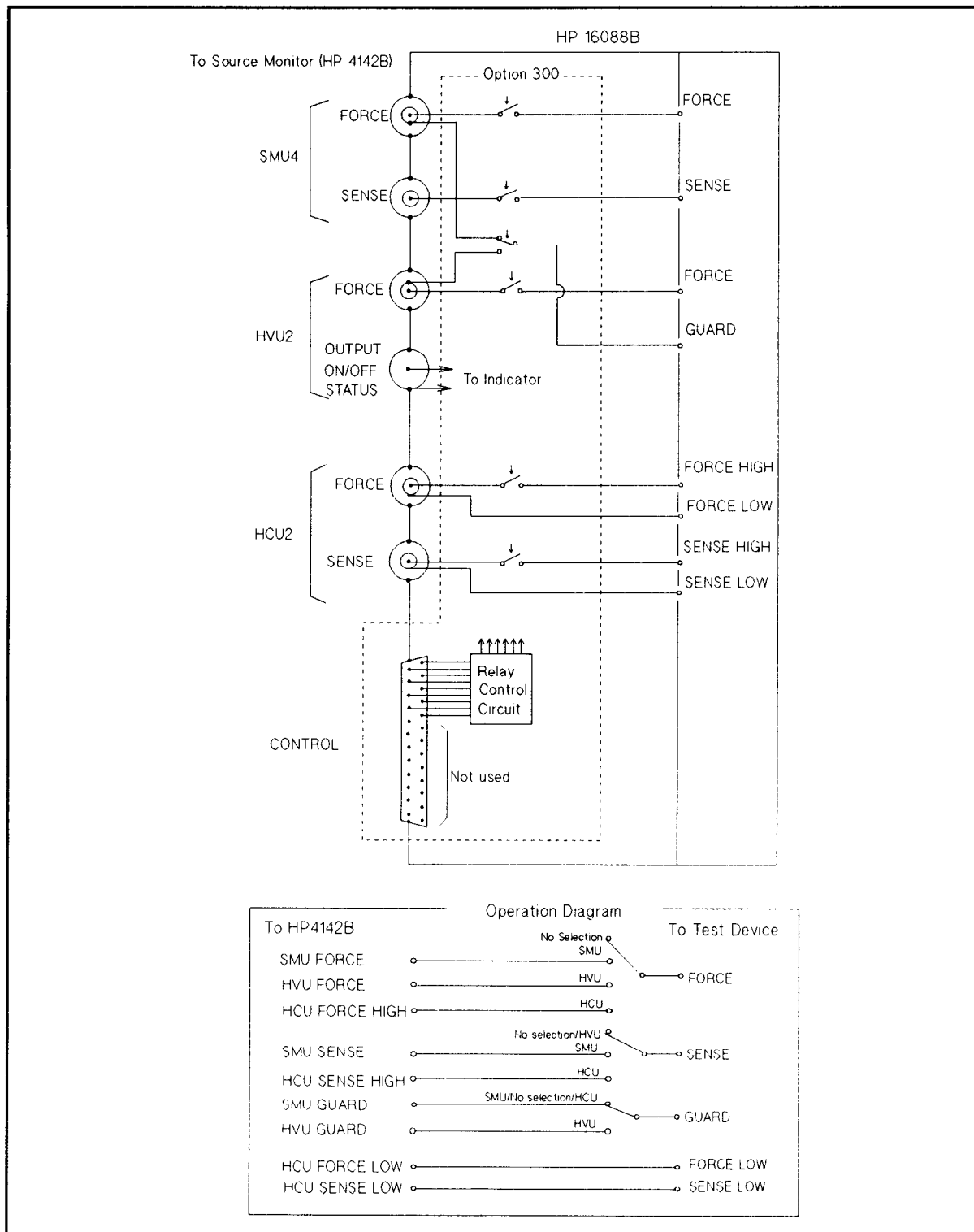
---

Figure 2-1 shows the circuit schematic in the standard test fixture.



**Figure 2-1. Circuit Schematic in the standard Test Fixture**

Figure 2-2 shows the circuit schematic of selectable channels in the test fixture with module selector (option 300).



**Figure 2-2. Circuit Schematic of selectable channels (option 300 only)**

The test fixture is equipped with an interlock (INTLK) terminal that prevents the user from getting an electric shock during operation. A Source Monitor has an INTLK terminal that is made from a BNC connector, and it must be connected to the INTLK terminal of the test fixture using a BNC-BNC cable. When the lid of the test fixture is open, two switches at the center conductor of the INTLK terminal are open. The instrument recognizes that the test lid of the fixture is not closed and does not output high voltage.

The test fixture is also equipped with an HVU ON/OFF STATUS terminal to indicate whether the output switch of the HVU is on or off. The HVU may output dangerous voltages of up to 1000 V.

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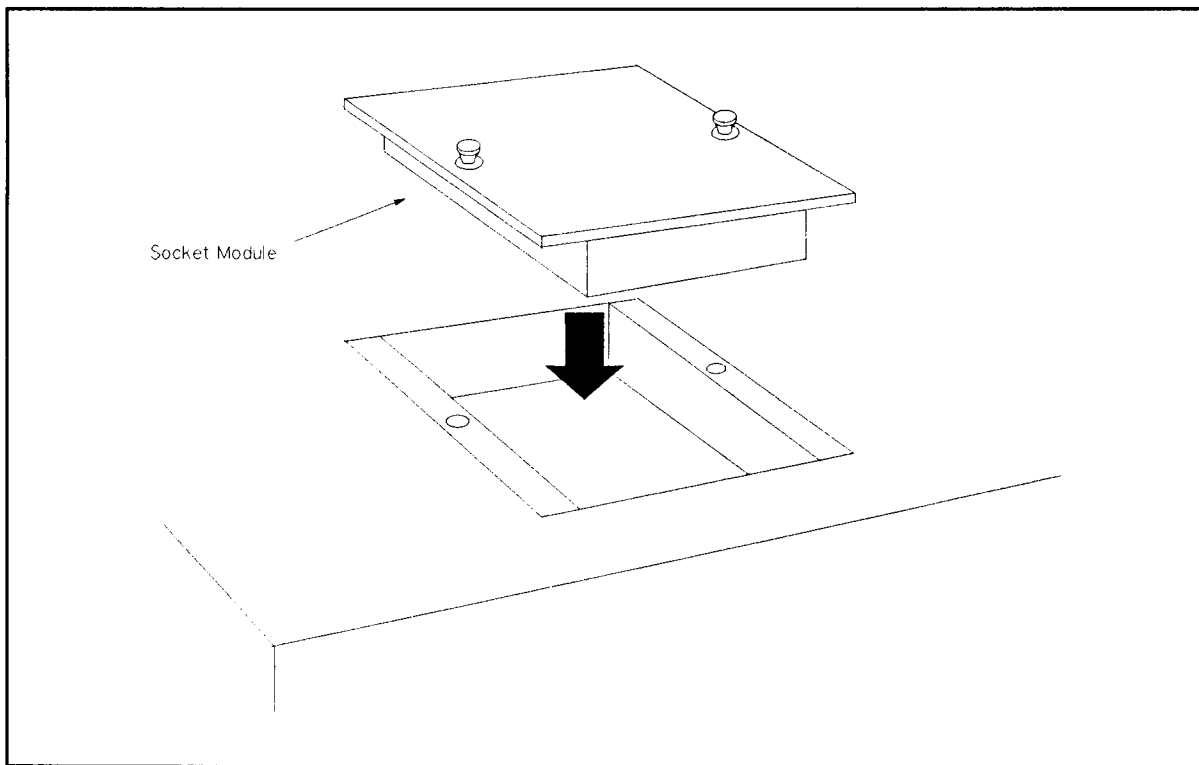
## Attaching a Socket Module in the Test Fixture

After choosing the correct socket module for the DUT, you must install the socket module into the test fixture. Figure 2-3 shows the attachment into the test fixture. Use the following procedure to attach the socket module:

1. Open the lid of the test fixture.
2. Check that the black plastic fasteners of the socket module are unlocked.
3. Put the socket module into the test fixture.
4. Press the black fasteners down to lock the socket module into place.

Use the following procedure to remove a socket module from the test fixture:

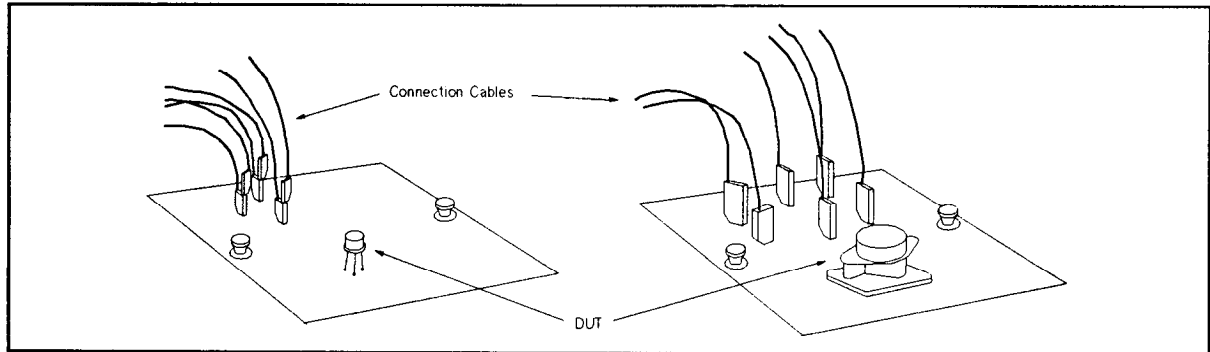
1. Open the lid of the test fixture.
2. Do not add any voltage or current to the terminals.
3. Disconnect the connection cables.
4. Pull up the black plastic fasteners on both sides of the socket module.
5. Lift the socket module from the test fixture.



**Figure 2-3. Attaching a Socket Module into the Test Fixture**

## Mounting and Wiring the DUT on the Socket Module

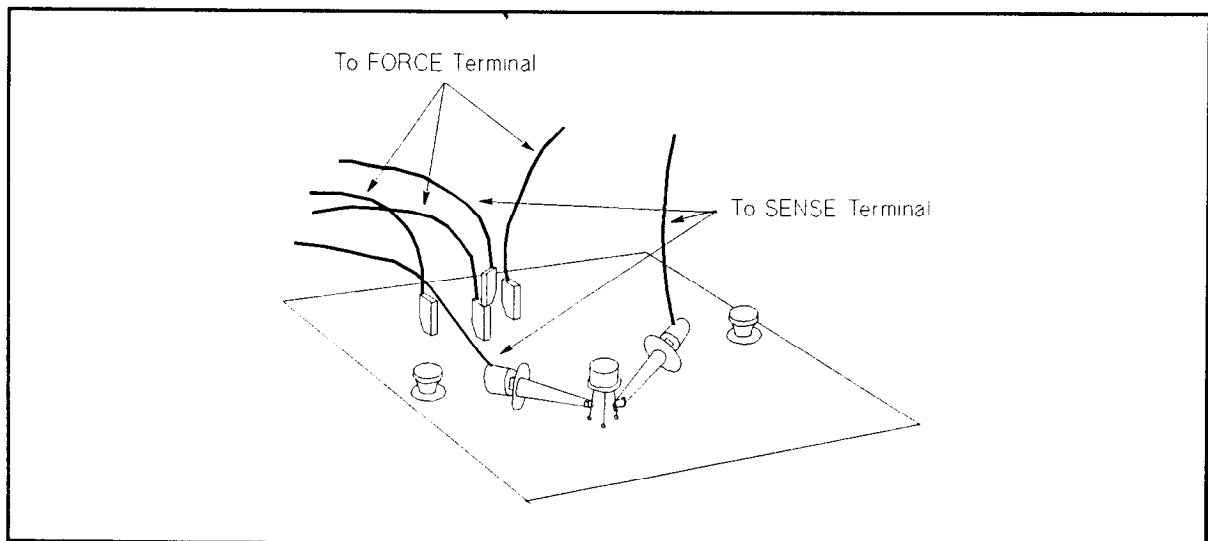
Nine socket modules are provided for mounting the DUTs. Three socket modules are for power devices and six socket modules are for low power devices. Figure 2-4 shows how to mount the DUT on the socket module.



**Figure 2-4. Mounting the DUT on the Socket Module**

The three socket modules for power devices have force and sense terminals for Kelvin connections. As shown in the example to the right in Figure 2-4, connect the FORCE and SENSE terminals on the test fixture to the FORCE and SENSE terminals on the socket module using miniature banana – miniature banana connection cables.

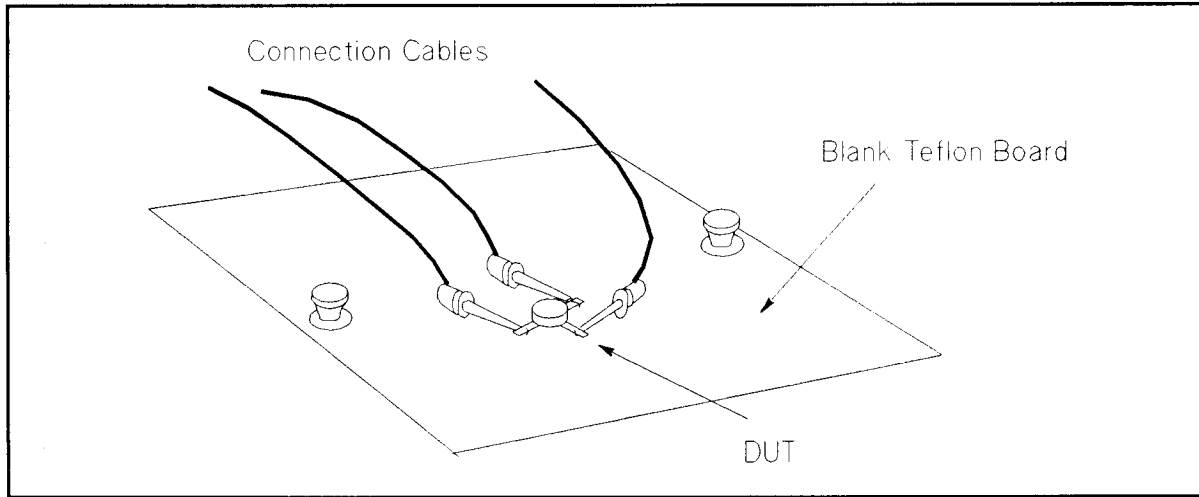
The six socket modules for low power devices have FORCE terminals only. As shown in the example to the left in Figure 2-4, connect both FORCE and SENSE terminals on the test fixture to the FORCE terminal on the socket module with miniature banana – pin plug connection cables. Insert one pin plug into the terminal of the socket module in place and insert the other pin plug into the tail hole of the inserted pin plug. To connect sense terminals as near as possible to the DUT, connect the sense terminals directly to the DUT with the miniature banana – miniature clip connection cables, as shown in Figure 2-5.



**Figure 2-5. How to Make Kelvin Connections Close to the DUT**

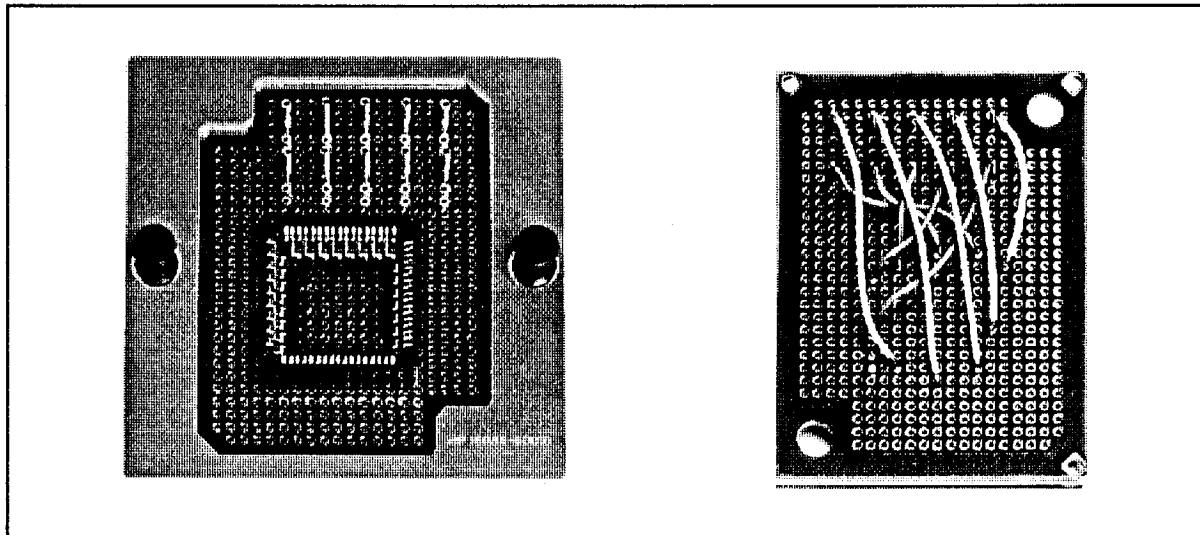
If there is no socket module for a uniquely shaped electric device, connect all the terminals directly to the DUT on the blank Teflon board with the miniature banana – miniature clip

connection cables, as shown in Figure 2-6. Make sure to place the DUT on the blank Teflon board.



**Figure 2-6. How to Make Connections on the Blank Teflon Board**

You can also create a mount on the universal socket module for uniquely shaped devices. Figure 2-7 shows an example of a universal socket module. The connection pins are used to connect to the pin plug terminal of the connection cable. Note that hydrochloric acid residue deposited by solder may cause electrical problems. Hewlett-Packard recommends that you solder the wiring on the universal board using low hydrochloric acid solder (HP part number: 8090-0433). Do not use the universal socket module for low-current measurements (less than 1 nA) that require that the leakage current be kept very low.



**Figure 2-7. An Example Using the Universal Socket Module**

## Maintenance

---

### Introduction

This chapter provides the following maintenance information: cleaning, performing safety tests and servicing.

---

### Cleaning the Test Fixture

To maintain high performance, the test fixture must be kept clean. Oil, perspiration, hair, fibrous dust, and dirt degrade board insulation, which increases leakage current and decreases measurement accuracy.

Hewlett-Packard recommends the following clean-up procedure:

Chassis, lid, inner plate, and socket modules:

1. Make sure that voltage or current is not present at any port.
2. Disconnect all cables from the test fixture.
3. Using lint-free paper, gently wipe the chassis, lid, and inner plate. For any area that will not come clean, dip the lint-free paper into alcohol and wipe the area gently.

Connection cables:

1. Disconnect the connection cables from test fixture.
2. Dip lint-free paper into alcohol and gently wipe the contact metal on the connection cables.

---

## Performing the Safety Tests

---

### Warning



**Dangerous voltages of up to 1000 V are forced to the HP 16088B. To prevent electric shock, confirm that the following circuit operation tests of the Interlock (INTLK) terminal and the OUTPUT ON/OFF STATUS terminal pass before using the fixture.**

---

- If you use this fixture with an HP 4142B equipped with HVUs, perform the tests as described in “Performing the Safety Tests with an HP 4142B” in this section.
- If you use this fixture with another high voltage source monitor unit, perform the tests as described in “Performing the Safety Tests without an HP 4142B” in this section.

### Performing the Safety Tests with an HP 4142B

#### Performing the INTLK Circuit Test

1. Open the fixture lid.
2. Press the **LOCAL/SELF TEST** key on the front panel of the HP 4142B to perform Self-Test.
3. Confirm that “U” is displayed in the ERROR/FAILURE display after Self-Test finishes.
4. Close the fixture lid (short the INTLK terminal).
5. Press the **LOCAL/SELF TEST** key to perform Self-test.
6. Confirm that “0” is displayed in the ERROR/FAILURE display after Self-Test finishes.

If step 3 and step 6 pass, the INTLK circuit works correctly. If step 3 or step 6 does not pass, repair the INTLK circuit.

#### Performing the OUTPUT ON/OFF STATUS Circuit Test

1. Press the **LOCAL/SELF TEST** key to perform Self-Test.
2. During Self-Test, confirm that the warning indicator connected to the OUTPUT ON/OFF STATUS terminal is lit for about 5 seconds for each HVU installed.
3. Confirm that the warning indicator is not lit after the Self-Test finishes.

If step 2 and step 3 pass, the OUTPUT ON/OFF STATUS circuit works correctly. If step 2 or step 3 does not pass, notify the nearest Hewlett-Packard office.

## **Performing the Safety Tests without an HP 4142B**

### **Performing the INTLK Circuit Test**

1. Open the fixture lid.
2. With a hand held multimeter, measure the resistance between the center and outer conductors of the INTLK terminal on the rear panel.
3. Confirm that the resistance is greater than 100 k $\Omega$  (interlock switch: off).
4. Close the fixture lid.
5. Perform step 2.
6. Confirm that the resistance is less than 2  $\Omega$  (interlock switch: on).

If step 3 and step 6 pass, the INTLK circuit works correctly. If step 3 or step 6 does not pass, repair the INTLK circuit.

### **Performing the OUTPUT ON/OFF STATUS Circuit Test**

1. Force 4 Vdc ( $\pm 1$  Vdc) between the center and outer conductors of the HVU1 OUTPUT ON/OFF STATUS terminal on the rear panel (center conductor: +, outer conductor: -).
2. Confirm that the warning indicator is lit.
3. Perform step 1 to the HVU2 OUTPUT ON/OFF STATUS terminal.
4. Confirm that the warning indicator is lit.

If step 2 and step 4 pass, the OUTPUT ON/OFF STATUS circuit works correctly. If step 2 or step 4 does not pass, notify the nearest Hewlett-Packard office.

---

## Performing the Relay Switching Tests

This section describes how to perform the relay switching tests to check the function of relays, which are on the relay board in the test fixture.

Perform the tests after repairing the test fixture to verify operation of relays and inside wiring of the test fixture.

---

**Caution** Place the test fixture within  $\pm 20^\circ$  of horizontal during relay switching tests.



If the angle exceeds  $\pm 20^\circ$ , the test fixture does not operate correctly (a relay that is set to off could be inadvertently set to on, and the resistance of the relay can increase).

---

You can easily perform the relay switching tests with an HP 4142B by sending HP-IB commands from a controller. Or you can perform the relay switching tests with a power supply when you don't have an HP 4142B and a controller.

### Performing the Relay Switching Tests by using a Power Supply

This section describes how to perform the relay switching tests by using a power supply. Figure 3-1 shows the circuit for the relay switching tests that use a power supply.

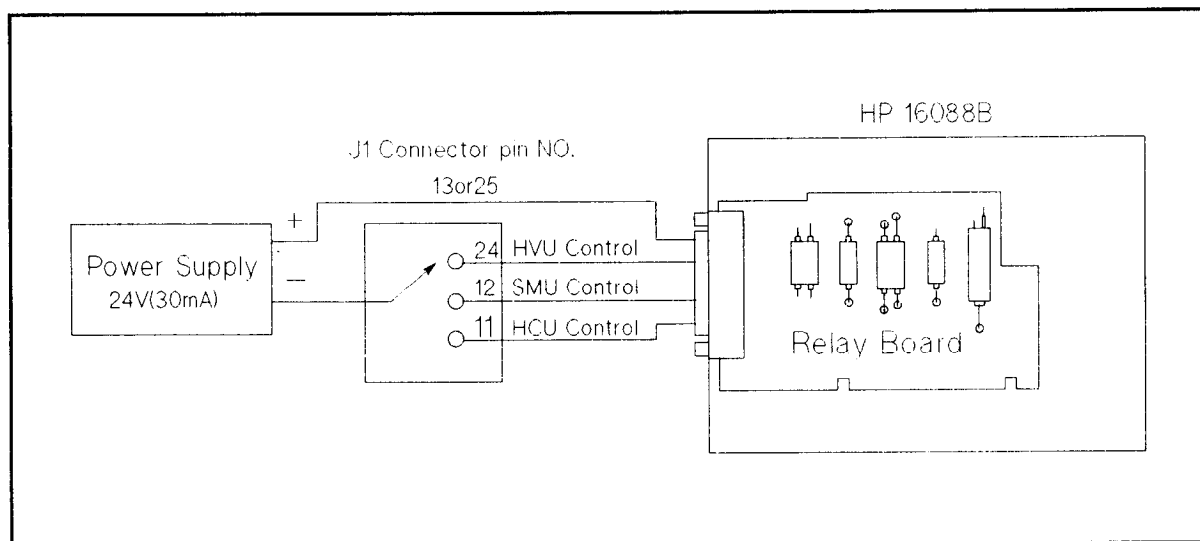


Figure 3-1. Circuit for Relay Testing by using a Power Supply

To test the relay switching, measure the resistance between connectors on the rear panel and pins of the DUT Connection Panel according to Table 3-1 and Table 3-2.

Figure 3-2 shows the locations of connectors on the rear panel and DUT Connection Panel.

**Table 3-1. Relay Testing with the Power Supply Turned OFF**

| Measurement Terminals        |                                  | Relay Tested | Measured Resistance |
|------------------------------|----------------------------------|--------------|---------------------|
| Connectors on the Rear Panel | Pins on the DUT Connection Panel |              |                     |
| SMU4 GUARD                   | HVU2 GUARD                       | K4           | <10 $\Omega$        |
| HVU2 GUARD                   | HVU2 GUARD                       | K4           | >100k $\Omega$      |
| HVU2 FORCE                   | HVU2 FORCE                       | K3           | >100k $\Omega$      |
| SMU4 FORCE                   | SMU4 FORCE                       | K2           | >100k $\Omega$      |
| SMU4 SENSE                   | SMU4 SENSE                       | K2           | >100k $\Omega$      |
| HCU2 FORCE HIGH              | HCU2 FORCE HIGH                  | K1           | >100k $\Omega$      |
| HCU2 SENSE HIGH              | HCU2 SENSE HIGH                  | K5           | >100k $\Omega$      |

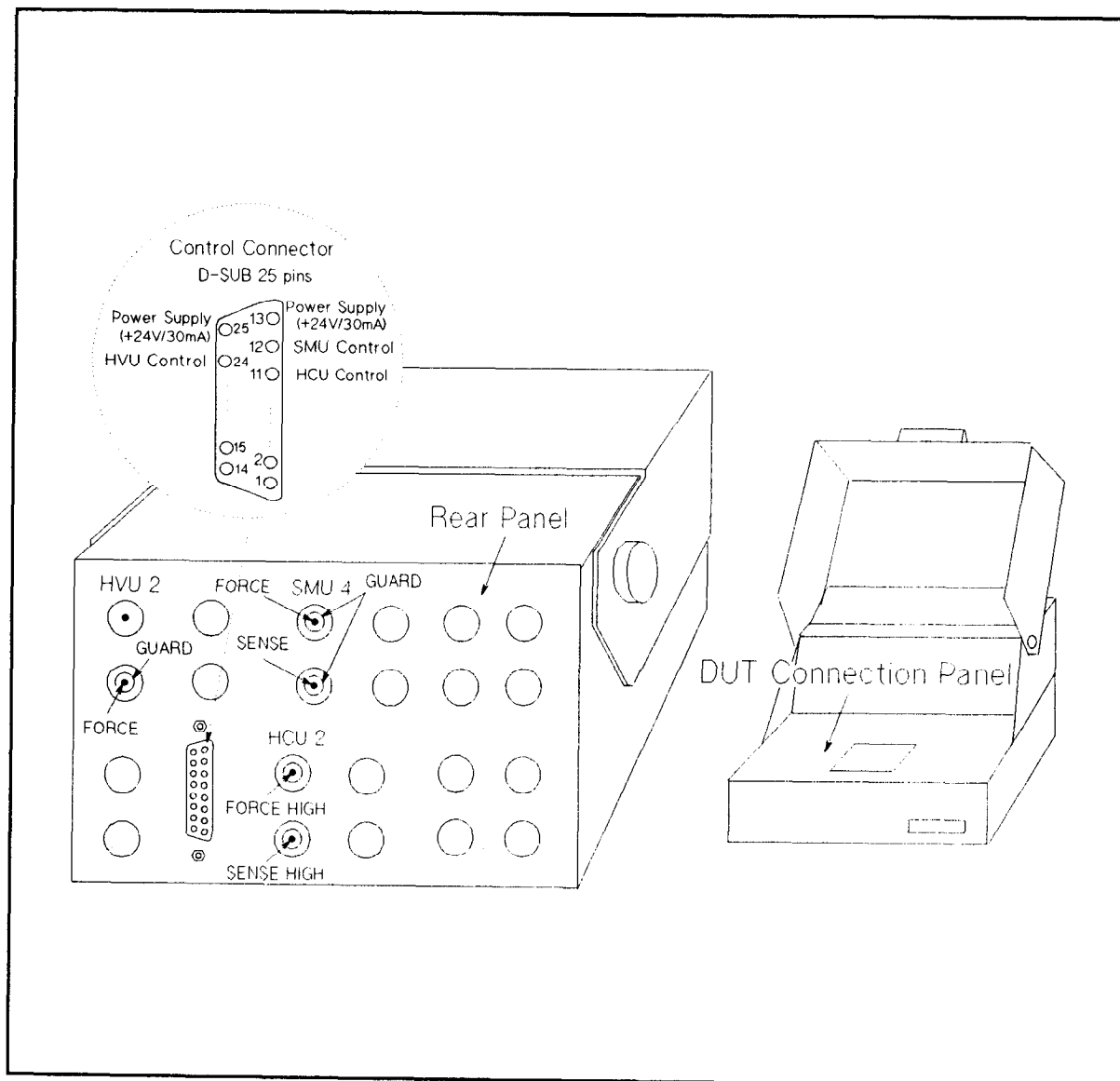
**Table 3-2. Relay Testing with the Power Supply Turned ON**

| Power Supply      | Measurement Terminals        |                                  | Relay Tested | Measured Resistance |
|-------------------|------------------------------|----------------------------------|--------------|---------------------|
|                   | Connectors on the Rear Panel | Pins on the DUT Connection Panel |              |                     |
| J1 24 HVU Control | SMU4 GUARD                   | HVU2 GUARD                       | K4           | >100k $\Omega$      |
| J1 24 HVU Control | HVU2 GUARD                   | HVU2 GUARD                       | K4           | <10 $\Omega$        |
| J1 24 HVU Control | HVU2 FORCE                   | HVU2 FORCE                       | K3           | <10 $\Omega$        |
| J1 12 SMU Control | SMU4 FORCE                   | SMU4 FORCE                       | K2           | <10 $\Omega$        |
| J1 12 SMU Control | SMU4 SENSE                   | SMU4 SENSE                       | K2           | <10 $\Omega$        |
| J1 11 HCU Control | HCU2 FORCE HIGH              | HCU2 FORCE HIGH                  | K1           | <10 $\Omega$        |
| J1 11 HCU Control | HCU2 SENSE HIGH              | HCU2 SENSE HIGH                  | K5           | <10 $\Omega$        |

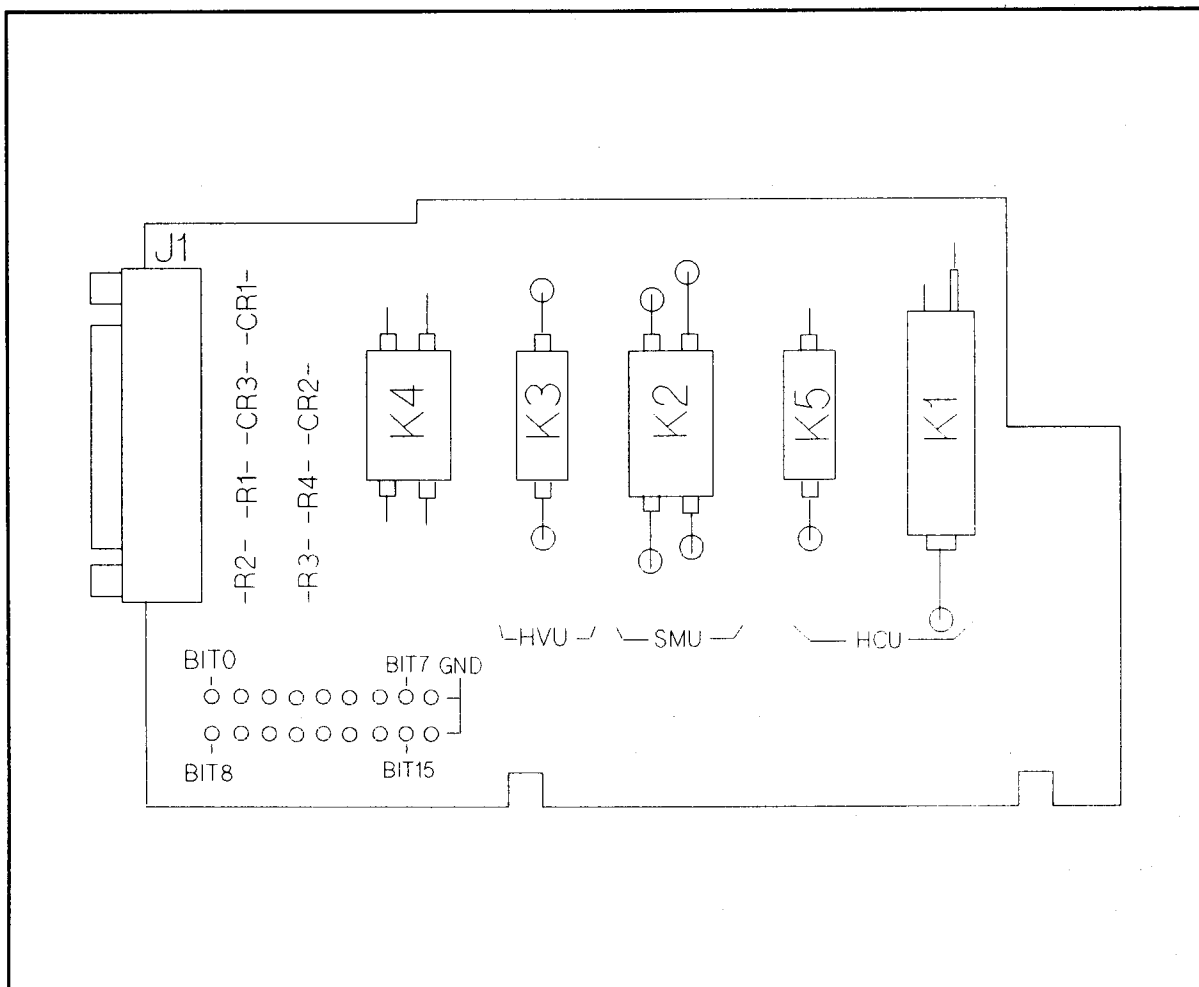
If the measured resistances do not correspond to Table 3-1 and Table 3-2, check the inside wiring of the test fixture. If there are any wiring mistakes, correct them.  
(For inside wiring of the test fixture, see Figure 3-8.)

If the wiring is correct and the measured resistances do not correspond to Table 3-1 and Table 3-2, replace the relays with new relays.

Figure 3-5 shows the circuit on the Relay Board of the test fixture.



**Figure 3-2. Locations of Connectors and DUT Connection Panel**



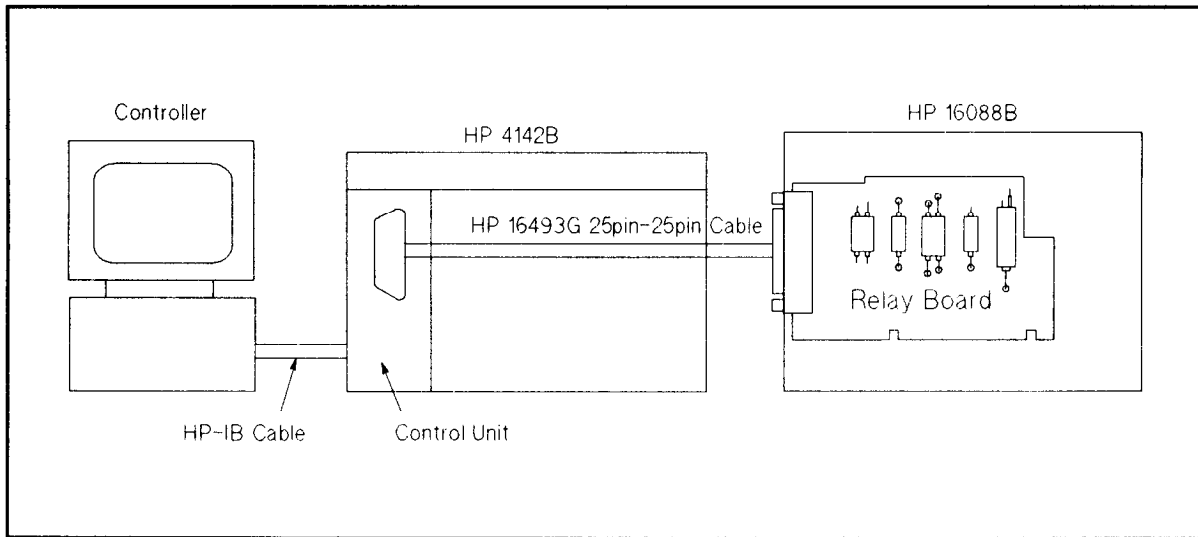
**Figure 3-3. Component Locations on Relay Board Assembly**

**Table 3-3. Part Numbers for Replaceable Relays**

| Relay Number | HP Part Number |
|--------------|----------------|
| K1           | 0490-1763      |
| K2           | 0490-1613      |
| K3           | 0490-1698      |
| K4           | 0490-1694      |
| K5           | 0490-1698      |

## Performing the Relay Switching Tests by using an HP 4142B

This section describes how to use the Control Unit of an HP 4142B and a controller to test switching of relays. Figure 3-4 shows the configuration for the relay switching tests that use the HP 4142B.



**Figure 3-4. Configuration for Relay Testing by using the HP 4142B**

By sending the ERC command as follows from the controller, you can set each control situation.

- For HVU Control: OUTPUT 717;"ERC";1,2
- For SMU Control: OUTPUT 717;"ERC";1,1
- For HCU Control: OUTPUT 717;"ERC";1,3
- For Open Condition: OUTPUT 717;"ERC";1,0

To test the relay switching, measure the resistance between connectors on the rear panel and pins of the DUT Connection Panel according to Table 3-4.

Figure 3-2 shows the locations of connectors on the rear panel and DUT Connection Panel.

**Table 3-4. Relay Testing by using ERC Commands**

| ERC Command | Measurement Terminals        |                                  | Relay Tested | Measured Resistance |
|-------------|------------------------------|----------------------------------|--------------|---------------------|
|             | Connectors on the Rear Panel | Pins on the DUT Connection Panel |              |                     |
| "ERC";1,2   | SMU4 GUARD                   | HVU2 GUARD                       | K4           | >100k $\Omega$      |
| "ERC";1,2   | HVU2 GUARD                   | HVU2 GUARD                       | K4           | <10 $\Omega$        |
| "ERC";1,2   | HVU2 FORCE                   | HVU2 FORCE                       | K3           | <10 $\Omega$        |
| "ERC";1,1   | SMU4 FORCE                   | SMU4 FORCE                       | K2           | <10 $\Omega$        |
| "ERC";1,1   | SMU4 SENSE                   | SMU4 SENSE                       | K2           | <10 $\Omega$        |
| "ERC";1,3   | HCU2 FORCE HIGH              | HCU2 FORCE HIGH                  | K1           | <10 $\Omega$        |
| "ERC";1,3   | HCU2 SENSE HIGH              | HCU2 SENSE HIGH                  | K5           | <10 $\Omega$        |
| "ERC";1,0   | SMU4 GUARD                   | HVU2 GUARD                       | K4           | <10 $\Omega$        |
| "ERC";1,0   | HVU2 GUARD                   | HVU2 GUARD                       | K4           | >100k $\Omega$      |
| "ERC";1,0   | HVU2 FORCE                   | HVU2 FORCE                       | K3           | >100k $\Omega$      |
| "ERC";1,0   | SMU4 FORCE                   | SMU4 FORCE                       | K2           | >100k $\Omega$      |
| "ERC";1,0   | SMU4 SENSE                   | SMU4 SENSE                       | K2           | >100k $\Omega$      |
| "ERC";1,0   | HCU2 FORCE HIGH              | HCU2 FORCE HIGH                  | K1           | >100k $\Omega$      |
| "ERC";1,0   | HCU2 SENSE HIGH              | HCU2 SENSE HIGH                  | K5           | >100k $\Omega$      |

If the measured resistances do not correspond to Table 3-4, check the inside wiring of the test fixture. If there are any wiring mistakes, correct them.  
(For inside wiring of the test fixture, see Figure 3-8.)

If the wiring is correct and the measured resistances do not correspond to Table 3-4, replace the relays with new relays. (For the locations and the part numbers of relays, see Figure 3-3 and Table 3-3.)

Figure 3-5 shows the circuit on the Relay Board of the test fixture.

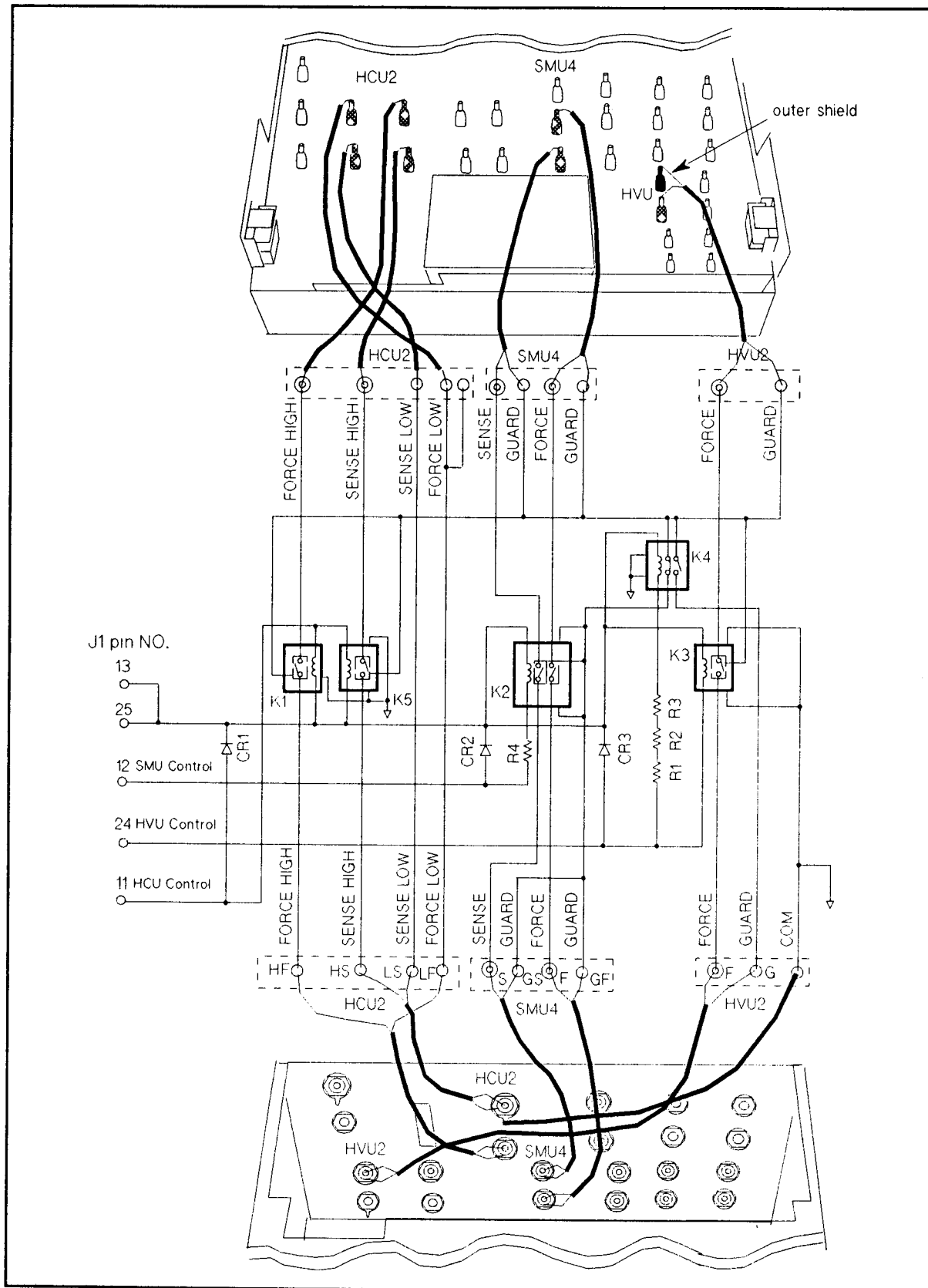


Figure 3-5. Circuit on the Relay Board of the Test Fixture

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## Upgrading to HP 16088B Option 300

You can upgrade from HP 16088B without Opt.300 to HP 16088B with Opt.300 by using the parts listed in the following table. For details about installation of Opt.300, see Figure 3-8.

**Table 3-5. Upgrade Parts List for Option 300**

| HP Part Number | Quantity               | Description                     |
|----------------|------------------------|---------------------------------|
| 8120-4856      | 22cm×2, 14cm×1, 35cm×1 | Coaxial Cable 50 $\Omega$       |
| 8120-0102      | 18cm×2                 | Coaxial Cable 50 $\Omega$       |
| 8120-5297      | 17cm                   | Coaxial Cable Pair <sup>1</sup> |
| 8150-5053      | 15cm×2                 | Wire 24 Black                   |
| 8150-4684      | 15cm×1                 | Wire 24 Orange                  |
| 8150-5063      | 15cm×1                 | Wire 24 Red                     |
| 8150-4689      | 15cm×1                 | Wire 24 Gray                    |
| 0515-1550      | 2                      | Screw M3-L 8 P-H                |
| 1531-0314      | 2                      | Clevis                          |
| 0535-0031      | 2                      | Nut                             |
| 16087-66501    | 1                      | Relay Board                     |

<sup>1</sup> This cable includes two coaxial cables—gray and black cables—wrapped in a tube. The gray cable is connected to the force terminal and the black cable is connected to the sense terminal of the HCU port.

After installation of Opt.300, be sure to perform the safety tests and the relay switching tests to verify the wiring and the safety of the test fixture.

---

## Servicing the Test Fixture

This section provides information for trained service personnel to repair the test fixture.

“Replaceable Parts” provides the HP part numbers of replaceable parts. When a part needs to be replaced, order the parts from the nearest HP Sales and Service Office.

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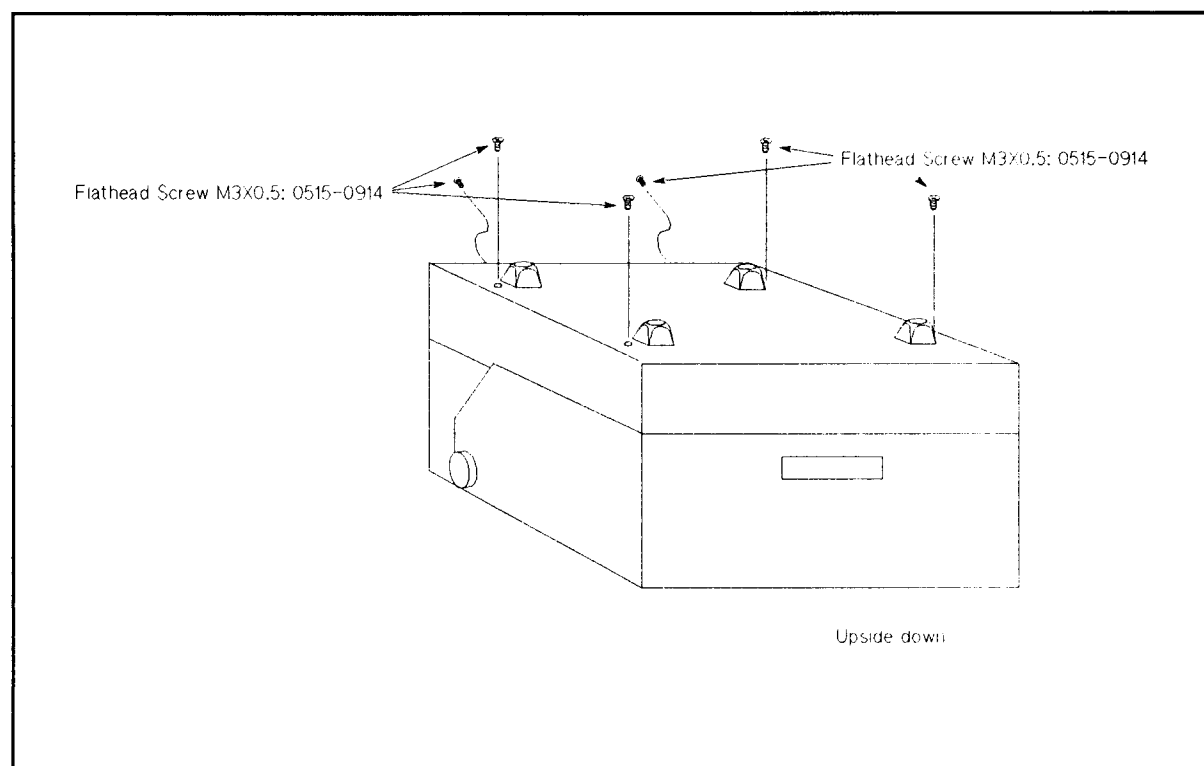
### Warning



**High voltages may be present in the test fixture when voltage or current is added to the test fixture. Dangerous voltage may be generated on wires or parts and the danger of electric shock exists.**

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Make sure that ports are not connected to the instruments before you repair the test fixture. When you remove the bottom cover, loosen the six flathead screws using a screwdriver, as shown in Figure 3-6.



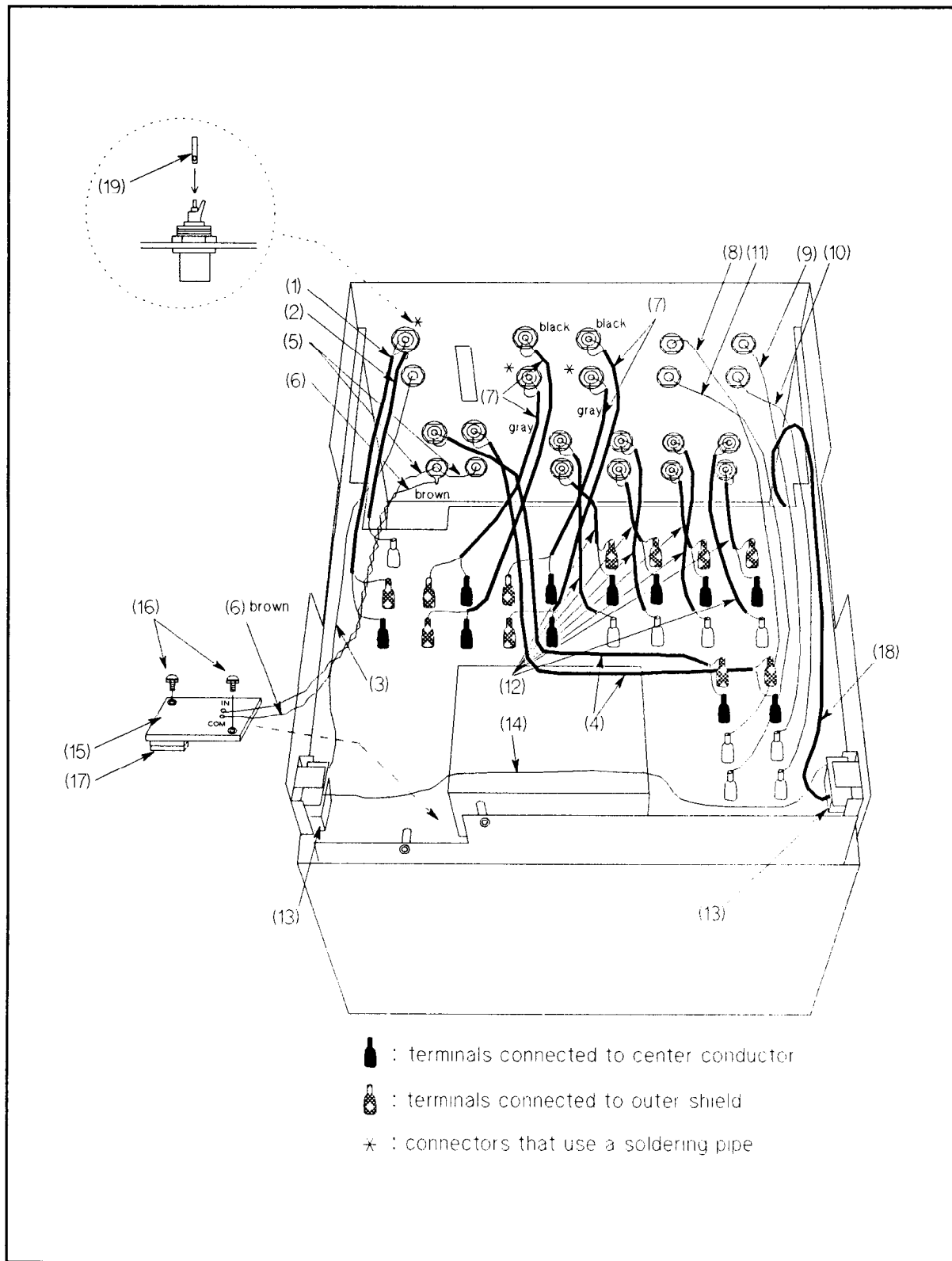
**Figure 3-6. Removing the Bottom Cover**

When wiring the test fixture and socket modules, use low hydrochloric acid solder (HP part number: 8090-0433) to prevent the flux in the solder from spreading unnecessarily. When soldering, make sure the terminals do not make contact with each other. After soldering, make sure that there are no lint bridges so that leakage current is minimal.

Keep the following items in mind when repairing socket modules:

- Place a ferrite bead at the 8 mm point of the terminal on the socket side and fix the bead using epoxy adhesive.
- Never allow the ferrite beads to make contact with each other.
- For the three socket modules used for power devices, wrap the contact of the wire and socket terminal using heat-shrink tube (HP part number: 0890-1496).

## Replaceable Parts

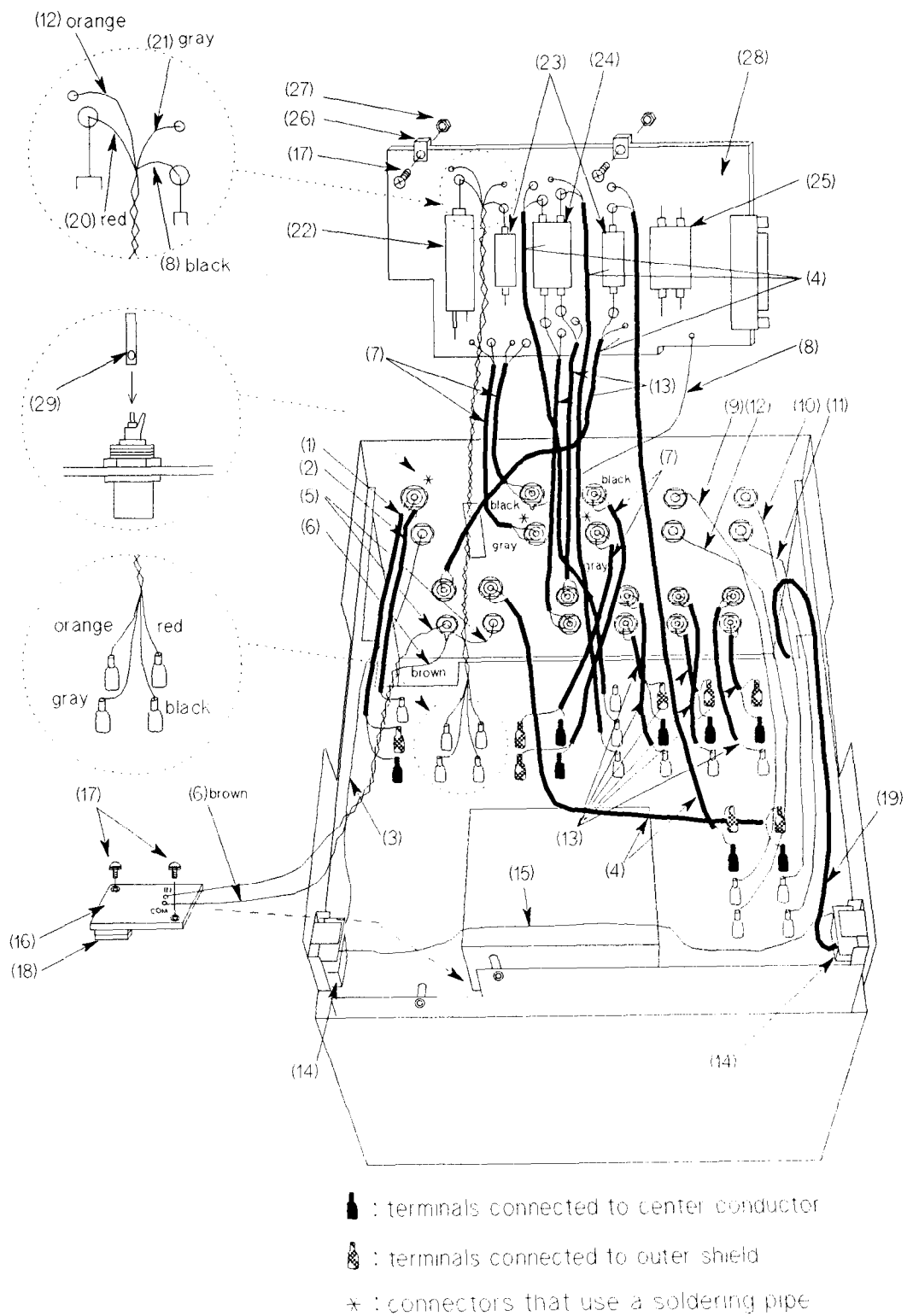


**Figure 3-7. View of Cable Connections in the Test Fixture without Option 300**

**Table 3-6.**  
**Parts List of Cable Connections in the Test Fixture without Option 300**

| Reference Designation | HP Part Number | Quantity      | Description                             |
|-----------------------|----------------|---------------|-----------------------------------------|
| (1)                   | 8120-0122      | 23cm×1        | Coaxial Cable                           |
| (2)                   | 8150-2605      | 23cm×1        | Wire 16 Black                           |
| (3)                   | 8150-0450      | 30cm×1        | Wire 24 Orange                          |
| (4)                   | 8120-4856      | 35cm×2        | Coaxial Cable 50 Ω                      |
| (5)                   | 8150-0451      | 6cm×1, 40cm×1 | Wire 24 Yellow                          |
| (6)                   | 8150-0448      | 40cm×1        | Wire 24 Brown                           |
| (7)                   | 8120-5297      | 24cm          | Coaxial Cable Pair <sup>1</sup>         |
| (8)                   | 8150-4685      | 34cm×1        | Wire 24 Yellow                          |
| (9)                   | 8150-4683      | 34cm×1        | Wire 24 Red                             |
| (10)                  | 8150-4682      | 34cm×1        | Wire 24 Brown                           |
| (11)                  | 8150-4684      | 34cm×1        | Wire 24 Orange                          |
| (12)                  | 8120-0102      | 25cm×8        | Coaxial Cable 50 Ω                      |
| (13)                  | 3101-0302      | 2             | Sense Switch (Single-Pole Double-Throw) |
| (14)                  | 8150-0449      | 22cm×1        | Wire 24 Red                             |
| (15)                  | 16088-66502    | 1             | LED Board                               |
| (16)                  | 0515-1550      | 2             | Screw M3-L 8 P-H                        |
| (17)                  | 1990-1219      | 1             | LED                                     |
| (18)                  | 16088-61617    | 1             | Cable Assy                              |
| (19)                  | 41422-24099    | 3             | Soldering Pipe                          |

- <sup>1</sup> This cable includes two coaxial cables—gray and black cables—wrapped in a tube. The gray cable is connected to the force terminal and the black cable is connected to the sense terminal of the HCU port.

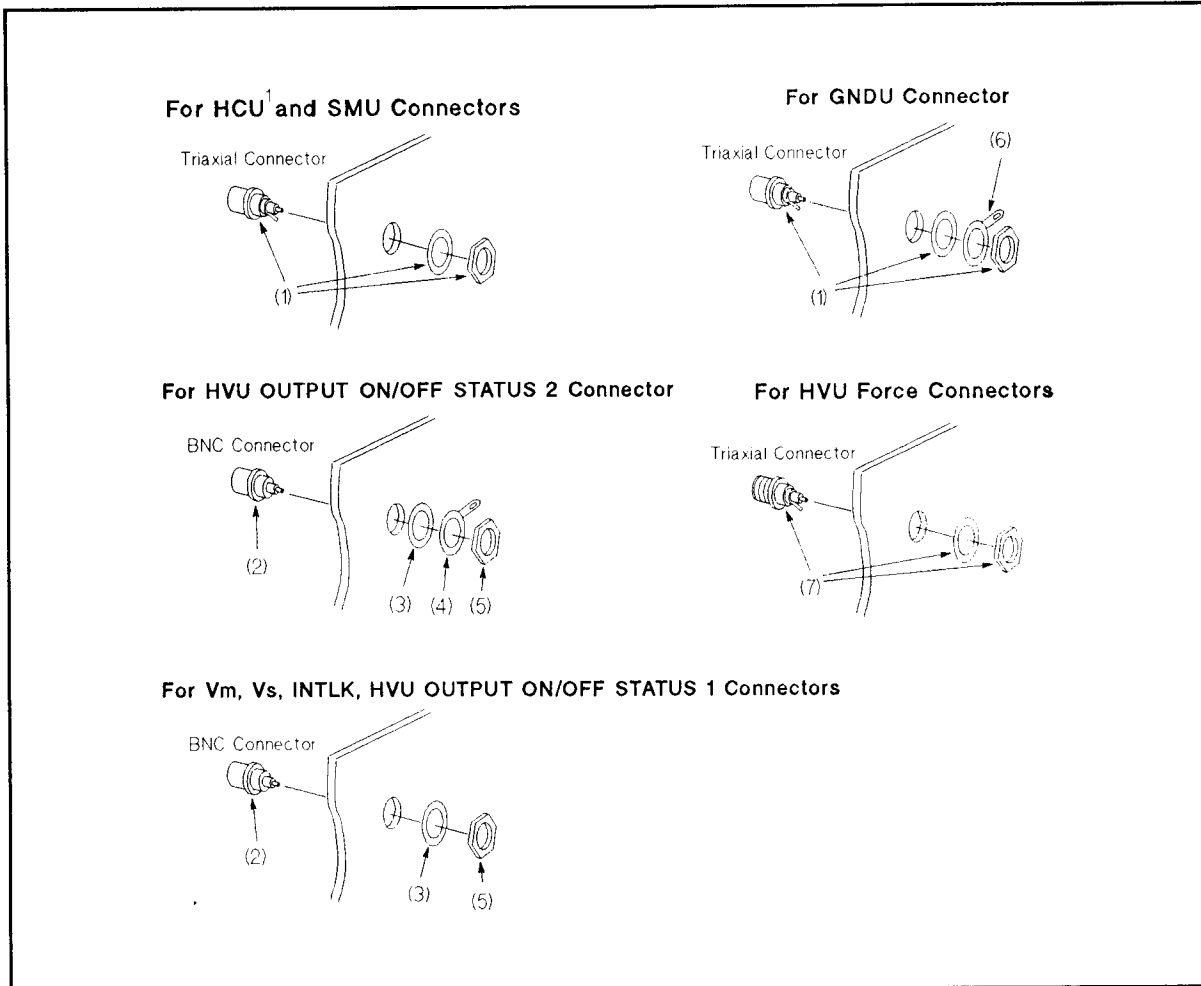


**Figure 3-8. View of Cable Connections in the Test Fixture with Option 300**

**Table 3-7.**  
**Parts List of Cable Connections in the Test Fixture with Option 300**

| Reference Designation | HP Part Number | Quantity                   | Description                             |
|-----------------------|----------------|----------------------------|-----------------------------------------|
| (1)                   | 8120-0122      | 23cm×1                     | Coaxial Cable                           |
| (2)                   | 8150-2605      | 23cm×1                     | Wire 16 Black                           |
| (3)                   | 8150-0450      | 3cm×1                      | Wire 24 Orange                          |
| (4)                   | 8120-4856      | 22cm×2<br>14cm×1<br>35cm×2 | Coaxial Cable 50 Ω                      |
| (5)                   | 8150-0451      | 6cm×1<br>40cm×1            | Wire 24 Yellow                          |
| (6)                   | 8150-0448      | 40cm×1                     | Wire 24 Brown                           |
| (7)                   | 8120-5297      | 24cm, 17cm                 | Coaxial Cable Pair <sup>1</sup>         |
| (8)                   | 8150-5053      | 15cm×1<br>18cm×1           | Wire 24 Black                           |
| (9)                   | 8150-4685      | 34cm×1                     | Wire 24 Yellow                          |
| (10)                  | 8150-4683      | 34cm×1                     | Wire 24 Red                             |
| (11)                  | 8150-4682      | 34cm×1                     | Wire 24 Brown                           |
| (12)                  | 8150-4684      | 34cm×1<br>12cm×1           | Wire 24 Orange                          |
| (13)                  | 8120-0102      | 25cm×6<br>18cm×2           | Coaxial Cable 50 Ω                      |
| (14)                  | 3101-0302      | 2                          | Sense Switch (Single-Pole Double-Throw) |
| (15)                  | 8150-0449      | 22cm×1                     | Wire 24 Red                             |
| (16)                  | 16088-66502    | 1                          | LED Board                               |
| (17)                  | 0515-1550      | 4                          | Screw M3-L 8 P-H                        |
| (18)                  | 1990-1219      | 1                          | LED                                     |
| (19)                  | 16088-61617    | 1                          | Cable Assy                              |
| (20)                  | 8150-5063      | 12cm×1                     | Wire 24 Red                             |
| (21)                  | 8150-4689      | 15cm×1                     | Wire 24 Gray                            |
| (22)                  | 0490-1763      | 1                          | Reed Relay                              |
| (23)                  | 0490-1698      | 2                          | Reed Relay                              |
| (24)                  | 0490-1613      | 1                          | Reed Relay                              |
| (25)                  | 0490-1694      | 1                          | Reed Relay                              |
| (26)                  | 1531-0314      | 2                          | Clevis                                  |
| (27)                  | 0535-0031      | 2                          | Nut                                     |
| (28)                  | 16087-66501    | 1                          | Relay Board                             |
| (29)                  | 41422-24099    | 3                          | Soldering Pipe                          |

<sup>1</sup> This cable includes two coaxial cables—gray and black cables—wrapped in a tube. The gray cable is connected to the force terminal and the black cable is connected to the sense terminal of the HCU port.



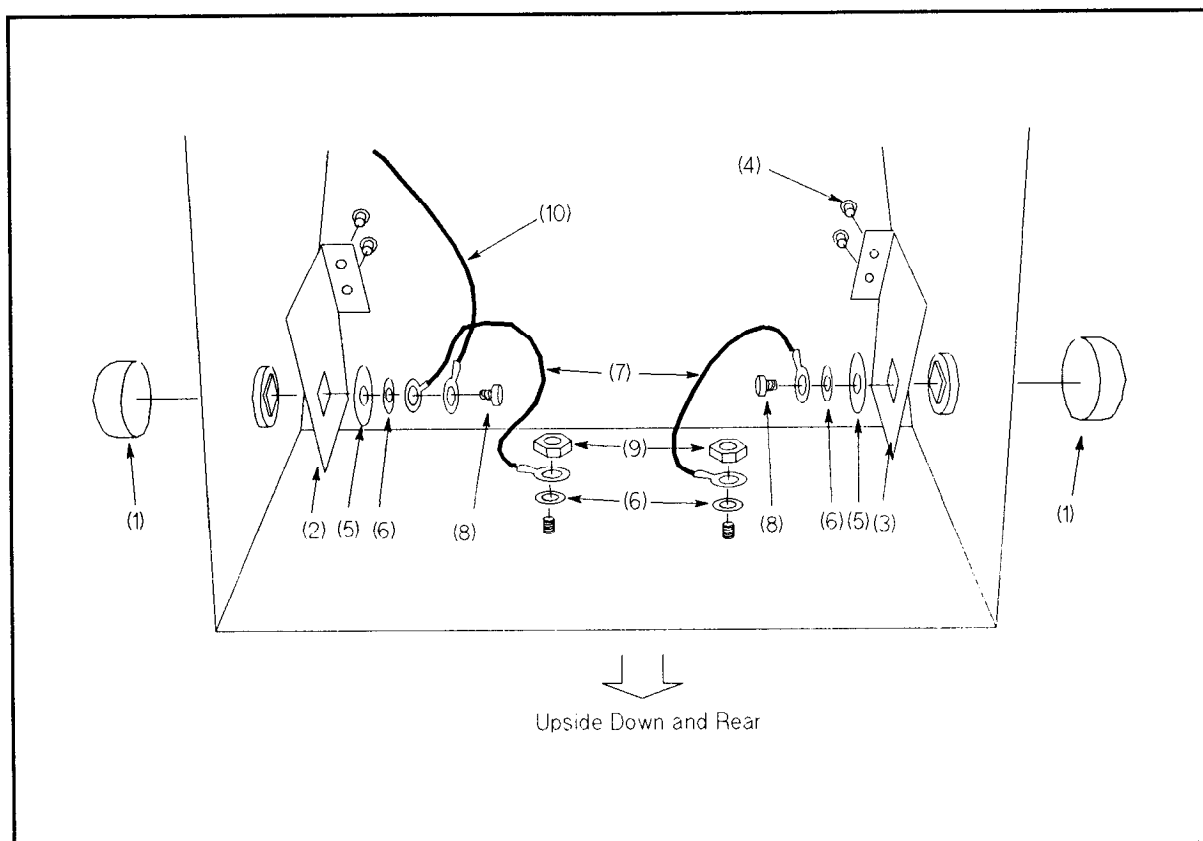
**Figure 3-9. How to Install Triaxial and BNC Connectors**

- <sup>1</sup> When you use option 300 in the test fixture, HCU 2 Sense Connector's installation is the same as GNDU's.

**Table 3-8. Parts List for Triaxial and BNC Connectors**

| Reference Designation | HP Part Number | Quantity           | Description        |
|-----------------------|----------------|--------------------|--------------------|
| (1)                   | 1250-1906      | 13                 | Triaxial Connector |
| (2)                   | 1250-0083      | 7                  | BNC Connector      |
| (3)                   | 2190-0016      | 7                  | Lock Washer        |
| (4)                   | 0360-1190      | 1                  | Terminal Washer    |
| (5)                   | 2950-0001      | 7                  | Nut                |
| (6)                   | 5000-4218      | 1 (2) <sup>1</sup> | Terminal Washer    |
| (7)                   | 1250-2228      | 2                  | Triaxial Connector |

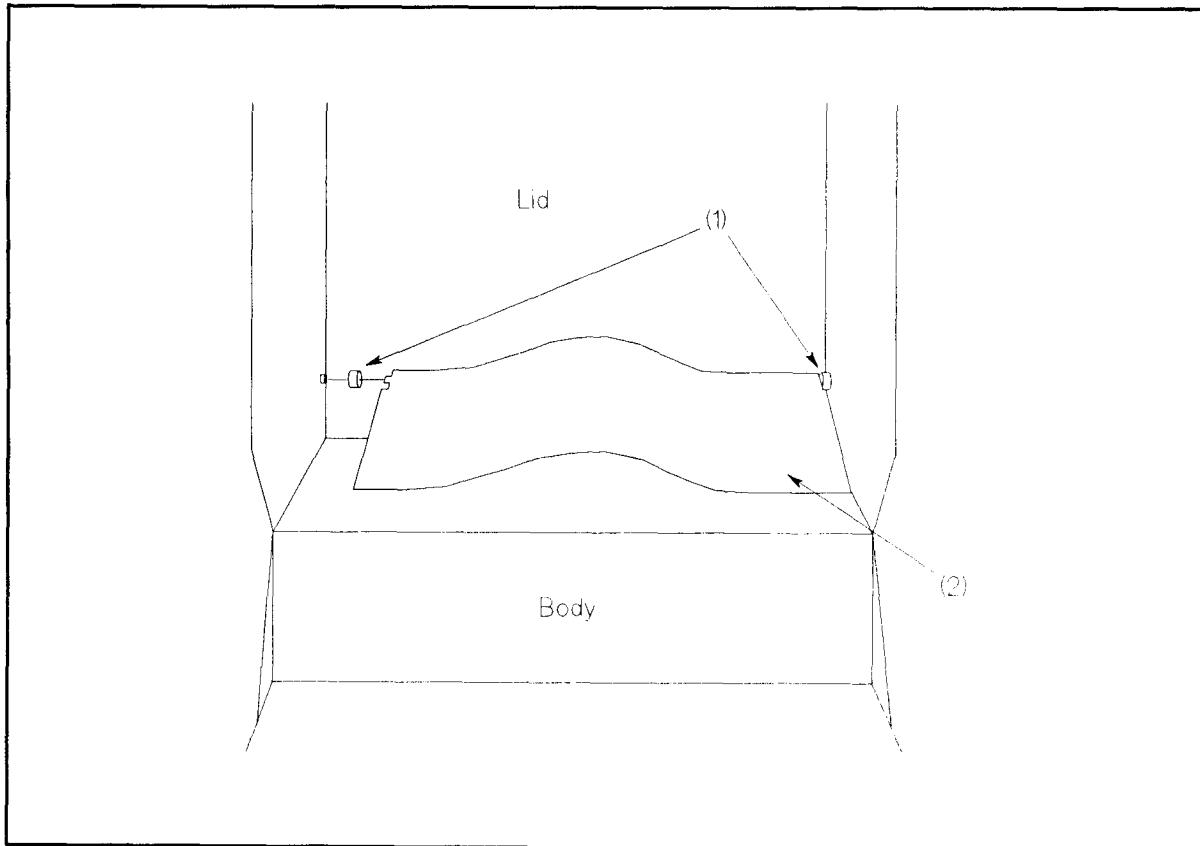
- <sup>1</sup> Number in the parenthesis shows the quantity, when option 300 is installed in the test fixture.



**Figure 3-10. Connections between Lid and Body**

**Table 3-9.  
Parts List for Connections between Lid and Body**

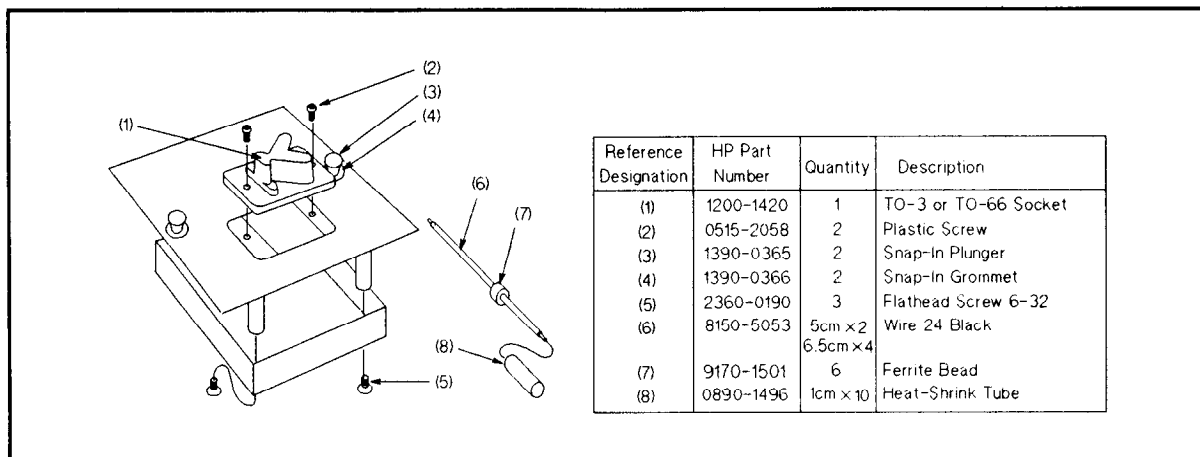
| Reference Designation | HP Part Number | Quantity | Description       |
|-----------------------|----------------|----------|-------------------|
| (1)                   | 16088-24005    | 2        | Cover             |
| (2)                   | 16088-01206    | 1        | Angle (Right)     |
| (3)                   | 16088-01205    | 1        | Angle (Left)      |
| (4)                   | 6960-0016      | 4        | Plug-Hole         |
| (5)                   | 3050-0893      | 2        | Flat Washer       |
| (6)                   | 2190-0644      | 4        | Lock Washer       |
| (7)                   | 16088-61616    | 2        | Cable Assy        |
| (8)                   | 0515-1550      | 2        | Screw M3-L 8 P-II |
| (9)                   | 0535-0031      | 2        | Nut with Locker   |
| (10)                  | 16088-61617    | 1        | Cable Assy        |



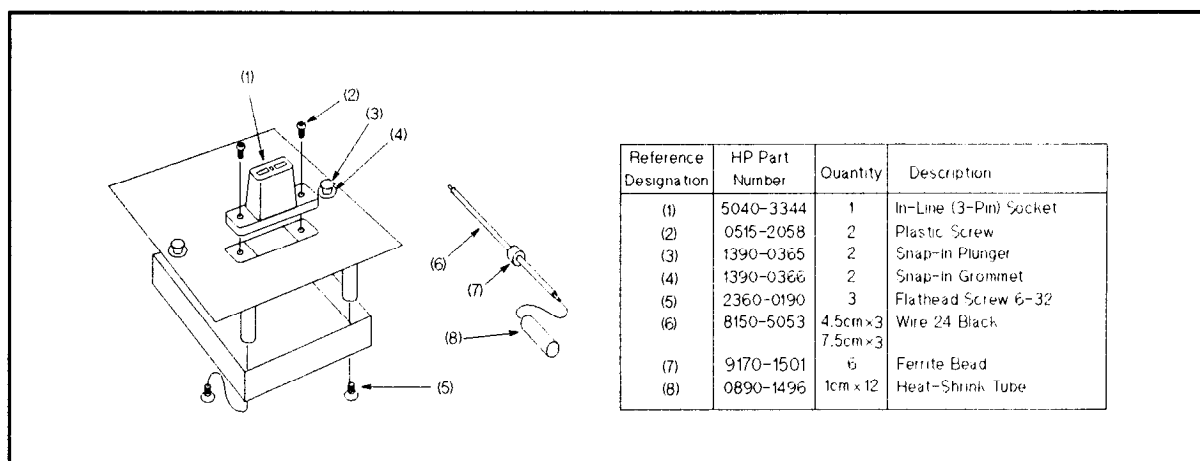
**Figure 3-11. Connections between Lid and Body**

**Table 3-10.**  
**Parts List for Connections between Lid and Body**

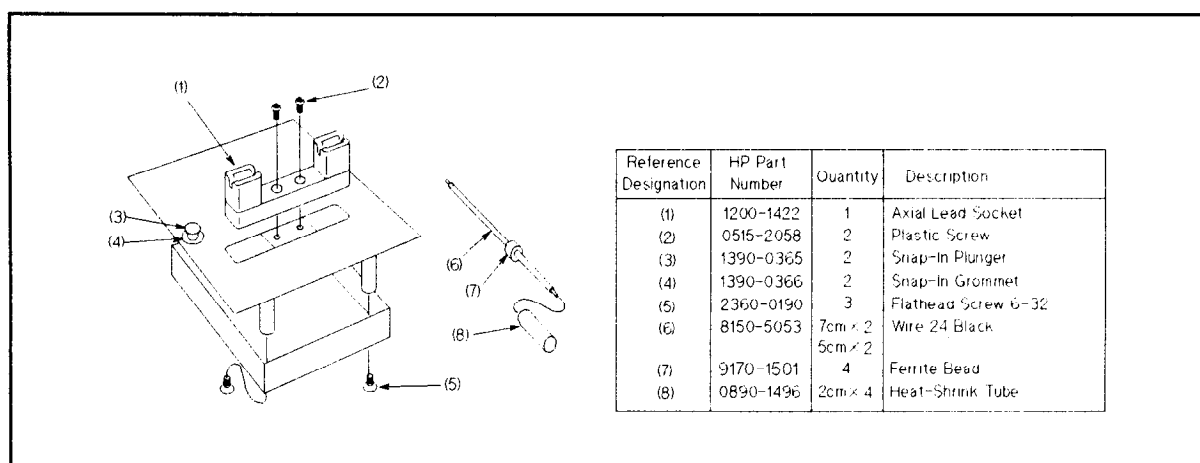
| Reference Designation | HP Part Number | Quantity | Description |
|-----------------------|----------------|----------|-------------|
| (1)                   | 16088-24003    | 2        | Bushing     |
| (2)                   | 16088-29001    | 1        | Plate       |



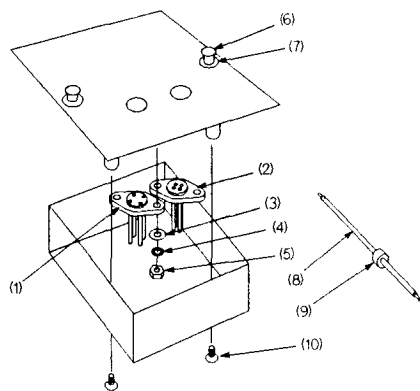
**Figure 3-12. TO-3 or TO-66 Package Socket Module**



**Figure 3-13. In-Line Package Socket Module**

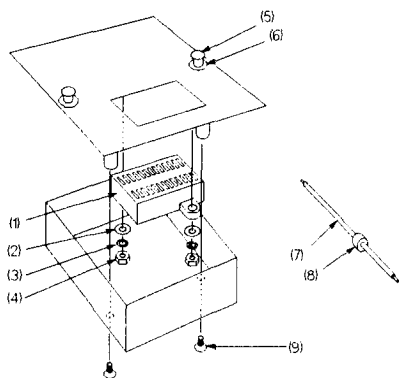


**Figure 3-14. Axial Lead Package Socket Module**



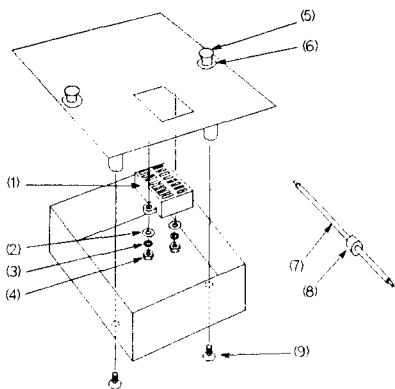
| Reference Designation | HP Part Number | Quantity | Description             |
|-----------------------|----------------|----------|-------------------------|
| (1)                   | 1200-0976      | 1        | TO (4-Pin Large) Socket |
| (2)                   | 1200-0977      | 1        | TO (4-Pin Small) Socket |
| (3)                   | 3050-0229      | 4        | Flat Washer             |
| (4)                   | 2190-0913      | 4        | Lock Washer             |
| (5)                   | 2260-0002      | 4        | Nut                     |
| (6)                   | 1390-0365      | 2        | Snap-In Plunger         |
| (7)                   | 1390-0366      | 2        | Snap-In Grommet         |
| (8)                   | 8150-4687      | 6cm x 4  | Wire 24 Blue            |
|                       | 8150-4688      | 7cm x 4  | Wire 24 Purple          |
| (9)                   | 9170-0029      | 8        | Core-Magnetic Bead      |
| (10)                  | 2360-0190      | 3        | Flathead Screw          |

**Figure 3-15. TO- (4-pin) Package Socket Module**



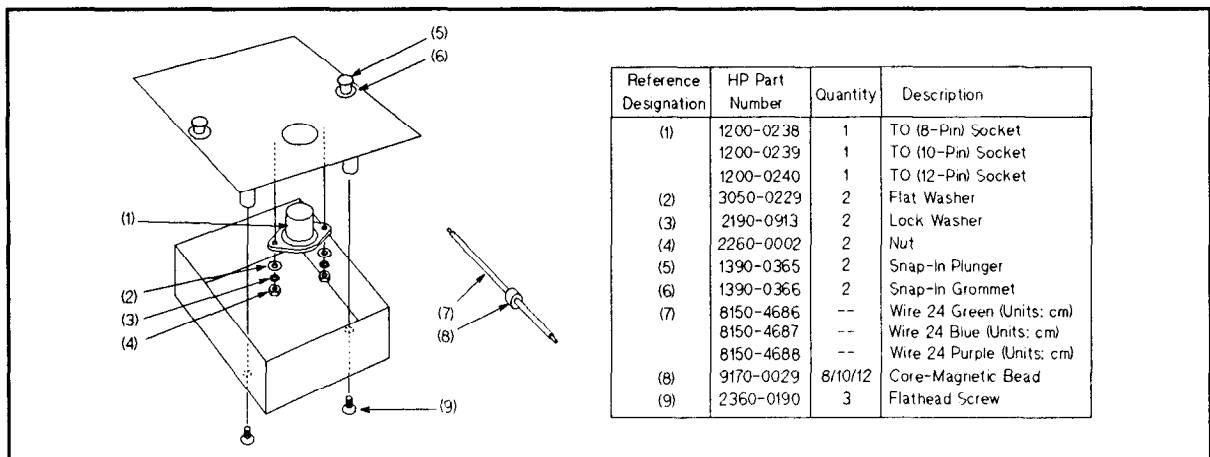
| Reference Designation | HP Part Number | Quantity | Description                  |
|-----------------------|----------------|----------|------------------------------|
| (1)                   | 1200-1152      | 1        | Dual-In-Line (28-Pin) Socket |
| (2)                   | 3050-0098      | 2        | Flat Washer                  |
| (3)                   | 2190-0112      | 2        | Lock Washer                  |
| (4)                   | 0610-0001      | 2        | Nut                          |
| (5)                   | 1390-0365      | 2        | Snap-In Plunger              |
| (6)                   | 1390-0366      | 2        | Snap-In Grommet              |
| (7)                   | 8150-4681      | 10cm x 3 | Wire 24 Black                |
|                       | 8150-4685      | 4cm x 4  | Wire 24 Yellow               |
|                       |                | 12cm x 2 |                              |
|                       | 8150-4686      | 5cm x 4  | Wire 24 Green                |
|                       | 8150-4687      | 6cm x 4  | Wire 24 Blue                 |
|                       | 8150-4688      | 7cm x 3  | Wire 24 Purple               |
|                       | 8150-4689      | 8cm x 3  | Wire 24 Gray                 |
|                       | 8150-4690      | 9cm x 5  | Wire 24 White                |
| (8)                   | 9170-0029      | 28       | Core-Magnetic Bead           |
| (9)                   | 2360-0190      | 3        | Flathead Screw               |

**Figure 3-16. Dual-In-Line (28-pin) Package Socket Module**

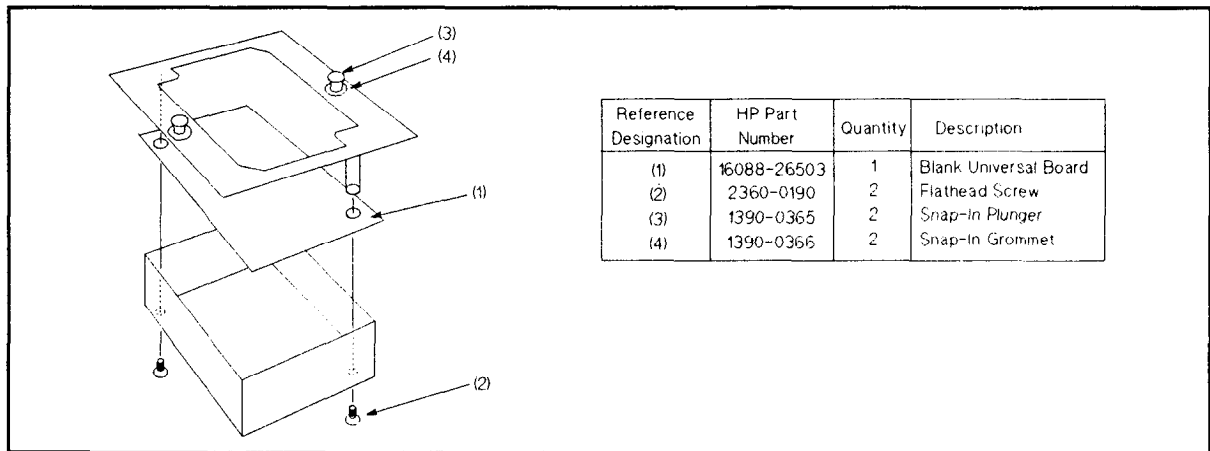


| Reference Designation | HP Part Number | Quantity | Description                  |
|-----------------------|----------------|----------|------------------------------|
| (1)                   | 1200-0978      | 1        | Dual-In-Line (18-Pin) Socket |
| (2)                   | 3050-0098      | 2        | Flat Washer                  |
| (3)                   | 2190-0112      | 2        | Lock Washer                  |
| (4)                   | 0610-0001      | 2        | Nut                          |
| (5)                   | 1390-0365      | 2        | Snap-In Plunger              |
| (6)                   | 1390-0366      | 2        | Snap-In Grommet              |
| (7)                   | 8150-4685      | 4cm x 2  | Wire 24 Yellow               |
|                       | 8150-4686      | 5cm x 1  | Wire 24 Green                |
|                       | 8150-4687      | 6cm x 2  | Wire 24 Blue                 |
|                       | 8150-4688      | 7cm x 7  | Wire 24 Purple               |
|                       | 8150-4689      | 8cm x 5  | Wire 24 Gray                 |
|                       | 8150-4690      | 9cm x 1  | Wire 24 White                |
| (8)                   | 9170-0029      | 28       | Core-Magnetic Bead           |
| (9)                   | 2360-0190      | 3        | Flathead Screw               |

**Figure 3-17. Dual-In-Line (18-pin) Package Socket Module**



**Figure 3-18. TO- (8-, 10-, and 12-pin) Package Socket Module**



**Figure 3-19. Universal Socket Module**



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**Manufacturing  
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16088-90013