

Keithley Instruments, Inc.

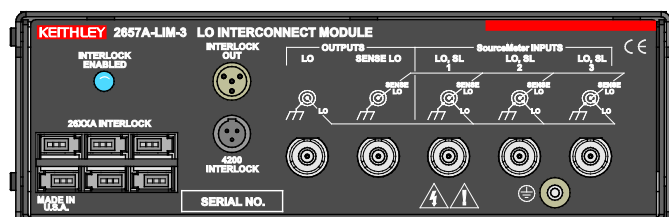
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Description

The Model 2657A-LIM-3 LO Interconnect Module establishes measurement commons (LO and sense LO) for a test system using multiple source-measure units (SMUs) that includes at least one Model 2657A High Power System SourceMeter® Instrument.

Figure 1: Model 2657A-LIM-3 LO Interconnect Module



The Model 2657A-LIM-3 connects LO terminals for up to three instruments. SMUs that can be used with the Models 2657A-LIM-3 and 2657A include:

- Model 2611A Single-Channel System SourceMeter® Instrument
- Model 2612A Dual-Channel System SourceMeter® Instrument
- Model 2635A Single-Channel System SourceMeter® Instrument
- Model 2636A Dual-Channel System SourceMeter® Instrument
- Model 4200-SCS Semiconductor Characterization System SMUs:
 - Model 4200-SMU Medium Power Source-Measure Unit
 - Model 4210-SMU High Power Source-Measure Unit

The Model 2657A-LIM-3 creates a single-point interlock connection for SMUs connected to the interlock input terminals. When the interlock circuit is interrupted by an open interlock switch, the outputs of all SMUs will disable.

Electrical characteristics

- DC current carrying capability: 1.5 A maximum
- Pulse current carrying capability: 10 A at 1% duty cycle
- Maximum voltage between LO and chassis ground*: 3000 V

* When connecting a lower voltage source-measure unit (SMU) to the Model 2657A-PM-200 protection module, the maximum voltage between LO and chassis ground is limited by the protection module.

Mounting Model 2657A-LIM-3 and Model 2657A-PM-200

You can mount one or two Model 2657A-PM-200 protection modules on top of the Model 2657A-LIM-3 using the supplied hardware.

The supplied mounting bracket can be used to mount the Model 2657A-LIM-3 anywhere you want.

Mounting the Model 2657A-PM-200 protection modules onto the Model 2657A-LIM-3

The Model 2657A-PM-200 protection modules may be mounted to the top or bottom of the Model 2657A-LIM-3. The assembly drawings below show top-side mounting.

A formed bracket and three long screws are supplied with the Model 2657A-LIM-3. Use the bracket and screws to secure the protection modules to the top of the Model 2657A-LIM-3. The screws should only be tightened enough to keep the protection modules secure. Do not overtighten.

The protection modules may instead be attached to the bottom surface of the Model 2657A-LIM-3 in the same fashion.

Figure 2: Mounting protection modules onto the Model 2657A-LIM-3

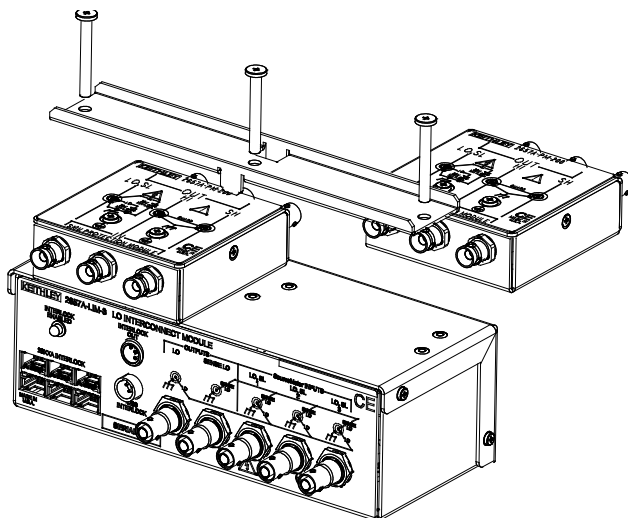
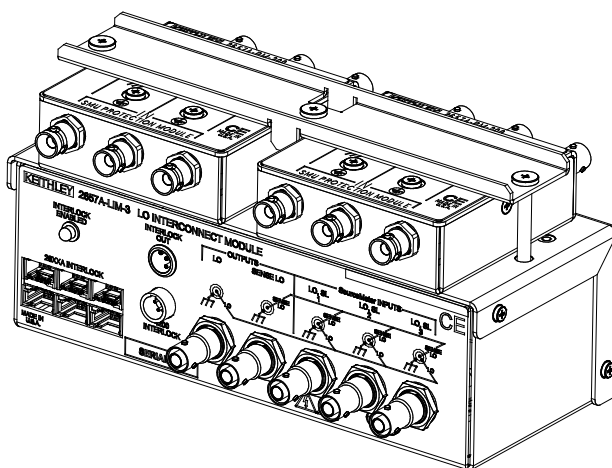


Figure 3: Finished bracket assembly



Mounting the Model 2657A-LIM-3

The Model 2657A-LIM-3 comes supplied with a flat mounting bracket. It is recommended that the Model 2657A-LIM-3 be secured in place under normal use. The flat mounting bracket can be used to secure the device on a prober, in a rack system, on a bench or in a test fixture. The flat mounting bracket is attached to the Model 2657A-LIM-3 with three supplied flat head screws. This mounting bracket can be attached to the Model 2657A-LIM-3 in multiple mounting orientations. The drawings below show bottom and back mounting positions.

After the Model 2657A has been secured in place, you can use the formed bracket to clamp one or two Model 2657A-PM-200 protection modules onto the top of it.

Figure 4: Mounting plate attached to the bottom of the Model 2657-LIM-3

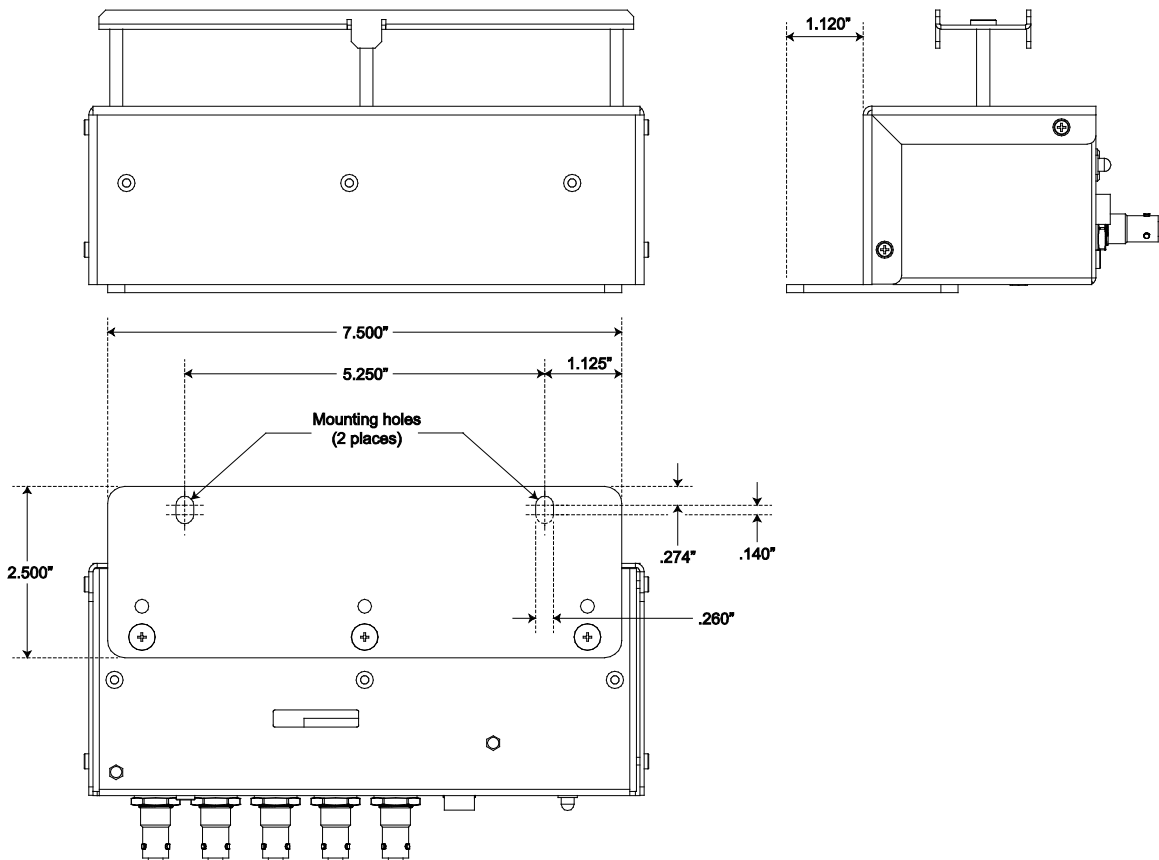
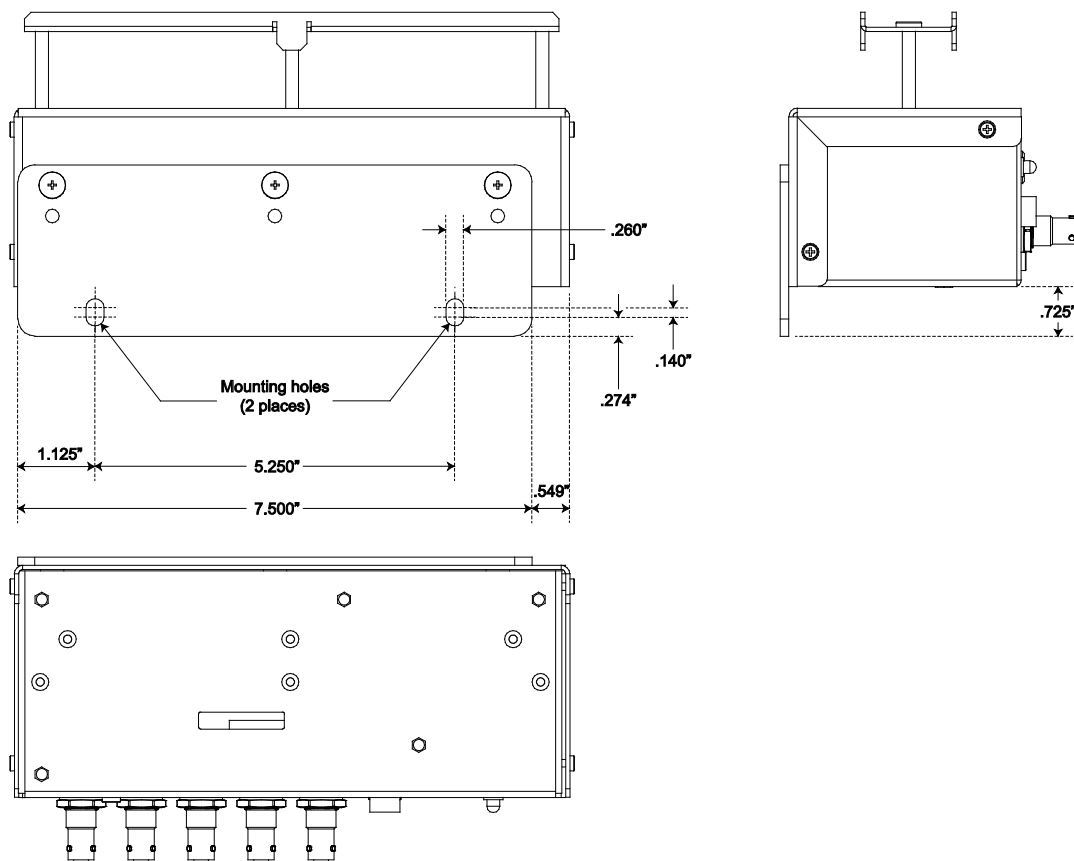


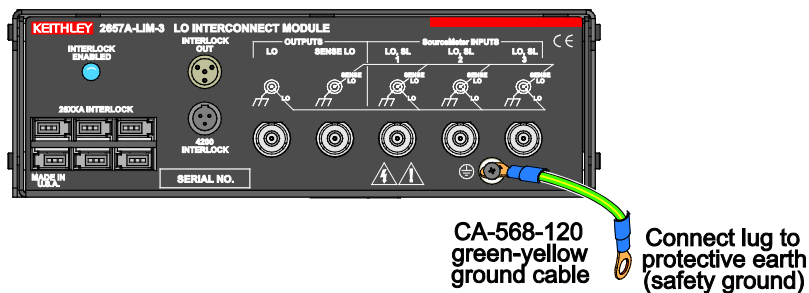
Figure 5: Mounting plate attached to the rear of the Model 2657-LIM-3



Connect the Model 2657A-LIM-3 to protective earth

Referring to the drawing below, connect one lugged end of the Model CA-568-120 ground cable to the screw terminal on the Model 2657A-LIM-3 and connect the other lugged end to protective earth (safety ground).

Figure 6: Model 2657A-LIM-3 grounding



⚠ WARNING

The Model 2657A-LIM-3 must be connected to protective earth (safety ground) using the supplied green-yellow ground cable (Model CA-568-120).

Safety interlock and test enclosure for DUT

The test system uses the Model 2657A High Power System SourceMeter® Instrument, which requires the use of the safety interlock. A properly configured safety interlock disables power from the source-measure units (SMUs) when the lid or door of a test enclosure for the device under test (DUT) is opened. Power is enabled when the lid or door is closed.

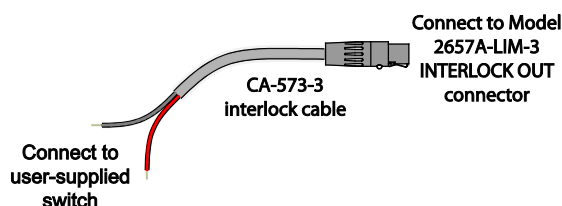
A user-supplied switch is required for the safety interlock. The normally-open switch must be used on a test fixture, on the enclosure of a semiconductor prober or device handler, or on the doors of a test-equipment rack.

The switch must be installed as follows:

- The switch must open when the lid or door of the test enclosure is opened.
- The switch must close when the lid or door of the test enclosure is closed.

The following drawing shows the supplied interlock cable that is used to connect the switch to the Model 2657A-LIM-3 INTERLOCK OUT connector.

Figure 7: Supplied interlock cable



The interlocks of the SMUs in the test system must also be connected to the Model 2657A-LIM-3. The connection drawings provided in the following topics show how to connect the interlocks to the Model 2657A-LIM-3.

The interlock circuit is powered from the connected SMUs. Power is routed through the Model 2657-LIM-3 to the closed external switch to activate the interlock. The Interlock voltage from the Model 4200-SCS is +12 V and the voltage from the other SMUs is +5 V.

Connections to device under test

The SMU terminals for connection to the device under test (DUT) are found at the following locations in the test system:

- The HI and SENSE HI terminals for the Model 2611A, 2612A, 2635A, 2636A, and 4200-SCS SMUs are accessed at the Model 2657A-PM-200.
- The HI and SENSE HI terminals for the Model 2657A are accessed at its rear panel.
- The common LO and SENSE LO terminals for the SMUs are accessed at the Model 2657A-LIM-3.

Internal to the Model 2657A-LIM-3, the SENSE LO terminal is connected to the LO terminal with a 100 k Ω resistor. This resistor permits access to LO and SENSE LO through a single connector (OUTPUT LO of the Model 2657A-LIM-3). This can be useful in applications where 4-wire sense is desired but it may be troublesome to add a fourth connection. Four-wire sense can be essentially achieved with three connections. Note that there may be some voltage error due to lead resistance from the OUTPUT LO connector of the Model 2657A-LIM-3 to the DUT.

The connection drawings provided in the following topics show the cables required to connect the SMUs to the DUT. The drawings show connections for 4-wire sensing. For 2-wire applications, the SH (sense HI) connectors of the Model 2657A-PM-200 and the SENSE HI connector of the Model 2657A are not used.

NOTE

Refer to the Model 2657A-PM-200 User's Guide for additional information on connecting a SMU to the protection module.

Connections using Model 2657A source-measure units

You can use the Model 2657A-LIM-3 with multiple Model 2657A source-measure units (SMUs).

Typical test configurations

- A. Two Model 2657A SMUs, 2-wire sensing
- B. Two Model 2657A SMUs, 4-wire sensing
- C. Three Model 2657A SMUs, 2-wire sensing
- D. Three Model 2657A SMUs, 4-wire sensing

Required accessories

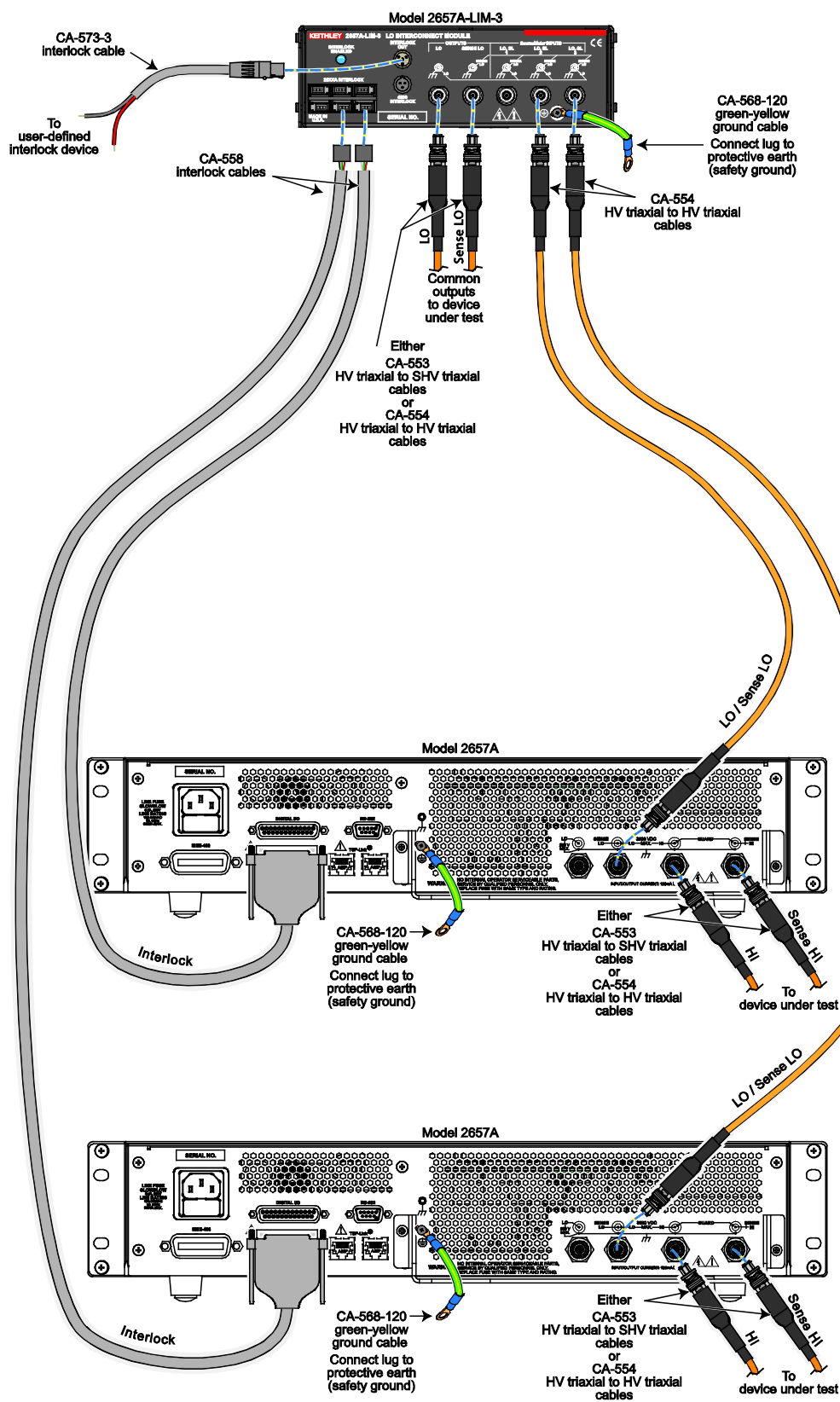
The following table lists accessory quantities for each test configuration. The connections for test configuration B are shown in the [Connection summary](#) (on page 7).

Accessory model	A. Two Model 2657As, 2-wire sensing			
	B. Two Model 2657As, 4-wire sensing			
	C. Three Model 2657As, 2-wire sensing			
	D. Three Model 2657As, 4-wire sensing			
CA-558 interlock cables	2	2	3	3
CA-573-3 interlock cable	1	1	1	1
CA-568-120 ground cables	3	3	4	4
CA-554 high-voltage triaxial cables	2	2	3	3
CA-553 standard triaxial cables or CA-554 high-voltage triaxial cables	3	6	4	8

Connection summary

Use the connection drawing below to connect Model 2657A source-measure units (SMUs) to the test system. The drawing shows connections for 4-wire sensing. For 2-wire applications, the SENSE HI connector of the Model 2657A SMUs is not used.

Figure 8: Connections using two Model 2657A SMUs



Connections using a Model 2657A and a Model 2611A or 2612A

You can use the Model 2657A-LIM-3 with a Model 2657A source-measure unit (SMU) and the Model 2611A or 2612A SMU.

Typical test configurations

- A. One Model 2611A or 2612A (one channel), one Model 2657A, 2-wire sensing
- B. One Model 2611A or 2612A (one channel), one Model 2657A, 4-wire sensing
- C. One Model 2612A (two channels), one Model 2657A, 2-wire sensing
- D. One Model 2612A (two channels), one Model 2657A, 4-wire sensing

Required accessories

The following table lists accessory quantities for each test configuration. The connections for test configuration D are shown in the [Connection summary](#) (on page 9).

Accessory model	A. Model 2611A or 2612A (one channel), Model 2657A, 2-wire sensing			
	B. Model 2611A or 2612A (one channel), Model 2657A, 4-wire sensing			
	C. Model 2612A (two channels), Model 2657A, 2-wire sensing			
	D. Model 2612A (two channels), Model 2657A, 4-wire sensing			
2657A-PM-200 protection modules	1	1	2	2
CA-558 interlock cables	2	2	2	2
CA-573-3 interlock cable	1	1	1	1
CA-568-120 ground cables	4	4	6	6
2600-TRIAx adapters	1	1	2	2
7078-TRX standard triaxial cables	2	3	4	6
CA-554 high-voltage triaxial cables	2	2	3	3
CA-553 standard triaxial cables or CA-554 high-voltage triaxial cables	3	6	4	8

Connection summary

Use the connection drawing below to connect source-measure unit (SMU) channels of the Model 2611A or 2612A and Model 2657A to the test system. For each Model 2657A-PM-200, make sure to use the IN connectors for connection to the Model 2600-TRIAx. Use the OUT connectors for connection to the Model 2657A-LIM-3 and device under test (DUT).

The drawing shows connections for 4-wire sensing. The Model 2657A-PM-200 SH (sense HI) connectors and Model 2657A SENSE HI connectors are not used for 2-wire applications.

NOTE

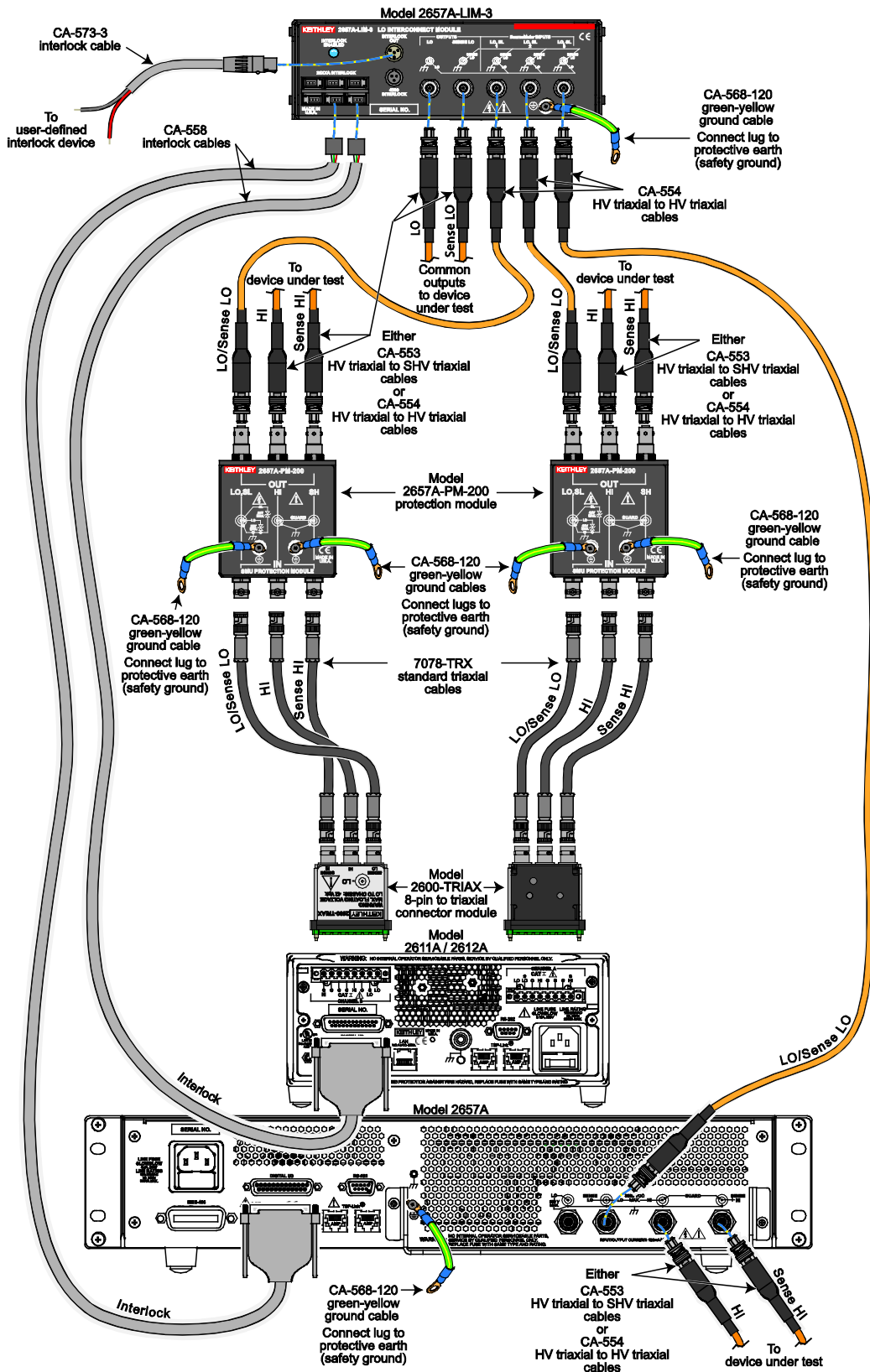
Using the Model 2611A or 2612A with the Model 2657A-LIM-3 connects system common LO to protective earth (safety ground).



CAUTION

Do not convert triaxial cables to BNC cables. Using BNC cables removes protection from the Model 2611A or 2612A and may result in damage to the SMU. You must use triaxial cables to connect to the lower-voltage SMU.

Figure 9: Connections using a Model 2657A and a Model 2611A or 2612A



Connections using a Model 2657A and a Model 2635A or 2636A

You can use the Model 2657A-LIM-3 with a Model 2657A source-measure unit (SMU) and the Model 2635A or 2636A SMU.

Typical test configurations

- A. One Model 2635A or 2636A (one channel), one Model 2657A, 2-wire sensing
- B. One Model 2635A or 2636A (one channel), one Model 2657A, 4-wire sensing
- C. One Model 2636A (two channels), one Model 2657A, 2-wire sensing
- D. One Model 2636A (two channels), one Model 2657A, 4-wire sensing

Required accessories

The following table lists accessory quantities for each test configuration. The connections for test configuration D are shown in the [Connection summary](#) (on page 12).

Accessory model	A. Model 2635A or 2636A (one channel), Model 2657A, 2-wire sensing			
	B. Model 2635A or 2636A (one channel), Model 2657A, 4-wire sensing			
	C. Model 2636A (two channels), Model 2657A, 2-wire sensing			
	D. Model 2636A (two channels), Model 2657A, 4-wire sensing			
2657A-PM-200 protection modules	1	1	2	2
CA-558 interlock cables	2	2	2	2
CA-573-3 interlock cable	1	1	1	1
CA-568-120 ground cables	4	4	6	6
7078-TRX standard triaxial cables	2	3	4	6
CA-554 high-voltage triaxial cables	2	2	3	3
CA-553 standard triaxial cables or CA-554 high-voltage triaxial cables	3	6	4	8

Connection summary

Use the connection drawing below to connect source-measure unit (SMU) channels of the Model 2635A or 2636A and Model 2657A to the test system. For each Model 2657A-PM-200, make sure to use the IN connectors for connection to the Model 2635A or 2636A. Use the OUT connectors for connection to the Model 2657A-LIM-3 and device under test (DUT).

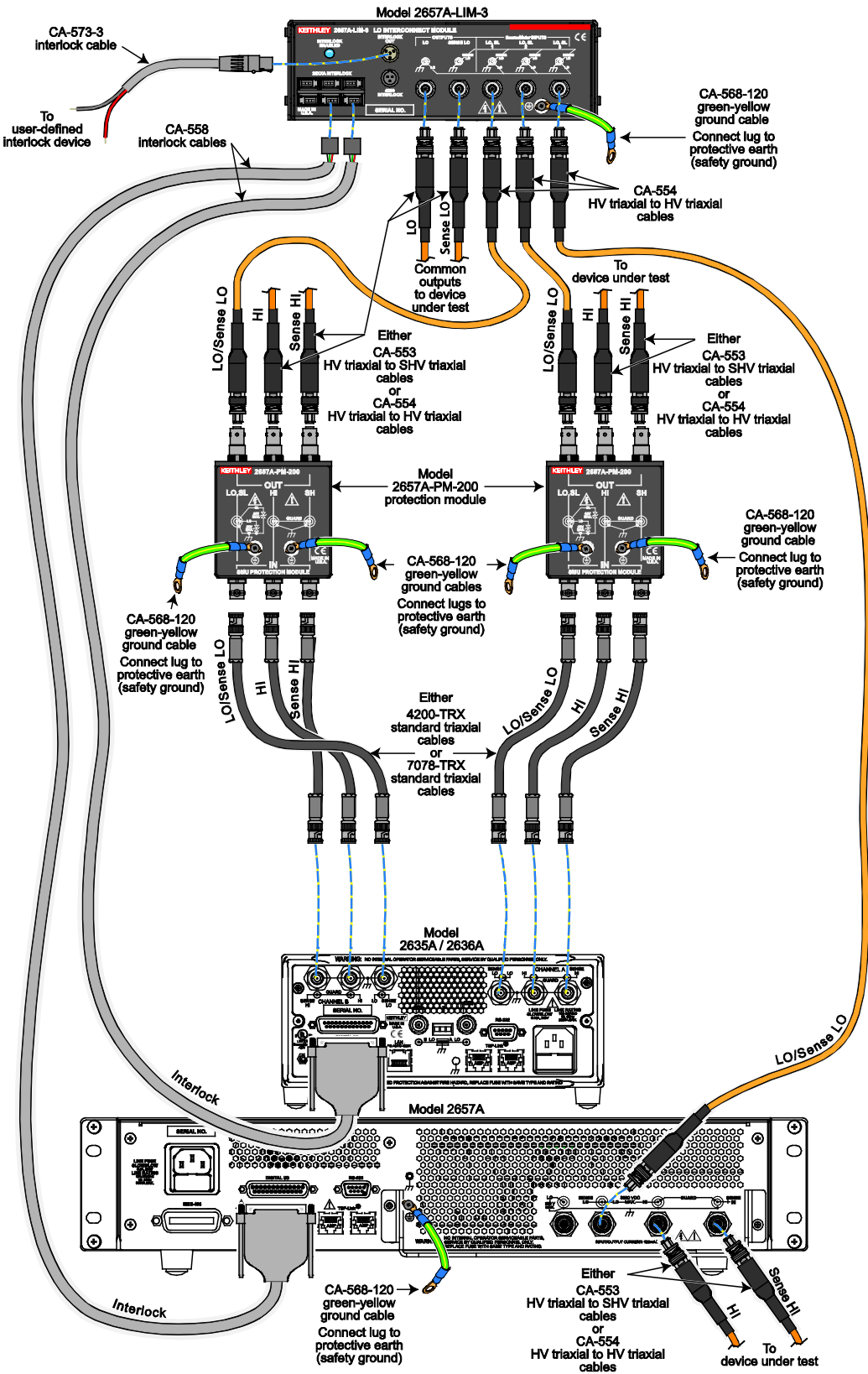
The drawing shows connections for 4-wire sensing. The Model 2657A-PM-200 SH (sense HI) connectors and Model 2657A SENSE HI connectors are not used for 2-wire applications.



CAUTION

Do not convert triaxial cables to BNC cables. Using BNC cables removes protection from the Model 2635A or 2636A and may result in damage to the SMU. You must use triaxial cables to connect to the lower-voltage SMU.

Figure 10: Connections using a Model 2657S and a Model 2635A or 2636A



Connections using a Model 2657A and Model 4200-SCS SMUs

You can use the Model 2657A-LIM-3 with a Model 2657A source-measure unit (SMU) and the Model 4200-SCS SMUs.

Typical test configurations

- A. One Model 4200-SCS SMU, one Model 2657A, 2-wire sensing
- B. One Model 4200-SCS SMU, one Model 2657A, 4-wire sensing
- C. Two Model 4200-SCS SMUs, one Model 2657A, 2-wire sensing
- D. Two Model 4200-SCS SMUs, one Model 2657A, 4-wire sensing

Required accessories

The following table lists accessory quantities for each test configuration. The connections for test configuration B are shown in the [Connection summary](#) (on page 15).

Accessory model	A. Model 4200-SCS SMU, Model 2657A, 2-wire sensing			
	B. Model 4200-SCS SMU, Model 2657A, 4-wire sensing			
	C. Two Model 4200-SCS SMUs, Model 2657A, 2-wire sensing			
	D. Two Model 4200-SCS SMUs, Model 2657A, 4-wire sensing			
2657A-PM-200 protection modules	1	1	2	2
CA-558 interlock cable	1	1	1	1
CA-573-3 interlock cable	1	1	1	1
236-ILC-3 interlock cables	1	1	2	2
CA-568-120 ground cables	4	4	6	6
4200-MTRX miniature triaxial cables	1	2	2	4
4200-TRX standard triaxial cables	1	1	2	2
237-TRX-T triaxial tee	0	0	1	1
CA-554 high-voltage triaxial cables	2	2	2*	2*
CA-553 standard triaxial cables or CA-554 high-voltage triaxial cables	3	6	4	8

* Because all Model 4200-SCS SMUs share a common LO, you only need to connect the LO,SL OUT connector of one Model 2657A-PM-200 to the Model 2657A-LIM-3.

NOTE

Refer to Model 2657A-PM-200 User's Guide for more information on accessories required to connect the Model 4200-SCS SMU with the Model 4200-PA preamplifier to the Model 2657A-PM-200.

Connection summary

Use the connection drawing below to connect Model 4200-SCS source-measure units (SMUs) and the Model 2657A to the test system. For each Model 2657A-PM-200, make sure to use the IN connectors for connection to the Model 4200-SCS. Use the OUT connectors for connection to the Model 2657A-LIM-3 and the device under test (DUT).

The drawing shows connections for 4-wire sensing. The Model 2657A-PM-200 SH (sense HI) connectors and Model 2657A SENSE HI connectors are not used for 2-wire applications.

NOTE

When using multiple SMUs that are installed in the Model 4200-SCS, each SMU needs its own protection module. To achieve adequate voltage protection, connect the GNDU Sense terminal to the LO, SL (LO and sense LO) connector of each protection module using triaxial tees (such as the Keithley Model 237-TRX-T) and additional triaxial cables (Model 4200-TRX).

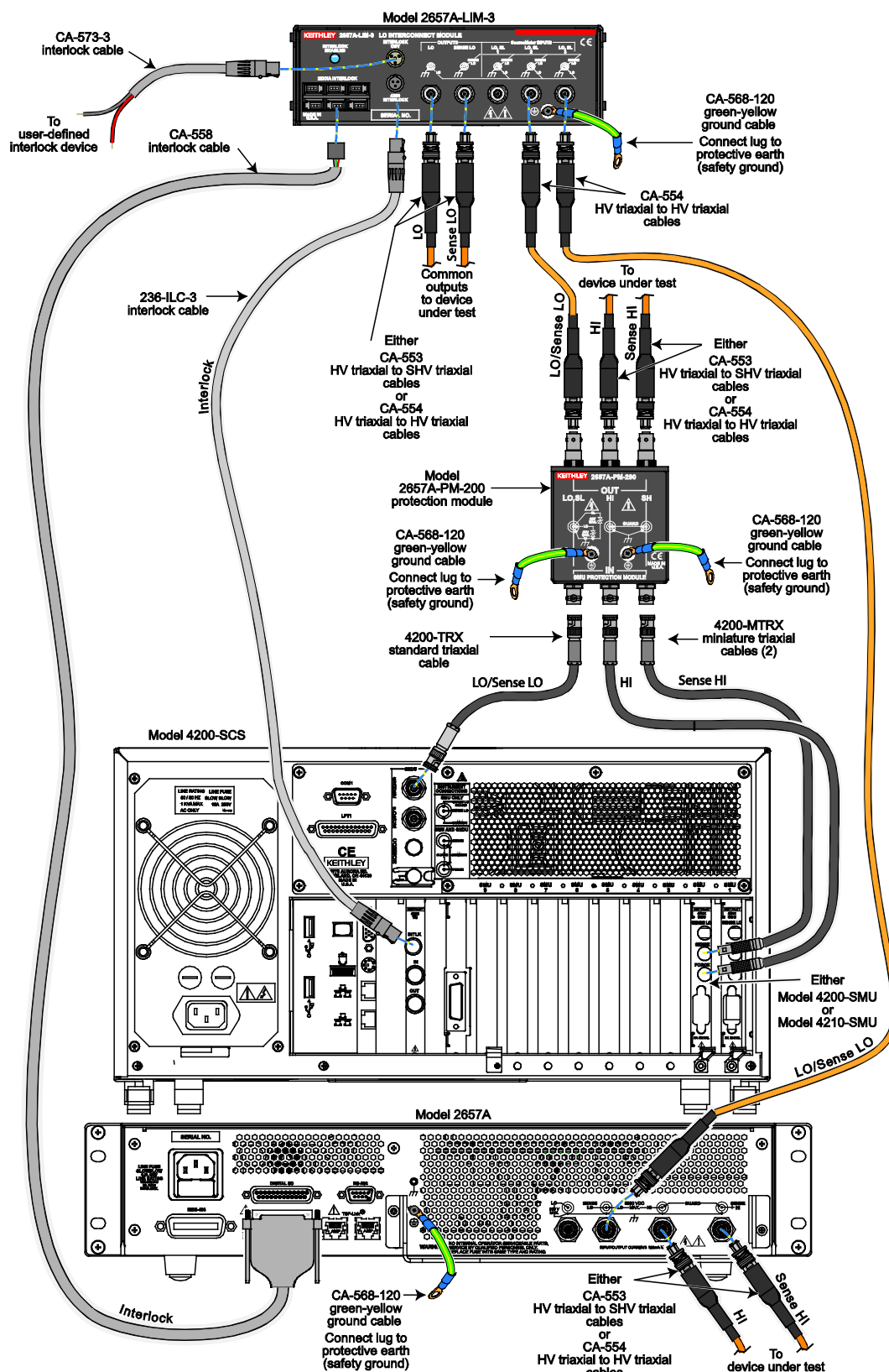
NOTE

If using a Model 4200-SCS SMU with the Model 4200-PA remote preamplifier (preamp), refer to the Model 2657A-PM-200 Protection Module User's Guide for information about connecting the protection module to the preamp.

NOTE

Connecting the Model 4200-SMU or 4210-SMU to the Model 2657A-PM-200 connects the LO terminal of the SMU to protective earth (safety ground).

Figure 11: Test system connections using a Model 2657A and a Model 4200-SCS SMU



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 nonhazardous 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 user documentation for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product warranty 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 user documentation. 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, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

Keithley Instruments products are designed for use with electrical signals that are rated Measurement Category I and Measurement Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Measurement Category I and must not be directly connected to mains voltage or to voltage sources with high transient overvoltages. Measurement Category II connections require protection for high transient overvoltages 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 user documentation.

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 30 V RMS, 42.4 V peak, or 60 VDC 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 V, 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, ensure that 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 the 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 means caution, risk of danger. The user should refer to the operating instructions located in the user documentation in all cases where the symbol is marked on the instrument.

The  symbol on an instrument means caution, risk of electric shock. Use standard safety precautions to avoid personal contact with these voltages.

The  symbol on an instrument shows that the surface may be hot. Avoid personal contact to prevent burns.

The  symbol indicates a connection terminal to the equipment frame.

If this  symbol is on a product, it indicates that mercury is present in the display lamp. Please note that the lamp must be properly disposed of according to federal, state, and local laws.

The **WARNING** heading in the user documentation 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 the user documentation 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., a 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.