KEITHLEY

# Model 8006 Component Test Fixture
## Instruction Manual

A GREATER MEASURE OF CONFIDENCE

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Keithley Instruments, Inc. warrants this product to be free from defects in material and workmanship for a period of 1 year from date of shipment.

Keithley Instruments, Inc. warrants the following items for 90 days from the date of shipment: probes, cables, rechargeable batteries, diskettes, and documentation.

During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley representative, or contact Keithley headquarters in Cleveland, Ohio. You will be given prompt assistance and return instructions. Send the product, transportation prepaid, to the indicated service facility. Repairs will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

# LIMITATION OF WARRANTY

This warranty does not apply to defects resulting from product modification without Keithley's express written consent, or misuse of any product or part. This warranty also does not apply to fuses, software, non-rechargeable batteries, damage from battery leakage, or problems arising from normal wear or failure to follow instructions.

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**4/02**

# Model 8006 Component Test Fixture
# Instruction Manual

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KEITHLEY

# Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

**Responsible body** is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

**Operators** use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

**Maintenance personnel** perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

**Service personnel** are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If a ⏚ screw is present, connect it to safety earth ground using the wire recommended in the user documentation.

The ⚠ symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The ⚡ symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

# Model 8006
# Component Test Fixture

**DEVICE SOCKET CONFIGURATION:**

20mm and 30mm axial (Kelvin), 4 pin T0-18/46;

4, 8, 10, and 12 pin T0-5, 28 pin DIP (0.100 in. pin spacing, 0.300 to 0.600 in. wide, zero insertion force, replaceable).

**CONNECTOR TYPE:** Three-lug triaxial (12), isolated BNC (2), 5-way binding posts (5), safety ground terminal (1), safety interlock (1).

**MAXIMUM COMMON MODE VOLTAGE FROM CHASSIS:**

| | |
|---|---|
| Triax inner shield | 1100V peak |
| BNC shell | 30V rms (DC to 60Hz) |
| 5-way binding posts | 1100V peak |

**ISOLATION FROM CHASSIS:** >1GΩ (triax inner shield, BNC shell, 5-way binding posts).

**MAXIMUM SIGNAL VOLTAGE:** 1100V peak, signal or guard to any signal, guard, panel shield, or module shield (except 600V peak, any signal to its own guard).

**MAXIMUM SIGNAL CURRENT:** 1A peak.

**OFFSET CURRENT:** <100fA.

**PATH ISOLATION (using triax or BNC connectors and cables):**

**Resistance:**

| | |
|---|---|
| Axial and Teflon® sockets | >100TΩ (>10,000TΩ typical*) |
| DIP socket | >1TΩ (>100TΩ typical*) |

**Capacitance (nominal):**

| | |
|---|---|
| Axial sockets | 0.2pF |
| Teflon® sockets | 1pF |
| DIP socket | 3pF |

**CROSSTALK @ 1MHz (typical*):** –70dB (50Ω source and measure).

**3dB BANDWIDTH (typical*):** 4MHz (50Ω source and measure).

**INSERTION LOSS @ 1MHz (typical*):** 0.3dB (50Ω source and 1MΩ measure).

**SOCKET KELVIN RESISTANCE:**

| | |
|---|---|
| Axial sockets: | <100µΩ (<10µΩ typical). |
| Teflon® and DIP sockets: | <20mΩ |

**ENVIRONMENT:**

**Operating:** 0° to 50°C, <70% non-condensing R.H. up to 35°C.
**Storage:** –25° to +70°C.

## GENERAL

**DIP SOCKET OPERATING LIFE:** >25,000 open-close cycles.

**LID INTERLOCK SWITCHING:** <28VDC, 50mA.

**DIMENSIONS, WEIGHT:** 140mm high x 300mm wide x 300mm deep (5.5 in. x 12 in. x 12 in.). Net weight 3.2kg (7 lbs. 2 oz.).

**ACCESSORIES SUPPLIED:**

Instruction manual

| | |
|---|---|
| Model 236-ILC-3: | Interlock Cable, 3m (10 ft.) |
| Model 8006-MJC: | Red/Black Teflon Clip Jumpers |
| Model 8006-MJG: | Guarded Teflon Mini Jumper (8) |
| Model 8006-MJS-1: | Red Teflon Mini Jumper (10) |
| Model 8006-MJS-2: | Black Teflon Mini Jumper (10) |
| Model 8006-MJS-3: | Blue Teflon Mini Jumper (10) |
| Model 8007-GND-3: | Safety Ground Wire |

**ACCESSORIES AVAILABLE:**

| | |
|---|---|
| Model 7078-TRX-3: | Triax Cable (3-lug), 0.9m (3 ft.) |
| Model 7078-TRX-10: | Triax Cable (3-lug), 3m (10 ft.) |
| Model 4801: | Low Noise Coax Cable, 1.2m (4 ft.) |

*At room ambient conditions (18° to 28°C, <40% R.H.).

Except where noted, specifications assume: Any socket, guarded measurement configuration, including guarded jumpers and 1m external triax cables.

# HOW TO USE THIS MANUAL

## SECTION 1
### General Information

Contains information on Model 8006 features, specifications, and accessories.

## SECTION 2
### Operation

Outlines test fixture connections and details how to connect the fixture to instruments for typical device tests.

## SECTION 3
### Service Information

Contains performance verification and cleaning procedures for the test fixture.

## SECTION 4
### Replaceable Parts

Lists replacement parts, and also includes component layout and schematic drawings for the Model 8006.

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## SECTION 1 — General Information

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## SECTION 3 — Service Information

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## SECTION 2 — Operation

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## SECTION 3 — Service Information

# SECTION 1
# General Information

## 1.1 INTRODUCTION

This section contains general information about the Model 8006 Component Test Fixture, and it is arranged in the following manner:

**1.2 Features**

**1.3 Warranty Information**

**1.4 Manual Addenda**

**1.5 Safety Symbols and Terms**

**1.6 Specifications**

**1.7 Unpacking and Inspection**

**1.8 Repacking for Shipment**

**1.9 Optional Accessories**

## 1.2 FEATURES

The Model 8006 Component Test Fixture provides a convenient way to connect a variety of instrumentation to standard packaged semiconductor devices. Although primarily intended for use with Keithley Models 236 and 237 Source Measure Units, the Model 8006 can also be used with a variety of other instrumentation, including voltage and current sources, DMMs, LCR meters, oscilloscopes, analyzers, CV meters, and electrometers. The Model 8006 has eight component sockets to simplify connections to a variety of devices.

Key features of the Model 8006 include:

- 12 triax connectors for connecting up to six Source Measure Units or other instrumentation requiring triaxial connections.
- Two BNC connectors and five binding posts for additional instrument connections.
- Interlock connector for safe operation.
- Two axial lead sockets (20mm and 30mm spacing), five TO package sockets, (two 4-pin, 8-pin, 10-pin, and 12-pin), and one 28-pin ZIF (zero insertion force) DIP socket.
- Color-coded mini jumpers supplied for easy device connections.
- All connecting points are clearly marked to minimize the possibility of errors when making test connections.
- Hinged lid with light-tight gasket and ground straps for shielded measurements.

## 1.3 WARRANTY INFORMATION

Warranty information is located on the inside front cover of this instruction manual. Should your Model 8006 require warranty service, contact the Keithley representative or authorized repair facility in your area for further information. When returning the fixture for repair, be sure to fill out and include the service form at the back of this manual in order to provide the repair facility with the necessary information.

## 1.4 MANUAL ADDENDA

Any improvements or changes concerning the test fixture or manual will be explained in an addendum included with the the unit. Be sure to note these changes and incorporate them into the manual before using or servicing the fixture.

## 1.5 SAFETY SYMBOLS AND TERMS

The following symbols and terms may be found on an instrument or used in this manual.

The ⚠ symbol on an instrument indicates that the user should refer to the operating instructions located in the instruction manual.

The ⚡ symbol on an instrument shows that high voltage may be present on the terminal(s). Use standard safety precautions to avoid personal contact with these voltages.

The ⏚ screw must be connected to safety earth ground using #18 AWG or larger wire.

The **WARNING** heading used in this manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading used in this manual explains hazards that could damage the unit. Such damage may invalidate the warranty.

## 1.6 SPECIFICATIONS

Model 8006 specifications may be found at the front of this manual.

## 1.7 UNPACKING AND INSPECTION

### 1.7.1 Inspection for Damage

Upon receiving the Model 8006, carefully unpack it from its shipping carton and inspect the fixture for any obvious signs of physical damage such as misalignment of the lid and base. Report any such damage to the shipping agent immediately. Save the original packing carton for possible future reshipment.

### 1.7.2 Shipment Contents

The following items are included with every Model 8006 order:

- Model 8006 Component Test Fixture.
- 30 standard color-coded Teflon® mini jumpers, 10 each red (Model 8006-MJS-1), black (Model 8006-MJS-2), and blue (Model 8006-MJS-3).
- 8 guarded Teflon® mini jumpers (Model 8006-MJG) for shielded or guarded connections.
- Red/black pair of Teflon® clip jumpers.
- Safety Interlock Cable (Model 236-ILC-3).
- Safety Grounding Cable (Model 8007-GND-3)
- Component Test Module (Model 8006-CTM)
- Source Measure Unit overlays to label jacks with Model 236/237 input/output nomenclature.
- Model 8006 Instruction Manual.
- Additional accessories as ordered.

### 1.7.3 Instruction Manual

If an additional instruction manual is required, order the manual package, Keithley part number 8006-901-00. The manual package includes an instruction manual and any pertinent addenda.

## 1.8 REPACKING FOR SHIPMENT

Should it become necessary to return the Model 8006 for repair, carefully pack the unit in its original packing carton or the equivalent, and include the following information:

- Advise as to the warranty status of the test fixture.
- Write ATTENTION REPAIR DEPARTMENT on the shipping label.
- Fill out and include the service form located at the back of this manual.

## 1.9 ACCESSORIES

**Model 236-ILC-3 Interlock Cable** — The Model 236-ILC-3 Interlock Cable connects the Model 8006 to the interlock circuit of the Model 236/237 Source Measure Unit. The Model 236-ILC-3 is 3m (10ft.) in length.

**Model 4801 Low-noise BNC Cable** — The Model 4801 is a low-noise coaxial cable, 1.2m (48in.) in length, with male BNC connectors on each end. The Model 4801 can be used for low-noise connections to the BNC connectors on the Model 8006.

**Model 7051 BNC Cables** — The Model 7051-2 is a 0.6m (2ft) BNC to BNC RG-58C cable. The Model 7051-5 is similar to the Model 7051-2 except that it is 1.5m (5ft.) long. The Model 7051 cables can be used to connect instruments to the BNC connectors on the Model 8006. The Model 7051 cables have a nominal 50Ω characteristic impedance.

**Model 7078-TRX Triax Cables** — The Model 7078-TRX Triax cables are low-noise cables terminated with male 3-slot triax connectors. The Model 7078-TRX-3 is 0.9m (3 ft.)

in length, and the Model 7078-TRX-10 is 3.0m (10 ft.) long. The Model 7078-TRX cables are recommended for making connections between the triax connectors on the Model 8006 and external instrumentation such as the Model 236/237 Source Measure Units.

**Model 8006-CTM Component Test Module** — The Model 8006-CTM Component Test Module is the module supplied with the Model 8006 Test Fixture. The Model 8006-CTM has two sets of axial lead Kelvin component clips, five TO package sockets (two 4-pin, 8-pin, 10-pin, and 12-pin), and one 24-pin DIP ZIF (zero insertion force socket).

**Model 8006-MJC Teflon® Red/Black Clip Jumpers** — These clip jumpers can be used to make connections directly to component test leads.

**Model 8006-MJG Guarded Teflon® Mini Jumpers** — The Model 8006-MJG contains eight guarded mini jumpers like the guarded jumpers supplied with the Model 8006.

**Model 8006-MJS Teflon® Mini Jumpers** — The Model 8006-MJS mini jumpers are the standard mini jumpers supplied with the Model 8006. The jumpers are available in three colors: black (Model 8006-MJS-1), red (Model 8006-MJS-2), and blue (Model 8006-MJS-3). Each package contains 10 jumpers.

**Model 8007-GND-3 Safety Grounding Cable** — The Model 8007-GND-3 Safety Grounding Cable is intended for connecting fixture chassis ground to safety earth ground. One Model 8007-GND-3 is supplied with the test fixture, and the cable is 3m (10ft.) in length.

**Source Measure Unit Overlays (PA-287)** — The overlay cards allow convenient identification of the rear panel and signal panel jacks to correspond to Model 236/237 Source Measure Unit input/output nomenclature.

# SECTION 2

# Operation

## 2.1 INTRODUCTION

This section contains information on making connections to the Model 8006, as well as considerations when making measurements using the test fixture, and it is organized as follows:

2.2 **Panel Configuration:** Briefly discusses the connectors and sockets located on the rear, instrument, and component panels.

2.3 **Instrument Connections:** Shows how to connect various types of instruments to the fixture, including Source Measure Units, current and voltage sources, electrometers, and matrix cards.

2.4 **Measurement Considerations:** Outlines a number of considerations that should be observed for optimum performance when using the test fixture.

2.5 **Typical Applications:** Covers typical test fixture applications such as diode, transistor, and IC tests.

WARNING

**The Model 8006 is intended for use by those who are familiar with using potentially hazardous voltages. Refer to the safety precautions summarized at the front of this manual before using the Model 8006.**

## 2.2 PANEL CONFIGURATION

The various connectors and sockets located on the Model 8006 are discussed below.

### 2.2.1 Rear Panel

The rear panel of the fixture is shown in Figure 2-1. Connectors located on the rear panel are summarized below.

WARNING

**The maximum differential signal voltage is 1100V peak. The maximum signal current for all connectors is 1A peak. Exceeding these values may create a shock hazard.**

⏚ — This terminal is intended for connecting the test fixture to safety earth ground.

WARNING

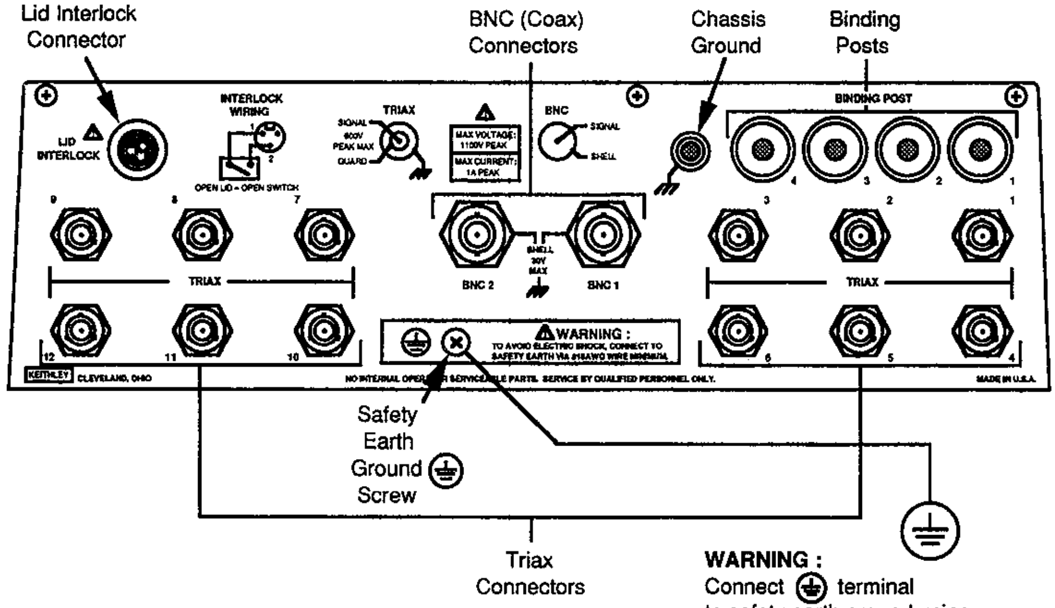
**Connect this terminal to safety earth ground using a #18 AWG or larger wire before making any other connections to the test fixture. Use the supplied safety ground cable for this connection.**

**LID INTERLOCK Connector** — The LID INTERLOCK is used with the Models 236 and 237 Source Measure Units, and provides a measure of safety when using hazardous voltages. A interlock circuit prevents the unit from applying power to the test fixture when the lid is open. Figure 2-2 shows how to connect the safety interlock to the unit using the supplied interlock cable.

WARNING

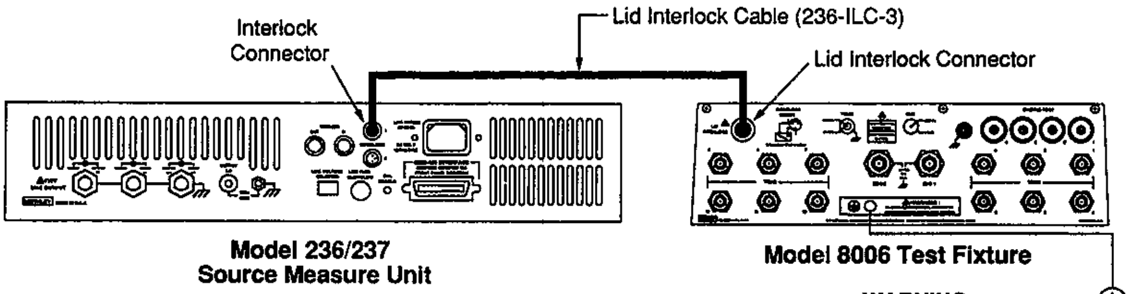
**Turn off the instrument power before connecting the interlock cable.**

Figure 2-3 shows safety interlock circuit wiring for those who wish to configure the safety interlock circuit for use with other equipment. Typically, the interlock switch would be connected to some form of digital detection circuits, as shown in Figure 2-3C. In this example, the switch is connected to a single NAND gate, with a pull-up resistor used on the input. Other typical interfacing examples include connection to a digital I/O port available on some instruments (for example, a Model 230 Voltage Source), and directly to a microprocessor through a PIA (Peripheral Interface Adapter). Other Keithley instruments with digital I/O ports include: Models 705 and



**WARNING :**
Connect ⏚ terminal
to safety earth ground using
#18 AWG minimum wire.
(Use supplied ground cable)

*Figure 2-1. Test Fixture Rear Panel*



**WARNING :** Safe operation requires use of lid interlock.

**WARNING :**
Connect ⏚ terminal
to safety earth ground using
#18 AWG minimum wire.
before use.

*Figure 2-2. Connecting Interlock Circuit to Source Measure Units*

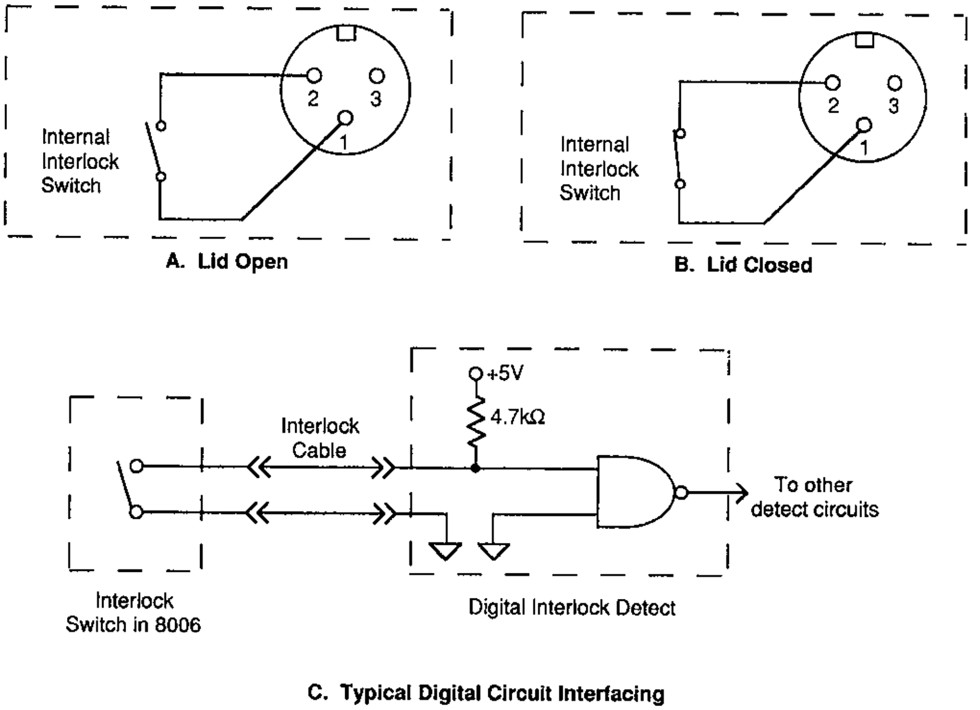


*Figure 2-3. Interlock Circuit Wiring*

706 Scanners, Model 220 Current Source, and Model 707 matrix.

**WARNING**
**User-supplied lethal voltages may be exposed when the lid is open. Safe operation requires the use of the lid safety interlock.**

**CAUTION**
**Do not exceed the specified ratings of the interlock circuits (28V, 0.05A).**

NOTE
The safety interlock cable supplied with the Model 8006 must be used in order for the unit to properly recognize that the test fixture lid is open.

**TRIAX Connectors** — The TRIAX connectors are laid out in four groups of three connectors each, for a total of 12. The center conductor of each triax connector is SIGNAL, the inner ring is GUARD, and the outer ring is connected to chassis ground. Note that the GUARD signal path can be used either for LO or guard when guarding is required.

**WARNING**
**Maximum triax connector common-mode signal voltage is 1100V peak. Maximum voltage between signal and GUARD is 600V peak.**

**BNC Connectors** — Two BNC connectors are included to provide shielded connections. The center conductor is SIGNAL, and the shell of each jack is SHELL (LO).

**WARNING**
**Maximum BNC connector common mode signal voltage is 30V RMS (dc to 60Hz).**

**5-Way Binding Posts** — Four of the binding posts can be used for such purposes as routing power to components being tested. These posts are numbered 1 through 4 The fifth binding post is chassis ground, and it is intended for measurement grounding connections only.

**WARNING**
**With hazardous voltages (>30V RMS), observe the following safety precautions when using banana plugs.**

1. **Turn off all sources and discharge all capacitors before connecting them to the banana plugs.**
2. **Dress all wires to ensure that no conductive surfaces are exposed after connecting them to the binding posts.**
3. **Always use the lid interlock with any sources connected to the banana plugs (see the lid interlock discussion above).**

### 2.2.2 Signal Panel

Figure 2-4 shows the signal panel of the test fixture. The signal panel has a number of test jacks that provide connecting points for the input/output pathways via the rear panel connectors. Each test jack on the panel is clearly marked with the corresponding rear panel connector terminal. For example, the four sets of triax terminals are individually marked as SIGNAL and GUARD to correspond to the SIGNAL and GUARD terminals of each rear panel TRIAX connector. The TRIAX connectors are numbered 1 through 12 in the same manner as the rear panel connector numbering.

The signal panel also has a test jack (PANEL SHIELD) that is connected to the shield located immediately under the signal panel. This jack can be connected to circuit LO for additional shielding, or it can be guarded by connecting it an appropriate guard potential from one of the signal panel jacks.

### 2.2.3 Component Test Module

Figure 2-4 shows the component test module, which contains sockets for a variety of device packages. These sockets include:

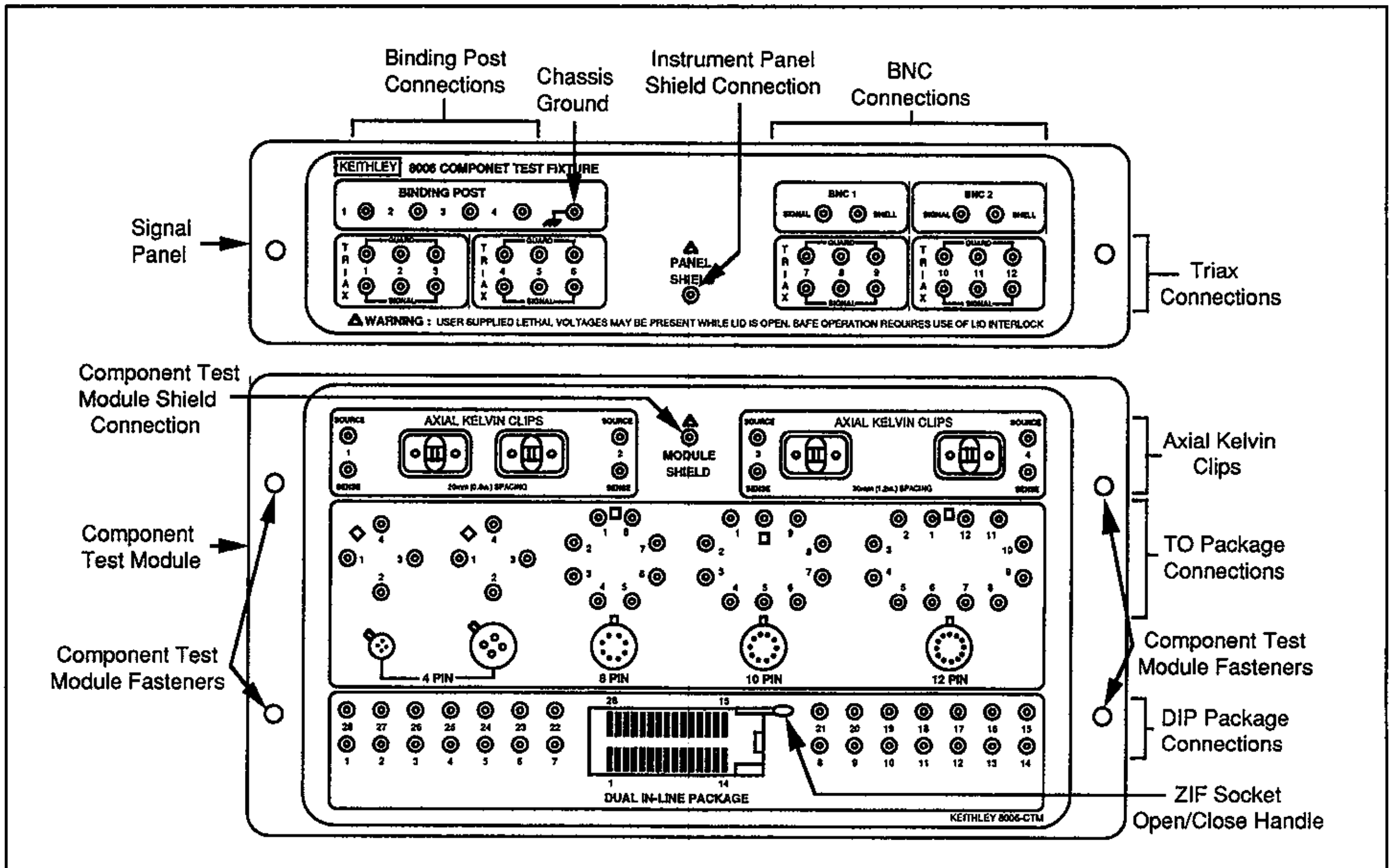


*Figure 2-4. Front Panel Showing Signal Panel and Component Test Module*

Two axial Kelvin clip pairs (20mm and 30mm spacing): Used for two-terminal axial-lead devices such as diodes, capacitors, and resistors. Each clip has a SENSE and a SOURCE connection which provide Kelvin connections to the device.

Two 4-pin TO package sockets (small pin and large pin): Intended primarily for use with transistors.

Three multi-pin TO package sockets (8-pin, 10-pin, and 12-pin TO-5): Designed for use with multi-pin transistor and IC packages.

28-pin dual in-line package ZIF socket: Accepts DIP packages up to 28 pins with 0.3 to 0.6in. lead spacing. The associated handle should be raised to open the socket, lowered to close the socket.

Each socket terminal has an associated test jack intended to connect that terminal to the desired input/output pathway using the supplied mini jumpers.

One of the test jacks (MODULE SHIELD) is connected to a box shield immediately under the component test module. This jack allows the shield to be connected to circuit LO for additional shielding, or to a guard potential if desired.

**Module Removal and Installation**

The Model 8006-CTM Component Test Module is designed for easy removal and installation. Additional modules can be purchased, allowing several device and circuit configurations to be easily interchanged for rapid testing.

To remove the component test module, first disconnect all jumpers to the signal panel, then pull up on the four fasteners that secure the module to the base (see Figure 2-4 for locations). After the fasteners are released, pull up on the module to remove it from the base.

To install the module, install it in the base with the fasteners aligned in the corresponding holes, then push down on the four fasteners to secure the module to the base.

## 2.2.4 Installing Devices in Sockets

> NOTE
> With some devices, you may encounter device oscillation which could affect measurements. Refer to paragraph 2.4.10 for details on verifying and preventing oscillation.

**Device Handling**

When handling very high impedance devices (such as high-megohm resistors) be careful not to contaminate the body of the device, which would lower its impedance. Also take care when handling static-sensitive devices such as MOSFETs so as not to damage them with static discharge. Handle such devices only at a grounded work station, and also ground yourself with a suitable wrist strap. Keep static-sensitive devices in their protective containers until ready for testing.

**Axial Kelvin Clips**

To install an axial component such as a resistor or diode in one of the two sets of axial Kelvin clips, hold the device by the test lead ends, then carefully push the device leads down into the clips until the device is properly seated.

**TO Package Sockets**

For TO package installation, carefully spread the leads apart so that they will line up with the holes in the socket, then slide the device leads down into the holes, taking care not to bend any of the leads. When installing these devices, be sure to line up the tab on the package body with the indicated tab position on the panel. Doing so will ensure that the numbers on the panel will correspond to the actual device terminal numbering.

**DIP Socket**

To install a device on the DIP socket, first raise the lever at the side of the socket to open the socket, then carefully install the device on the socket. Once the device is properly seated, lower the lever to lock the device into place.

To remove a device from the DIP socket, first raise the lever, then pull the device free of the socket.

## 2.2.5 Installing Jumpers

In order to complete device connections, it will be necessary for you to install the mini jumpers between the appropriate socket jacks and the desired input/output pathway jacks located on the signal panel.

**Standard Mini Jumpers**

For many connections, the standard color-coded jumpers supplied with the Model 8006 can be used. These jumpers can be stacked to allow two or more connections to a single jack. Figure 2-5 shows an example of jumpers installed between the binding post jacks and one pair of axial component sockets using 4-wire connections.

**Guarded Jumpers**

For critical measurements requiring low offset current, low noise, or high path isolation, the guarded jumpers should be used with the jumper shield connected to the appropriate GUARD or SHELL jack on the signal panel. Doing so will shield or guard the sensitive pathway right down to the device socket.

Figure 2-5 also shows an example of connections using a guarded jumper. Note that the jumper shield is connected to the GUARD terminal of one of the triax connecting jacks, while the center conductor at the same end is connected to SIGNAL.

**WARNING**
**Make certain hazardous voltages are not present on any of the front panel terminals before installing jumpers. To avoid a possible shock hazard, always use the lid safety interlock, and discharge all capacitors before installing or removing jumpers.**

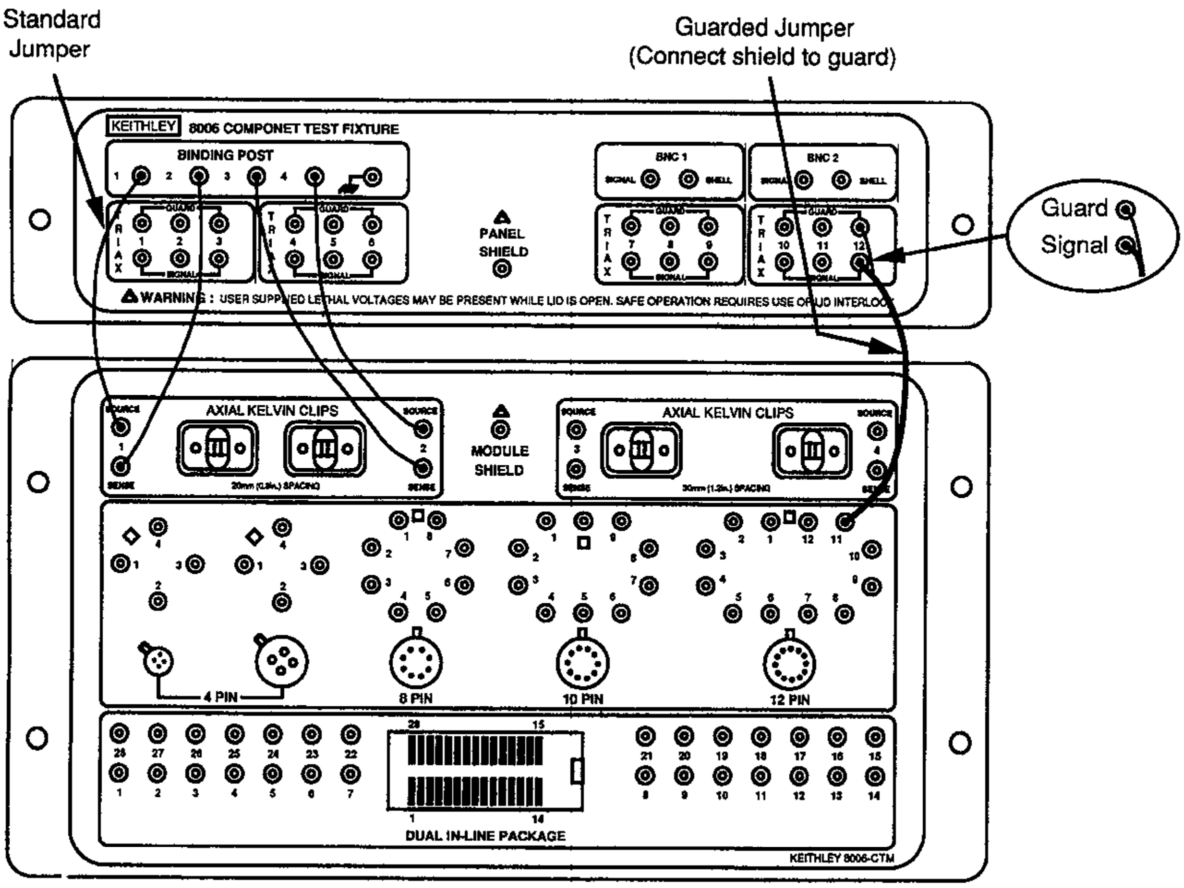


*Figure 2-5. Jumper Installation Examples*

**Jumper Cleaning**

In critical applications, or in high-humidity environments, it may be necessary to clean the coax jumpers with Freon® or methanol before using them. Allow the jumpers to dry thoroughly (several hours in a low-humidity environment) before use, and handle them only with clean gloves after cleaning to avoid new contamination.

All jumpers should be periodically cleaned with Freon® or methanol to remove dirt or other contamination that could degrade overall performance. Again, cleaned jumpers should be allowed to dry for several hours in a low-humidity ambient-temperature environment, or for 30 minutes to one hour in a 50°C low-humidity environment before use.

### 2.2.6 Panel and Module Guarding

Each triax pathway can be individually guarded by applying the guard signal to the inner shield of the cable. When using the Model 236 or 237 Source Measure Unit, guard is automatically applied through the inner shield of the OUTPUT HI and SENSE HI connecting cables and appears at the GUARD jacks for the associated signal panel triax connections. You can connect this guard to the PANEL or MODULE SHIELD jack, as shown in the example of Figure 2-6.

Additional information on guarding is located in paragraph 2.4.4.

### 2.2.7 Source Measure Unit Overlays

A set of Source Measure Unit overlays is supplied to allow convenient marking of rear panel and signal panel jacks to correspond to Model 236/237 input/output nomenclature. Blank overlays are also supplied to support custom test configurations.

## 2.3 INSTRUMENT CONNECTIONS

The following paragraphs discuss connecting the Model 8006 Test Fixture to typical instruments including Source Measure Unit, current and voltage sources, electrometers, matrix switching cards and DMMs. Recommended cables for the various connecting schemes are also covered.

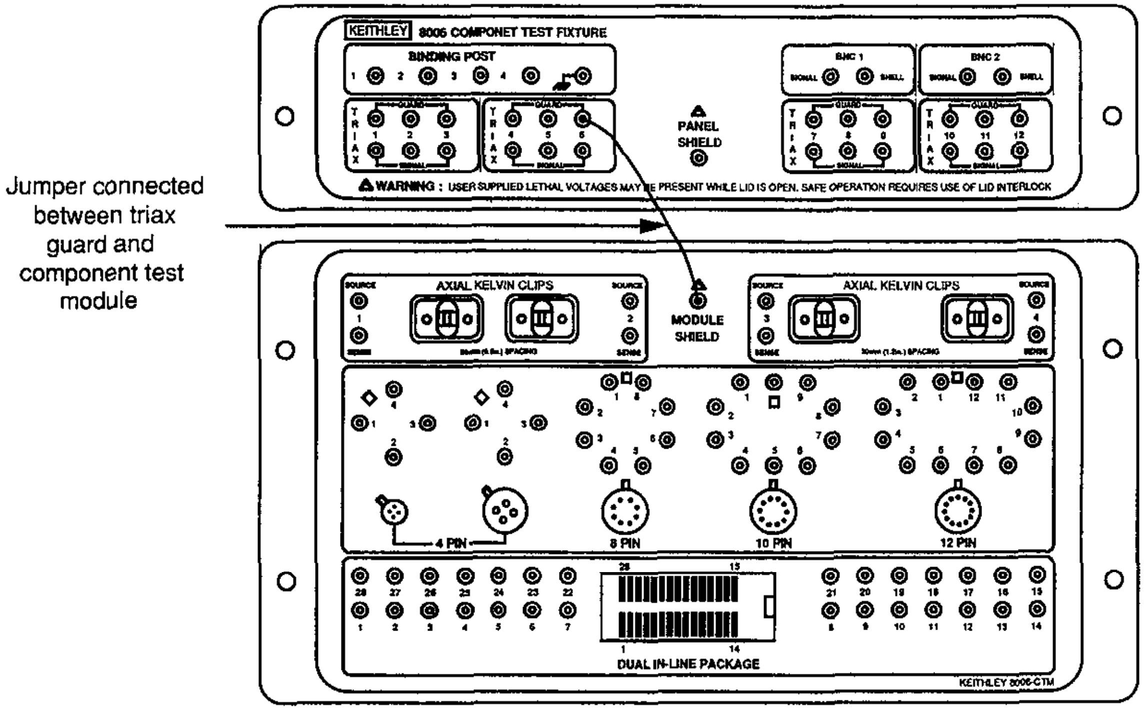

Jumper connected between triax guard and component test module

*Figure 2-6. Example of Module Guarding*

**WARNING**
**Do not exceed the maximum test fixture signal level, as defined in the specifications and stated on the rear panel. Always turn off all power and discharge all capacitors before connecting or disconnecting cables. Lethal voltages may be exposed when the lid is open. Safe operation requires the use of the lid safety interlock (see paragraph 2.2.1).**

## 2.3.1 Source Measure Unit Connections

Typical connections between the Model 8006 and the Model 236/237 Source Measure Units are shown in Figure 2-7. Note that remote sensing, and two connecting methods for local sensing are shown.

NOTE
With some devices, you may encounter device oscillation that will affect your measurements. Refer to paragraph 2.4.10 for details on verifying and preventing oscillation.

### Remote Sensing Connections

Remote sensing connections are shown in Figure 2-7A and 2-7B. Model 7078-TRX triax cables are recommended for all three connections. For the OUTPUT HI and SENSE HI cables (A and B), the center conductor is HI, the inner shield is GUARD, and the outer shield is chassis ground. Note that the remaining cable (connected to C) carries both OUTPUT LO and SENSE LO via the inner shield and center conductor respectively.

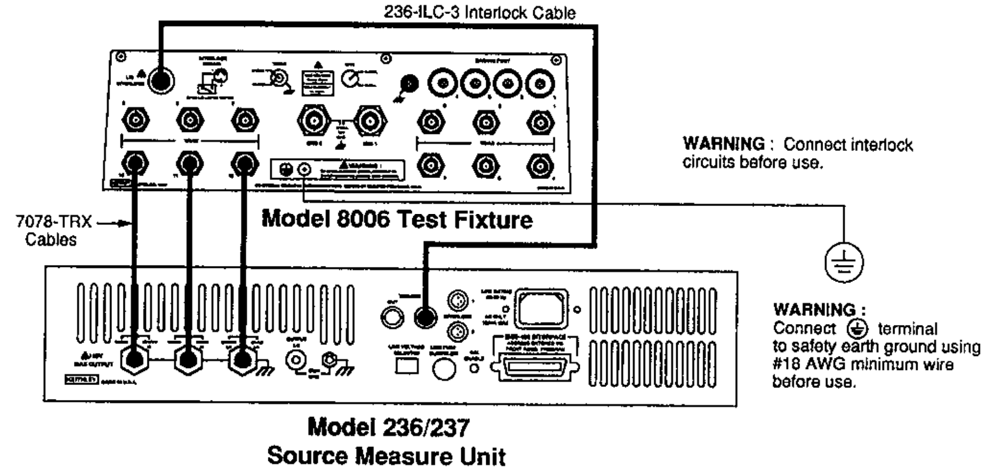
Be careful not to confuse the terminal conventions on the Source Measure Unit and the test fixture. HI appears on the SIGNAL jacks, and guard OUTPUT HI and SENSE HI actually appears on the GUARD jacks on the signal panel of the test fixture. As with all connections, you must complete the connections to the DUT in the appropriate device socket with the mini jumpers. Use standard mini jumpers for unshielded and unguarded pathways, and use guarded jumpers for guarded or shielded pathways.

### Local Sensing Connections (Banana Plug for LO)

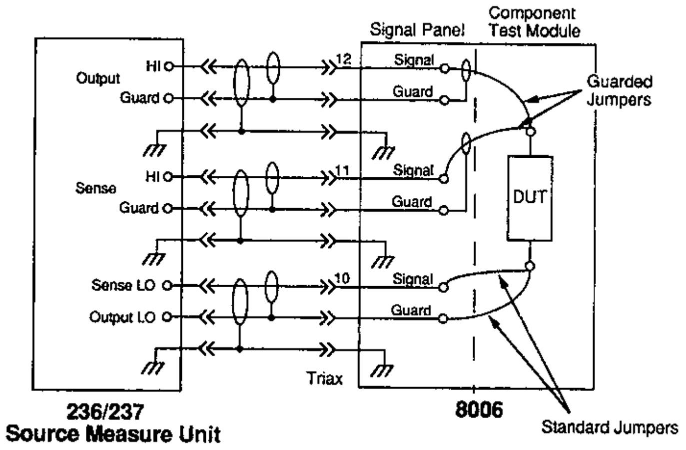
Connections for local sensing require only one triax cable, and a single banana plug patch cord (Figure 2-7C and 2-7D). Note that local sensing is recommended only for lower current situations where voltage drops across the test cables and connectors is not a consideration. Also, this configuration is recommended for less-critical applications where noise is not a problem.

### Local Sensing Connections (Triax Cable for LO)

Where noise pickup is a consideration, the local sensing connections shown in Figure 2-7E and 2-7F are recommended. Here, two Model 7078-TRX triax cables are used to connect the Source Measure Unit to the test fixture. When installing jumpers, keep in mind that OUTPUT LO appears on GUARD on the signal panel with this connection scheme.

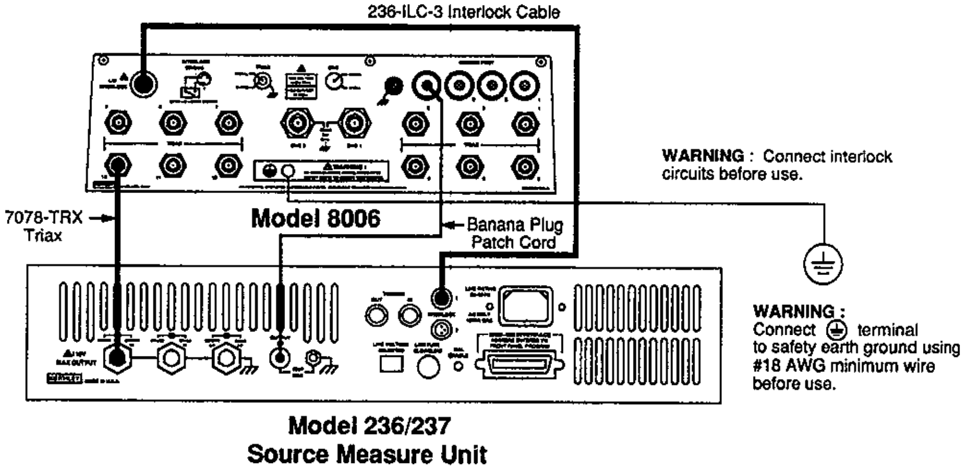


A. Connections (Remote sensing)

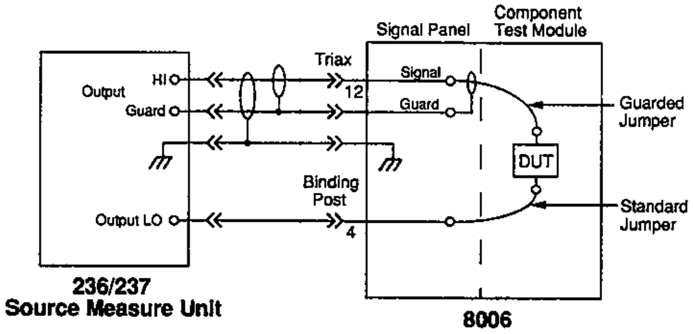


B. Equivalent Circuit (Remote Sensing)

*Figure 2-7. Source Measure Unit Connections*

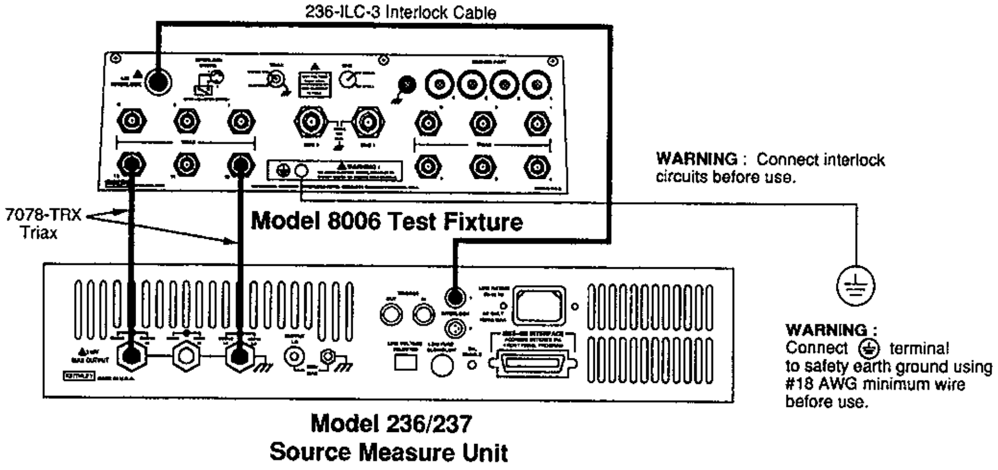


C. Connections (Local sensing, banana plug for LO)

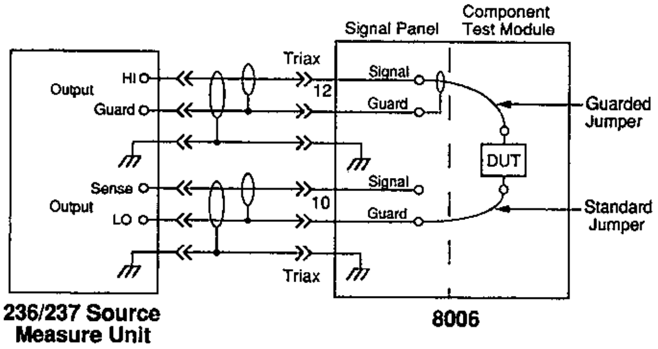


D. Equivalent Circuit (Local sensing, banana plug for LO)

Source Measure Unit Connections (Cont.)



E. Connections (Local sensing, triax for LO)



F. Equivalent Circuit (Local sensing, triax for LO)

Source Measure Unit Connections (Cont.)

## 2.3.2 Current Source Connections

### Unguarded Connections

Figure 2-8 shows unguarded connections between the test fixture and a typical current source, a Keithley Model 220. Again, a Model 7078-TRX triax cable is recommended for connections. A Model 6172 2-slot to 3-lug adapter will be necessary at the current source output jack. Note that the center conductor is HI, the inner shield is LO, and the outer shield is chassis ground.

### Guarded Connections

Guarded connections can also be made using a Model 6167 Guarded Adapter along with the current source, as shown in Figure 2-9. In this instance, the triax cable carries HI on the center conductor and GUARD on the inner shield. LO is routed through a separate wire connected between current source OUTPUT COMMON and a test fixture binding post. In some cases, it may be necessary to shield LO using triaxial or coaxial cable to minimize noise pickup.

The Model 6167 Guarded Adapter normally connects output LO to the outer shell of the output triax connector, and it must be modified to avoid connecting current source LO to chassis ground at the test fixture end. To modify the fixture, disconnect the internal wire going to the output triax connector outer shell.

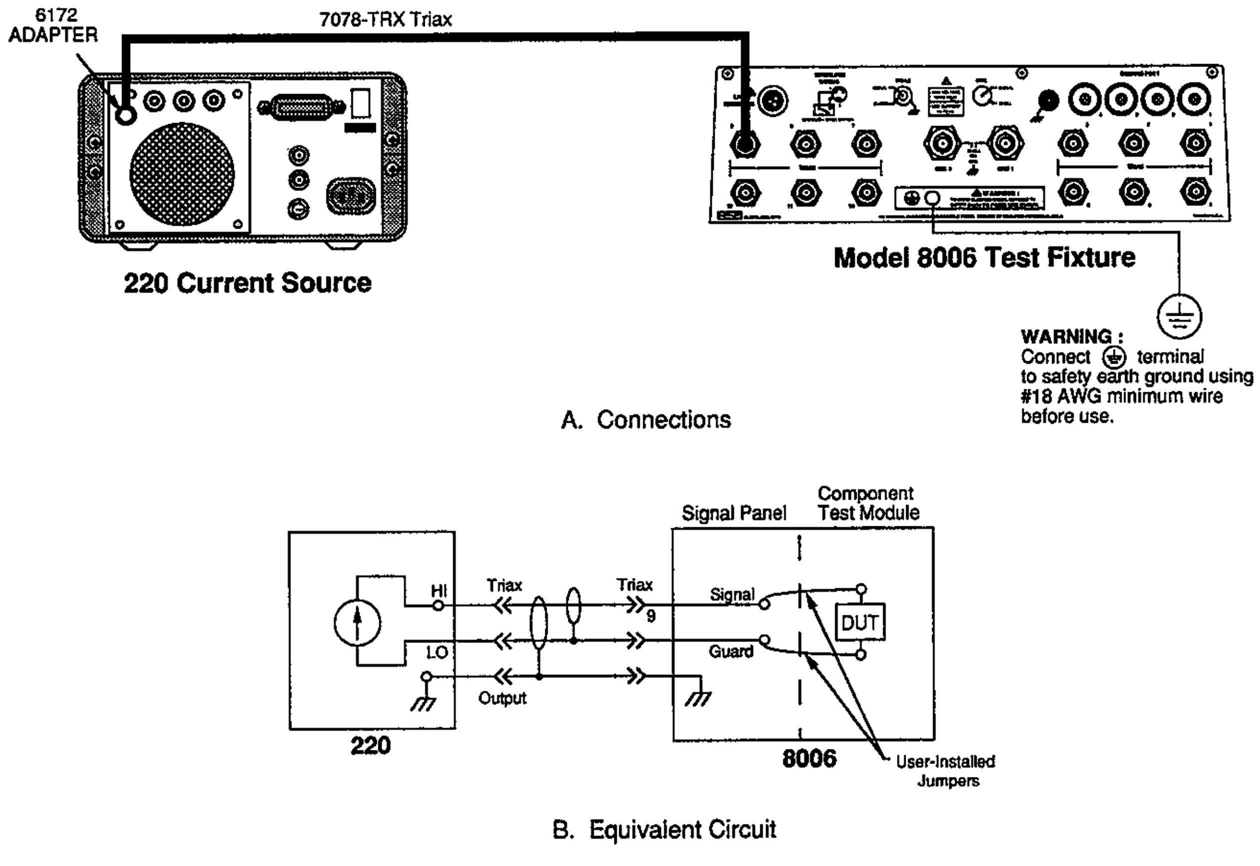
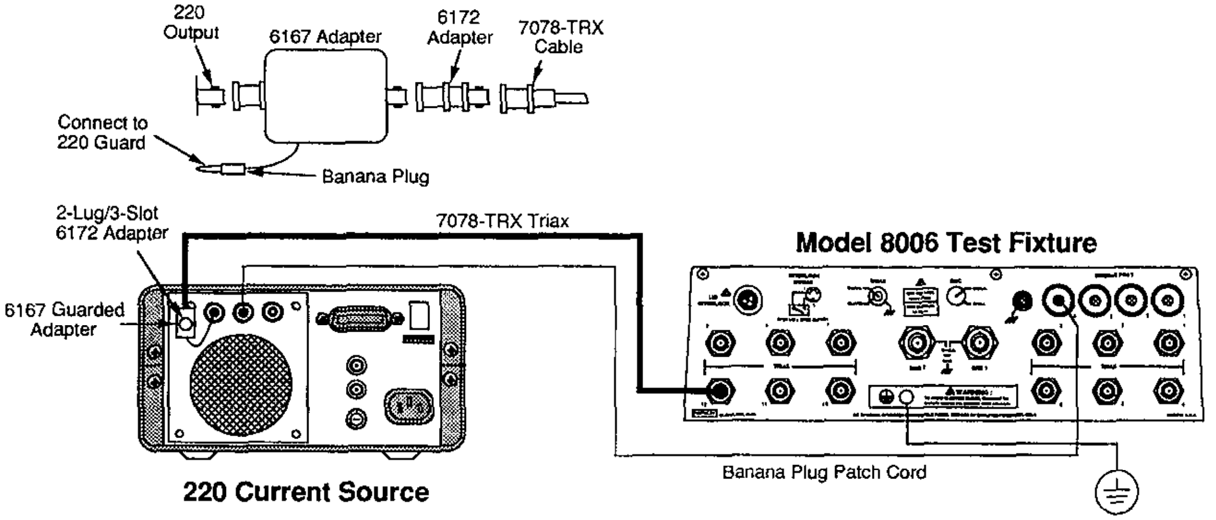
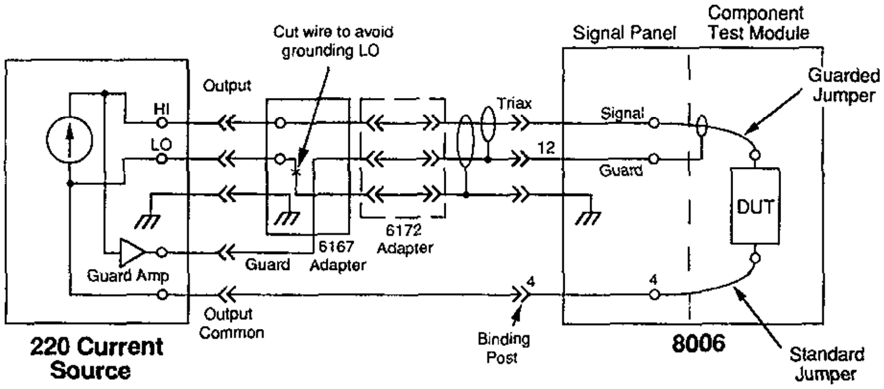


*Figure 2-8. Unguarded Current Source Connections*



A. Connections

**WARNING :**
Connect ⏚ terminal
to safety earth ground using
#18 AWG minimum wire
before use.



B. Equivalent Circuit

*Figure 2-9. Guarded Current Source Connections*

## 2.3.3 Voltage Source Connections

**Unshielded Connections**

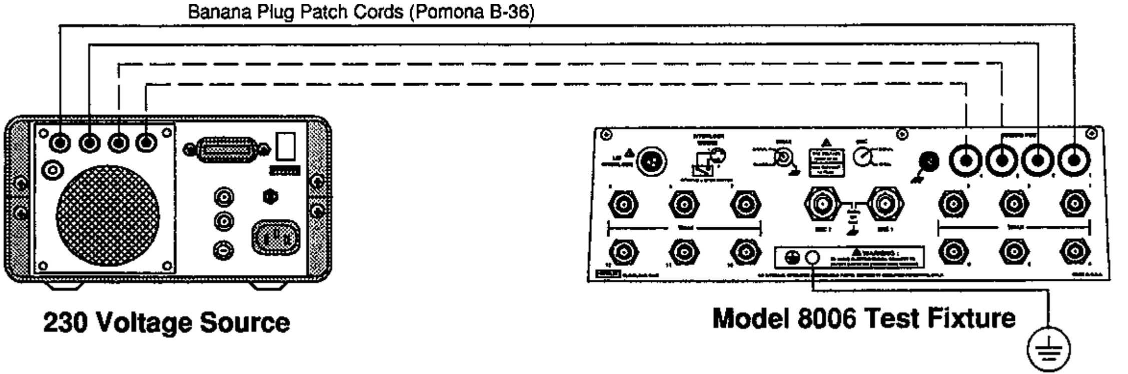
Unshielded voltage source connections are shown in Figure 2-10. Here, OUTPUT HI and LO are connected to test fixture binding posts using banana plug patch cords (Pomona B-36-0 and B-36-2).

For remote sensing, add the indicated cords and jumpers (shown with dashed lines).

**Shielded Connections**

For low signal levels or noisy test environments, shielded connections should be used to minimize noise (Figure 2-11). A male BNC to dual banana plug coaxial cable (Pomona 2BC-BNC-36) should be used for connections. At the voltage source, the cable shield should be connected to OUTPUT LO, and the center conductor should be connected to OUTPUT HI.

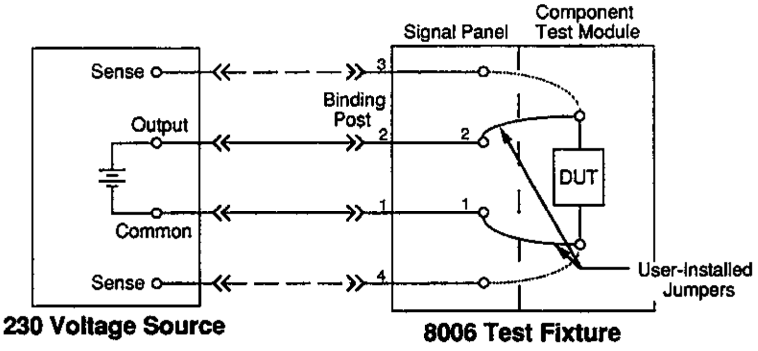
**WARNING**
**Do not float the Model 230 more than 30V RMS above earth ground.**



A. Connections

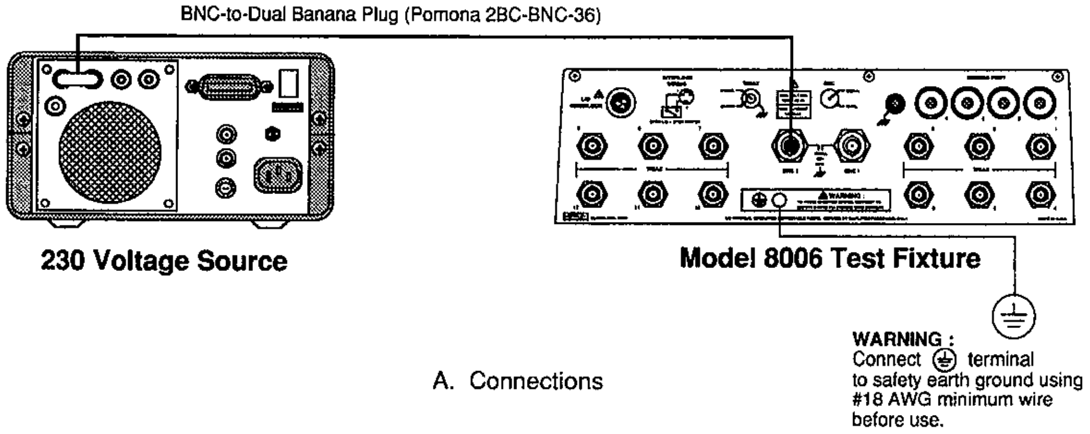
NOTE : Add — — for remote sensing connections

**WARNING :**
Connect ⏚ terminal to safety earth ground using #18 AWG minimum wire before use.

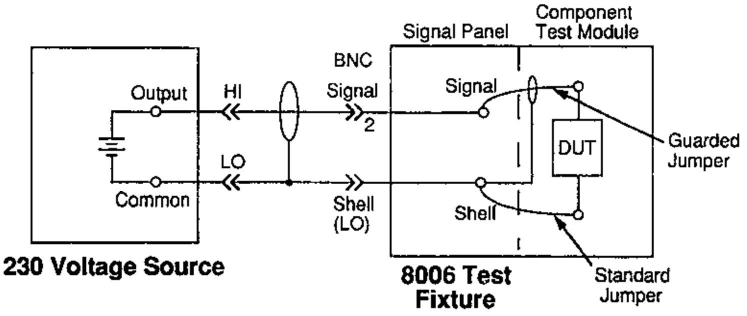


B. Equivalent Circuit

*Figure 2-10. Unshielded Voltage Source Connections*



A. Connections



B. Equivalent Circuit

*Figure 2-11. Shielded Voltage Source Connections*

## 2.3.4 Electrometer Connections

### Unguarded Connections

Typical unguarded electrometer connections are shown in Figure 2-12. Again, a single Model 7078-TRX triax cable can be used to make the connections. The center conductor is HI, the inner shield is LO, and the outer shield is chassis ground. A Model 6172 2-slot to 3-lug adapter will be necessary on the electrometer INPUT jack to adapt the cable to the electrometer INPUT connector. Note that V-Ω GUARD should be off, and the ground link between chassis ground and COM should be removed. Typical voltage source connections are also shown in Figure 2-12.

### Guarded Connections

Figure 2-13 shows guarded electrometer connections. Again, a triax cable/adapter combination is used between the electrometer INPUT jack and the desired triax connector on the test fixture. In this case, the center conductor is HI, the inner shield is GUARD, and the outer shield is chassis ground. LO is separately routed by connecting electrometer COM to a test fixture binding post using an ordinary patch cord. If measurement noise is a problem, route LO through a shielded path (either coax or triax) using suitable cables.

For guarded measurements, the V-Ω GUARD switch on the electrometer should be in the ON position. Also, the ground link between chassis ground and COM should normally be removed. In some cases, however, low-noise

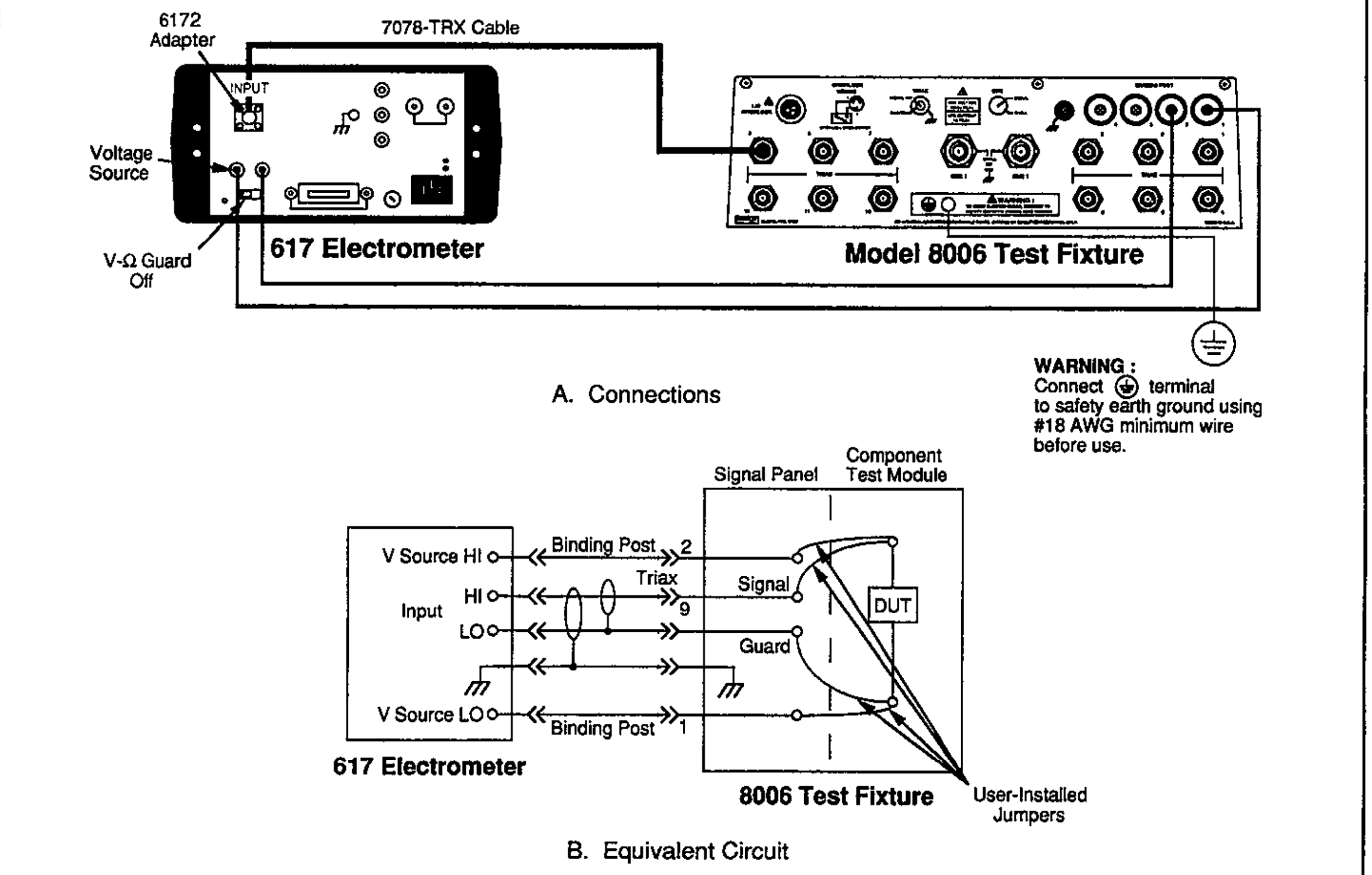


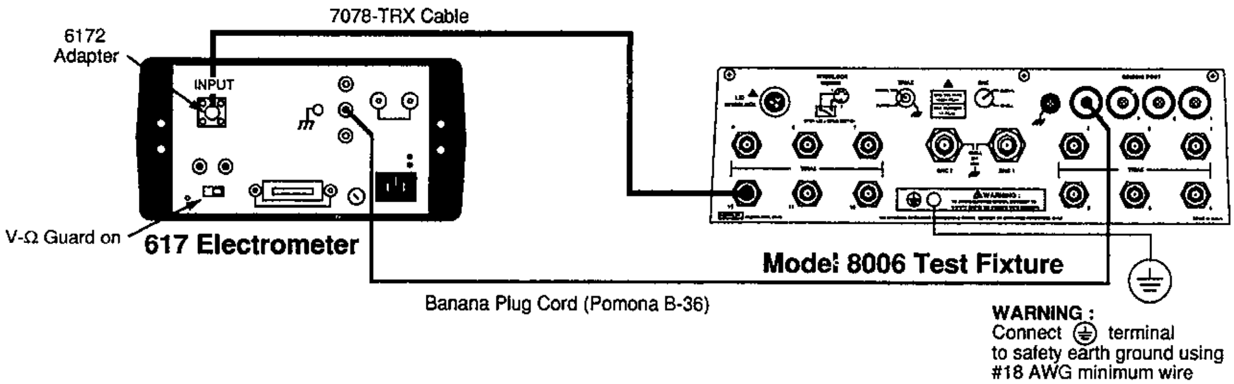
*Figure 2-12. Unguarded Electrometer Connections*

performance may be obtained with the ground link installed.

## 2.3.5 Matrix Card Connections

Typical connections to a Model 7072 Semiconductor Matrix Card are shown in Figure 2-14. Direct connections without adapters using Model 7078-TRX triax cables are used. Each cable carries SIGNAL (can be HI or LO) on the center conductor, GUARD on the inner shield, and chassis ground on the outer shield.

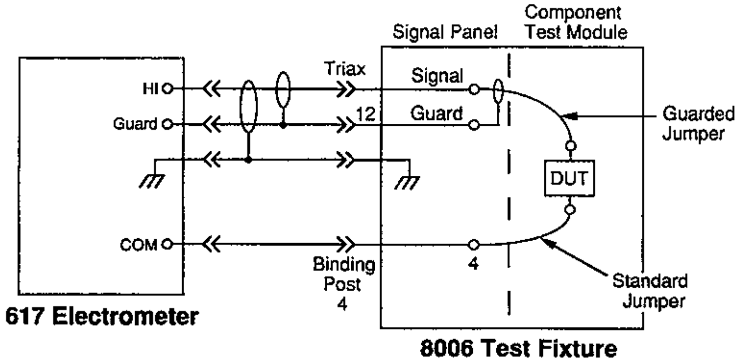
Connections to other types of matrix cards can be made in a similar manner by using the appropriate cables. For example, connections to a Model 7073 Coaxial Matrix Card would be similar except that coaxial cable to the BNC connectors would be made instead of the triax combination shown in Figure 2-14.



**WARNING :**
Connect ⏚ terminal to safety earth ground using #18 AWG minimum wire before use.

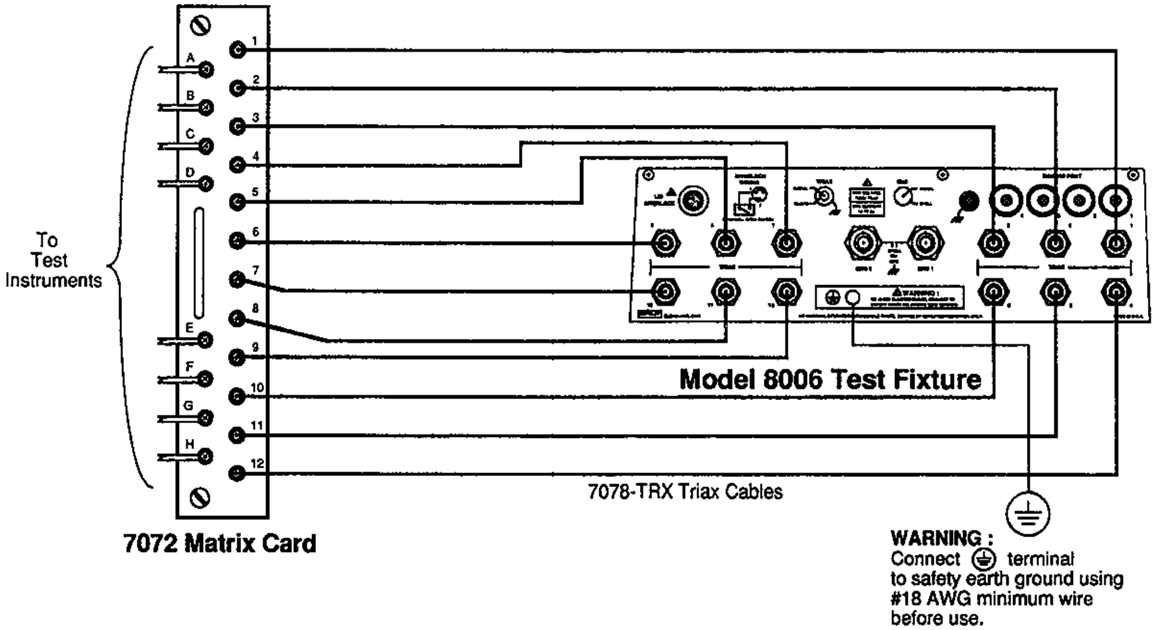
A. Connections

Note : See Figure 2-12 for voltage source connections

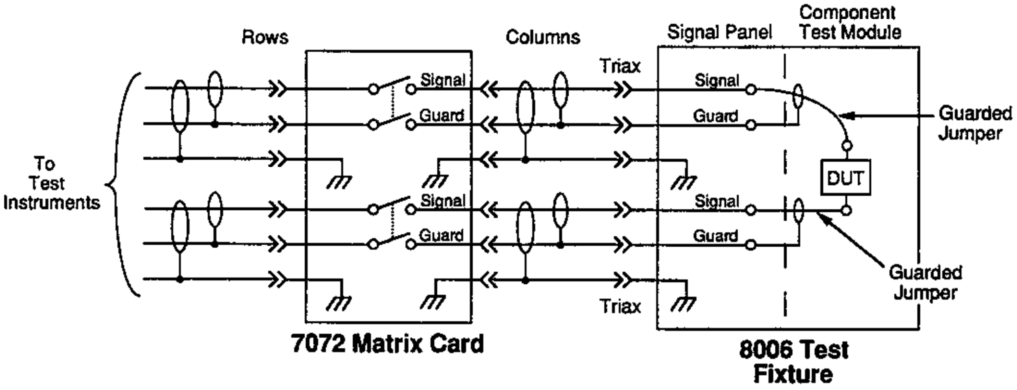


B. Equivalent Circuit

*Figure 2-13. Guarded Electrometer Connections*



A. Connections



B. Equivalent Circuit (Two pathways shown)

*Figure 2-14. Matrix Card Connections*

## 2.3.6 DMM Connections

### Unshielded Connections

Figure 2-15 shows typical unshielded DMM connections. VOLT/OHMS HI and LO are connected to the binding posts using ordinary banana plug patch cords (Pomona B-36-0 and B-36-2). For 4-wire measurements, simply connect two additional patch cords between OHMS SENSE HI and LO and the remaining two binding posts, as well as additional jumpers (shown as dashed lines).

### Shielded Connections

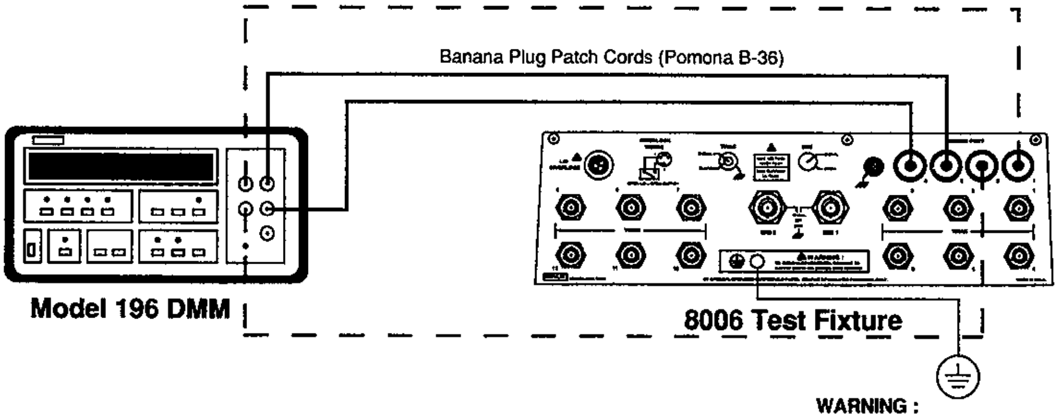
If measurement noise is a consideration, the shielded connections shown in Figure 2-16 should be used. A male BNC to dual banana plug cable (Pomona 2BC-BNC-36) is recommended for shielded connections. Connect VOLTS/OHMS HI to the center conductor, and connect VOLTS/OHMS LO to the cable shield. If shielded 4-wire connections are required, connect a second shielded cable between OHMS SENSE HI and LO and the remaining BNC connector on the test fixture.

## 2.3.7 Miscellaneous Instrument Connections

Other instruments such as oscilloscopes, CV meters, LCR meters, and network analyzers can also be connected to the test fixture using appropriate cables. The cables used will, of course, depend on the type of connector(s) on the test instrument. The following general recommendations apply when connecting these types of instruments to the Model 8006.

### 50Ω BNC Connections

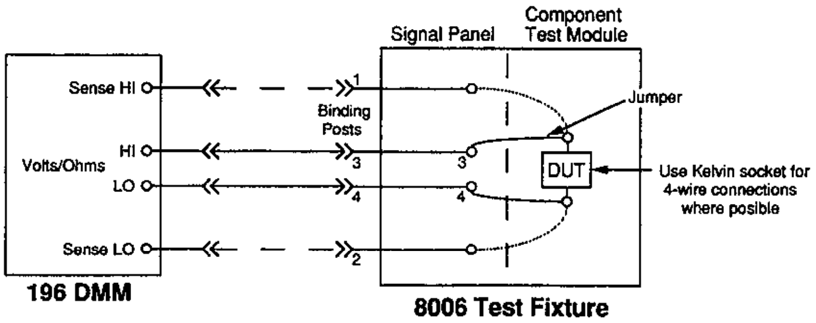
For instruments requiring 50Ω BNC connections, the Model 7051 BNC cables are recommended. Connect the cables to the BNC 1 or BNC 2 jacks on the test fixture. If more than two BNC connections are required, these BNC cables can be connected to the test fixture TRIAX jacks us-



**WARNING :**
Connect ⏚ terminal to safety earth ground using #18 AWG minimum wire before use.

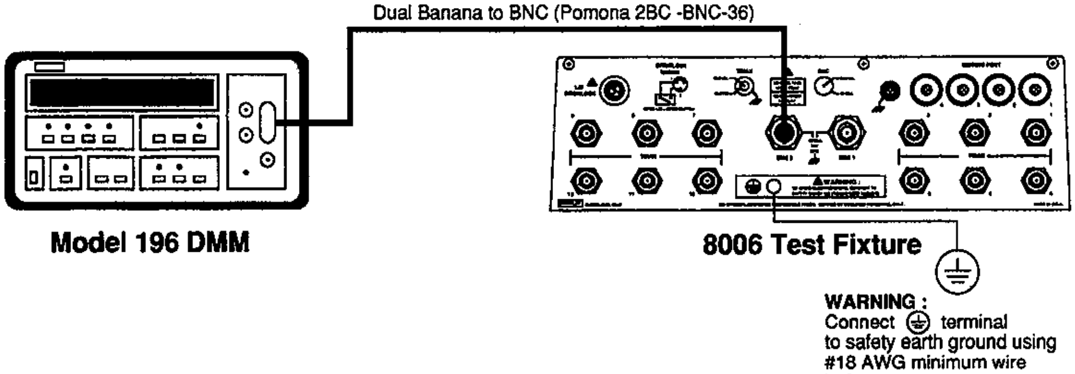
A. Connections

NOTE : Add — — for Kelvin (4-wire) connections.



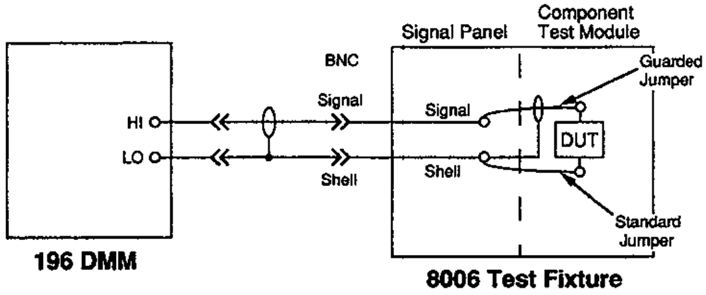
B. Equivalent Circuit

*Figure 2-15. Unshielded DMM Connections*



**WARNING :**
Connect ⏚ terminal
to safety earth ground using
#18 AWG minimum wire
before use.

A. Connections



B. Equivalent Circuit

*Figure 2-16. Shielded DMM Connections*

ing Model 7078-TRX-BNX triax-to-BNC adapters. Note, however, that the 50Ω impedance may not be maintained through the adapters and triax jacks.

### Low-Noise BNC Connections

For low-noise BNC connections, Model 4801 low noise coaxial cables are recommended. Connect these cables to BNC 1 or BNC 2 on the test fixture. Again, these cables can also be connected to the TRIAX connectors using Model 7078-TRX-BNC adapters, if required.

### Triaxial Cable Connections

Instruments equipped with triax connectors can be connected to the desired test fixture TRIAX jack(s) using Model 7078-TRX triax cables. Since these cables are equipped with 3-slot male triax connectors, a Model 6172 2-slot to 3-lug triax adapter will be necessary to connect the cables to instrument equipped with 2-lug female triax connectors.

As an alternative to the above arrangement for 2-lug jacks, you can use Model 7024 triax cables, which are terminated with 2-slot male connectors on each end. Model 6171 3-slot to 2-lug triax adapters will be necessary to connect these cables to the TRIAX connectors on the test fixture jacks.

## 2.4 MEASUREMENT CONSIDERATIONS

Many measurements made with the Model 8006 can be affected by noise and leakage paths. The following paragraphs discuss possible problems that might affect these measurements and ways to minimize their effects.

### 2.4.1 Path Isolation

Path isolation is simply the equivalent impedance between any two test paths in a measurement system. Ideally, the path isolation should be infinite, but the actual resistance and distributed capacitance of cables, connectors, and sockets results in less than infinite path isolation values for these devices.

### Equivalent Circuit

The equivalent path isolation circuit is shown in Figure 2-17. The path isolation resistance, $R_P$, and the path isolation capacitance, $C_P$, are assumed to be lump-sum values, and they represent the isolation from one SIGNAL pathway to another including one-meter triax cables and guarded jumpers to the socket connecting jack. In this instance, triax pathways are shown, but path isolation to BNC and binding-post pathways is similar.

### Isolation Resistance

Path isolation resistance forms a signal path that is in parallel with the equivalent resistance of the DUT, as shown in Figure 2-18. For low-to-medium device resistance values, path isolation resistance is seldom a consideration; however, it can seriously degrade measurement accuracy when testing high-impedance devices. The current flowing through such a device, for example, can be substantially attenuated by the current divider action of the device source resistance and path isolation resistance, as shown in Figure 2-19. Such leakage paths ($R_{PATH}$) bleed some of the current away from the device under test ($R_{DUT}$), reducing measurement accuracy.

### Test Fixture Isolation Resistance

The path isolation of the test fixture itself depends on the connectors and sockets being used. For the triax and BNC connectors, the limiting factor is the socket, with the axial and TO sockets having substantially higher guaranteed path isolation values than the DIP socket. The typical isolation for the DIP socket is much better, however; see the specifications for complete details.

The path isolation value for the binding posts is much lower than for the BNC and triax connectors. For that reason, the binding posts should only be used for non-critical signal paths such as power supply routing.

### Path Isolation Capacitance

Any distributed capacitance between measurement pathways affects dc measurement settling time as well as ac measurement accuracy. Thus, it is important that such capacitance be kept as low as possible. Although the distributed capacitance of the test fixture is generally fixed by design, there is one area where you do have control over the capacitance in your test system: the connecting

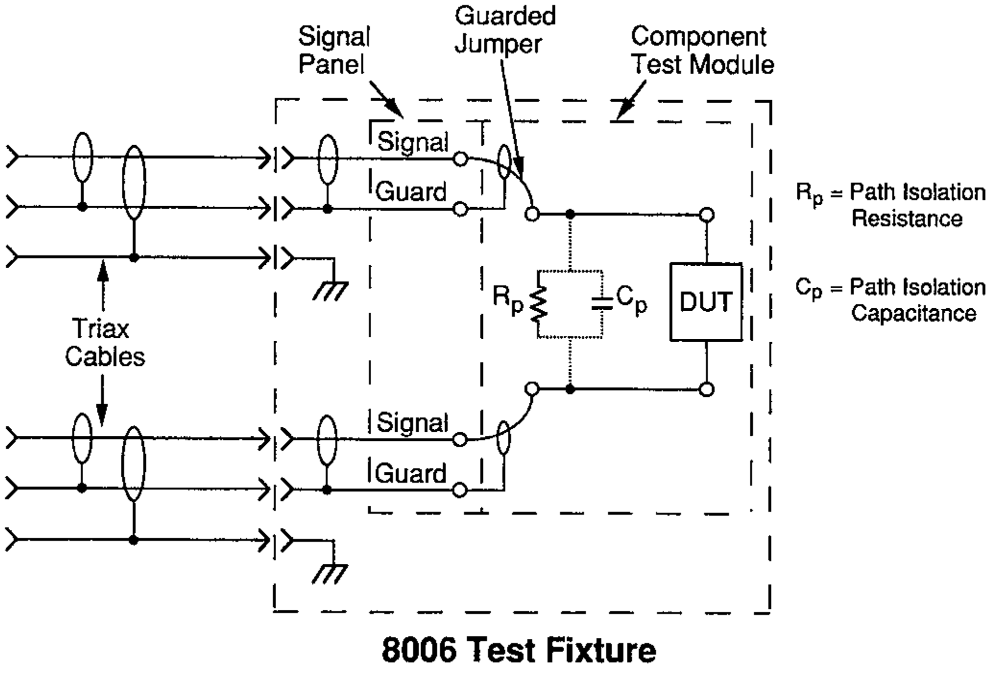
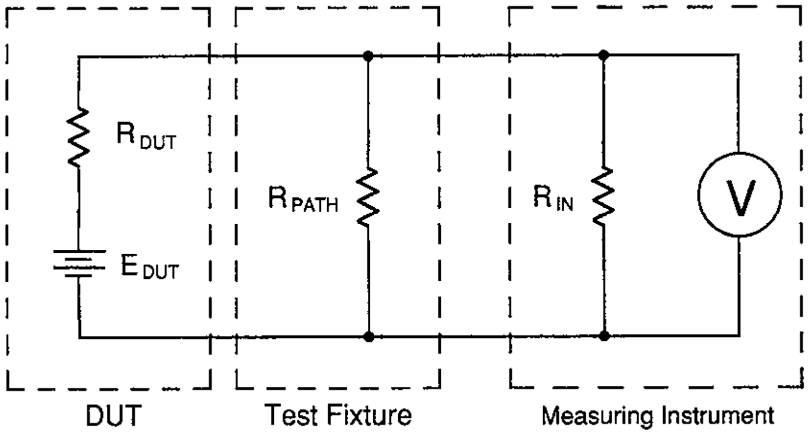


Figure 2-17. Path Isolation Equivalent Circuit



$R_{DUT}$ = Source resistance of DUT

$E_{DUT}$ = Source voltage of DUT

$R_{PATH}$ = Path isolation resistance

$R_{IN}$ = Input resistance of measuring instrument

*Figure 2-18. Path Isolation Resistance*

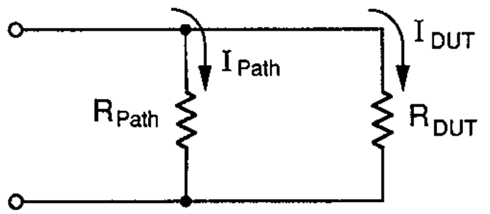


*Figure 2-19. Current Error Caused by Path Isolation Resistance*

cables. Use only low-capacitance cabling, and keep all cables as short as possible. Also, guarded jumpers minimize path capacitance to the test sockets.

**Test Fixture Isolation Capacitance**

The test fixture isolation capacitance depends on the socket in question. In general, the isolation capacitance is much lower for the axial component socket than for the TO or DIP package sockets.

Keep in mind that the capacitance is highest between adjacent terminals of a given socket. For that reason, it may be advantageous to measure low capacitance values between non-adjacent terminals of a socket whenever possible.

**Minimizing Path Isolation Effects**

The effects of path resistance and capacitance can be minimized by using guarded jumpers whenever possible. Paragraph 2.4.4 discusses guarding in more detail.

## 2.4.2 Keeping Connectors and Sockets Clean

As is the case with any high-resistance device, the integrity of connectors and sockets can be compromised if they are not handled properly. If the insulation becomes contaminated, the path isolation resistance will be substantially reduced, affecting high-impedance measurements.

Oils and salts from the skin will contaminate insulators, reducing their resistance. Also, contaminants present in the air can be deposited on the insulator surfaces. To avoid these problems, never touch the connector or socket insulating material. In addition, the test fixture should be used only in clean environments to avoid contamination.

If the connector or socket insulators should become contaminated, either by inadvertent touching, or from airborne deposits, they can be cleaned with a cotton swab dipped in clean methanol. After thorough cleaning, they should be allowed to dry for one-half to one hour in a low-humidity environment before use, or they can be dried more quickly using dry nitrogen gas. Do not use air from an ordinary air compressor because oil present in the air may result in contamination. Also, do not use air from a tank because it can cause moisture to condense on the socket.

## 2.4.3 Shielding

Proper shielding of all signal paths and devices under test is important to minimize noise pickup in virtually any semiconductor test system. Otherwise, interference from noise sources such as line frequency and RF fields can seriously corrupt a measurement.

### Triaxial Cable Shielding

For unguarded measurements, the inner shield of the triaxial cable that surrounds the signal path should be connected to signal LO (or to chassis ground for instruments without isolated LO terminals). An example of how to maintain a shielded pathway from an instrument to the test fixture is shown in Figure 2-20.

### Coaxial Cable Shielding

Coaxial cables can also be used to provide effective shielding. Connect each coaxial cable to one of the BNC connectors on the test fixture. The center conductor should be connected to HI of the test instrument, and the cable shield should be connected to LO, as in the example of Figure 2-21. Coaxial cables can also be connected to one of the triax connectors by using a Keithley Model 7078-TRX-BNC triax to BNC adapter.

WARNING

**Do not apply driven guard to coaxial cables because hazardous voltages may be placed on the outer cable shields, creating a possible shock hazard. Maximum common-mode voltage for the BNC jacks (or any BNC cable) is 30V RMS (dc to 60Hz).**

### Panel and Module Shielding

In many cases, it may be desirable to connect the signal panel or component module shields to circuit LO or chassis ground. To do so, simply connect a mini jumper between each shield jack to the appropriate circuit terminal (LO or chassis ground). As with any shielding situation, experimentation may be necessary to determine the configuration that results in the lowest noise.

### Jumper Shielding

Guarded jumpers should be used in cases where the shield must be carried through as close to the device socket as possible. Simply connect the jumper shield to a shield connection on the signal panel. Typically circuit GUARD will be used as the shield connecting point, although better noise performance may obtained by con-

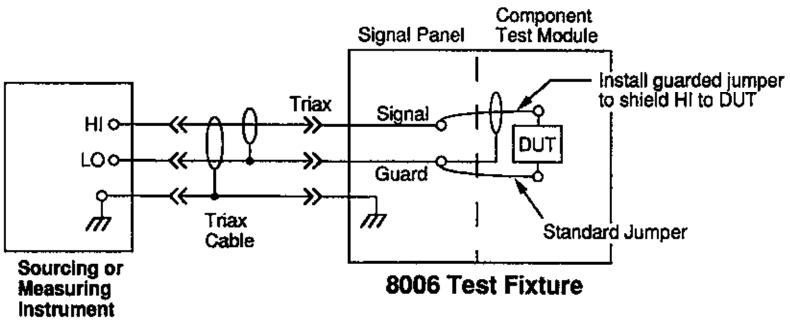


*Figure 2-20. Shielding Example Using Triaxial Cables*

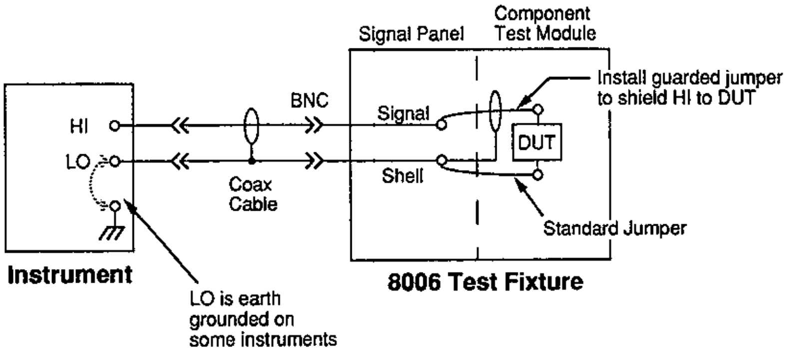


*Figure 2-21. Shielding Example Using Coaxial Cables*

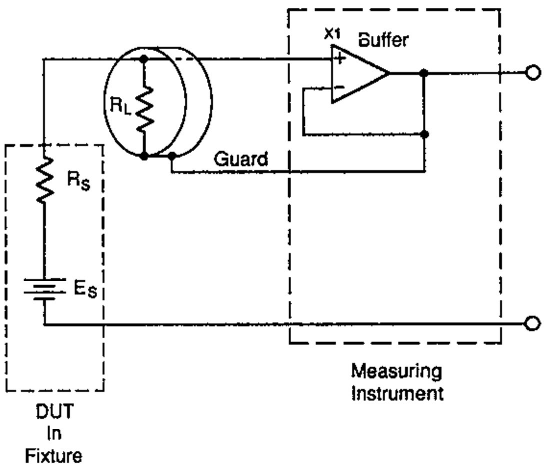
necting shields to chassis ground in some cases. The same general consideration applies to shield connection points throughout a test system. Usually, experimentation is the best way to determine the best shielding configuration. In order to avoid ground loops, connect the shield to only to one point in the circuit.

## 2.4.4 Guarding

Guarding is especially important in high-impedance circuits where leakage resistance and capacitance could have degrading effects on the measurement. Guarding consists of using a shield surrounding a conductor that is carrying the high-impedance signal. This shield is driven by a low-impedance amplifier to maintain the shield at signal potential. For triaxial cables, the inner shield is used as guard.

### Guarding Principles

Guarding minimizes leakage resistance effects by driving the inner cable shield with a unity-gain amplifier, as shown in Figure 2-22. Since the amplifier has a high input impedance, it minimizes loading on the high-impedance signal lead. Also, the low output impedance ensures that the shield remains at signal potential, so that virtually no leakage current flows through the leakage resistance, $R_L$. Leakage between inner and outer shields may be considerable, but that leakage is of little consequence because that current is supplied by the buffer amplifier rather than the signal itself.



$E_S$ = DUT source voltage

$R_S$ = DUT source resistance

$R_L$ = Leakage resistance

*Figure 2-22. Guarded Circuit*

In a similar manner, guarding also reduces the effective cable capacitance, resulting in much faster measurements on high-impedance circuits. Because any distributed capacitance is charged through the low impedance of the buffer amplifier rather than by the high-impedance source, settling times are shortened considerably by guarding.

### Using Guarding

In order to use individual pathway guarding effectively with the Model 8006, the inner shield of the connecting triaxial cable carrying the HI signal path should be connected to the guard output of the sourcing or measuring instrument. That guard output must be at the same dc potential as the signal being guarded. Many instruments such as the Model 236/237 Source Measure Units automatically drive the inner shield of the HI signal pathways at guard potential (in the case of the Model 236 and 237, both OUTPUT HI and SENSE HI are separately guarded).

Any LO signal pathways running through triaxial cables need not be guarded. For the LO signal path, simply connect the inner shield to LO at the measuring or sourcing instrument.

### Typical Guarded Connections

Figure 2-23 shows typical guarded connections, with the guard path carried through the inner shield of the connecting cable. Note that guard appears on the GUARD jack of the signal panel on the test fixture. Also note that LO is routed through a binding post in this example; in some cases, it may be necessary to connect LO using shielded wire to avoid detrimental effects on the measurement.

### Panel and Module Guarding

For very critical measurements, it may be desirable to connect the instrument panel or component test module shields to guard potential. To do so, simply connect a mini jumper between the desired GUARD jack on the signal panel and the signal panel or component test module shield jack, as required.

### Jumper Guarding

With sensitive measurements, guarding can be carried through to the device socket by using the guarded jumpers in place of the standard jumpers. To connect these jumpers for guarding, simply connect the jumper shield to the guard potential on the signal panel. For example, if you are using a Model 236/237, guard appears on the GUARD jack for the associated signal panel connections.

**WARNING**
**Hazardous voltage may be present on GUARD.**

## 2.4.5 Cable Noise Currents

Noise currents can be generated by bending or flexing the triaxial or coaxial connecting cables. These currents, which are known as triboelectric currents, are generated by charges created between a conductor and insulator caused by friction between conductors and insulators.

In order to minimize cable noise currents, tie down cables to avoid flexing, and isolate the cables from vibration sources such as motors and pumps. Also, avoid temperature extremes that could result in cable expansion and contraction.

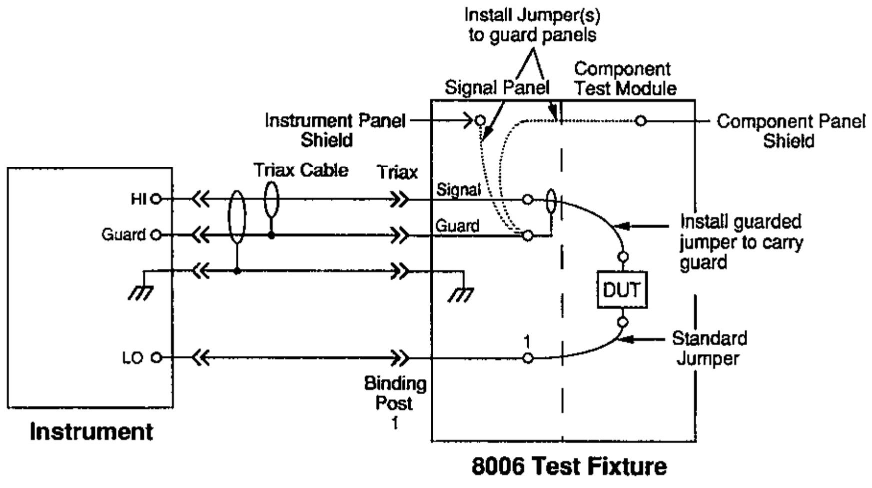


*Figure 2-23. Typical Guarded Signal Connections*

## 2.4.6 Magnetic Fields

When a conductor loop cuts through magnetic lines of force, a very small current is generated. This phenomenon will frequently cause unwanted signals to occur in the test leads of a test system. If the conductor has sufficient length or cross-sectional area, even weak magnetic fields such as those of the earth can create sufficient signals to affect low-level measurements.

Two ways to reduce these effects are: (1) reduce the lengths of the connecting cables, and (2) minimize the exposed circuit area. In extreme cases, magnetic shielding may be required. Special metal with high permeability at low flux densities (such as mu metal) are effective at reducing these effects.

Even when the conductor is stationary, magnetically-induced signals may still be a problem. Fields can be produced by various signals such as the ac power line voltage. Large inductors such as power transformers can generate substantial magnetic fields, so care must be taken to keep the test fixture, instruments, and connecting cables a good distance away from these potential noise sources.

## 2.4.7 Radio Frequency Interference

RFI (Radio Frequency Interference) is a general term used to describe electromagnetic interference over a wide range of frequencies across the spectrum. Such RFI can be particularly troublesome at low signal levels, but is can also affect measurements at high levels if the fields are of sufficient magnitude.

RFI can be caused by steady-state sources such as radio or TV signals, or some types of electronic equipment (microprocessors, high speed digital circuits, etc.), or it can result from impulse sources, as in the case of arcing in high-voltage environments. In either case, the effect on the measurement can be considerable if enough of the unwanted signal is present.

RFI can be minimized in several ways. The most obvious method is to keep the test fixture, instruments, and signal leads as far away from the RFI source as possible. Additional shielding of the test fixture, signal leads, sources, and measuring instruments will often reduce RFI to an acceptable level. In extreme cases, a specially-constructed screen room may be required to sufficiently attenuate the troublesome signal.

Many instruments incorporate internal filtering that may help to reduce RFI effects in some situations. In some cases, additional external filtering may also be required. Keep in mind, however, that filtering may have detrimental effects on the desired signal.

## 2.4.8 Ground Loops

When two or more instruments are connected together, care must be taken to avoid unwanted signals caused by ground loops. Ground loops usually occur when sensitive instrumentation is connected to other instrumentation with more than one signal return path such as power line ground. As shown in Figure 2-24, the resulting ground loop causes current to flow through the instrument LO signal leads and then back through power line ground. This circulating current develops a small, but undesirable voltage between the LO terminals of the two instruments. This voltage will be added to the source voltage, affecting the accuracy of the measurement.

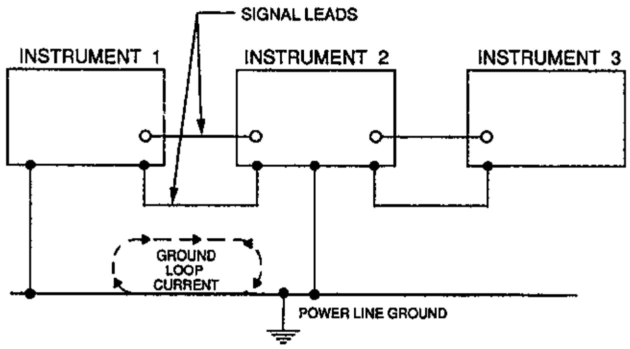


*Figure 2-24. Power Line Ground Loops*

Figure 2-25 shows how to connect several instruments together to eliminate this type of ground loop problem. Here, only one instrument is connected to power line ground.

Ground loops are not normally a problem with instruments having isolated LO terminals. However, all instruments in the test setup may not be designed in this manner. When in doubt, consult the manual for all instrumentation in the test setup.

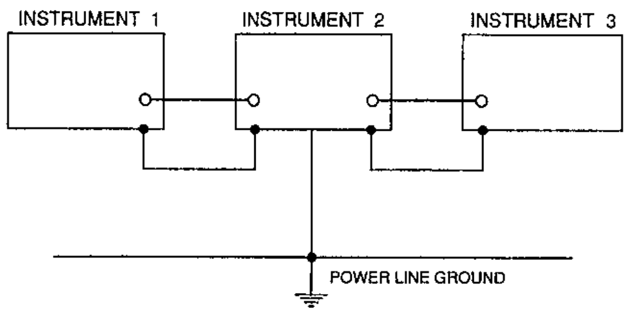


*Figure 2-25. Eliminating Ground Loops*

## 2.4.9 Kelvin Connections

Kelvin (4-wire) connections are often necessary in cases where higher currents are used to avoid measurement errors caused by voltage drops across connectors and cables. Examples of instruments that frequently use Kelvin connections are the Models 236 and 237 Source Measure Units (when using remote sensing), and DMMs making 4-wire resistance measurements like the Models 196 and 199.

### Kelvin Connection Example

Figure 2-26 shows a typical example of unshielded Kelvin connections using 4-wire signal pathways to a 2-terminal DUT mounted in one of the axial Kelvin sockets. In cases where noise is a problem, the shielded configuration shown in Figure 2-27 is recommended.

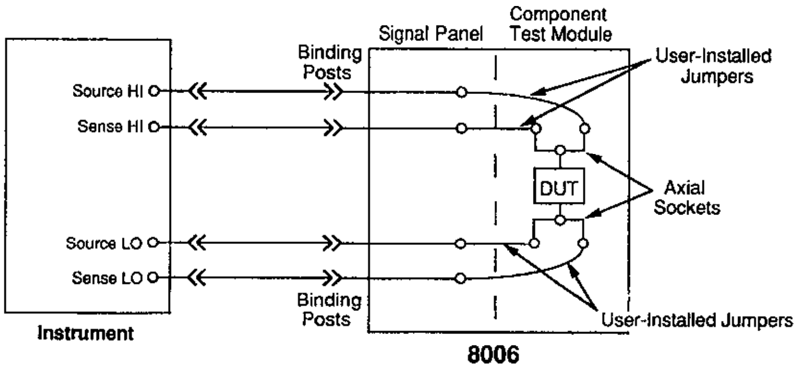


*Figure 2-26. Unshielded Kelvin Connections*

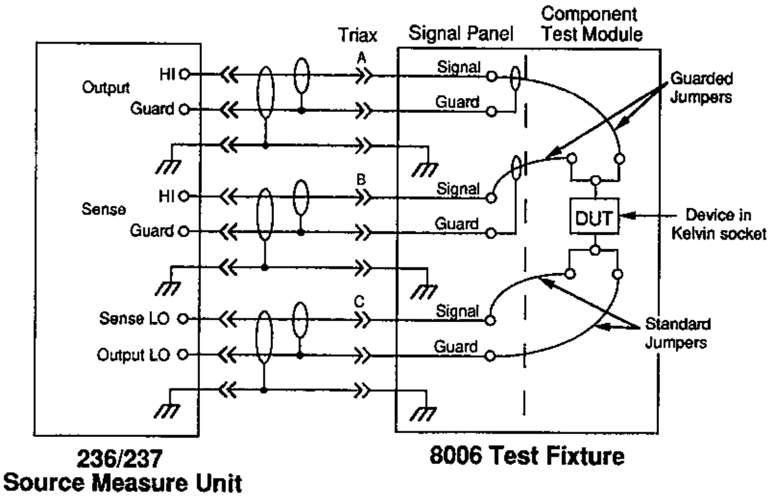


*Figure 2-27. Shielded Kelvin Connections*

### Socket Kelvin Resistance

When using the axial sockets, Kelvin pathways are carried through directly to the DUT located in the socket. With Kelvin connections to transistor and DIP sockets, however, Kelvin connections can only be carried through to the socket terminal, as shown in Figure 2-28. As a result, there is some small residual resistance, $R_{SKT}$, present in the pathway between the connecting jack and the socket terminal. For this reason, the socket Kelvin resistance for the transistor and DIP sockets is substantially higher than the axial socket Kelvin resistance. Since socket Kelvin resistance could affect the accuracy of low-resistance measurements, it is recommended that you use the axial sockets for such measurements whenever possible.

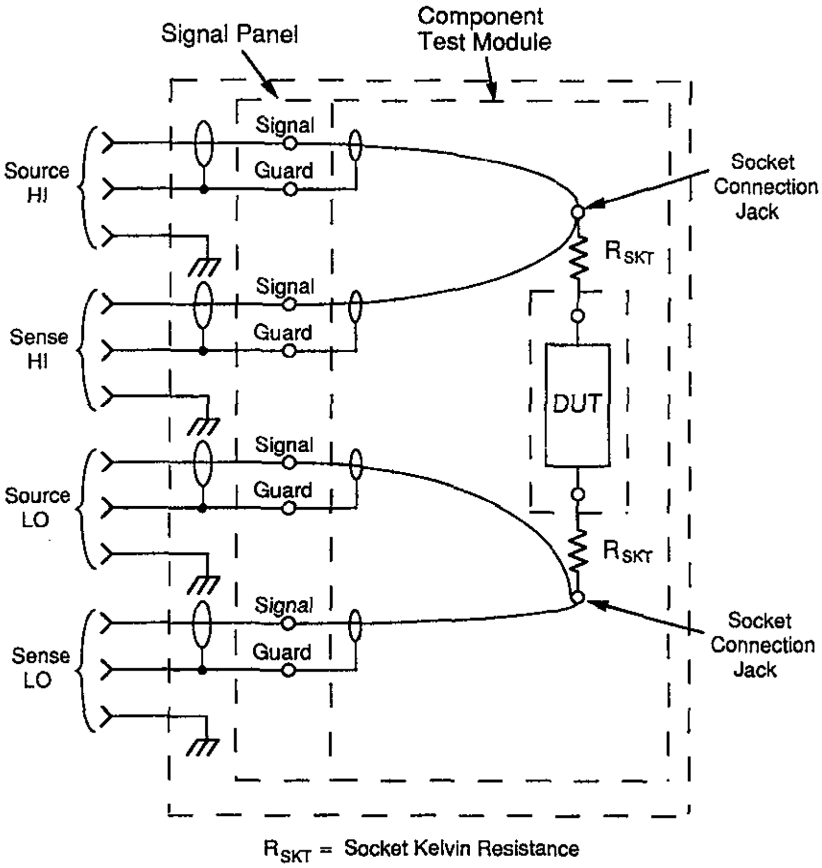


*Figure 2-28. Kelvin Connections Equivalent Circuits*

## 2.4.10 Device Oscillation

In some cases, you may encounter device oscillation that will affect your measurements. Such oscillations are the result of parasitic feedback caused by stray capacitance and inductance in the test system. The following paragraphs cover important aspects of oscillation such as devices likely to oscillate, signs of possible oscillations, and methods to eliminate oscillations.

### Conditions Conducive to Oscillation

Oscillations are more likely with multiple-instrument test setups (for example, with Source Measure Units) when testing devices with high gain-bandwidth products such as RF FETs, small-geometry bipolar transistors, and GaAs MESFETs. Other components that may oscillate include negative-resistance devices such as UJTs.

### Verifying the Presence of Oscillations

From a dc testing standpoint, the most obvious signs of possible oscillations include:

- Unrepeatable or unstable measurements
- Inconsistent readings across measurement ranges
- Unexpected data values
- Data varying significantly with changes in the integration rate of the instrument
- Significant changes in data with added instrument filtering.

If any of these conditions are noted, the presence of oscillations can be verified with an oscilloscope. Note, however, that connecting an oscilloscope may affect the oscillations, either increasing or decreasing them, or possibly even dampening them out completely. If the presence of oscillations is verified, note the oscillation frequency so that appropriate remedies can be applied, as outlined below.

### Eliminating Oscillations

We will now briefly discuss the following five methods for eliminating device oscillation:

- Adding ferrite beads in series with the gate (base) lead.
- Adding series resistance to the gate (base) lead.
- Connecting a series RC circuit between the drain (collector) and gate (base).
- Connecting a series RC circuit between the gate (base) and source (emitter).
- Adding shunt capacitance between the drain (collector) and source (emitter).

Each of these methods is shown schematically in Figure 2-29, which shows a typical FET test configuration. The configuration for a bipolar transistor would be similar, with the emitter, base, and collector leads replacing the source, gate, and drain leads respectively.

### Method 1: Adding Ferrite Beads

The Model 8006 Test Fixture already includes internal ferrite beads on each socket lead as a precautionary measure against oscillations in most nominally stable test configurations. When testing very high frequency devices, however, it may be necessary to add additional ferrite beads to the gate (base) lead of the DUT (Figure 2-29A). The additional beads act to reduce the Q of the parasitic feedback circuit, decreasing the likelihood of oscillations. Since ferrite beads will typically have an impedance of 100Ω or less at the frequency of interest, it may be necessary to use two or more beads, particularly with high-gain devices. Fair-Rite Products Corp. is a good source for shield-bead kits for this application (see below for address).

### Method 2: Adding Series Gate Resistance

A series gate (base) resistance, $R_G$, can also be added to reduce the Q of the parasitic feedback network (Figure 2-29B). This method should be used only if the added gate resistance will have no undesirable effects on the measured device parameters. The resistor should have the following value in order to be effective:

$$R_G > \frac{1}{2\pi f_O L_G}$$

Where:

$R_G$ = value of added gate resistance
$f_O$ = frequency of undesired oscillation
$L_G$ = equivalent inductance connected to gate, including cables

### Methods 3 and 4: Installing Series RC Circuits

Another useful method is to install a series RC network between the gate (base) and the drain (collector), as in Figure 2-29C, or between the gate (base) and the source (emitter), as shown in Figure 2-29D. These RC circuits act to reduce the overall loop gain that would occur near any resonance point caused by the parasitic feedback. In order to be effective, the relationship between RC and the oscillation frequency should be as follows:

$$RC > \frac{1}{2\pi f_O}$$

and,

$$R < \sqrt{\frac{L_G}{C_{G\text{-}D}}}$$

Where:

$f_O$ = frequency of undesired oscillation
R = value of added resistance
C = value of added capacitance
$L_G$ = total equivalent inductance connected to gate including cables
$C_{G\text{-}D}$ = gate-to-drain capacitance of DUT in socket.

### Method 5: Shunt Capacitance

One final (and simpler) method is to install a shunt capacitance, C, between the drain (collector) and source (emitter) leads of the device under test (Figure 2-29E). This capacitance will cancel some of the inductance present in the cables used between the test fixture and instrumentation. The recommended range of value for this capacitor is between 5pF and 1500pF. Note that the use of values larger than 1500pF may result in Source Measure Unit oscillation or increase circuit settling times unacceptably.

### Installing Components

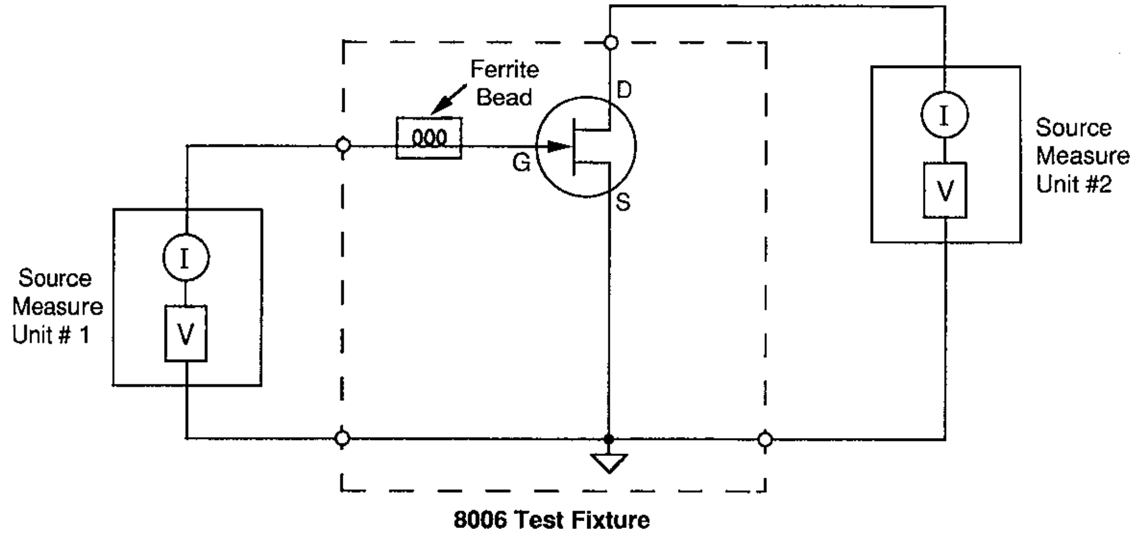
Where possible, components should be installed as close to the DUT as possible. Ferrite beads, for example, can be slipped over the appropriate DUT test leads, while resistors and capacitors can be installed in the Kelvin sockets and then jumpers installed to the device under test.

### Recommended Reading

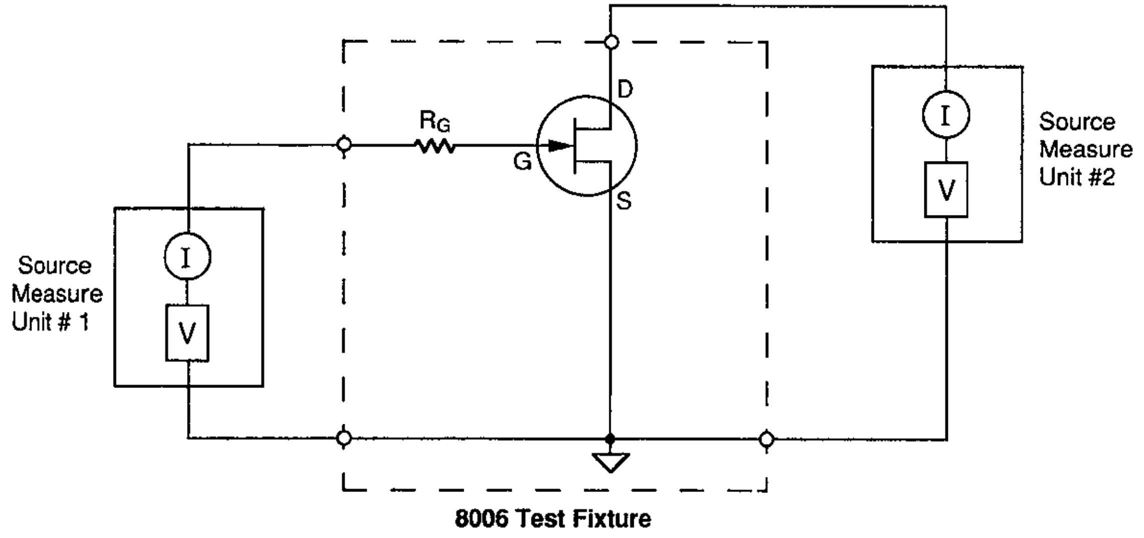
For additional information on the subject of device oscillation and how to prevent it, refer to the following literature:

Fair-Rite, Linear Ferrites, Fair-Rite Products Corp., P.O. Box J, Wallkill, N.Y. 12589.

Small-Signal Transistor Data, Motorola Inc., Box 20912, Phoenix, AZ 85036.

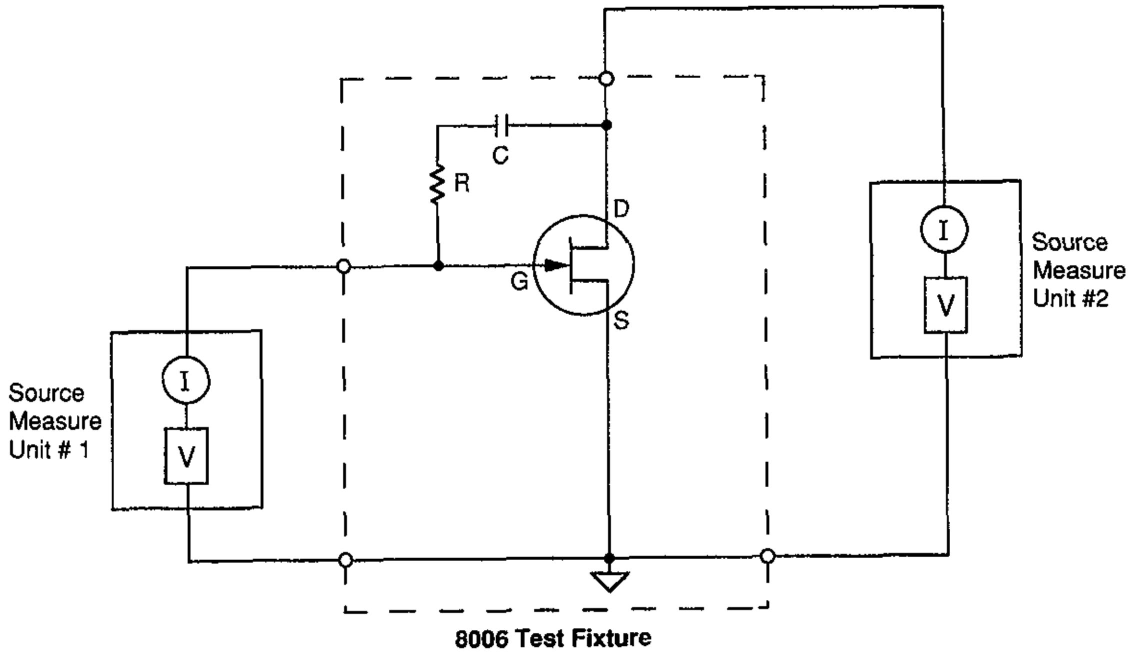


**A. Method 1, Series Ferrite Bead in Gate**

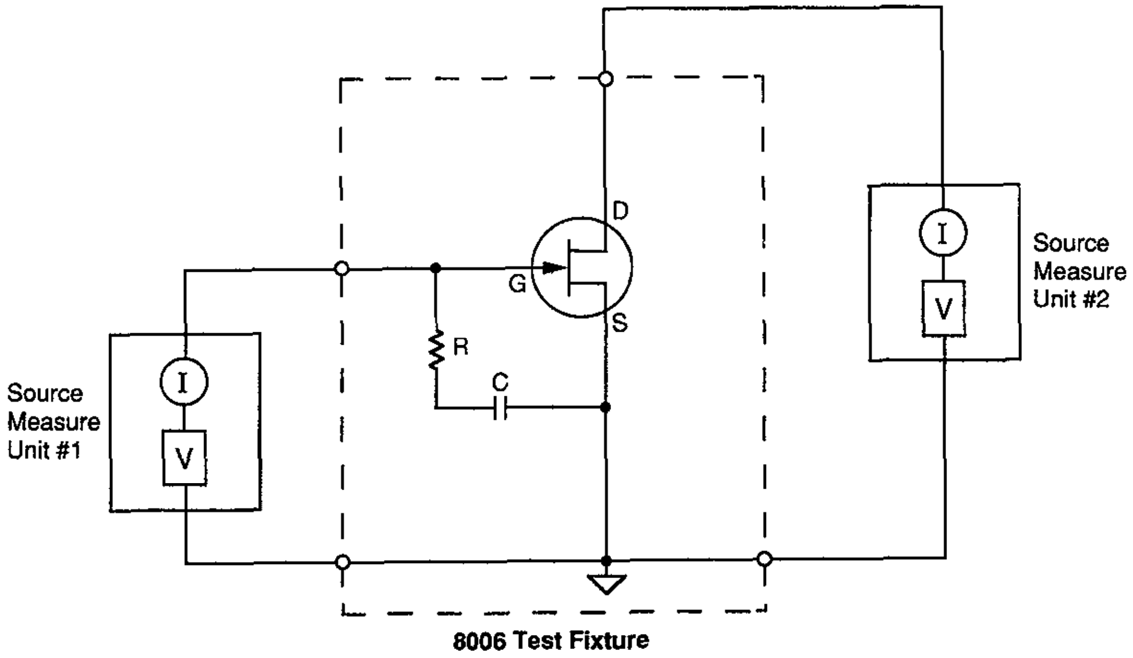


**B. Method 2, Series Resistance in Gate**

*Figure 2-29. Eliminating Oscillations*

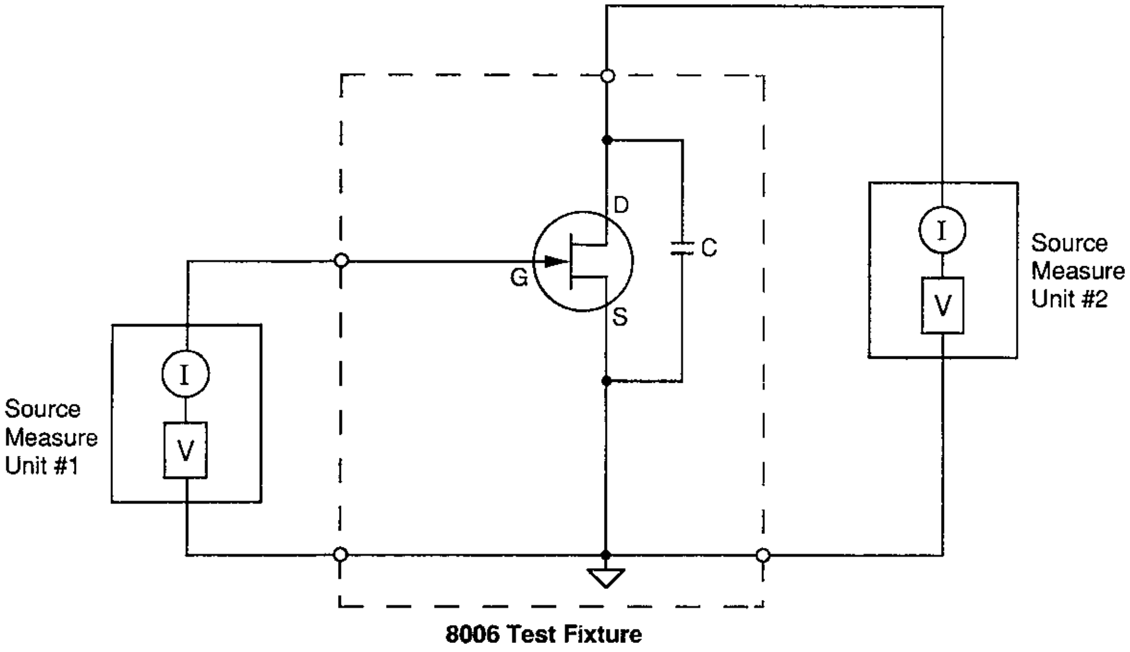


**C. Method 3, Series RC Circuit, Gate to Drain**



**D. Method 4, Series RC Circuit, Gate to Source**

*Eliminating Oscillations (Cont.)*



**E. Method 5, Shunt Capacitance, Drain to Source**

*Eliminating Oscillations (Cont.)*

## 2.4.11 Environmental Considerations

### Cleanliness

The test fixture should be operated only in a clean environment. Otherwise, any dust or dirt that settles on the fixture sockets, connectors, or jumpers could degrade fixture specifications. Even if front panel sockets are periodically cleaned, long-term internal dirt build-up could also affect specifications. If such contamination is suspected, perform the performance verification procedures outlined in Section 3. Clean all internal parts using the procedure discussed in paragraph 3.3 if contamination is verified.

### Humidity

The test fixture should be operated within the humidity limits given in the specifications at the front of this manual. Note that offset current and path isolation in particular are affected by humidity. For best results, use the fixture in a low-humidity environment.

### Light

Some devices are affected by light, which is the main reason the Model 8006 is equipped with a light-tight gasket. In order to ensure that the light-tight environment for the device is maintained, periodically check the gasket in the base for deterioration. Also, make certain that no obstructions such as test leads keep the lid from seating properly.

For extremely light-sensitive measurements, place a length of opaque tape or other dark material over the center three inches of the hinge, completely covering the hinge slots. Doing so will ensure that no light leaks through the interlock switch slot in the base.

## 2.4.12 Vibration

Any vibration could affect fixture performance due to piezoelectric and triboelectric effects. To obviate these effects, keep the fixture and cables as far away as possible from vibration-producing sources such as motors and pumps. Place the test fixture on a vibration-isolating base such as rubber if vibration sources cannot be completely eliminated.

## 2.4.13 Low-Current and Low-Voltage Measurements

### Low-Current Measurements

The effects of the fixture offset current come into play with very low currents. To minimize these effects, enable the instrument zero or suppression feature with no device installed in the sockets and the lid closed to cancel the offset current. Install the device, and make the measurement with zero or suppress enabled. Measurements should be made as soon as possible after suppression to ensure that the offset currents are properly suppressed.

### Low-Voltage Measurements

Similarly, low-voltage measurements can be affected by thermal EMF voltages.These voltages, which are typically generated at connector and relay contact points, can also be suppressed by using the zero feature of the measuring instrument. However, since these offsets are thermally generated, temperature variations will cause their values to drift. For that reason, the fixture should be operated in a thermally-stable environment, especially when making critical, low-voltage measurements. Also, it will be necessary to rezero the measuring instrument often if thermal drift is noted.

## 2.4.14 Cumulative Power

Each signal pathway of the test fixture is rated 1100V, 1A peak. From these values, it is obvious that the theoretical total power that could be dissipated by device(s) in the fixture is extremely high. Note, however, that there is a practical limit as to how much cumulative power can be safely dissipated within the test fixture. To avoid fixture damage, restrict cumulative power so that the operating temperature of the fixture does not exceed the value stated in the specifications at the front of this manual.

CAUTION
**Significantly exceeding the recommended operating temperature may cause fixture damage.**

## 2.4.15 AC Measurements

Ac performance of the test fixture is especially important to those making ac measurements. For that reason, specifications for insertion loss, crosstalk, and 3dB bandwidths are summarized at the front of this manual.

An overview of how to go about testing these aspects of fixture performance are summarized in paragraph 3.2.6.

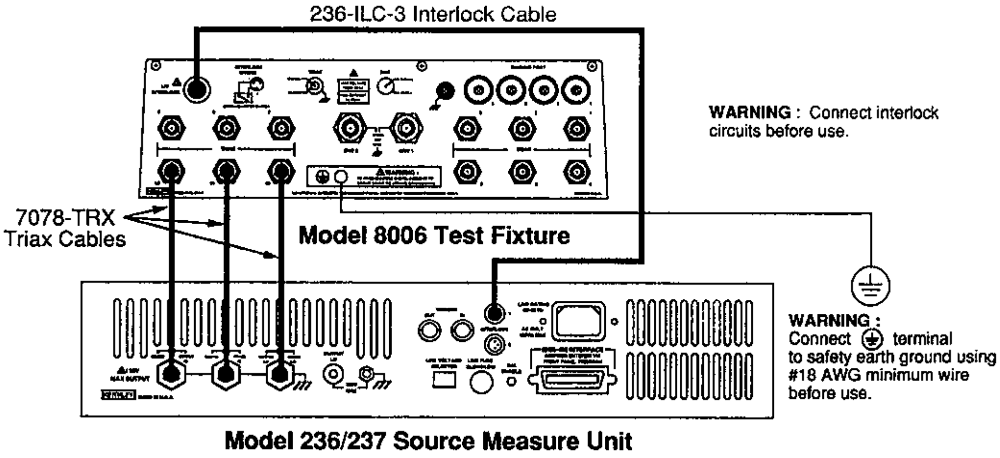
## 2.5 TYPICAL APPLICATIONS

The following paragraphs discuss typical applications for the Model 8006 Test Fixture including diode tests, transistor tests, and IC tests. For additional applications, refer to the Model 236/237 Applications Manual.

### 2.5.1 Diode Testing

Diode tests such as $V_F$ vs. $I_F$ (forward voltage vs. forward current), $I_{LKG}$ vs. $V_R$ (leakage current vs. reverse voltage), and zener breakdown voltage can be performed using the Model 8006 along with the necessary test equipment. Figure 2-30 shows the basic configuration for making such diode tests using the test fixture along with a Model 236 Source Measure Unit. The Source Measure Unit can source current and simultaneously measure voltage or source voltage and simultaneously measure current, providing all the measurement capability required for this particular application.

Note that Model 7078-TRX triax cables are used to connect the test fixture to the Source Measure Unit. In order to complete connections, mini jumpers must be installed, as shown in Figure 2-31. Note that guarded jumpers are used for both the output and sense HI pathways, while standard jumpers are used for the LO pathways.



**Note :** Remote connections shown. See Figure 2-7 for local sensing connections

*Figure 2-30. Test Configuration for Diode Tests*

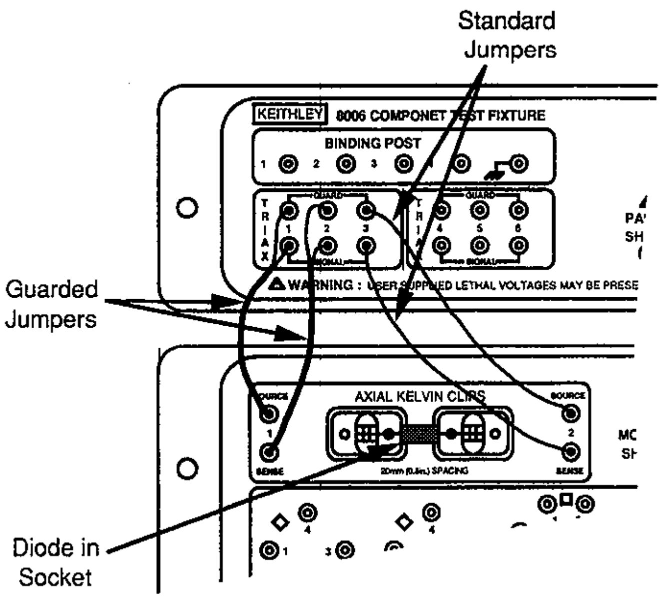


*Figure 2-31. Jumper Installation for Diode Tests*

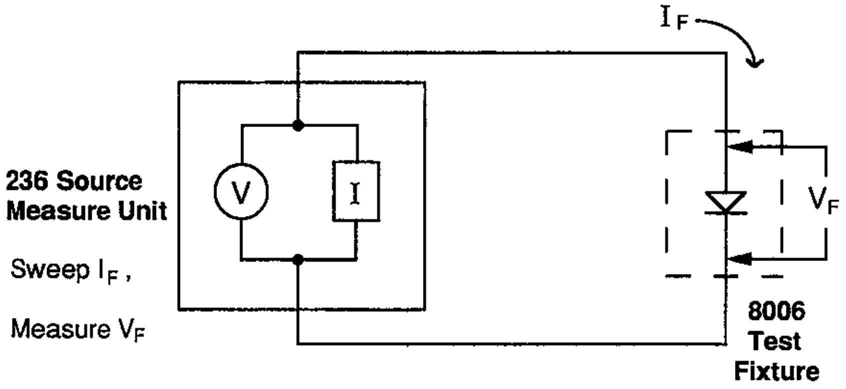


*Figure 2-32. Equivalent Circuit for $V_F$ vs. $I_F$ Tests*

**$V_F$ vs. $I_F$ Test**

The forward voltage drop across a diode can be determined by forcing a forward current ($I_F$) through that diode, and then measuring the resulting voltage drop ($V_F$) across the diode. Figure 2-32 shows the equivalent circuit for the $V_F$ vs. $I_F$ test. Note that the Source Measure Unit is set up to source current and then measure the resulting voltage drop across the diode. In order to perform the $V_F$ vs. $I_F$ test, the unit is programmed to sweep across the desired range of $I_F$ at the required increments. At each current value, the forward voltage, $V_F$, is measured and stored for later analysis and plotting.

**Diode Leakage Current Test**

Diode leakage current is tested by reverse biasing the diode and then measuring the current flowing through the diode. Figure 2-33 shows the equivalent circuit of the test setup, with the Source Measure Unit now used to source the reverse bias voltage, $V_R$, and then measure the resulting leakage current, $I_{LKG}$.

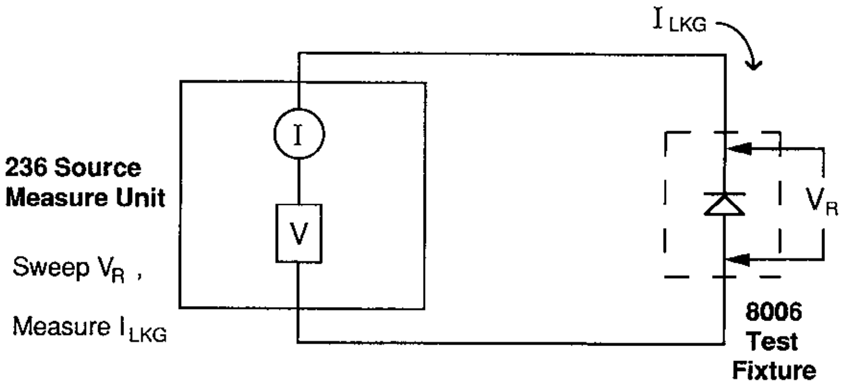


*Figure 2-33. Equivalent Circuit for Leakage Test*

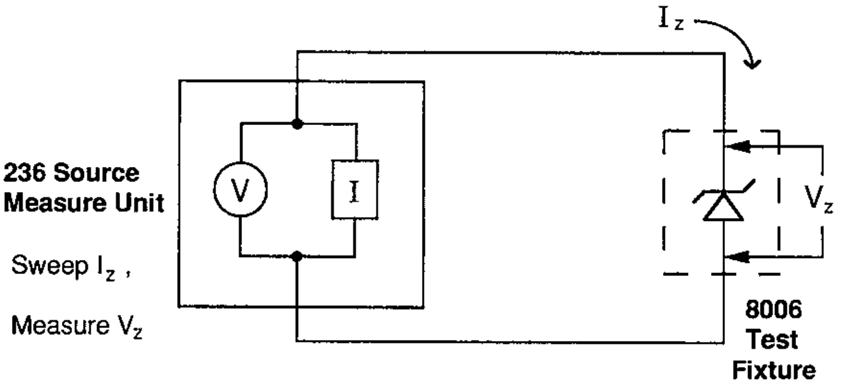


*Figure 2-34. Equivalent Circuit for Zener Diode Test*

In order to perform the leakage test, the Source Measure Unit is programmed to sweep the reverse bias voltage across the desired range at specific increments. At each voltage value, the diode leakage current, $I_{LKG}$, is measured by the unit and then stored for later analysis and plotting.

**Zener Diode Test**

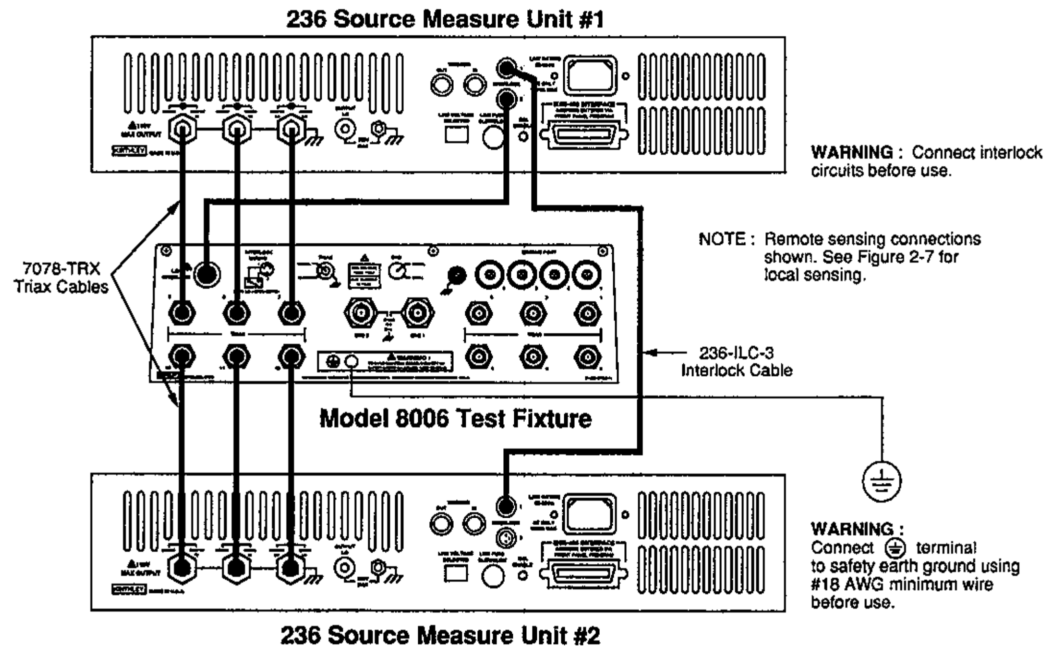
A common test on zener diodes is the breakdown or zener test. This test can be performed by forcing a reverse current through the diode while monitoring the reverse voltage across the device. Curves made from tests made across a range of values will show the characteristic zener or breakdown "knee" at the point where the diode begins to conduct heavily in the reverse direction. In the reverse breakdown point, the voltage across the device remains nearly constant.

Figure 2-34 shows the equivalent circuit for the zener diode test. Here, the Source Measure Unit sources the reverse current through the diode, and it also measures the reverse voltage across the device. To perform the test, the reverse bias current is swept across the required range, and the reverse voltage across the diode is measured at each current. Plots made from the test data should show the characteristic zener curve.

## 2.5.2 Transistor Testing

Typical transistor tests include current gain, common-emitter characteristics, and open-lead leakage tests ($I_{CBO}$

and $I_{CEO}$). Figure 2-35 shows a typical test configuration using the Model 8006 along with two Model 236 or 237 Source Measure Units that can be used for a variety of transistor tests (only one Source Measure Unit is necessary to perform two-lead tests such as leakage, while a third Source Measure Unit will be needed if programmable substrate bias is required). Typical mini jumper connections, are shown in Figure 2-36. Note that guarded jumpers are used for collector and base connections, while standard jumpers are used for emitter connections.



**WARNING** : Connect interlock circuits before use.

NOTE : Remote sensing connections shown. See Figure 2-7 for local sensing.

**WARNING :** Connect ⏚ terminal to safety earth ground using #18 AWG minimum wire before use.

*Figure 2-35. Test Configuration for Transistor Tests*

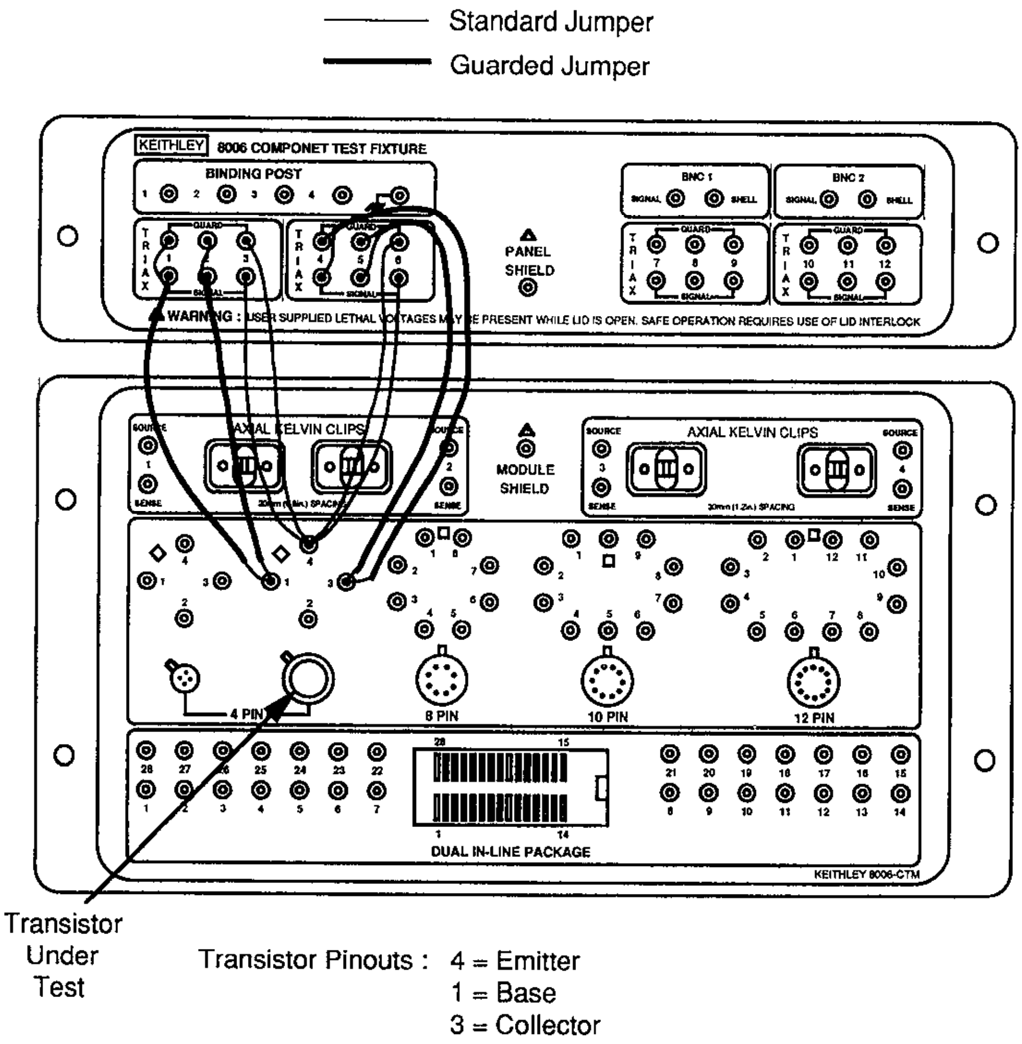


*Figure 2-36. Typical Jumper Installation for Transistor Tests*

### Current Gain

The dc common-emitter current gain, β, of a transistor is calculated as follows:

$$\beta = \frac{I_C}{I_B}$$

Figure 2-37 shows the equivalent circuit for the current gain test. Unit1 is used to source the base current, $I_B$. Unit 2 sources the collector-emitter voltage, $V_{CE}$, and it also measures $I_C$.

In order to perform the current gain test, Unit 2 is first set to the desired value of $V_{CE}$. Unit 1 sets base current, and Unit 2 measures collector current. The current gain can then be calculated as outlined above.

### Common-Emitter Characteristics

Common-emitter characteristics are determined by stepping the base current, $I_B$, through a range of values. At each $I_B$ value, the collector-emitter voltage, $V_{CE}$, is swept across the desired range, and the collector current, $I_C$, is then measured. When the data are plotted, the result is the familiar family of common-emitter curves.

Figure 2-38 shows a typical test configuration for measuring common-emitter characteristics. Unit 1 is used to set the base current, $I_B$, to the desired values. Unit 2 provides the collector-emitter voltage, $V_{CE}$, and it also measures the collector current, $I_C$.

### Leakage Tests

Transistor leakage tests are performed by applying a reverse bias across two leads while leaving the third lead open. Typical of such tests are $I_{CBO}$ (collector-base leakage current, emitter open) and $I_{CEO}$ (collector-emitter leakage current, base open).

Figure 2-39 shows a typical test configuration for measuring $I_{CBO}$. Here, the Source Measure Unit is used to reverse bias the transistor junction and measure $I_{CBO}$.

## 2.5.3 IC Testing

Typical of tests that can be performed on ICs mounted on the test fixture are input bias current and offset voltage tests on operational amplifiers. The following paragraphs describe instrument connections, IC power supplies, and give an overview of these tests.

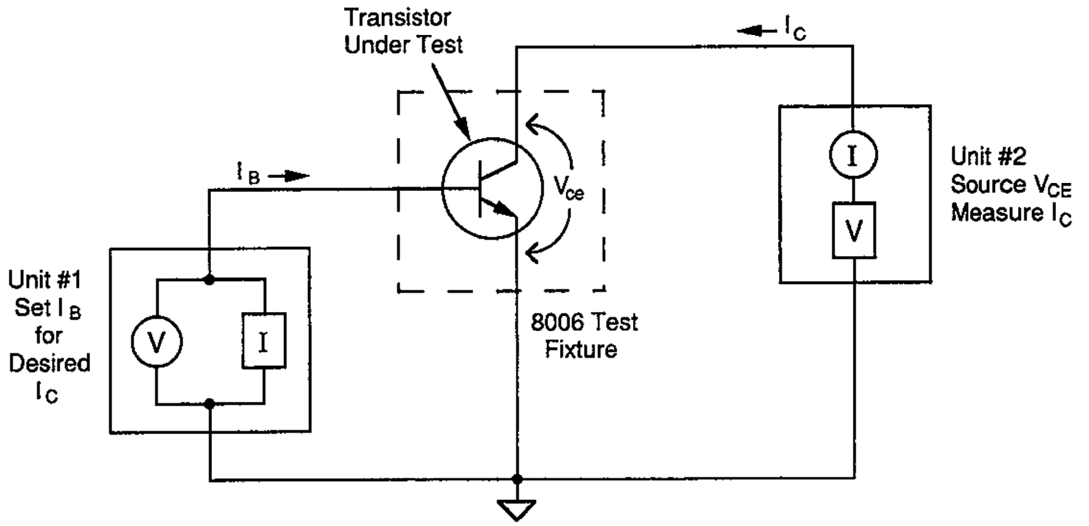


*Figure 2-37. Test Configuration for Current Gain Test*

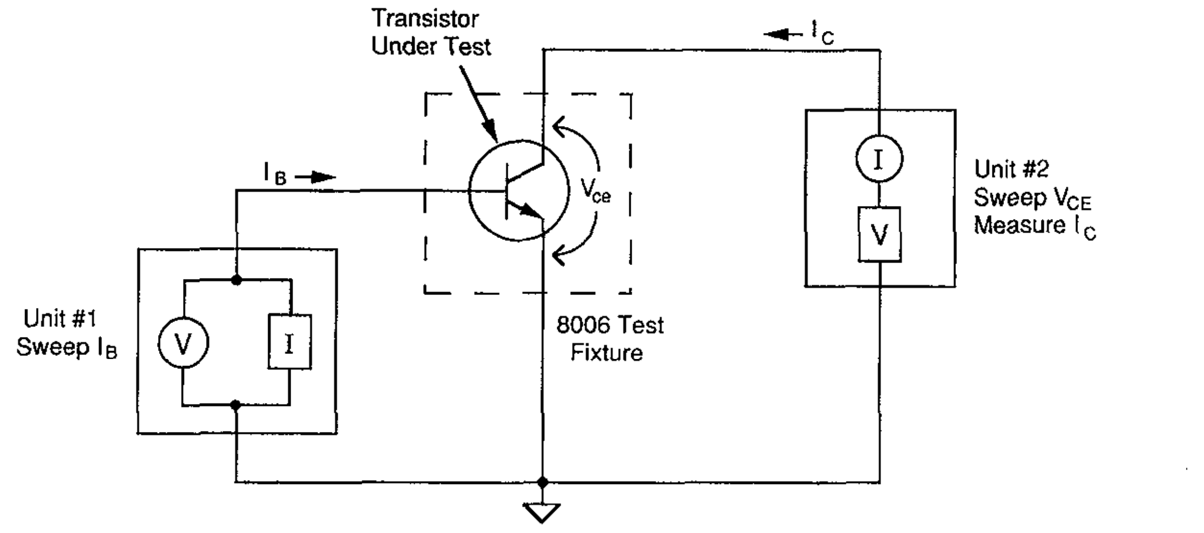


*Figure 2-38. Test Setup for Measuring Common-emitter Characteristics*

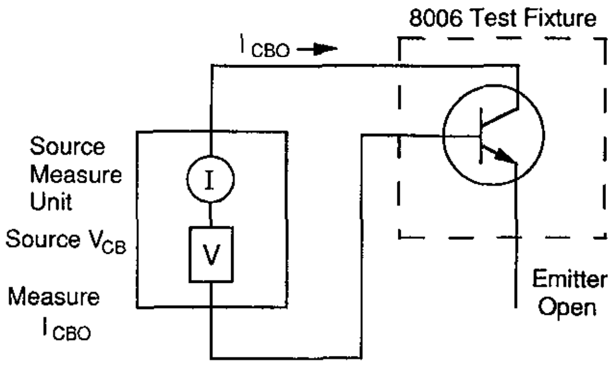


*Figure 2-39. Configuration for $I_{CBO}$ Test*

### Equipment Connections

Figure 2-40 shows how to connect the test instrument, a Model 196 DMM, to the test fixture for these tests. A BNC-to-dual banana plug cable is used to connect the DMM VOLTS/OHMS terminals to one of the BNC connectors on the test fixture.

### IC Power Supplies

Any ICs to be tested must be powered in some manner by external power supplies. Typically, analog ICs may be powered by ±15V supplies, connections for which are shown in Figure 2-41. Note that the + and – supply terminals can be routed through two of the binding posts.

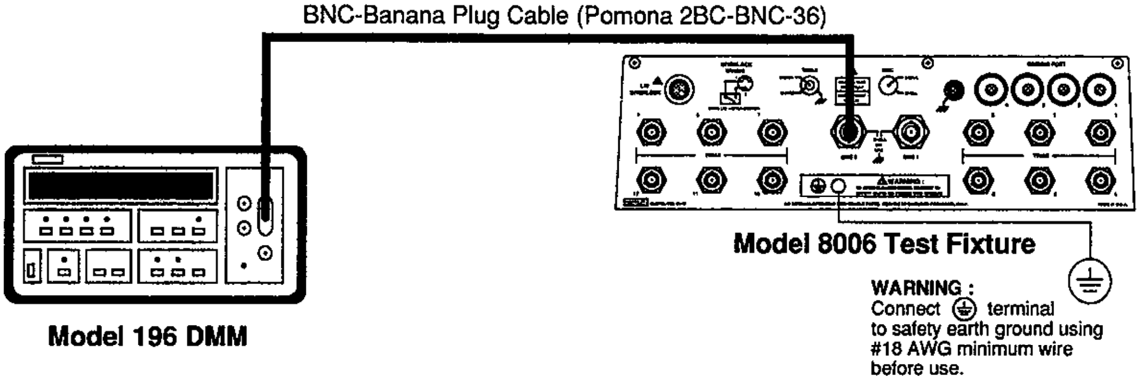
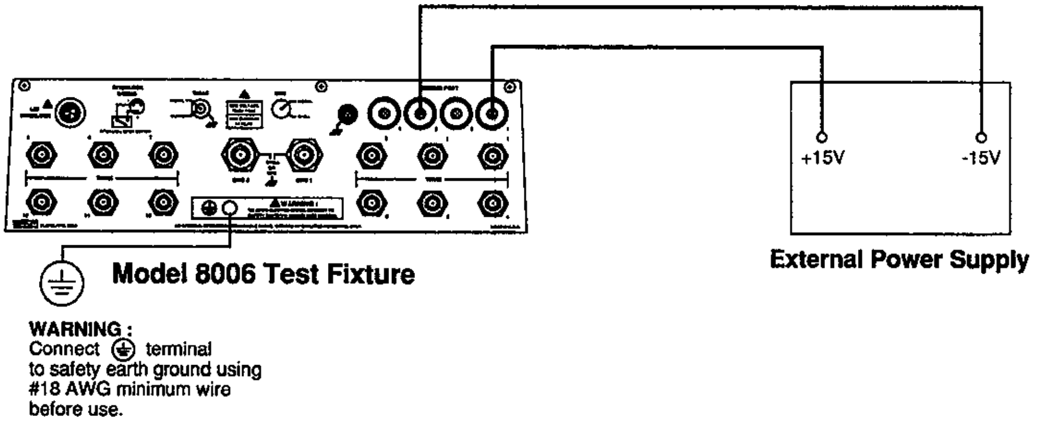
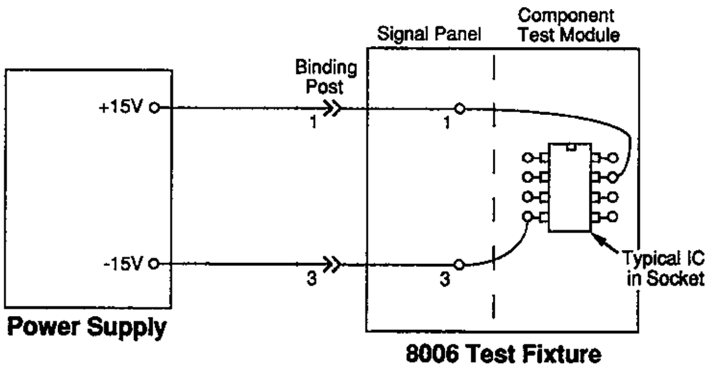


*Figure 2-40. Equipment Connections for Op Amp Tests*



A. Connections



B. Equivalent Circuit

*Figure 2-41. IC Power Supply Connections*

### Jumper Installation

Figure 2-42 shows typical jumper installation for IC tests. In this example, power supply jumpers are connected between the binding post jacks, while a guarded and standard jumpers are connected to the BNC jacks. The exact connecting points to the DIP socket jacks will, of course, depend on the particular IC being tested.

### Input Bias and Offset Current

The input bias current is defined as the dc biasing current required at either op amp input to provide an output voltage of zero (assuming no input signal or input offset voltage). The input offset current is simply the difference between the two input bias current values.

As shown in Figure 2-43, two input bias currents, $I_{B1}$ and $I_{B2}$, are measured by placing high-value resistors between the output and inverting input, as well as between the non-inverting input and circuit common or LO. The output voltage, $E_O$, is then measured for each bias current with the resistor for the bias current not being measured shorted. The bias current amplitude can then be determined as follows:

$$I_{B1} = \frac{E_O}{R_2}$$

or,

$$I_{B2} = \frac{-E_O}{R_2}$$

The input offset current, $I_{OS}$, is simply the difference between the two input bias current values.

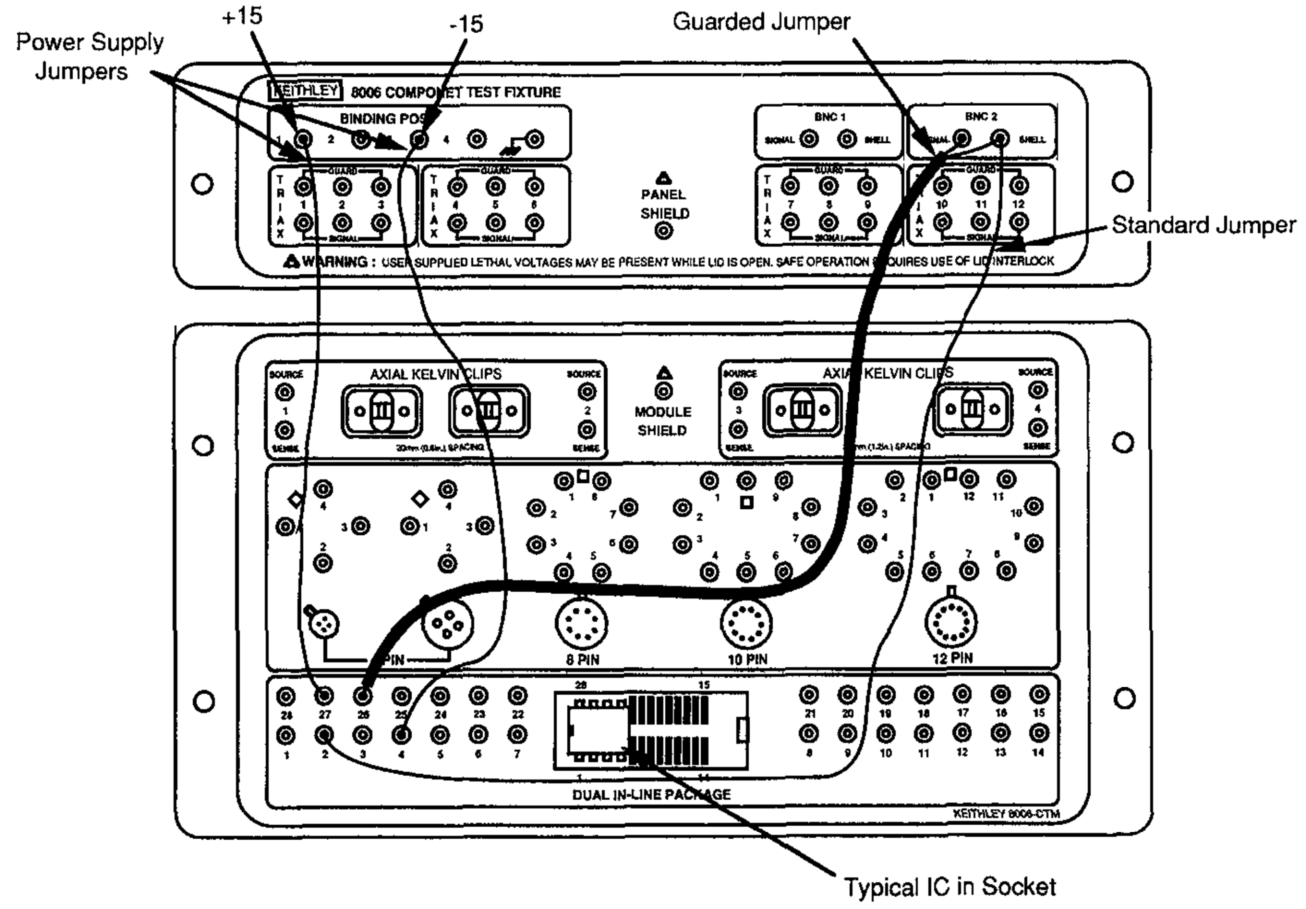


*Figure 2-42. Typical Jumper Installation for IC Test*

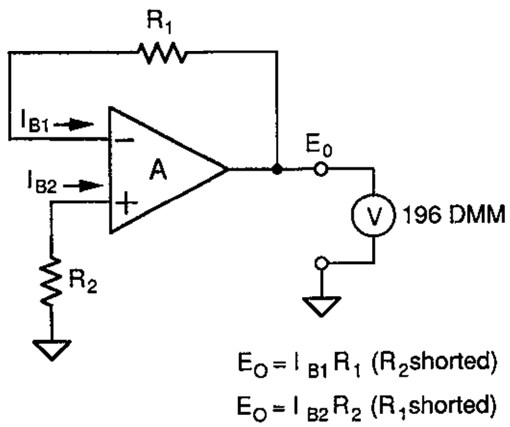


*Figure 2-43. Circuit to Determine Input Bias Current*

The resistor values will depend on the magnitude of the expected input bias current. For best results, choose values that will result in an $E_O$ value of 1-2V. For example, with an input bias current of 1pA, a resistance value of $10^{12}\Omega$ will result in an output voltage of 1V.

### Input Offset Voltage

The input offset voltage, $V_{OS}$, is defined as the differential dc input voltage required to provide zero volts at the output (assuming zero input signal and source resistance). The offset voltage of an op amp can be determined by using the circuit shown in Figure 2-44. Once the output voltage is measured by the DMM, the offset voltage can be calculated as follows:

$$V_{OS} = \frac{-E_O}{1001}$$

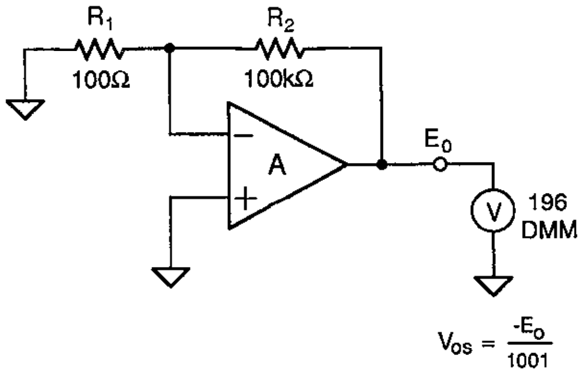


*Figure 2-44. Determining Input Offset Voltage Using DMM*

If a more sensitive instrument such as the Model 181 Nanovoltmeter is available, a circuit with unity-gain can be used, as shown in Figure 2-45. Here, the offset voltage is directly measured by the instrument with no computation necessary on the part of the user.

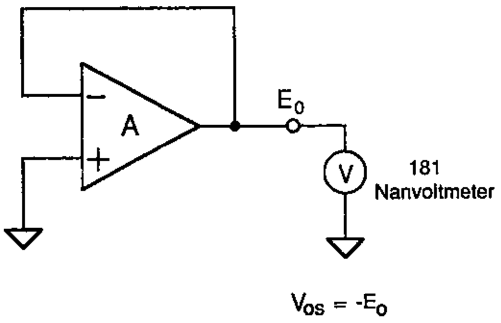


*Figure 2-45. Determining Input Offset Voltage Using Nanovoltmeter*

## 2.5.4 Semiconductor Parameter Analysis Switching System

A semiconductor parameter analysis switching system is capable of complete dc characterization of semiconductors. Such a system can perform a variety of tests (including those outlined earlier in the paragraph) on diodes, bipolar transistors, and FETs, both in discrete and IC packages. The following paragraphs outline a typical system for such analysis.

### System Configuration

Figure 2-46 shows the general configuration of a semiconductor test switching system. The various parts of the system operate as follows:

**Model 236/237 Source Measure Units:** The system shown includes two Model 236 or 237 Source Measure Units. Each unit can simultaneously force voltage and measure current, or force current and measure voltage.

**Model 707 Switching Matrix:** Controls the matrix card to open and close signal paths as required. The switching matrix gives the test system the capability to connect any DUT pin to any instrument test node.

**Model 7072 Semiconductor Matrix Card:** Switches the test pathways to the device under test. In this particular application, one matrix card provides 12-pin test capability. For more complex applications, a total of six cards can be installed in one mainframe, providing up to 72-pin switching capability in one mainframe. Additional test fixtures would also be required to expand the test configuration.

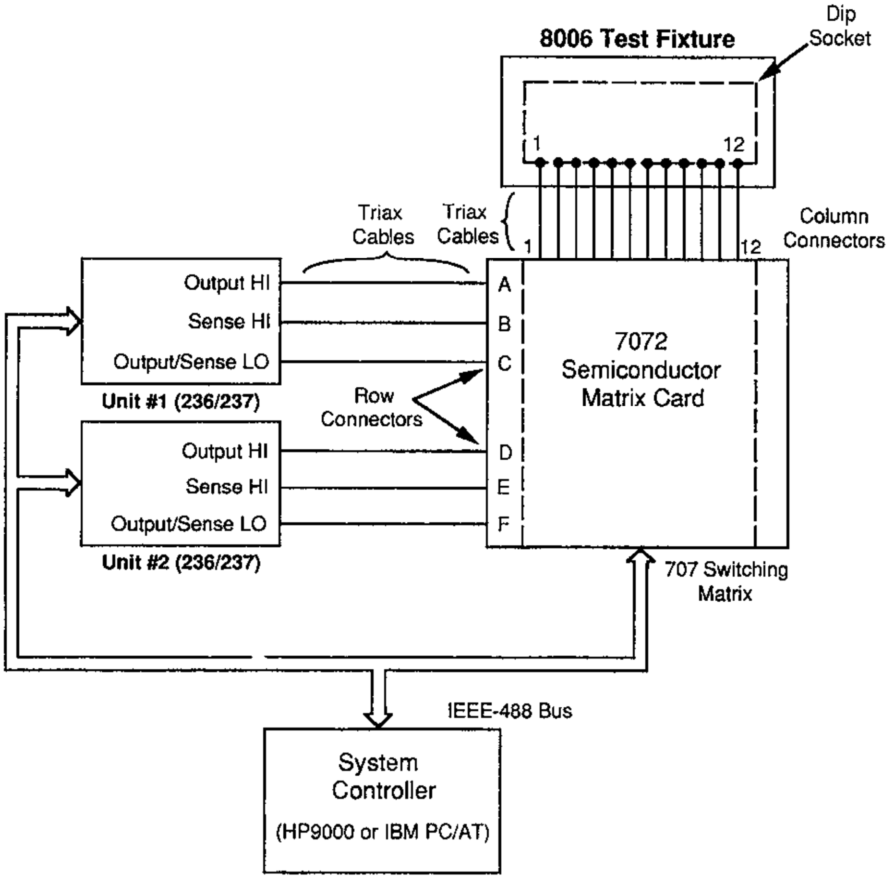


*Figure 2-46. Semiconductor Parameter Analysis Switching System*

**System Controller:** Controls the Source Measure Units and switching matrix with user-supplied software. Typical controllers are HP 9000 Series 200 or 300 (with HP-IB interface), and IBM PC, AT, or compatible computers (equipped with an IEEE-488 interface).

**Model 8006 Test Fixture:** Provides the connection interface between the device under test and the matrix card(s).

## Typical Test Configuration

A typical test configuration for the semiconductor parameter analysis switching system is shown in Figure 2-47. This configuration can be used for such applications as current gain and common-emitter characteristic testing. Unit 1 is used to supply the base current, $I_B$. Unit 2 is used to set $V_{CE}$ to the desired value, and it also measures $I_C$.

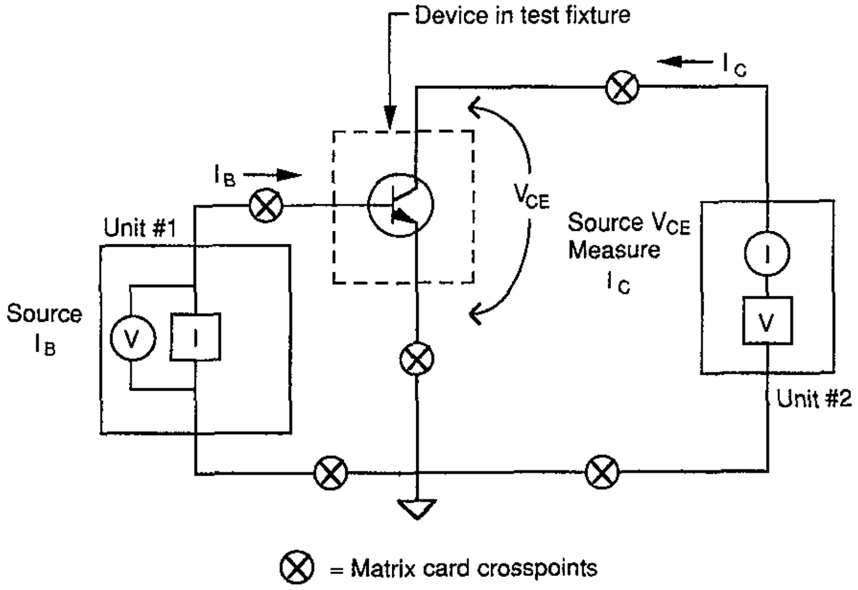


*Figure 2-47. Typical Test Configuration*

# SECTION 3
# Service Information

## 3.1 INTRODUCTION

This section contains information on servicing the Model 8006 Test Fixture, and it is arranged as follows.

**3.2 Performance Verification:** Outlines the procedures necessary to verify that the test fixture meets its stated specifications for offset current and path isolation.

**3.3 Handling and Cleaning Precautions:** Details methods to clean fixture board surfaces and connectors to remove contamination that could affect performance.

**3.4 Disassembly:** Covers disassembly of the Model 8006.

**3.5 Interlock Switch Calibration:** Gives the procedure to adjust the safety interlock switch for proper operation.

WARNING

**The information in this section is intended only for qualified service personnel. Some of the procedures may expose you to hazardous voltages that could result in personal injury or death. Do not attempt to perform these procedures unless you are qualified to do so.**

## 3.2 PERFORMANCE VERIFICATION

Performance verification can be checked to see that the test fixture meets its stated specifications, as described in the following paragraphs.

### 3.2.1 Environmental Conditions

All tests should be performed at an ambient temperature between 18° and 28°C and at a relative humidity of less than 70% unless otherwise noted. If the test fixture has been subjected to temperature or humidity extremes, allow the unit to environmentally stabilize for at least one additional hour before beginning the tests.

### 3.2.2 Recommended Test Equipment

Test equipment recommended for the performance verification tests is summarized in Table 3-1.

**Table 3-1. Recommended Test Equipment**

| Qty. | Description | Specification | Application |
|---|---|---|---|
| 1 | Keithley Model 617 Electrometer | 2pA, ± 1.6% | Path insulation, offset current |
| 2 | Model 4801 Low-noise Coax Cable | | Both (BNC) |
| 2 | Model 7078-TRX-3 Triax Cables | | Both (triax) |
| 1 | Pomona 5299 3-lug Triax to BNC Adapter- | | Path insulation, resistance |
| 2 | Pomona 1894 BNC to Banana Plug Adapter | | Path insulation, resistance |
| 1 | Keithley 6172 2-slot to 3-lug Triax Adapter | | Path insulation, offset current |
| 1 | Keithley 6147 Triax to BNC Adapter | | Both (BNC) |
| 1 | 4 in. length of stranded wire | | Path insulation |
| | | | Path isolation |

## 3.2.3 Performance Record

Table 3-2 can be used to record the verification values for the sockets and terminals being tested.

**Table 3-2. Performance Record**

**Date:** __________ **Serial Number:** ________

**Time:** __________ **Performed by:** __________

| Jack, Socket Terminal | Isolation Resistance | Offset Current |
|---|---|---|
| | | |
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## 3.2.4 Isolation Resistance Verification

Follow the procedure below to verify that isolation resistance between any two given paths meets stated specifications. Should the test fixture fail any path isolation tests, clean the associated sockets and connectors, as discussed in paragraph 3.3.

**Recommended Equipment**

- Model 617 Electrometer
- Model 7078-TRX-3 Triax Cables (2)
- Model 4801 Coax Cables (2)
- Pomona Model 5299 3-Lug Triax to BNC Adapter
- Pomona Model 1894 BNC Female to Banana Plug Adapter (2)
- Pomona Model 2BC-36 Banana Plug Patch Cord
- Model 6172 2-slot to 3-lug Triax Adapter
- Model 6147 Triax to BNC Adapter
- 4in. length of #18-20 AWG stranded wire

**Triax Test Connections**

Figure 3-1 shows the test connections for the path isolation verification tests on the triax connectors. Use the Model 7078-TRX triax cables to make the test connections. Connect one triax cable to the HI terminal of the Model 617 voltage source using the triax to BNC and BNC to banana plug adapters. Connect the second triax cable to the electrometer INPUT jack using a Model 6172 2-slot to 3-lug adapter. Finally, connect the 4in. length of wire between the LO terminal of the electrometer voltage source and COM, and remove the link between COM and chassis ground.

**BNC Test Connections**

Figure 3-2 shows the test connections for the path isolation verification tests on the BNC connectors. Use the Model 4801 low-noise coax cables to make the test connections. Connect one coax cable to the HI terminal of the Model 617 voltage source using the BNC to banana plug adapter. Connect the second coax cable to the electrometer INPUT jack using a Model 6147 Triax to BNC adapter. Finally, connect the 4in. length of wire between the LO terminal of the electrometer voltage source and COM, and remove the link between COM and chassis ground.

**Combining BNC and Triax Connections**

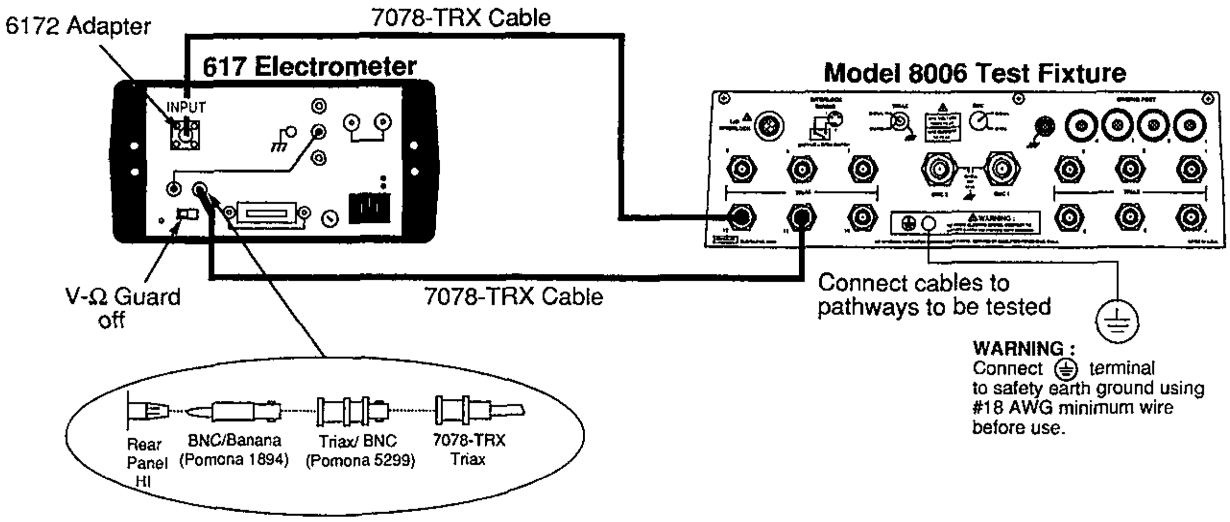
Pathways between BNC and triax connectors can be checked by making the connections to both triax and BNC connectors. Simply use the required connecting method from Figure 3-1 and Figure 3-2 to make connections to the triax and BNC connectors.

**Jumper Connections**

In order to complete pathway connections, install two guarded mini jumpers between the triax or BNC terminals on the signal panel and the socket terminals you intend to incorporate into the pathways being tested. For the guarded jumpers, the jumper shield should be connected to the GUARD or SHELL jack of the associated connector terminal on the signal panel.

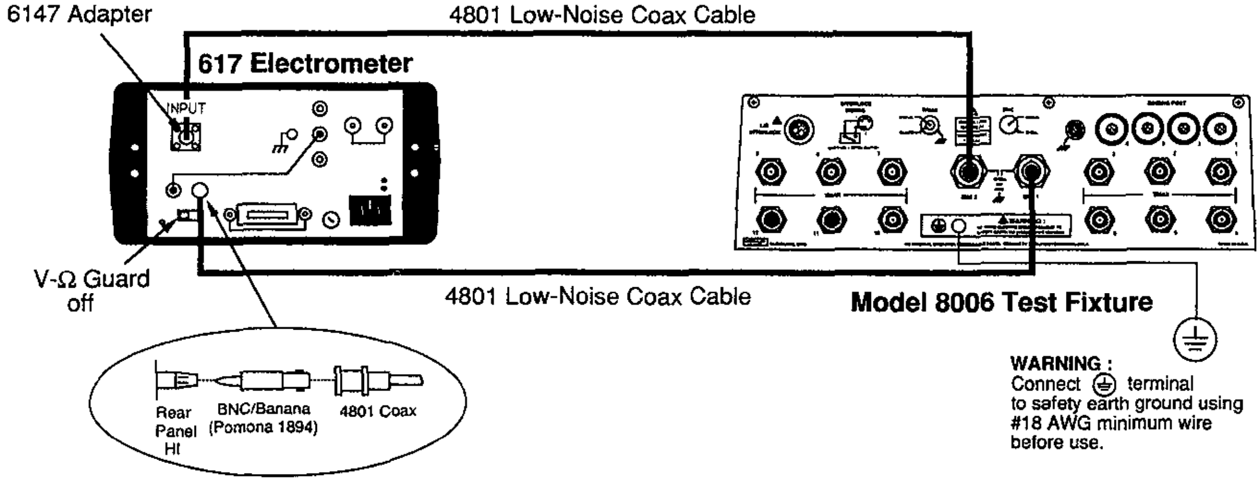
**Procedure**

Follow the procedure below to check the path isolation resistance between any two given pathways.



**WARNING :** Connect ⏚ terminal to safety earth ground using #18 AWG minimum wire before use.

*Figure 3-1. Path Isolation Verification Triax Connections*



**WARNING :** Connect ⏚ terminal to safety earth ground using #18 AWG minimum wire before use.

*Figure 3-2. Path Isolation Verification BNC Connections*

WARNING

**Hazardous voltage will be used in the following test procedure. Be careful not to contact this voltage to avoid possible personal injury or death. Perform the procedure with the lid closed.**

1. Turn on the Model 617 Electrometer, and allow the unit to warm up for at least one hour for rated accuracy. Make sure the electrometer is set for the unguarded mode (GUARD off).
2. Select the amps function and the 2pA range on the electrometer, and enable zero check. Zero correct the electrometer by pressing ZERO CORRECT. Leave zero correct enabled for the remainder of the test.
3. Connect the test fixture to the Model 617, as described above and shown in Figure 3-1 (triax connections), Figure 3-2 (BNC connections), or Figure 3-3 (binding post connections). Make sure that no components are mounted on the fixture and that the fixture lid is closed.
4. Program the Model 617 voltage source for a voltage of +100V, but do not yet turn on the output.
5. With the electrometer on the 2pA range, disable zero check, and allow the reading to settle completely. If necessary, move the Model 617 uprange to obtain an on-scale reading.
6. Once the reading has settled, enable suppress to null out any leakage current in the system.
7. Turn on the voltage source, enable the V/I ohms mode, and turn on autoranging on the electrometer.
8. Allow the reading to settle, then verify that the reading is greater than the required value for the socket and pathway being tested as follows:

   Triax and BNC connectors (axial and TO sockets): $>1 \times 10^{14}\Omega$.
   Triax and BNC connectors (DIP socket): $>1 \times 10^{12}\Omega$.

Also, record the reading in Table 3-2 for future reference.

9. Turn off the voltage source, select amps, and enable zero check. Disable suppress, and change the triax cables and mini jumper connections to the next set of pathways you intend to test.
10. Repeat steps 5 through 9 for all pathways pairs to be tested.

## 3.2.5 Offset Current Verification

Follow the procedure below to verify that offset current for the triax and BNC pathways is below specifications. Should the fixture fail the test, clean the connectors, as described in paragraph 3.3.

**Required Equipment**

- Model 617 Electrometer
- Model 4801 Low-noise Coax Cable
- Model 7078-TRX-3 Triax Cable
- Model 6172 2-slot to 3-lug Triax Adapter
- Model 6147 Triax to BNC Adapter

**Triax Test Connections**

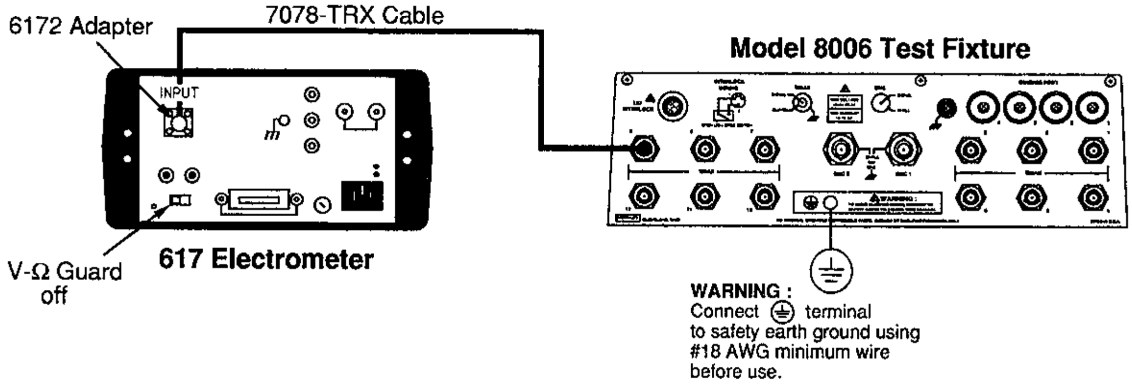
Figure 3-3 shows the test connections for the offset current tests on triax connectors. Note that the pathway being tested should be connected to the INPUT jack of the electrometer through the Model 7078-TRX-3 triax cable and the Model 6172 2-slot to 3-lug adapter. Also, make certain that the link between COM and chassis ground has been removed, and that the V-Ω, GUARD switch is in the OFF position.

**BNC Test Connections**

Figure 3-4 shows the test connections for the offset current tests on BNC connectors. Note that the pathway being tested should be connected to the INPUT jack of the electrometer through the Model 4801 Low-noise Coax Cable and the Model 6147 Triax to BNC adapter. Also, make certain that the link between COM and chassis ground has been removed, and that the V-Ω, GUARD switch is in the OFF position.

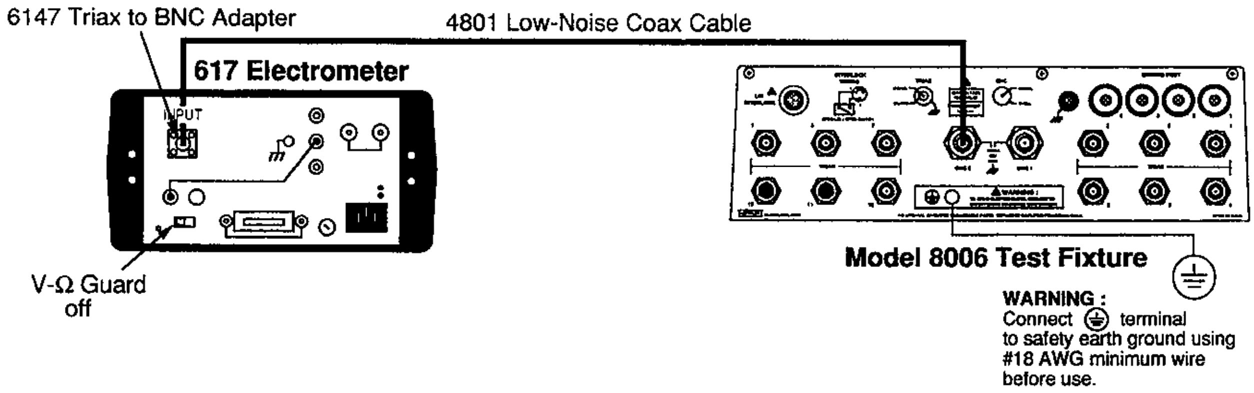
**Jumper Installation**

In order to complete pathway connections, install one guarded mini jumper between the triax or BNC terminal on the signal panel and the socket terminal you intend to test. The shield of the guarded jumper should be connected to the GUARD or SHELL jack of the associated connector jack on the signal panel.



**WARNING :**
Connect ⏚ terminal
to safety earth ground using
#18 AWG minimum wire
before use.

*Figure 3-3. Triax Connections for Offset Current Test*



**WARNING :**
Connect ⏚ terminal
to safety earth ground using
#18 AWG minimum wire
before use.

*Figure 3-4. BNC Connections for Offset Current Test*

**Procedure**

1. Turn on the Model 617 Electrometer, and allow the unit to warm up for at least one hour for rated accuracy. Make sure the electrometer is set for the unguarded mode (GUARD off).
2. Select the amps function and the 2pA range on the electrometer, and enable zero check. Zero correct the electrometer by pressing ZERO CORRECT. Leave zero correct enabled for the remainder of the test. After zero correcting the instrument, enable autoranging.
3. Connect the test fixture pathway to the INPUT jack of the electrometer as described above. Make certain that all components have been removed from the device sockets, then close the test fixture lid.
4. Disable zero check, then allow the reading to settle.
5. Verify that the current reading is less than 100fA ($10^{-13}$A), and record the reading in Table 3-2 for future reference.
6. Enable zero check, then connect the next pathway to be checked.
7. Repeat steps 4 through 6 for all pathways to be checked.

## 3.2.6 AC Performance

Ac performance aspects such as insertion loss, crosstalk, and 3dB bandwidth need not normally be tested as part of the verification procedure because these factors are fixed by design, and they will not usually change in the field. However, those who are interested in characterizing the performance of their test fixture can do so as outlined below. Insertion loss, 3dB bandwidth, and crosstalk specifications are located in the specifications section at the front of this manual.

NOTE
Ac specifications are typical.

**Equipment**

In order to test ac performance, a network analyzer or separate RF signal generator and voltmeter or oscilloscope will be necessary. This equipment should have the following basic specifications:

Source frequency: 1MHz-4MHz
Source output impedance: 50Ω
Measure frequency: 1MHz-4MHz
Measure input impedance: 50Ω (1MΩ for insertion loss).

**Test Connections**

Figure 3-5 show the test connections for ac tests. Since most RF instruments are equipped with BNC jacks, it will be necessary to use triax/BNC adapters (Pomona 5299) to connect triax cables to the test equipment. BNC jacks should be connected using 50Ω coaxial cables (Model 7051). Jumpers should be connected between the appropriate jacks on the signal panel and the socket terminal jacks on the component test module. Note that the pathways being tested should be shorted together for the 3dB bandwidths and insertion loss tests. Also, the guards should be jumpered as shown.

WARNING
**Connect the ⏚ terminal of the test fixture to safety earth ground using the supplied safety grounding cable before measuring.**

**3dB Bandwidth**

For this test, sweep the source frequency from 1MHz to 4MHz, and set the measurement device as appropriate. Install a jumper between the two socket terminal jacks for the pathways being tested. Verify that the frequency response drops off by no more than 3dB at the specified frequency.

**Insertion Loss**

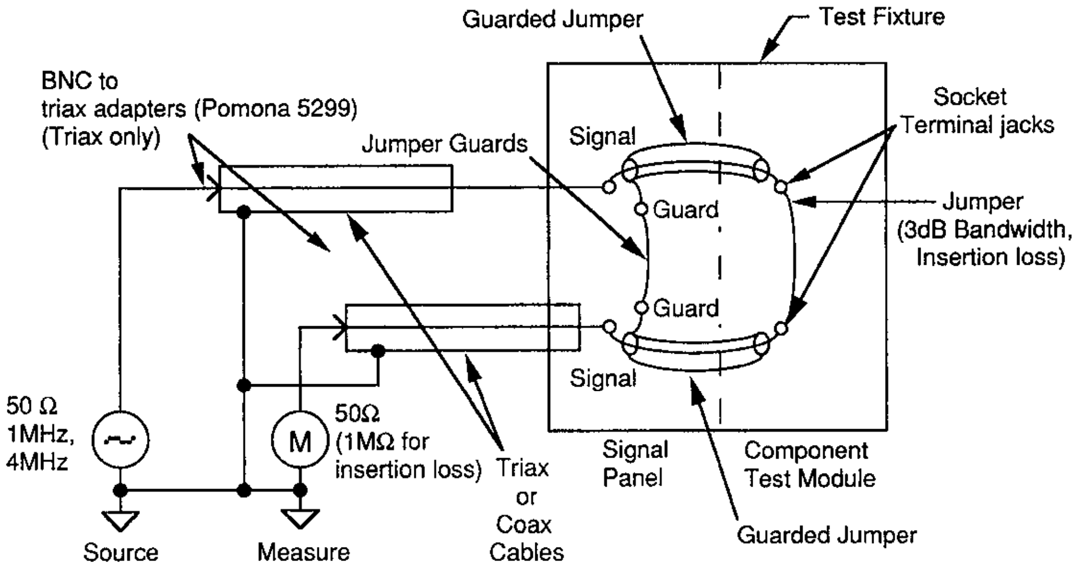
To test insertion loss, set the signal generator to 1MHz with an output impedance of 50Ω. The measurement device should have an input impedance of 1MΩ. Note that the socket terminals should remain shorted for this test.

**Crosstalk**

For this test, the test frequency is 1MHz. Remove the jumper between socket terminals, and test between adjacent terminals. Doing so will give you worst-case results because adjacent socket terminals have the highest capacitance.

## 3.3 HANDLING AND CLEANING PRECAUTIONS

Because of the high-impedance areas on the Model 8006, care should be taken when handling or servicing the fixture to prevent possible contamination that could degrade performance.



WARNING :
Connect triax outer shell to measurement LO.
Connect ⏚ to safety earth ground using supplied safety grounding cable.

*Figure 3-5. Connections for AC Response Test*

### 3.3.1 Component Test Module Handling and Cleaning

The following precautions should be taken when handling the component test module.

1. When removing the component test module from the unit, handle the board only at the edges whenever possible. Do not touch any sockets not associated with component or jumper installation.
2. Do not store or operate the test fixture in an environment where dust could settle on the jacks or connectors. Use dry nitrogen gas to clean dust off the jacks and connectors if necessary.
3. Do NOT remove the component module shield unless absolutely necessary!
4. After soldering to the sockets while making repairs or modifications, remove flux from soldered areas using Freon® TMS or TE (or the equivalent) dipped clean cottons swabs or a clean, soft brush. When cleaning, take care not to spread the flux to other areas of the module. Once the flux is removed, swab only the soldered area with methanol, then blow dry the board with dry nitrogen gas.
5. After cleaning, the module should be placed in a 50°C low-humidity environment for at least one hour before use.

### 3.3.2 Connector Cleaning

Connectors are also subject to performance degradation caused by contamination due to dirt build-up or improper handling. Connectors can be cleaned with methanol dipped cotton swabs. After cleaning, allow connectors to dry for at least one hour in a 50°C low-humidity environment before use.

## 3.4 DISASSEMBLY AND ASSEMBLY

### 3.4.1 Disassembly

WARNING

**Turn off all power and disconnect all test cables and wires from the test fixture before beginning disassembly.**

CAUTION

**During disassembly or reassembly be careful not to touch any socket or test jack insula-**

**tors to avoid contamination that could compromise fixture performance.**

Refer to Figure 3-6, and disassemble the test fixture as follows.

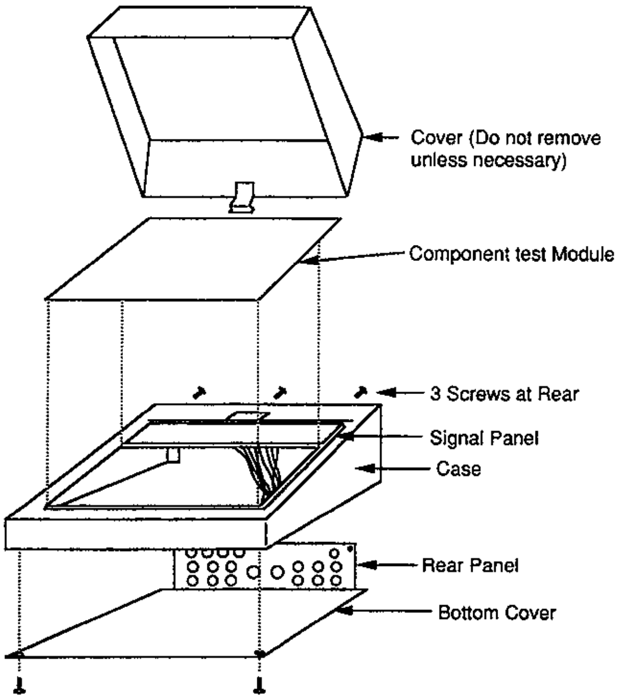


*Figure 3-6. Fixture Disassembly*

1. Remove any jumpers installed on the test fixture.
2. Release the four fasteners that secure the component test module, then remove the module from the base. To gain access to wiring inside the module, remove the two screws that secure the bottom module shield, then remove the shield.

CAUTION

**Removal of the component module shield is not recommended unless absolutely necessary. Specifications may be degraded by contamination if the shield is removed.**

3. Remove the screws that secure the bottom/rear panel to the chassis, then remove the panel. Three screws are located at the bottom front, and the remaining three screws are located on the rear panel across the top.
4. Release the two signal panel fasteners by carefully prying up on them with a small flat-blade screwdriver. Slide the signal panel slightly to the side and tilt it until you can slide it down through the hole in the base until the panel rests inside the fixture.
5. Carefully pull the rear/top panel away from the base until you can access the interlock switch connector. Disconnect the interlock switch plug from the connector, then pull the bottom/rear panel away from the base, while holding on to the signal panel.

NOTE

If the hinge screws are loosened, the interlock switch must be calibrated, as discussed in paragraph 3.5. For this reason, it is recommended that the lid not be removed unless absolutely necessary.

## 3.4.2 Reassembly

When reassembling the fixture, keep the following important points in mind.

1. If the lid was removed, first assemble the lid to the base. First make sure the hinge is aligned in the rear gasket recess, as shown in Figure 3-7. Also make sure the lid is properly aligned (centered) in the light-tight gasket on the base at all points around the perimeter of the base, then tighten all hinge screws securely while making sure the lid remains centered. After tightening the screws, check for smooth operation without interference throughout the entire range of motion.

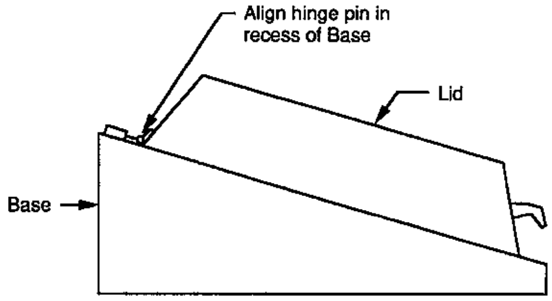


*Figure 3-7. Hinge Alignment*

WARNING

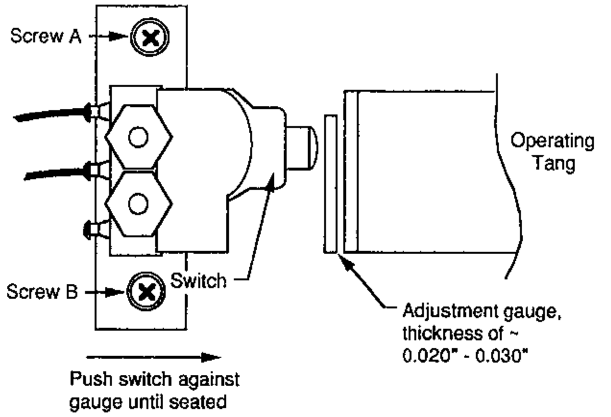
**Be sure the lid grounding straps are installed under the hinge.**

2. Make sure the component test module shield is installed and secured.
3. Be sure to connect the safety interlock switch connector.
4. Secure the signal panel first and then component test module with the fasteners.
5. If the lid was removed, calibrate the safety interlock switch, as discussed in the following paragraph.

## 3.5 INTERLOCK SWITCH CALIBRATION

Follow the procedure below to make certain that the safety interlock switch operates properly. This procedure must be performed if the hinge screws are loosened for any reason, and it can also be performed if you suspect that the interlock switch does not operate properly. The switch adjustment locations are shown in Figure 3-8.

1. Remove the bottom cover from the test fixture (see paragraph 3.4).
2. Loosen the switch adjustment screws A and B (see Figure 3-8 for locations) just enough to move the switch.
3. Close the top cover on the test fixture, then turn the fixture upside down.
4. Insert a 0.020-0.030in. thickness gauge between the operating tang on the back edge of the lid and the switch button (see Figure 3-8).
5. Push the switch up against the gauge until it seats firmly. Make sure the lid remains securely closed.
6. Tighten the switch adjustment screw A first, then tighten screw B, making certain that the switch does not move.
7. After adjustment, verify that the switch opens before the front edge of the lid opens >0.25-0.40in.
8. After adjustment, replace the bottom cover, then secure it with the screws removed earlier.



Adjustment Procedure

*Figure 3-8. Safety Interlock Switch Adjustment*

# SECTION 4
# Replaceable Parts

## 4.1 INTRODUCTION

This section contains a list of replaceable parts for the Model 8006 as well as a component layout drawing and schematic diagram of the test fixture.

## 4.2 PARTS LIST

Parts for the fixture are listed in Tables 4-1 and 4-2.

## 4.3 ORDERING INFORMATION

To place an order, or to obtain information about replacement parts, contact your Keithley representative or the factory (see the inside front cover of this manual for addresses). When ordering parts, be sure to include the following information:

1. Test fixture model number (8006)
2. Test fixture serial number
3. Part description
4. Circuit designation, if applicable
5. Keithley part number (see parts list)

## 4.4 FACTORY SERVICE

If the test fixture is to be returned to Keithley Instruments for repair, perform the following:

1. Complete the service form located at the back of this manual, and include it with the unit.
2. Carefully pack the test fixture in the original packing carton or the equivalent.
3. Write ATTENTION REPAIR DEPARTMENT on the shipping label.

## 4.5 COMPONENT LAYOUT AND SCHEMATIC DIAGRAM

Drawing number 8006-100 is the component layout for the signal board. Drawing number 8006-130 shows a component layout of the personality board.

# TABLE 4-1. PARTS LIST FOR COMPONENT TEST MODULE

| CIRCUIT DESIG. | DESCRIPTION | KEITHLEY PART N. |
|---|---|---|
| | CHOKE | CH-48 |
| | CHOKE | CH-49 |
| | LUG | LU-123 |
| | RECEPTACLE TEST SOCKET | SO-108-2 |
| | SHIELD | 8006-311 |
| | STANDOFF | ST-137-13 |
| | TEFLON SPACER | 8006-314 |
| S81 | UNIVERSAL ZIF TEST SOCKET | SO-107-2 |
| SO1..SO70, | TEST JACK,INSULATED | TJ-9 |
| SO71 | SOCKET,TYPE TO-18,4-PIN | SO-110 |
| SO72 | SOCKET,TYPE TO-5,4-PIN | SO-111*, SO-123** |
| SO73 | SOCKET,TYPE TO-5,8-PIN | SO-112*, SO-124** |
| SO74 | SOCKET,TYPE TO-5,10-PIN | SO-113*, SO-125** |
| SO75 | SOCKET,TYPE TO-5,12-PIN | SO-114*, SO-126** |
| SO76..SO80,<br>SO82..SO85 | AXIAL OR RADIAL LEAD TEST SOCKET | SO-117 |

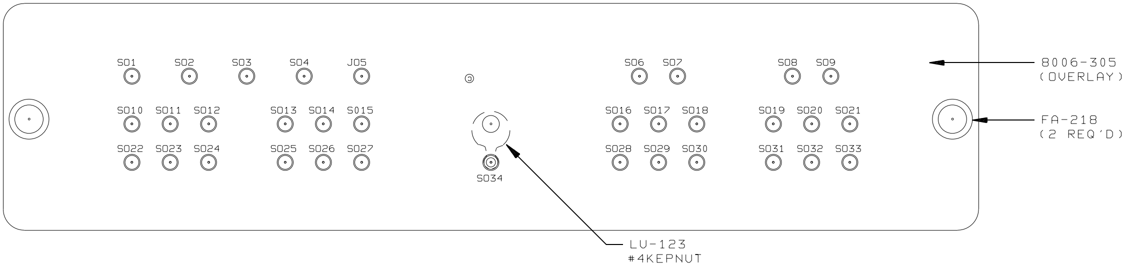
* SERIAL NUMBERS 446739 THROUGH 446775
**ALL OTHER UNITS

## TABLE 4-2. PARTS LIST FOR TEST FIXTURE

| CIRCUIT DESIG. | DESCRIPTION | KEITHLEY PART NO. |
|---|---|---|
| | BINDING POST | BP-15 |
| | BINDING POST | BP-24-9 |
| | BUMPER | FE-18 |
| | CASTING, MACHINED | 8006-302 |
| | CONNECTOR, 3 PIN | CS-659 |
| | FEET | FE-17-1 |
| | GROUND STRAP | 8007-321 |
| | GUARDED JUMPER | 8006-MJG |
| | HINGE | H-6 |
| | INTERLOCK CABLE | 236-ILC-3 |
| | JUMPER CABLE | 8006-MJS-1 |
| | JUMPER CABLE | 8006-MJS-3 |
| | JUMPER CABLE | 8006-MJS-2 |
| | REAR PANEL / BOTTOM COVER | 8006-307 |
| | SAFETY GROUND CABLE | 8007-GND-3 |
| | TOP COVER | 8007-310 |
| | HANDLE | HH-35 |
| | NUT BAR | 8007-322 |
| | NUT BAR | 8007-320 |
| | SWITCH | SW-477 |
| | CABLE,BNC | CA-76-1 |
| | CABLE,TRIAX | CA-73-1 |
| | FASTENER | FA-218 |
| | LUG | LU-123 |
| | LUG | LU-65 |
| | OVERLAY | 8006-305 |
| SO1..SO34 | TEST,JACK INSULATED | TJ-9 |

NO. 8006-100

| LTR. | ECO NO. | REVISION | ENG. | DATE |
|---|---|---|---|---|
| A | 13070 | RELEASED | SZ | 10-19-88 |
|  |  |  |  |  |
|  |  |  |  |  |



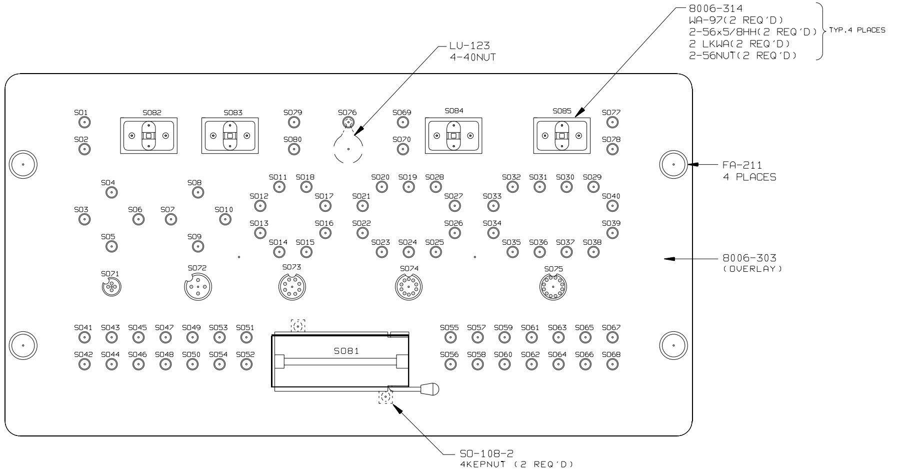
| MODEL | NEXT ASSEMBLY | QTY. |
|---|---|---|
|  |  |  |
|  |  |  |
|  |  |  |
| 8006 |  | 1 |

USED ON

| | | | | |
|---|---|---|---|---|
| DO NOT SCALE THIS DRAWING | DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED | DATE 10-18-88 | SCALE 1:1 | TITLE COMPONENT LAYOUT,<br>SIGNAL BOARD |
| KEITHLEY KEITHLEY INSTRUMENTS INC.<br>CLEVELAND, OHIO 44139 | XX=±.015 ANG.=±1° | DRN. SAZ | ENG. APPR. KG | |
| | XXX=±.005 FRAC.=±1/64 | MATERIAL ———— | | B |
| | SURFACE MAX. 63 | FINISH ———— | | NO. 8006-100 |

NO. 8006-130

| LTR. | ECO NO. | REVISION | ENG. | DATE |
|---|---|---|---|---|
| A | 13070 | RELEASED | SZ | 10-21-88 |
| B | 13210 | REVISED | SZ | 1-20-89 |
| C | 13470 | REVISED;ARTWORK WAS REV.B | SZ | 5-18-89 |
| D | 13524 | CHG'D ART.REV.FROM C TO D. CHG'D. SO-72 THRU SO-75 TO REFLECT NEW BODY STYLE. | AJS | 8-4-89 |



NOTE: FOR COMPONENT INFORMATION REFER TO BILL OF MATERIAL, (8006-000-02).

| | | |
|---|---|---|
| | | |
| | | |
| | | |
| 8006-CTM | | 1 |
| MODEL | NEXT ASSEMBLY | QTY. |
| USED ON | | |

| | | | | |
|---|---|---|---|---|
| DO NOT SCALE THIS DRAWING | DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED | DATE 9-29-88 | SCALE 1:1 | TITLE COMPONENT LAYOUT, PERSONALITY BOARD |
| KEITHLEY KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44139 | XX=±.015 ANG.=±1° | DRN. SAZ | ENG. APPR. KH | |
| | XXX=±.005 FRAC.=±1/64 | MATERIAL | | C NO. 8006-130 |
| | SURFACE MAX. 63 | FINISH | | |

KEITHLEY

# Service Form

**Model No.** ____________ **Serial No.** ____________ **Date** ____________

**Name and Telephone No.** ________________________________

**Company** ________________________________

List all control settings, describe problem and check boxes that apply to problem. ________________________________

☐ Intermittent
☐ IEEE failure
☐ Front panel operational

☐ Analog output follows display
☐ Obvious problem on power-up
☐ All ranges or functions are bad

☐ Particular range or function bad; specify ____________
☐ Batteries and fuses are OK
☐ Checked all cables

Display or output (check one)

☐ Drifts
☐ Unstable
☐ Overload

☐ Unable to zero
☐ Will not read applied input

☐ Calibration only
☐ Data required

☐ Certificate of calibration required

(attach any additional sheets as necessary)

Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not). Also, describe signal source.

Where is the measurement being performed? (factory, controlled laboratory, out-of-doors, etc.)

________________________________

What power line voltage is used? ____________ Ambient temperature? ____________°F

Relative humidity? ____________ Other? ____________

Any additional information. (If special modifications have been made by the user, please describe.)

________________________________

Be sure to include your name and phone number on this service form.

KEITHLEY

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