RE-INVENTING TEST & MEASUREMENT THROUGH ***SPEED*** AND **SIMPLICITY**

Model 8010 High Power Device Test Fixture Interconnection Reference Guide

A GREATER MEASURE OF CONFIDENCE

KEITHLEY

Safety precautions

Observe the following safety precautions 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 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. Main supply voltage fluctuations not to exceed ± 10% of the nominal voltage.

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 V DC 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.


This 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.


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


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


This symbol indicates a connection terminal to the equipment frame.

If the mercury 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.

WARNING This 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.

CAUTION This 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, remove power from the 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 and servicing.

Power and environmental characteristics

For indoor use only.

Maximum signal voltage (signal or guard to any signal)	Three-lug high-voltage triaxial connector: 3280 V Three-lug standard triaxial connector: 210 V Eight-pin screw terminal connector: 40 V Two-pin high-current screw terminal connector: 40 V
Maximum signal current	Three-lug high-voltage triaxial connector: 120 mA DC Three-lug standard triaxial connector: 1.5 A DC Eight-pin screw terminal connector: 1 A DC Two-pin high-current screw terminal connector: 15 A DC, 50 A pulsed with one SMU; 100 with two SMUs
Maximum combined DC current	15 A DC
Maximum pulse current	100 A at 1 % duty cycle for Model 2651A High Power SourceMeter Instrument path 10 A at 1 % duty cycle for Series 2600A and Model 4200 paths
Altitude	Maximum 2000 m above sea level
Operating	0 °C to 50 °C, 70 % relative humidity up to 35 °C. Derate 3 % relative humidity/°C, 35 °C to 50 °C
Storage	-25 °C to 65 °C
Safety	Listed to UL61010-1:2004 Conforms to European Union Low Voltage Directive

Introduction to the Model 8010 test fixture

Thank you for choosing a Keithley Instruments product. The Model 8010 provides a safe, low noise, complete environment for testing a variety of packaged device types. The replaceable socket modules allow for a variety of package types, including the user-supplied socket types.

The Model 8010 allows you to connect one Model 2657A High Power SourceMeter for up to 3000 V testing. You can connect up to two Model 2651A High Power SourceMeters for 50 A or 100 A testing. For lower power terminals, you can connect up to three other SourceMeters (Models 2611A, 2612A, 2635A, 2636A, or 4200-SCS).

The Model 8010 documentation includes:

- **Interconnection Reference Guide:** Provides a quick reference for typical test connections and basic connection information.
- **User's Manual:** Provides complete connection information and sample applications.

The User's Manual is in PDF format and is on the CD-ROM that is included with the test fixture. If you do not have Adobe Reader®, you can download a free copy at http://get.adobe.com/reader/.

CD-ROM contents

The CD-ROM that is included with your test fixture contains the following Model 8010 product documentation in PDF:

- Interconnection Reference Guide (this document)
- User's Manual
- Specifications

For additional information, see http://www.keithley.com/support.

List of supplied accessories

In addition to the Model 8010 Test Fixture, you should have received:

- Model 8010 Interconnection Reference Guide (this document)
- Model 8010 High Power Device Test Fixture Product Information CD-ROM
- Two pre-installed TO-247 device test boards (8010-120; to reorder, use Keithley part number 8010-DTB)
- Customizable test board (8010-130; to reorder, use Keithley part number 8010-CTB)
- Three 6.56 ft (2 m) interlock cables (CA-558-2)
- Two 120 in. (304.6 cm) green/yellow ground cables with lugs (CA-568-120)
- Ten 8 in. (203.2 mm) black stack-up banana cables (CA-560-0)
- Two 8 in. (203.2 mm) red stack-up banana cables (CA-560-2)
- Ten insulating plugs (8010-317)
- One 10 in. (254 mm) black high-current banana cable (CA-562-0)
- One 10 in. (254 mm) red high-current banana cable (CA-562-2)
- Six 9.5 in. (241 mm) low noise BNC-banana cable (CA-563)
- Two document pouches (8010-318)

Optional and replacement boards that can be purchased are:

- TO-247 device test board (8010-DTB) for use with three-terminal TO-247 or two-terminal axial-lead devices at the maximum rated voltage and current
- 8010-CTB customizable test board (8010-CTB) that you can configure for the maximum rated voltage and current
- TO-220 or TO-247 device test board (8010-DTB-220) for use with three-terminal TO-220 or TO-247 devices that are limited to 1000 V and the maximum rated current
- 8010-DTB-CT device test board that you can use for curve tracing.

Refer to the packing list for additional items that might have shipped with your instrument.

For additional accessories, see the catalog, www.keithley.com, or the CD-ROM.

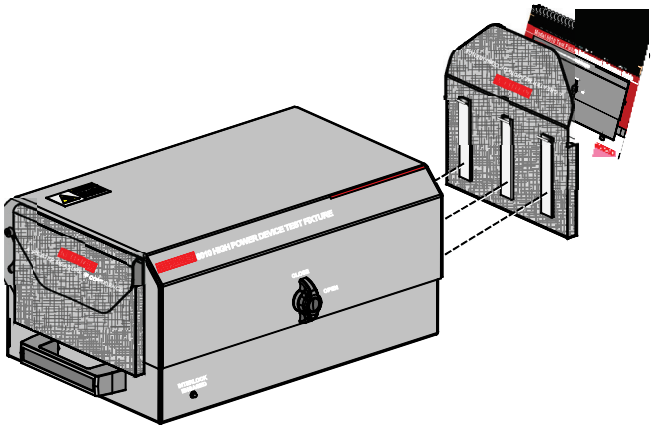
Attach pouches to the test fixture

Before installing the test fixture, attach the pouches (part number 8010-318) to the sides of the fixture, as shown here.

One pouch can be used to store the Interconnection Reference Guide and the other can be used to store Model 8010 cables and accessories.

To attach the pouches:

1. Make sure that the areas to which you want to attach the pouches are clean. If you need to clean the test fixture, use a soft, lint-free cloth and 70 percent isopropyl alcohol.
2. Close the lid of the test fixture.
3. Remove the protective backing from the hook and loop fastener strips.
4. Position the pouch. Make sure placement of the pouch does not interfere with the closing of the lid or your ability to use the handles.
5. Press firmly.



8010 placement considerations

The Model 8010 is intended for use on a bench. Make sure you have enough clearance to open the lid.

Assumptions for connection diagrams

When you use the connection diagrams in this Interconnection Reference Guide, be aware of the following assumptions.

SourceMeter® Instrument information

You cannot use a Model 2651A and Model 2657A simultaneously to test a single device.

You can use a Model 2651A or Model 2657A simultaneously with a Series 2600A instrument. When a Series 2600A is referenced in the Model 8010 documentation, you can use any of the following SourceMeter Instruments:

- Model 2611A
- Model 2612A
- Model 2635A
- Model 2636A

Using remote sense

If you are using remote sense connections, you must enable remote sense on the instrument.

Types of devices

All three-terminal devices under test (DUTs) are assumed to be MOSFETs. Therefore, the labels G-D-S on the connection diagrams relate to the Gate, Drain, and Source of a MOSFET device.

If you are testing an insulated gate bipolar transistor (IGBT), make the following substitutions:

- G: Connect to the gate
- D: Connect to the collector
- S: Connect to the emitter

If you are testing a bipolar junction transistor, make the following substitutions:

- G: Connect to the base
- D: Connect to the collector
- S: Connect to the emitter

Insulating plug use

The Model 8010 comes with insulating plugs that can be used when testing two-terminal devices.

The three-pin socket inherently shorts the force and sense pins together. When you are using the axial terminal posts in 4-wire mode, this can cause measurement errors. You should insert the insulating plug into the three-pin socket when testing axial-lead devices in 4-wire sense mode where a short between force and sense will cause measurement errors.

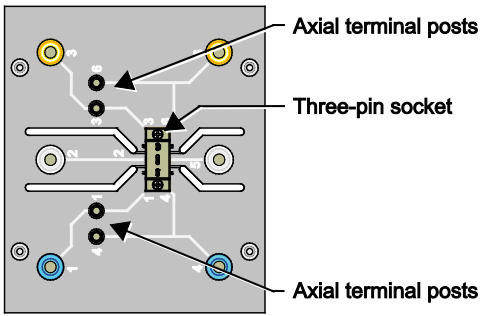
Do not use the insulating plug when testing higher resistance devices (greater than 1 MΩ). Using the plug for these tests may cause leakage measurement errors.

Testing two-terminal TO-247 devices

The two-terminal interconnection diagrams that are shown in this document are intended for axial-lead devices. However, you can adapt the setups so that you can test two-terminal TO-247 devices.

To test TO-247 devices, you need to:

1. Remove the insulating plug (if used) from the three-pin socket.
2. Verify that the four axial device terminal posts are not connected to anything.
3. Place the two-terminal TO-247 device into the three-pin socket.



Using both sides of the test fixture

In several of the interconnection diagrams, it is noted that you can make equivalent connections on the other side of the test fixture. For example, if you have an ongoing test using the Series 2600A connected to the high-current side, you could set up a one-time test using the equivalent terminals on the high-voltage side.

Note that this option is not available for test setups when you are using a Model 2651A or Model 2657A.

WARNING

Do not simultaneously connect terminals in the high current and high voltage areas of the fixture to the same terminals in the center area (the area bordered in blue). Simultaneous connections can result in electric shock (see previous graphic).

Connect the test fixture external wiring (current-voltage)

Important test system safety information

This product is sold as a stand-alone test fixture that may become part of a system that could contain hazardous voltages and energy sources. It is the responsibility of the test system designer, integrator, installer, maintenance personnel, and service personnel to make sure that the system is safe during use and that it is operating properly.

It is important that you consider the following factors in your system design and use:

- The international safety standard UL 61010-1: 2004 defines voltages as hazardous if they exceed 30 V RMS and 42.4 V peak, or 60 V DC for equipment rated for dry locations. Keithley Instruments products are only rated for dry locations.
- Read and comply with the specifications of all instruments in the system. The overall allowed signal levels may be constrained by the lowest rated instrument in the system. For example, if you are using a 500 V power supply with a 300 V DC rated switch, the maximum allowed voltage in the system is 300 V DC.
- Make sure any test fixture connected to the system protects the operator from contact with hazardous voltages, hot surfaces, and sharp objects. Use shields, barriers, insulation, and safety interlocks to accomplish this.
- Provide training to all system users so that they understand all potential hazards and know how to protect themselves from injury.

⚠ WARNING

Never connect the guard terminal from any instrument to the LO terminal of any instrument in the Model 8010 or to the chassis. Connecting guard to LO can disable the high voltage protection that is installed across the Model 4200 or Model 2600A SourceMeter Instrument connections. This may result in hazardous live voltages being present at the HI, SHI, SLO, or LO terminals.

To keep users safe, always read and follow all safety warnings provided with each of the instruments in your system.

⚠ WARNING

Hazardous voltages may be present on the output and guard terminals. To prevent electrical shock that could cause injury or death, NEVER make or break connections to the Model 8010 while the output from the SourceMeter Instrument (SMU) is on. Turn off the instrument from the instrument front panel or disconnect the main power cord from the rear of the instrument before handling cables connected to the outputs. Putting the SMU into standby does not guarantee the outputs are not powered if a hardware or software fault occurs.

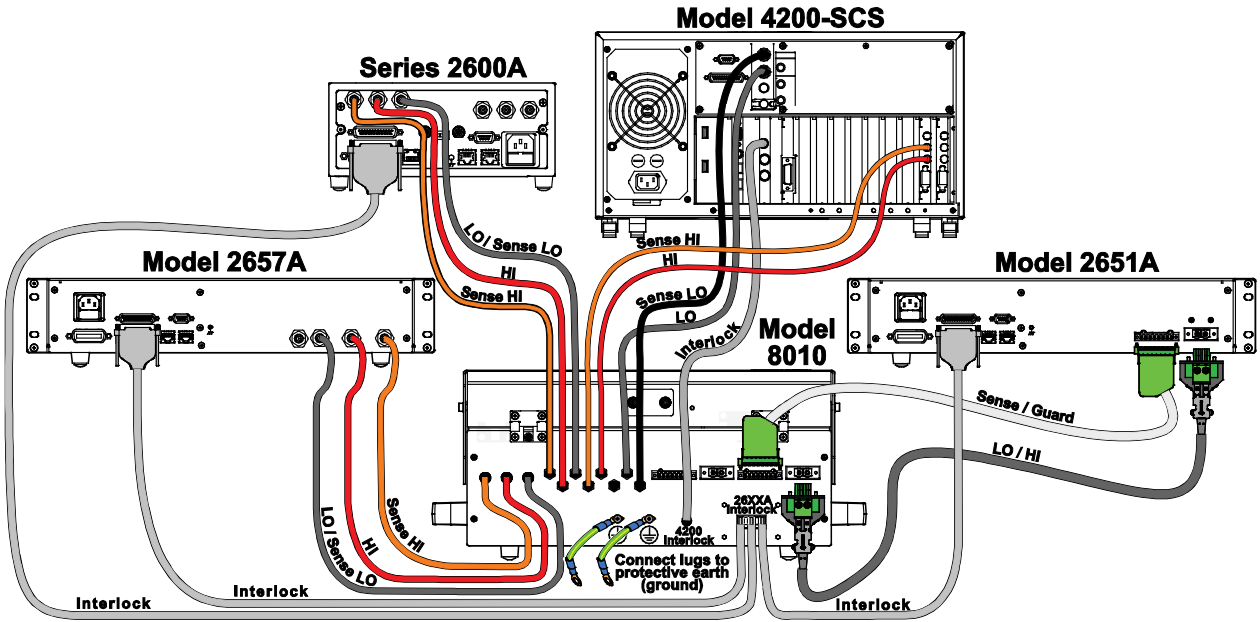
⚠ WARNING

Verify that all wiring is inside of the cross-hatched area of the test fixture. Ensure that wires do not protrude beyond the fixture lid and that the lid will close securely. Exposed wire may result in electric shock, causing death or serious injury.

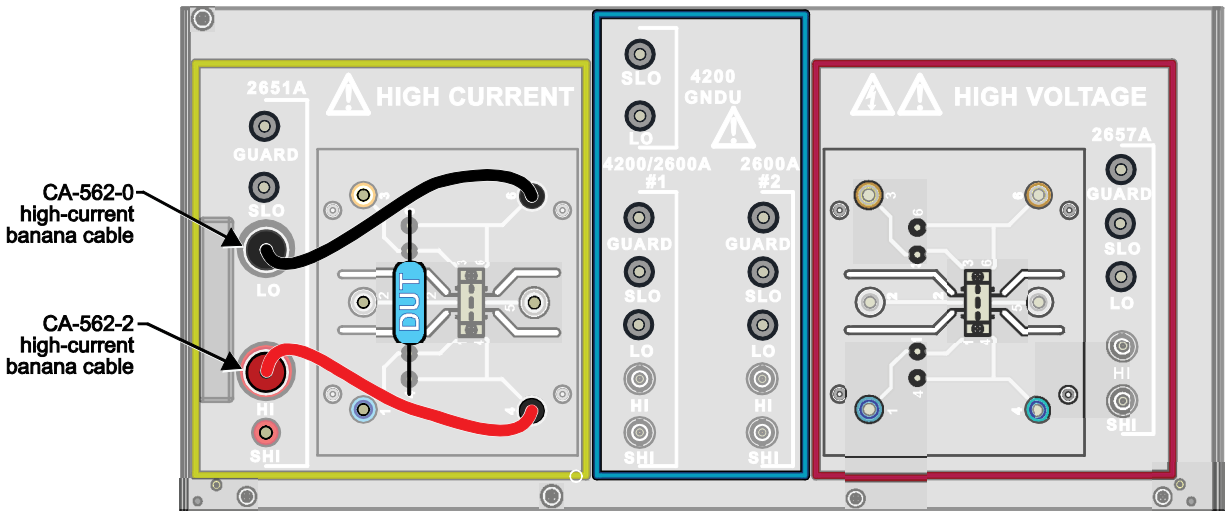
⚠ WARNING

The Model 8010 is provided with two protective earth (safety ground) terminals on the rear panel. Ensure that both protective earth terminals are properly connected to a known protective earth before connecting instruments to the test fixture. Failure to connect both protective earth terminals can result in electric shock.

External wiring diagram (current-voltage) measurement connections

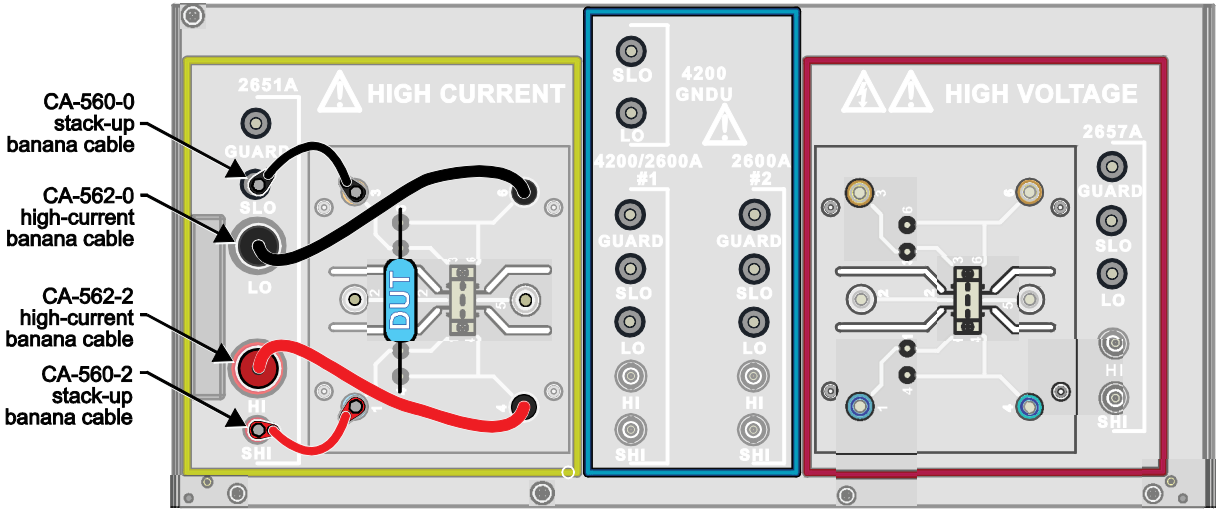


Two-terminal axial-lead DUT with a Model 2651A connected (local sense) (lid open view of device test boards)

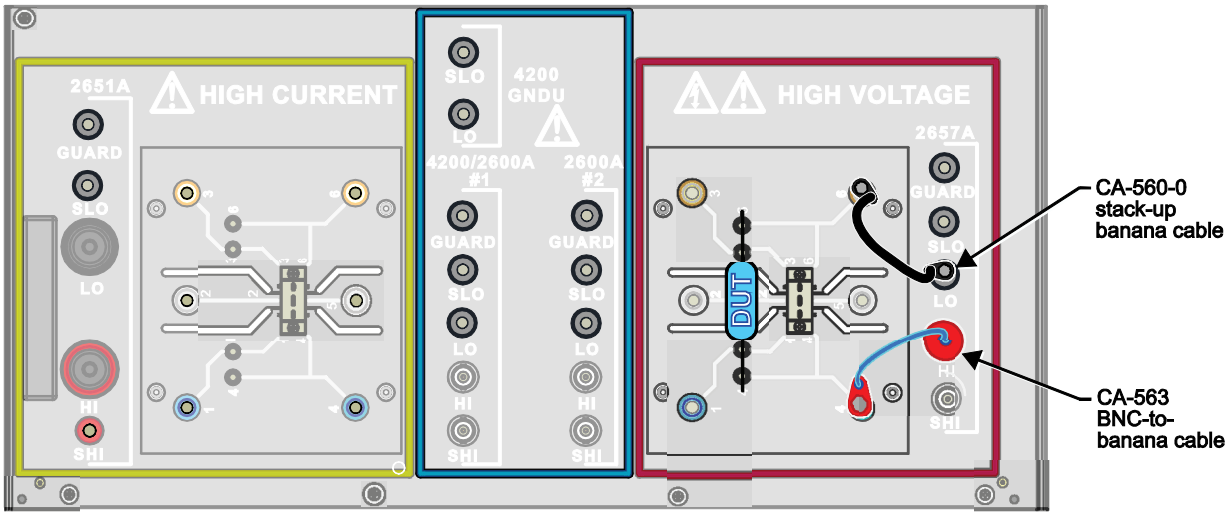


Two-terminal axial-lead DUT with a Model 2651A connected (remote sense; current-voltage)

Note: You may need to add an insulating plug to prevent four-wire remote sense measurement errors. See Insulating plug use for detail.

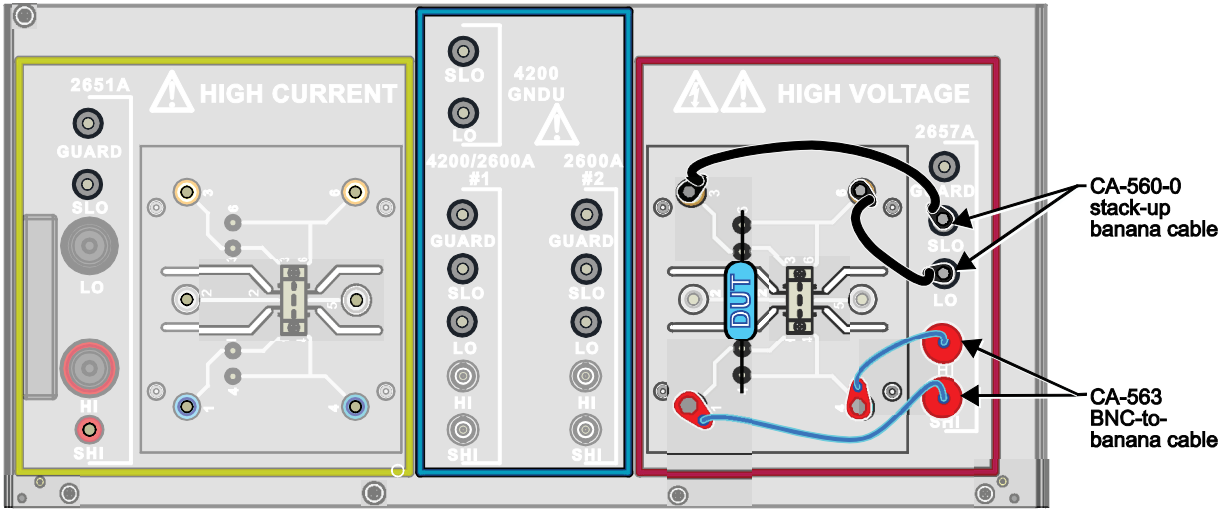


Two-terminal axial-lead DUT with a Model 2657A connected (local sense)



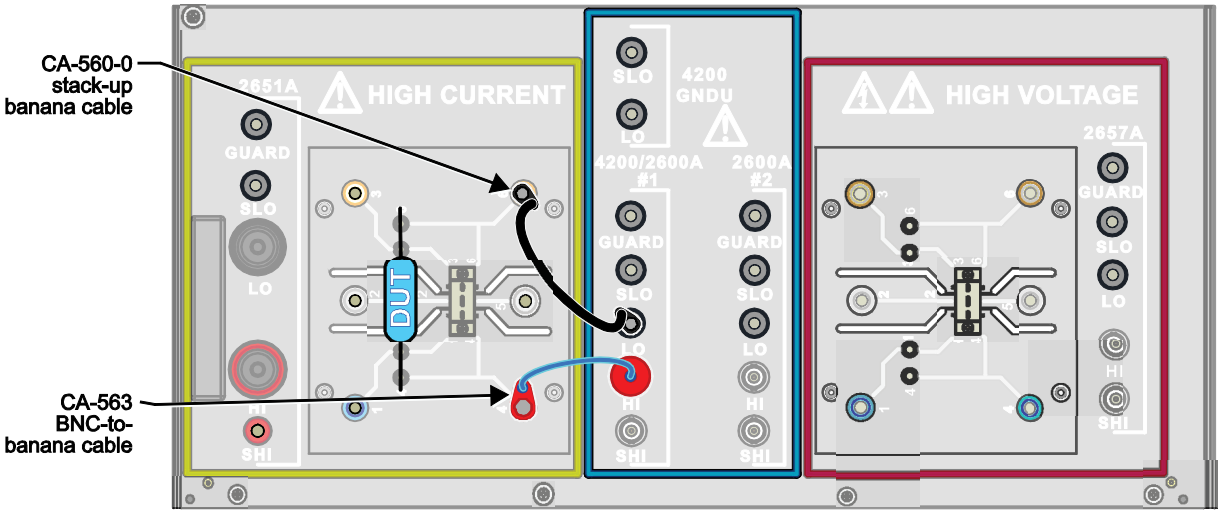
Two-terminal axial-lead DUT with a Model 2657A connected (remote sense)

Note: You may need to add an insulating plug to prevent four-wire remote sense measurement errors. See Insulating plug use for detail.



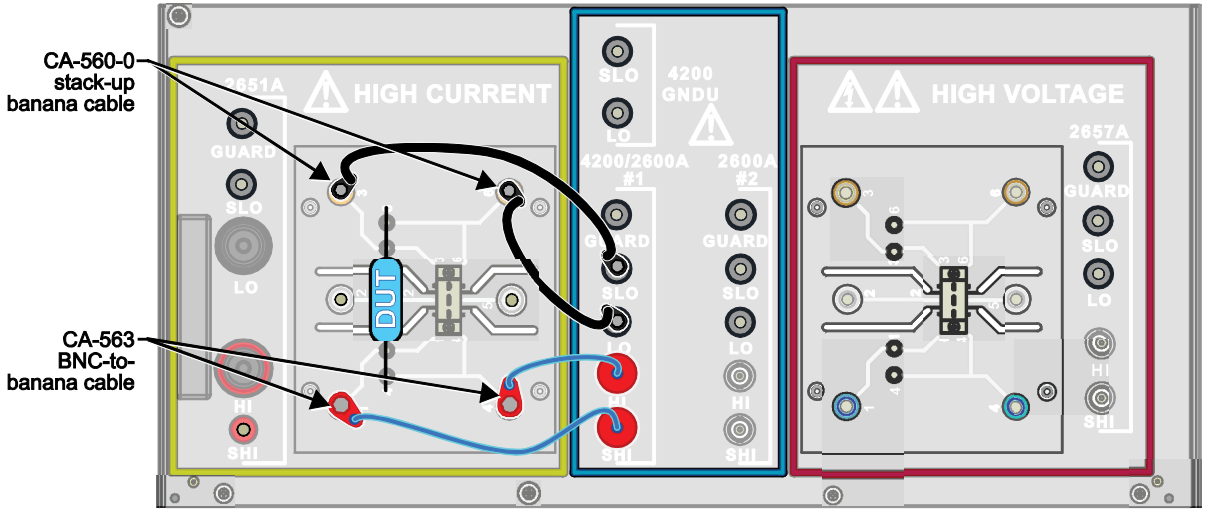
Two-terminal axial-lead DUT with a Series 2600A connected (local sense)

You can use equivalent connections for the high-current section (this option is not available for a Model 2651A or Model 2657A instrument).

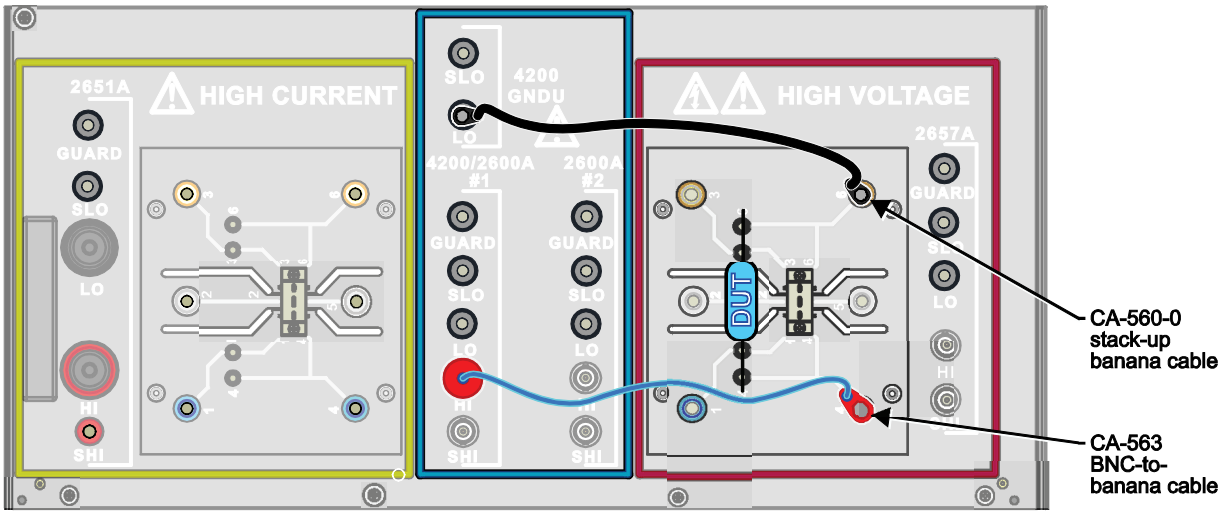


Two-terminal axial-lead DUT with a Series 2600A connected (remote sense)

Notes: You may need to add an insulating plug to prevent four-wire remote sense measurement errors. See Insulating plug use for detail.
You can use equivalent connections for the high-current section (this option is not available for a Model 2651A or Model 2657A instrument).

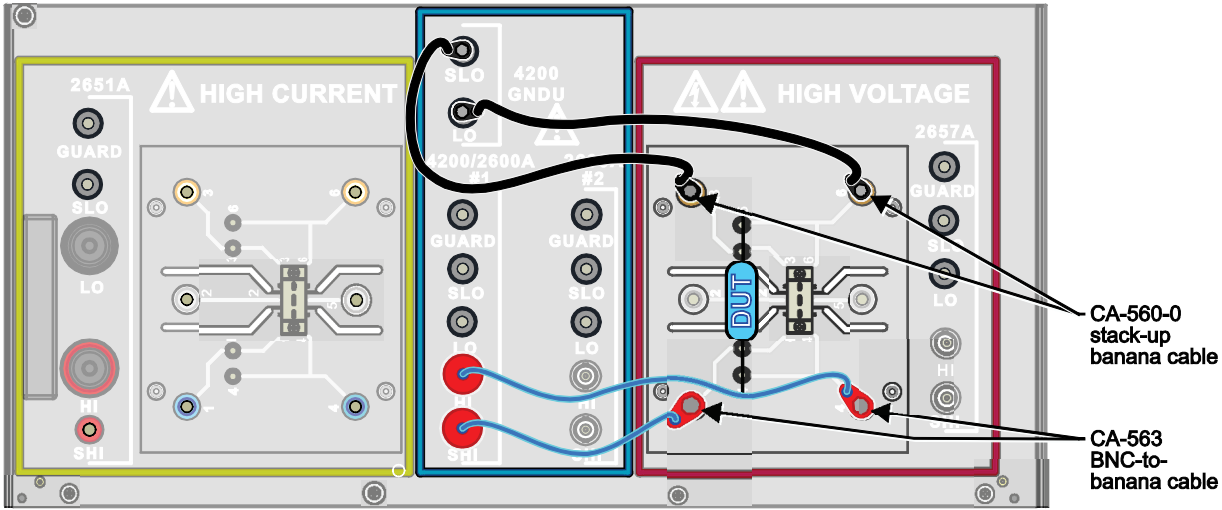


Two-terminal axial-lead DUT with a Model 4200-SMU connected (local sense)



Two-terminal axial-lead DUT with a Model 4200-SMU connected (remote sense)

Notes: You may need to add an insulating plug to prevent four-wire remote sense measurement errors. See Insulating plug use for detail.



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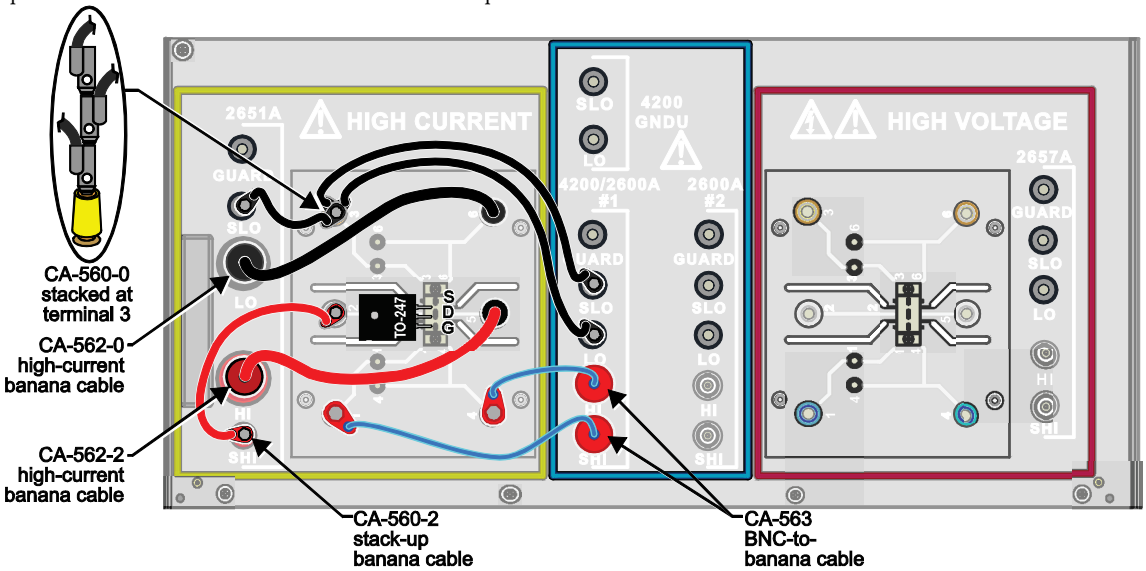
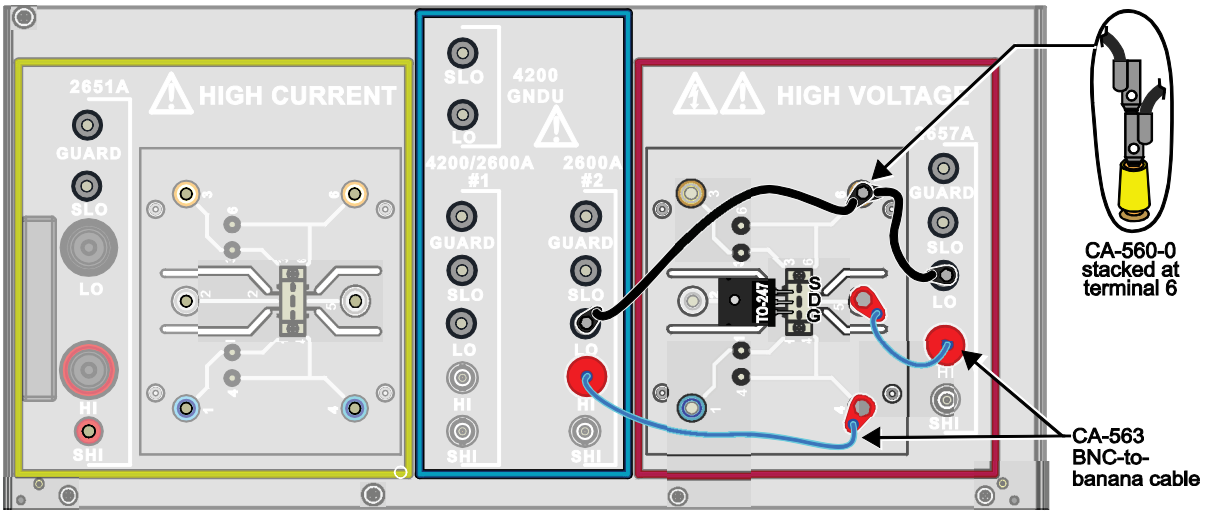
Three-terminal DUT with one or two Model 2651A instruments and Series 2600A instrument connected (remote sense; current-voltage)

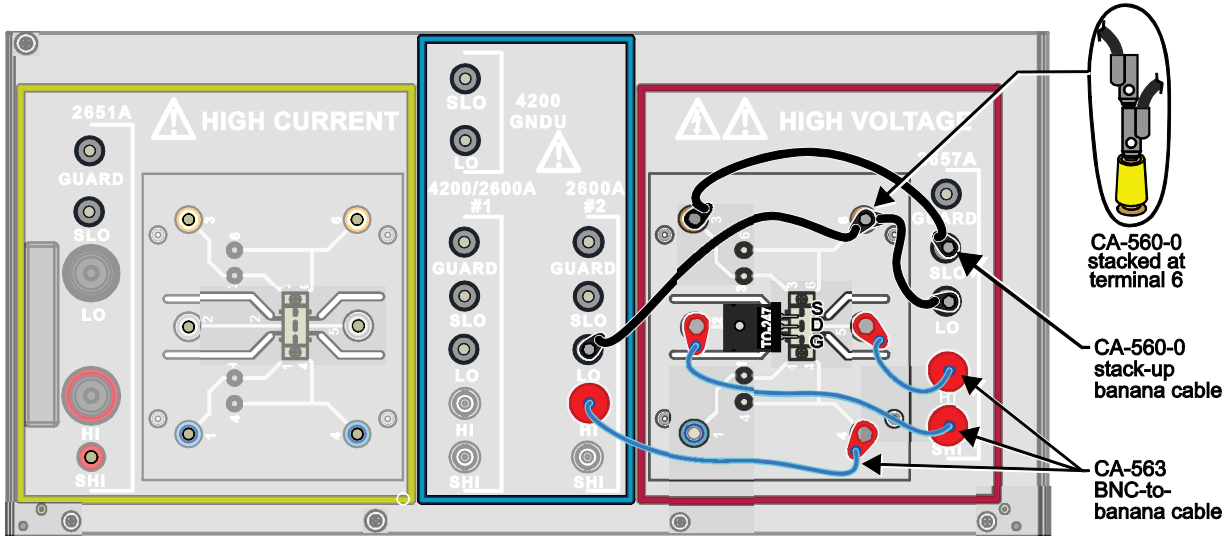
Note: Multiple Model 2651A instruments will be connected in parallel.



Three-terminal DUT with a Model 2657A and a Series 2600A connected (local sense)

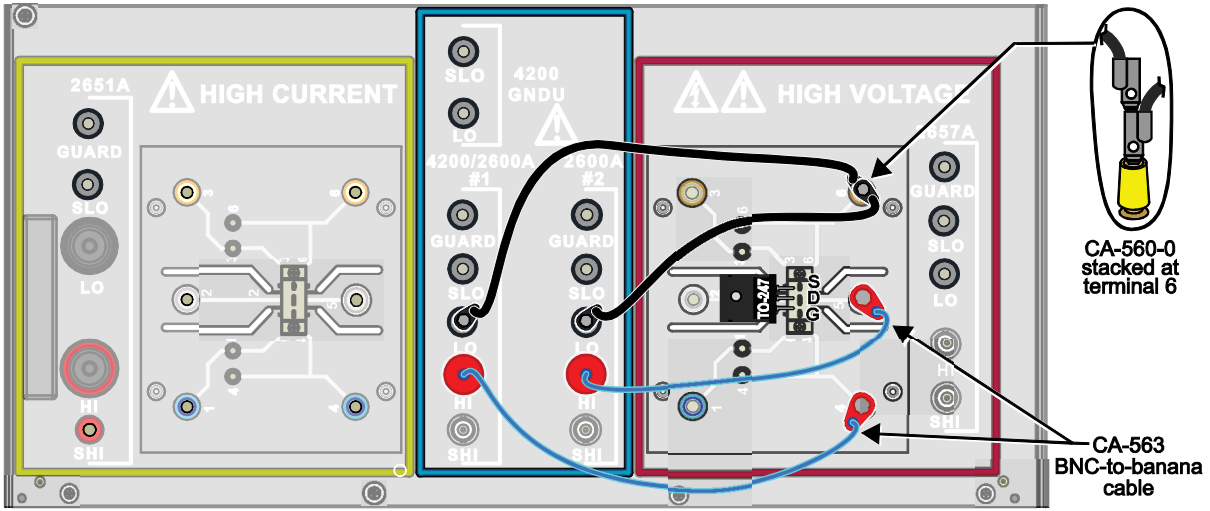


Three-terminal DUT with a Model 2657A and a Series 2600A connected (remote sense)



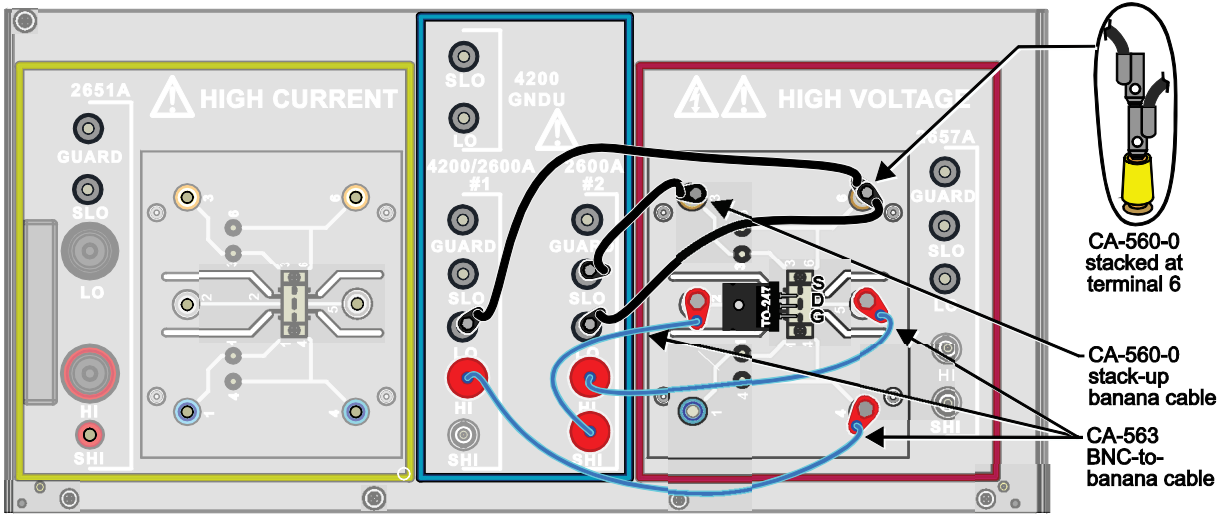
Three-terminal DUT with two Series 2600A instruments connected (local sense)

You can use equivalent connections for the high-current section (this option is not available for a Model 2651A or Model 2657A instrument).

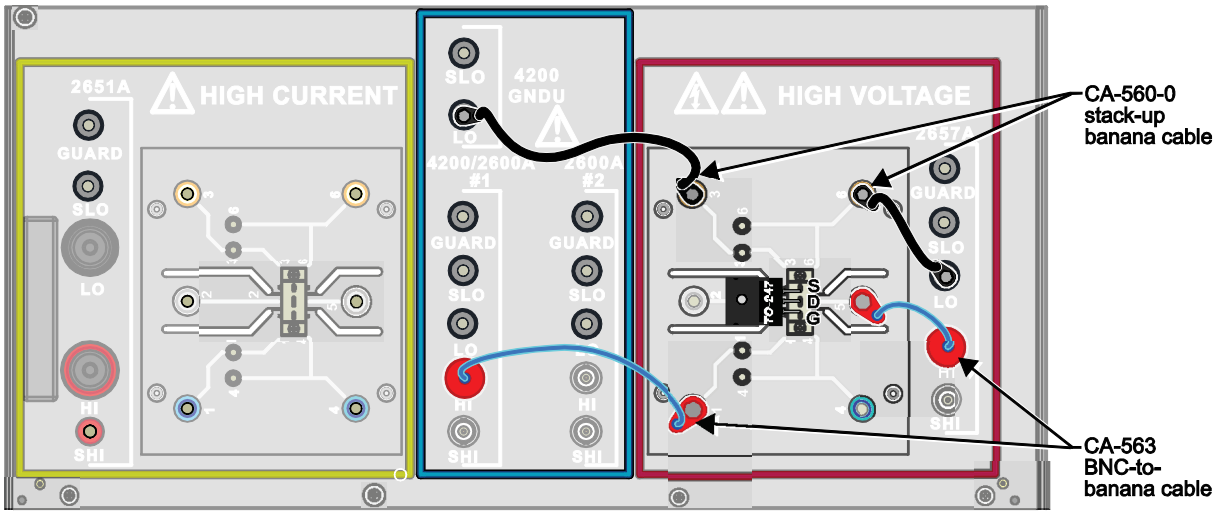


Three-terminal DUT with two Series 2600A instruments connected (remote sense)

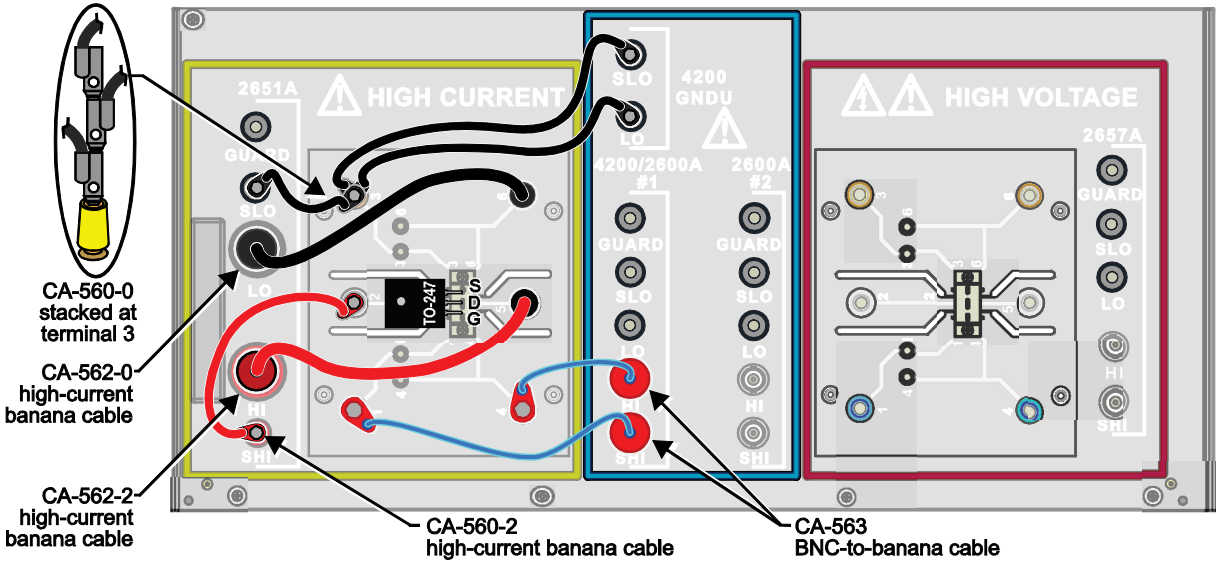
You can use equivalent connections for the high-current section (this option is not available for a Model 2651A or Model 2657A instrument).



Three-terminal DUT with a 4200 and 2657A connected (local sense)

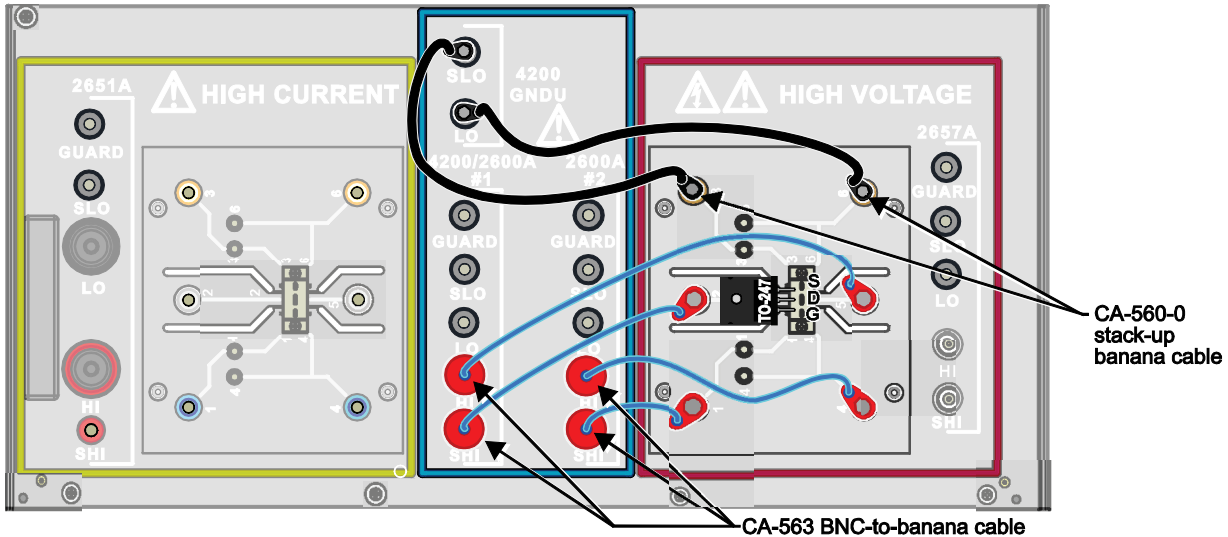


Three-terminal DUT with a 4200 and 2651A connected (remote sense)



Three-terminal DUT with a Model 4200-SMU connected (remote sense)

Note: The SLO and LO terminals for all Model 42xx SMUs in a Model 4200-SCS chassis are joined in the 4200 GNDU.



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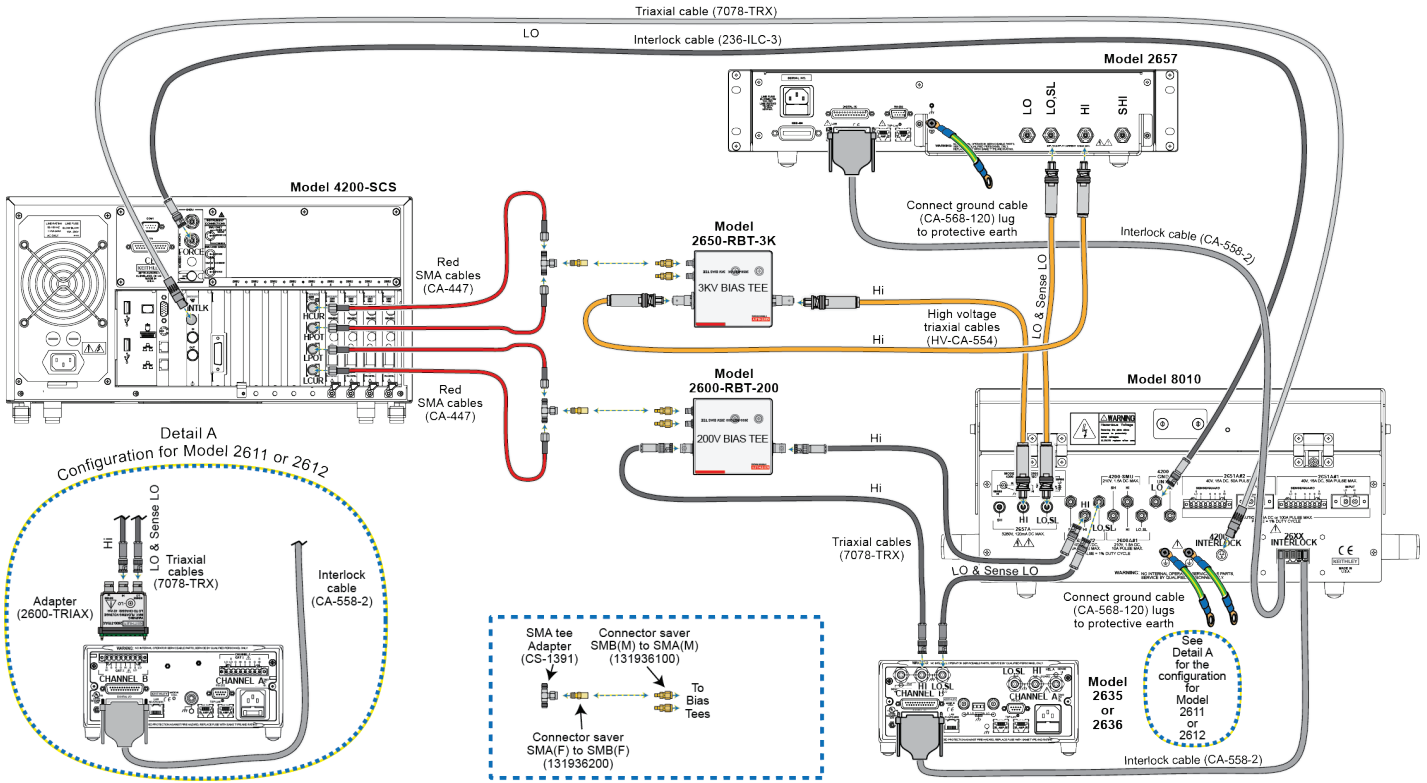
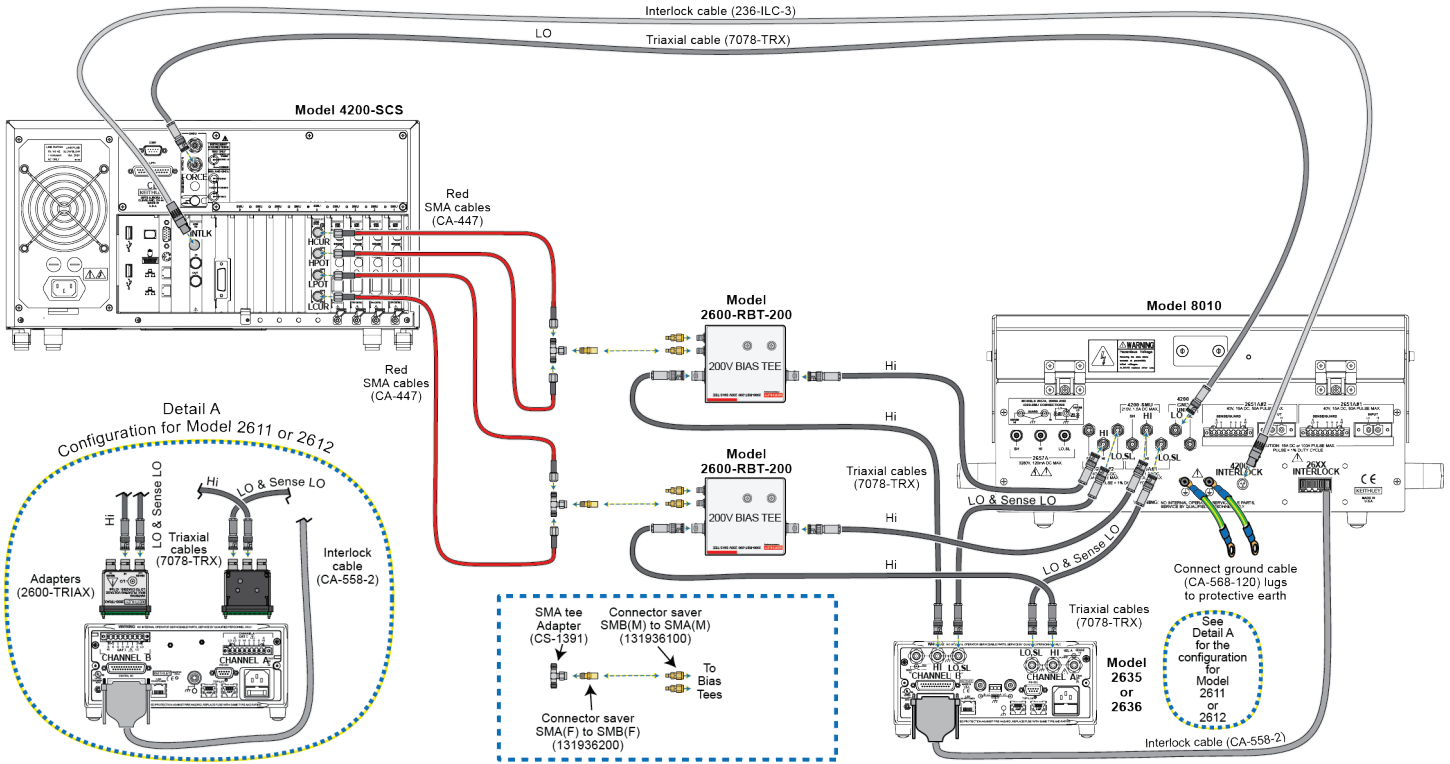
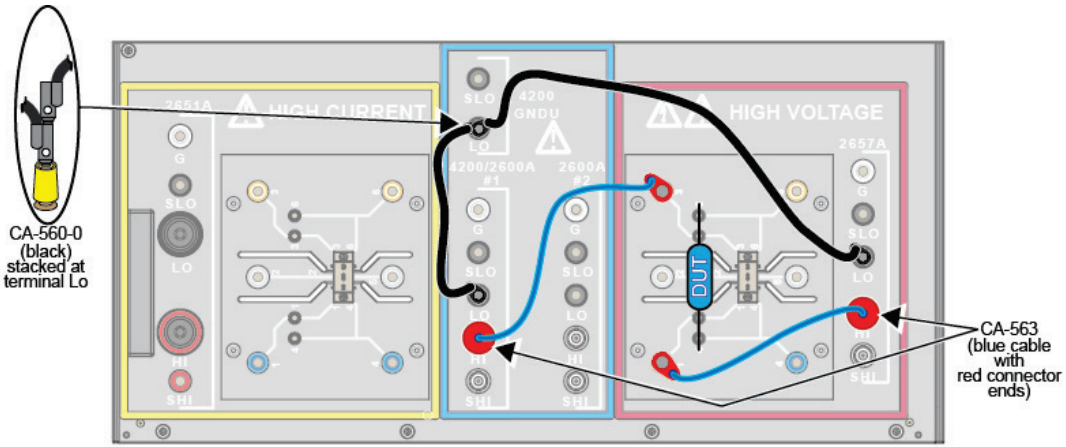
External wiring (capacitance-voltage) with CVU-3K-KIT 2-terminal connection



External wiring (capacitance-voltage) with CVU-200-KIT 2-terminal connection

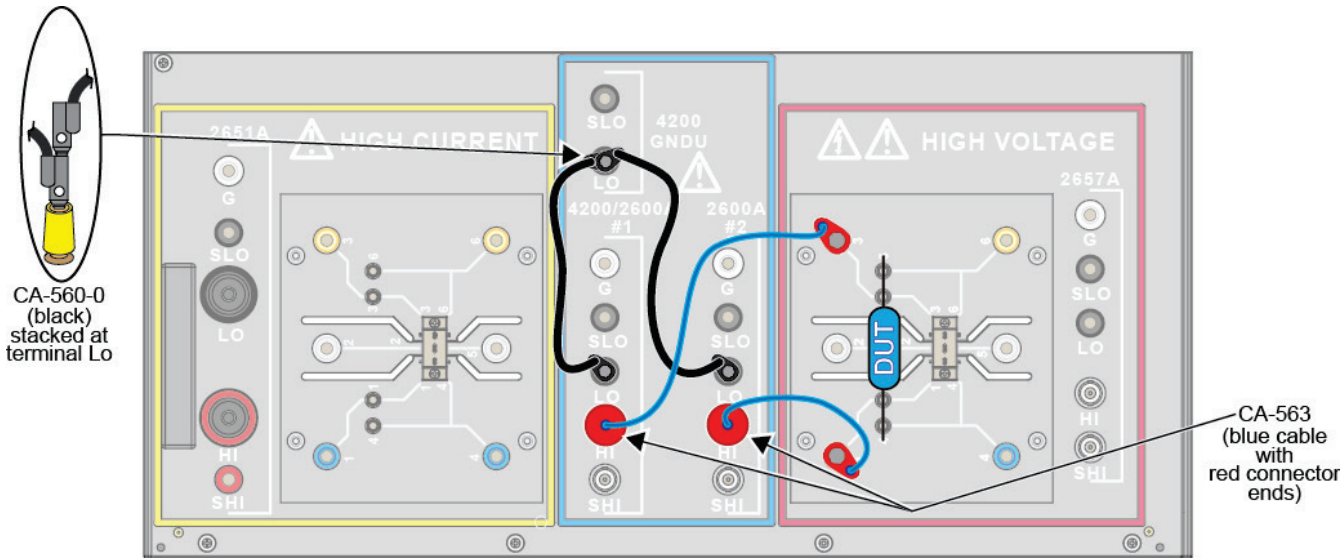


CVU-3K-KIT 2-terminal DUT (local sense)



Note that this configuration can be used for testing 2-terminal TO-247 devices, too. When testing 2-terminal TO-247 devices make sure to remove the plug from the socket, if inserted; make sure the four axial device terminal posts are disconnected; place the 2-terminal TO-247 device into the 3-pin socket.

CVU-200-KIT 2-terminal DUT (local sense)



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