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**Multi-Measurement Prober Cable Kit  
Quick Start Guide**

**Overview**

The Keithley Instruments Model 4210-MMPC-C multi-measurement cable kit (see Figure 1) is a collection of standard and custom connectors and accessories used to take I-V and C-V measurements using a single prober cable setup. It is also used with the Keithley Model 4225-PMU or 4200-PIV-A package to perform pulse I-V measurements. This kit has been assembled for use with the Cascade Microtech 12000 prober series (manipulator type DCM-200 series).

**NOTE** For C-V testing, this Quick Start Guide applies to both the Model 4200-CVU card and the new 1 kHz Model 4210-CVU card. For pulse I-V testing, this guide also applies to the Models 4200-PG2, 4205-PG2, 4220-PGU, and 4225-PMU pulse cards.

**Prober cable kit contents**

Figure 1 shows the cables, adapters, and supplies that are included in the Model 4210-MMPC-C multi-measurement cable kit. Also, note that there is an 8" x 10" bag and two screws in this kit (not shown): 4-40x3/16CUPSTBK.

**Figure 1: Model 4210-MMPC-C multi-measurement prober cable kit**



## Quick Start Guide topics

The guide contains information about the installation and use of this cable kit:

- **Connecting Model 4200** instrumentation to the prober bulkhead: Explains how to make connections from the Model 4200 to the prober bulkhead.
- **Installing the prober cable kits:** Explains how to make connections from the prober bulkhead to the prober pins.
- **Usage scenarios:** Provides the specific prober cable setups:
  - I-V testing (2-wire and 4-wire)
  - C-V testing (2-wire and 4-wire)
  - Pulse I-V measurements using the Keithley Model 4200-PIV-A
  - Pulse I-V measurements using the Keithley Model 4225-PMU with the 4225-RPM

## Related documents

The following documents (in PDF format) are located on the Model 4200 Complete Reference CD:

- **PA-993:** This is a one-page packing list for the Model 4210-MMPC-S Multi-Measurement Prober Cable Kit for the Suss MicroTec PA200/300 series prober. A photo shows all the components of the cable kit.
- **PA-994:** This is a one-page packing list for the Model 4210-MMPC-C Multi-Measurement Prober Cable Kit for the Cascade MicroTech 12000 series prober. A photo shows all the components of the cable kit.
- **Section 16** of the 4200-SCS Reference Manual – The Reference Manual PDF can be found on the main 4200-SCS Complete Reference. Open the Complete Reference web page by double-clicking the Complete Reference icon in the upper-left corner of the 4200 desktop.
- **White Paper** – Labs' Demands for Greater Measurement Flexibility Require Cabling Systems Capable of Accommodating Multiple Measurement Types: This white paper explains the different cabling requirements for I-V, C-V, and pulse I-V testing. It also describes an easy-to-use single multi-measurement cabling system (Model 4210-MMPC-C for the Cascade Microtech 12000 prober).

## Connecting Model 4200 instrumentation to the prober bulkhead

<b>WARNING</b>	<i>To prevent injury or death due to electric shock, remove all power from the Model 4200-SCS and shut down the Cascade prober before installing the prober cable kit.</i>
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The Model 4200 connects to the female triax connectors on the prober bulkhead.

### I-V testing

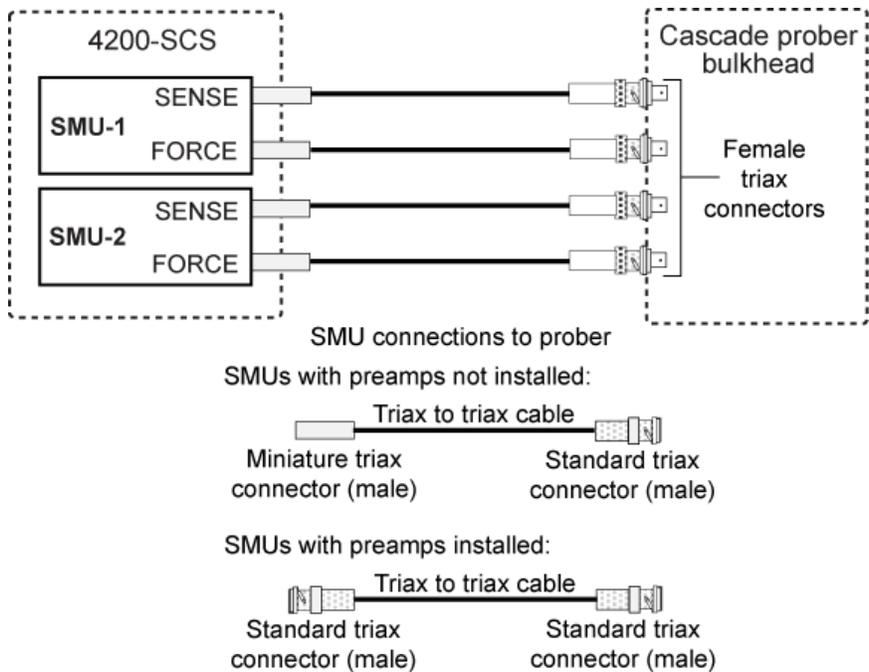
For I-V testing, connect the triax cables of your Model 4200 source-measure units (SMUs) to the standard female triax connectors on the bulkhead of the prober. Figure 2 shows two Model 4200 SMU prober connections.

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**NOTE** Figure 2 shows SMUs that do not use preamps. These SMUs use the supplied triax cables that are terminated with a miniature triax connector on one end and a standard triax connector on the other end. If your SMUs are equipped with preamps, use the supplied cables that are terminated with standard triax connectors on both ends. Figure 2 shows both cables.

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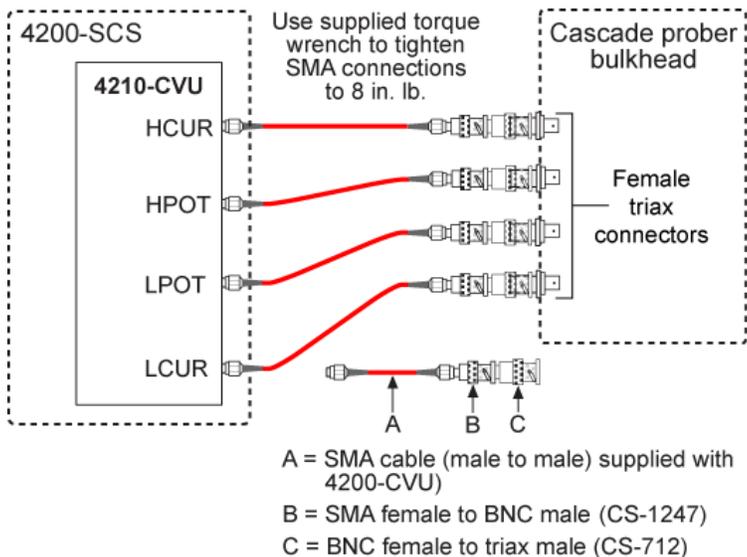
**Figure 2: Model 4200 SMU connections to the prober**



### C-V testing

Two prober cable kits include the cable adapters needed to connect the subminiature version A (SMA) cables of the Model 4210-CVU to the female triax connectors on the bulkhead of the prober. Figure 3 shows how to make the connections. A torque wrench is supplied with the Model 4210-CVU.

**Figure 3: Model 4210-CVU prober connections**



## Pulse I-V testing using the Keithley Model 4200-PIV-A

**NOTE** Four prober cable kits are required for 4-pin, PIV-A pulse I-V testing.

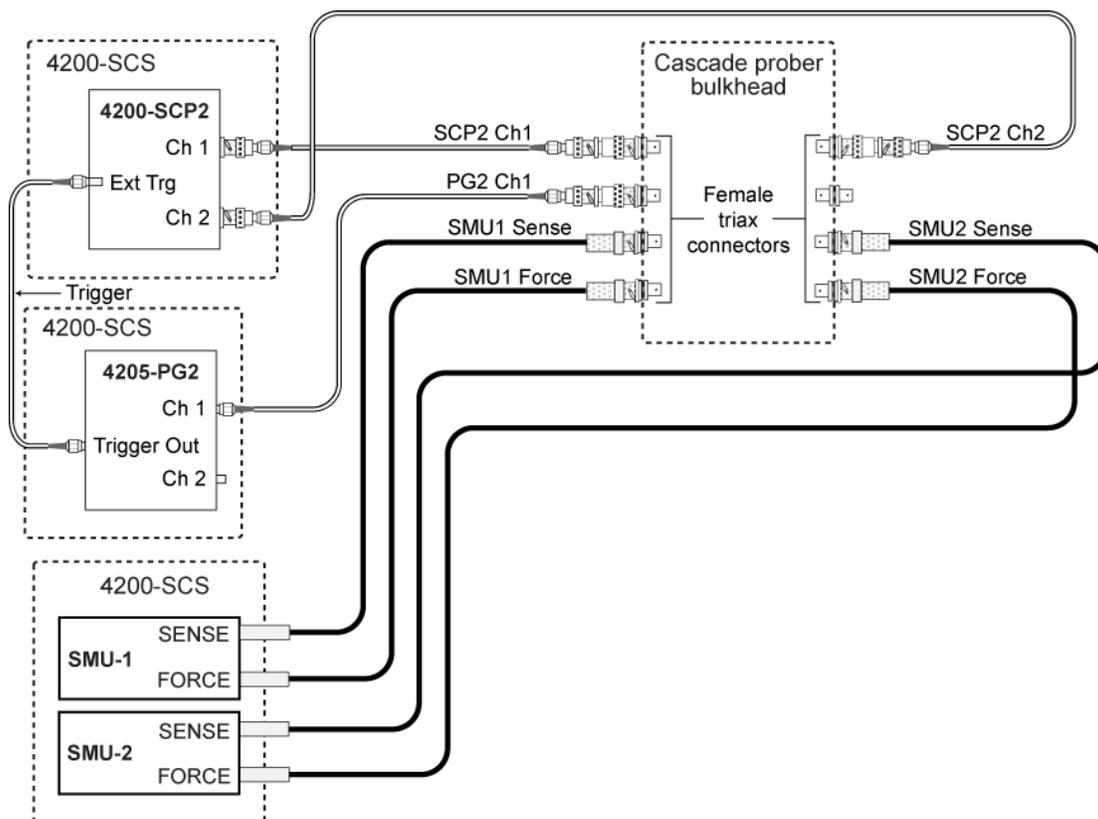
Perform 4-pin pulse I-V measurements using four prober cable kits with the Keithley Instruments Model 4200-PIV-A package, which includes a scope card, pulse generator card, software, and other components.

Use the supplied cables and connectors to connect the Model 4200 to the bulkhead of the prober (see Figures 4 and 5).

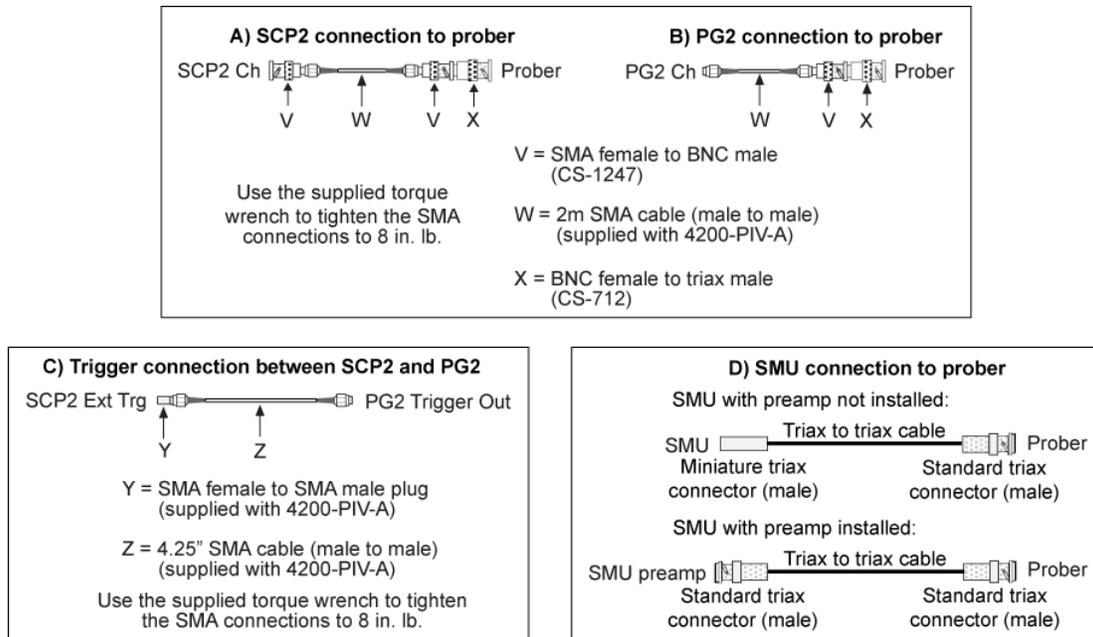
Figure 4 shows the Model 4200 connections to the prober and the trigger connection between the scope card (Model 4200-SCP2) and pulse generator card (Model 4205-PG2). Figure 5 identifies the cables and adapters used to make the connections.

**NOTE** Figure 4 shows source-measure units (SMUs) that are not equipped with preamps. These SMUs use the supplied triax cables that are terminated with a miniature triax connector on one end and a standard triax connector on the other end. If your SMUs are equipped with preamps, use the supplied cables that are terminated with standard triax connectors on both ends. Figure 5D shows both cables.

**Figure 4: Model 4200-PIV-A instrumentation connections**



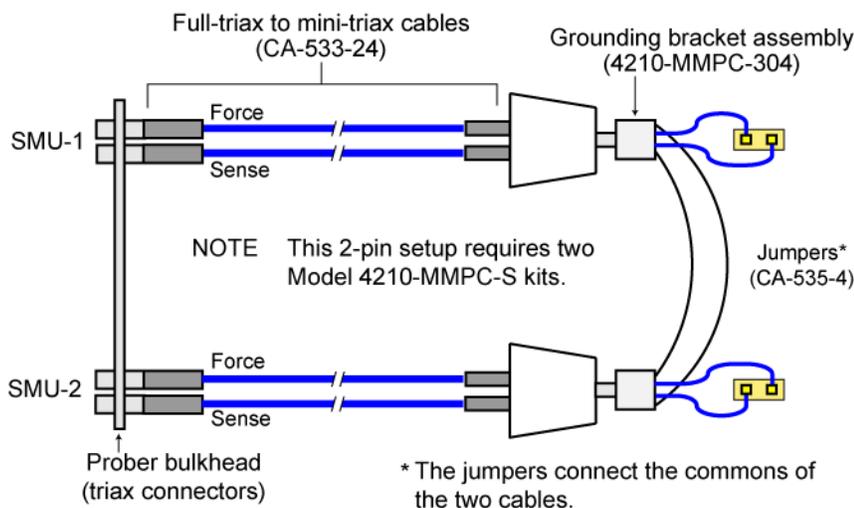
**Figure 5: Cables and adapters used for instrumentation connections**



## Installing the prober cable kits: Basic cable setup

Figure 6 shows the basic cable setup for the 2-pin I-V and C-V testing scenarios described in this guide. The 4-pin I-V and 4-pin C-V testing scenarios require minor setup changes; pulse I-V setup, which is more complex, is described later in this Quick Start Guide.

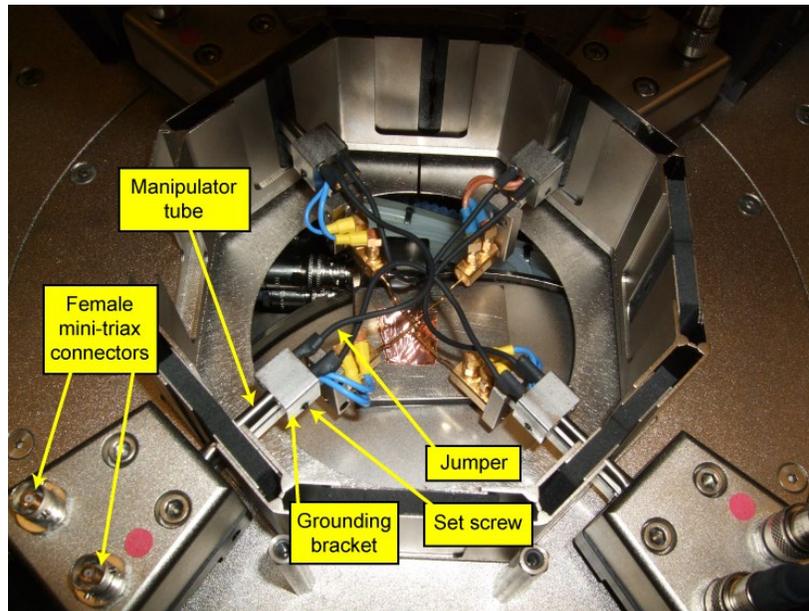
**Figure 6: Basic 2-pin prober cable setup**



## Installation guidelines

Figure 7 shows the prober cable assemblies of four Model 4200-MMPC-C kits installed in a Cascade Microtech 12000 series prober.

**Figure 7: Four prober cable assemblies installed in a Cascade prober**



To install the Cascade prober kit:

1. Referring to Figure 7, mount each grounding bracket onto the tube of a manipulator.
2. Firmly tighten the set screws to secure the brackets to the tubes.
3. Black jumpers are used to connect the commons of the cable assemblies together. The jumpers plug into the grounding brackets. Referring to Figure 7, connect the jumpers from one grounding bracket to another. For the basic 2-pin setup in Figure 6, it is good practice to install the second jumper. It not only improves the connection, but it is a good place to store the extra jumper.

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**NOTE** Figure 7 shows an example of good routing for the jumper wires. When routing the wires, consider the possible movements of the manipulators.

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4. Referring to Figure 6, connect the prober manipulators to the prober bulkhead connectors using the supplied triax cables. Each cable is terminated with a full-triax connector on one end and a mini-triax connector on the other end. Figure 7 shows the mini-triax connectors mounted on the manipulators.

## Usage scenarios

### I-V testing: 2-pin I-V setup

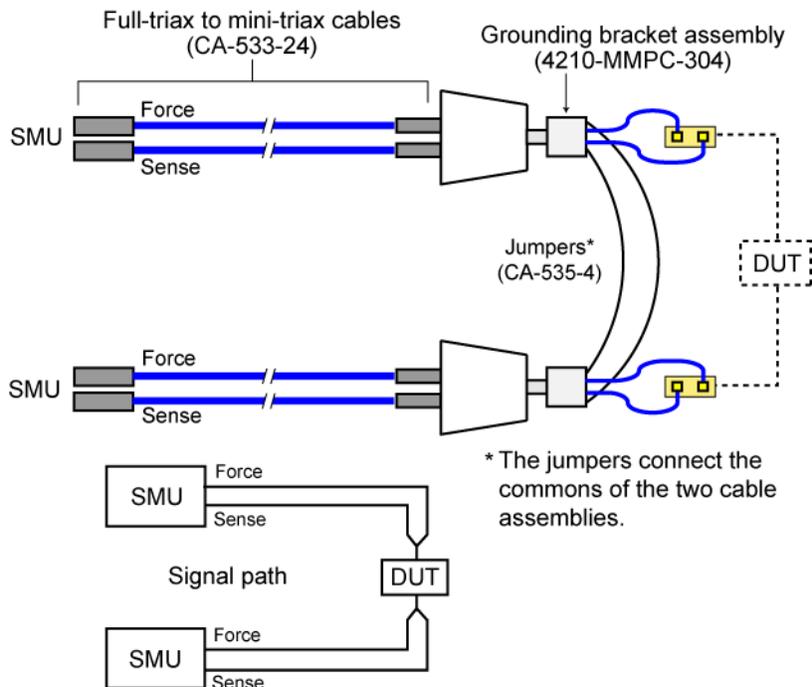
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**NOTE** The setup for 2-pin I-V testing requires two prober cable kits.

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With two Model 4200-SMUs connected to the prober bulkhead, use the fundamental setup shown in Figure 8 to perform 2-pin I-V testing. Figure 2 shows the SMU connections to the outside of the bulkhead.

**Figure 8: Test setup for 2-pin I-V testing**

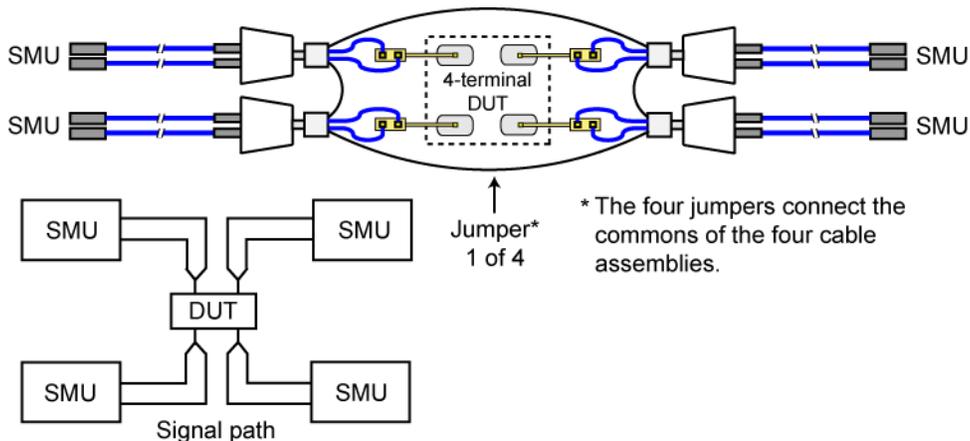


**I-V testing: 4-pin I-V setup**

**NOTE** The setup for 4-pin I-V testing requires four prober cable kits.

With four Model 4200-SMUs connected to the prober bulkhead, use the setup shown in Figure 9 to perform 4-pin I-V testing. Figure 2 shows two SMUs connected to one of the bulkhead connection panels. Connect two additional

**Figure 9: Test setup for 4-pin I-V testing**

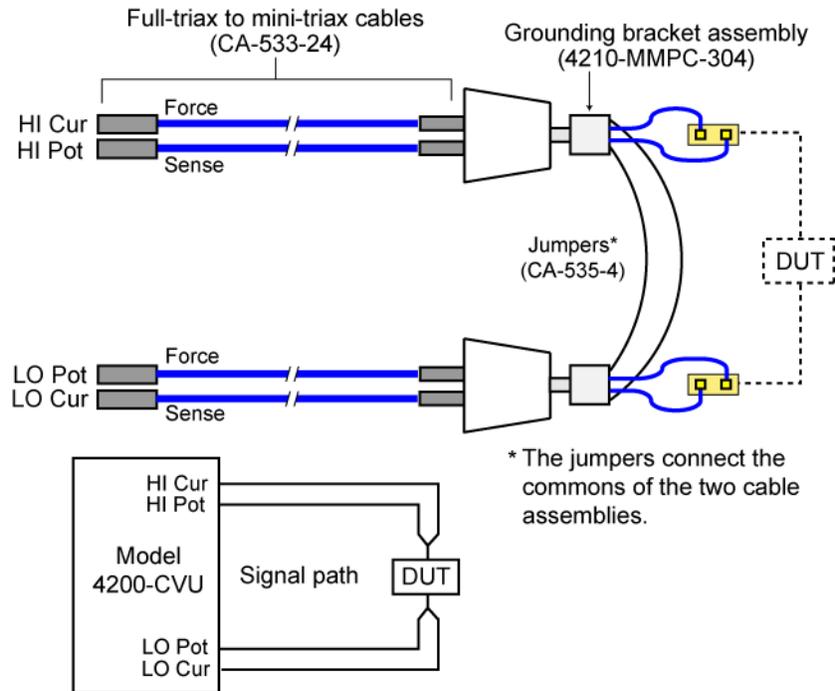


**C-V testing: 2-pin C-V setup**

**NOTE** The setup for 2-pin C-V testing requires two prober cable kits.

With a Model 4210-CVU connected to the prober bulkhead, use the fundamental setup shown in Figure 10 to perform 2-pin C-V testing. Figure 4 shows the CVU connections to the outside of the bulkhead.

**Figure 10: Test setup for 2-pin C-V testing**

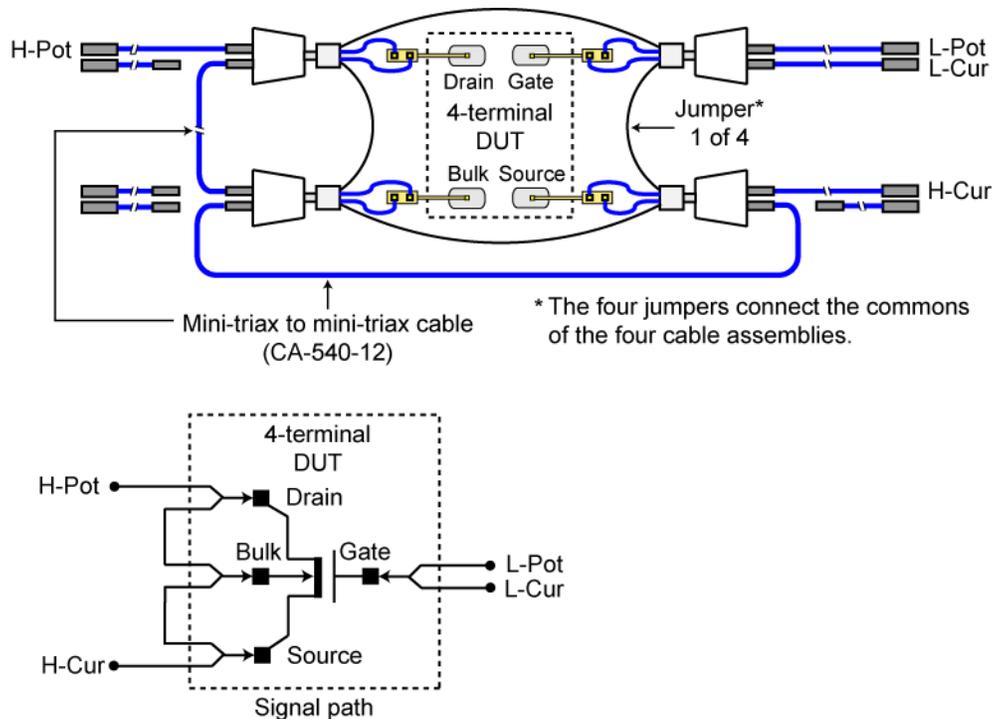


### C-V testing: 4-pin C-V setup

**NOTE** The setup for 4-pin C-V testing requires four prober cable kits.

A typical test for a field effect transistor (FET) is to connect the drain, bulk, and source together and perform the measurement across the gate. With a Model 4200-CVU connected to the prober bulkhead, use the setup shown in Figure 11 to perform 4-pin C-V testing.

**Figure 11: Test setup for 4-pin C-V testing**



## Four-pin pulse I-V test setup using the Keithley Model 4200-PIV-A

**NOTE** The setup for 4-pin pulse I-V testing requires four prober cable kits.

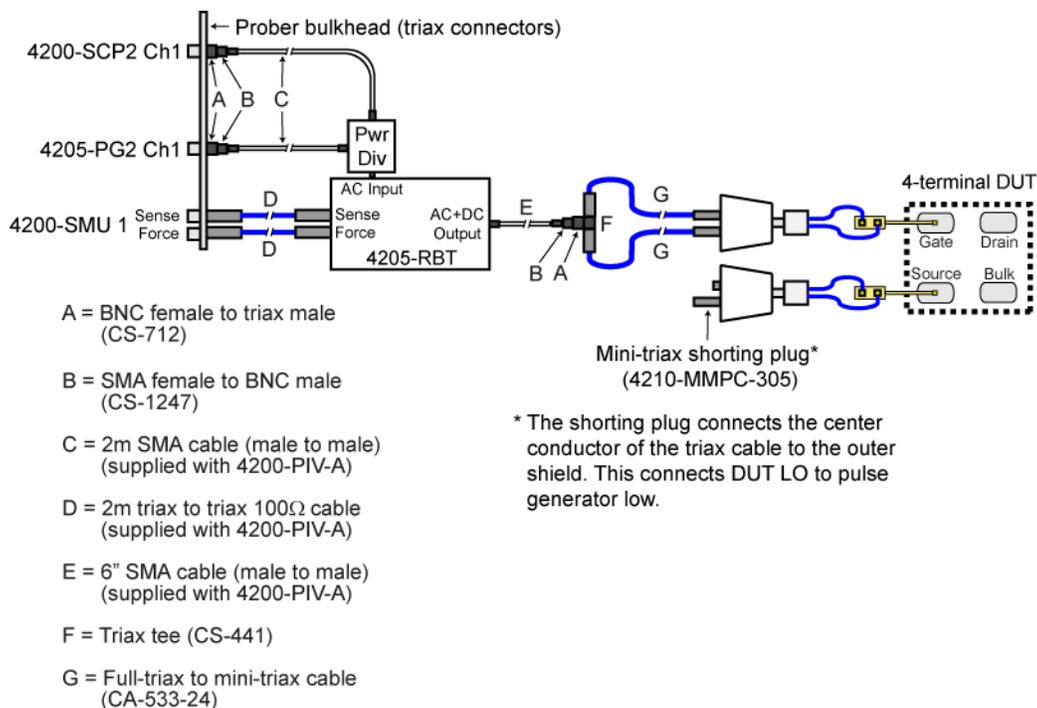
The Model 4200-PIV-A is a factory-installed package that includes a scope card, pulse generator card, software and other components to perform 4-pin pulse I-V measurements.

The test setup for using the Model 4200-PIV-A is shown in Figures 12, 13, and 14. Figure 12 shows the connections from the prober bulkhead to the gate and source of the 4-terminal device. Figure 13 shows the connections from the bulkhead to the drain and bulk. Figure 14 shows the jumper connections. The four jumpers connect the commons of the cable assemblies together. These four jumper connections are required to complete the test circuit signal path.

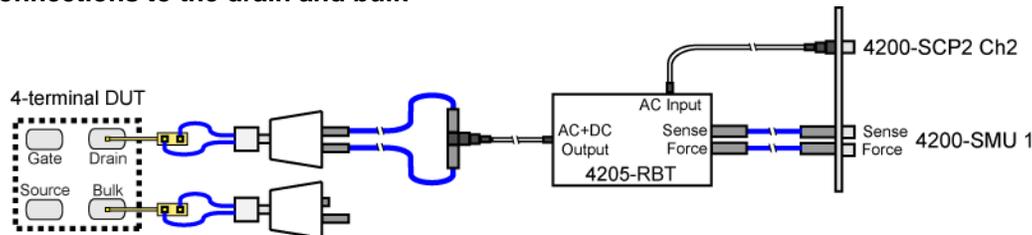
Figure 4 shows how the Model 4200 connects to the outside of the bulkhead.

**NOTE** Details on using the Model 4200-PIV-A package are provided in the Model 4200-SCS User's Manual (see *How to use the Model 4200-SCS to perform a pulse I-V test on my device* in Section 3). Figure 3-25 shows the block diagram of the test setup.

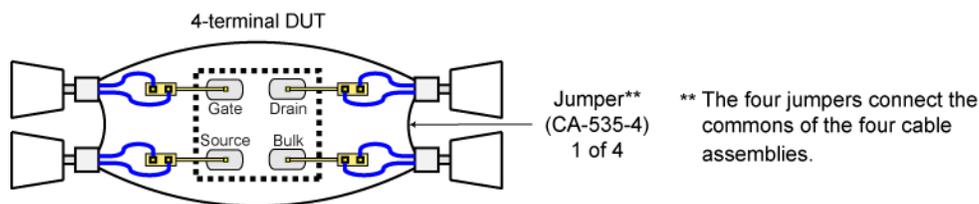
**Figure 12: Connections to the gate and source of the DUT**



**Figure 13: Connections to the drain and bulk**



**Figure 14: Jumper connections**



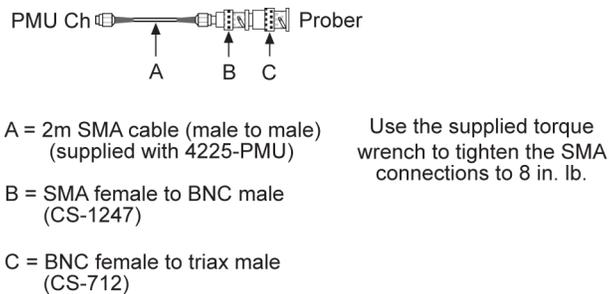
## Setup using the Keithley Model 4225-PMU for pulse I-V measurements

**NOTE** The setup for four-pin pulse I-V testing requires four prober cable kits.

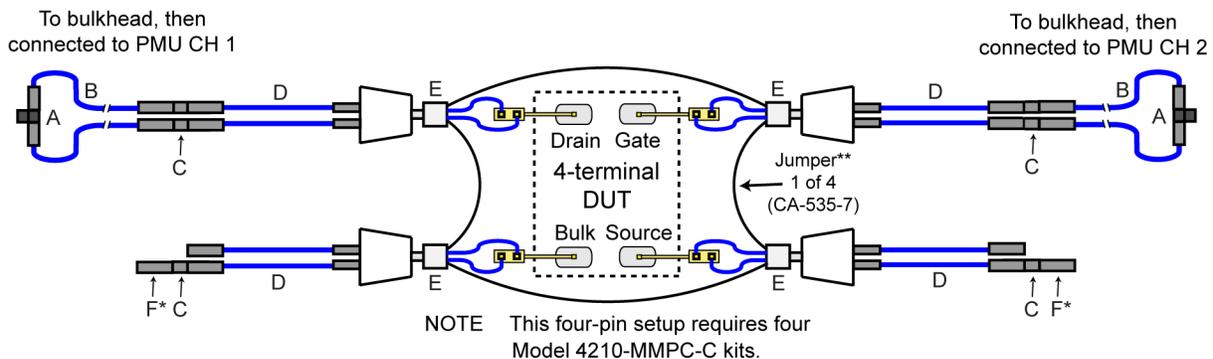
The Model 4225-PMU is an Ultra Fast I-V Module that is an instrument card for the Model 4200-SCS. The PMU has two channels of voltage pulse source with integrated simultaneous voltage and current measurement.

Figure 15 shows the cable and adapters needed to connect a PMU channel to the prober bulkhead and Figure 16 shows a typical prober connection setup for testing a four-pin device. .

**Figure 15: Cable and adapters used to connect PMU channel to probe bulkhead**



**Figure 16: Basic four-pin probe setup for PMU**



- A = Triax tee (CS-737)
  - B = 24" triax to triax 100 Ω cable (CA-534-24)
  - C = Triax female to triax female adapter (CS-751)
  - D = Full-triax to mini-triax cable (4210-MMPC-304)
  - E = Grounding bracket assembly (4210-MMPC-304)
  - F = Triax shoring plug\* (CS-1546)
- \* The triax shoring plug (F) connects the center conductor of the triax cable to the outer shield. This connects DUT LO to pulse generator low.
  - \*\* The four jumpers connect the commons of the four cable assemblies.

## Setup using the Keithley Model 4225-RPM for I-V, C-V, or pulse I-V measurements

**NOTE** The setup for three-pin pulse I-V testing requires three prober cable kits. The setups for four-pin testing require four prober cable kits.

The 4225-RPM is a Remote Amplifier/Switch that is an optional item to the Model 4225-PMU. The PMU has two channels, so each PMU instrument card supports two (2) RPMs. The MMPC cables simplify the connection and re-connection between the instruments and the device-under-test. The combination of the MMPC cables with the RPM permits testing I-V, C-V, or pulse I-V automatically, without any manual cable re-connections. When using only two RPMs on a four-terminal device, some re-cabling is required for certain C-V test configurations.

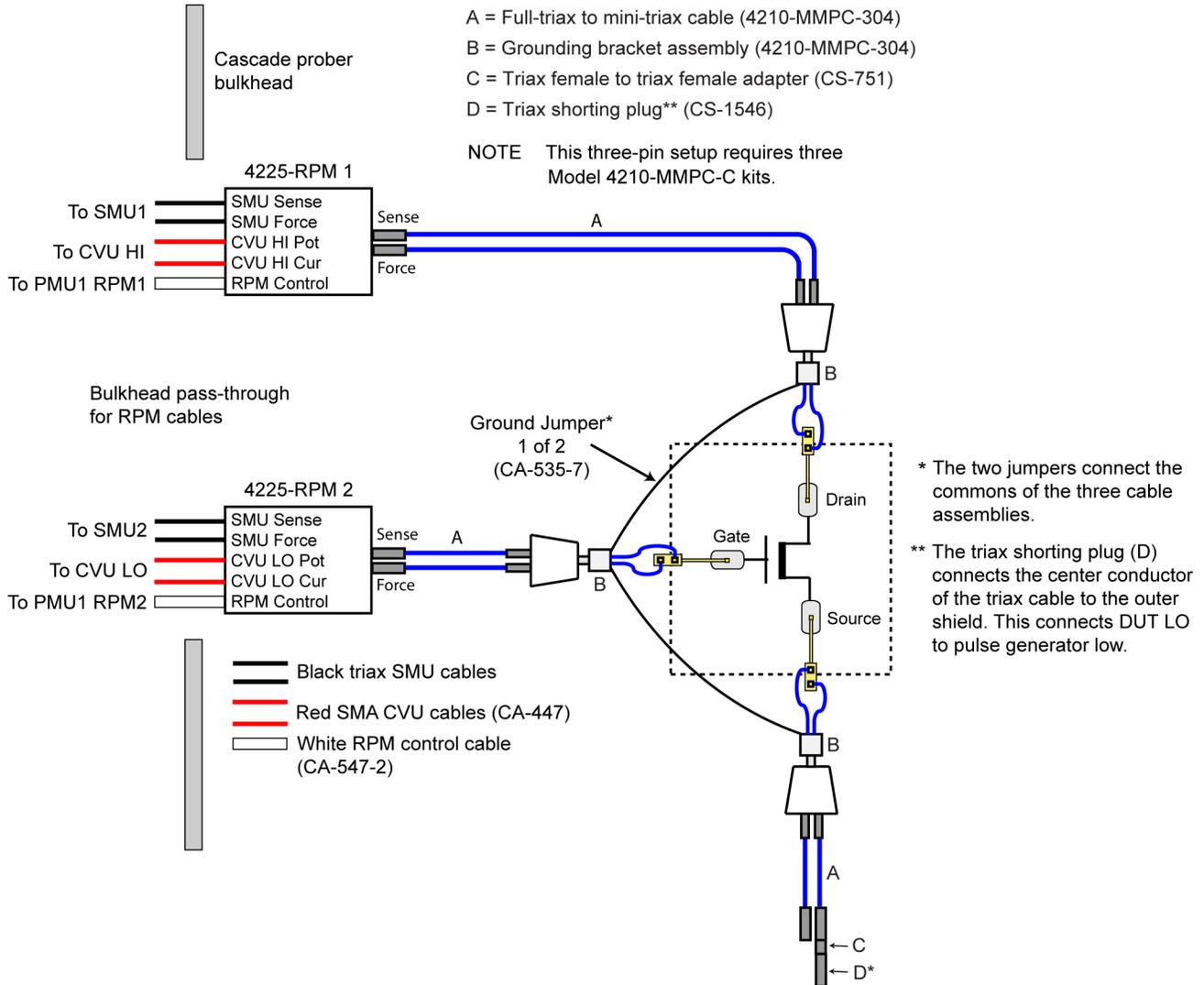
The 4225-RPM has the appropriate connector types at the input and output of the RPM enclosure to eliminate any adapters when connecting cables to the RPM. On the input side, there are two triax connectors for SMU Force and SMU Sense. There are two SMA connectors for CVU POT and CVU CUR. There is also an RPM control connector for the control and power of the RPM from the 4225-PMU. The output of the RPM is a pair of triax cables (Force and Sense), which connect directly to the MMPC cables as shown in the figures below.

See Section 16 of the 4200 Reference Manual for 4225-PMU and 4225-RPM information and how to configure an ITM for a pulse IV test.

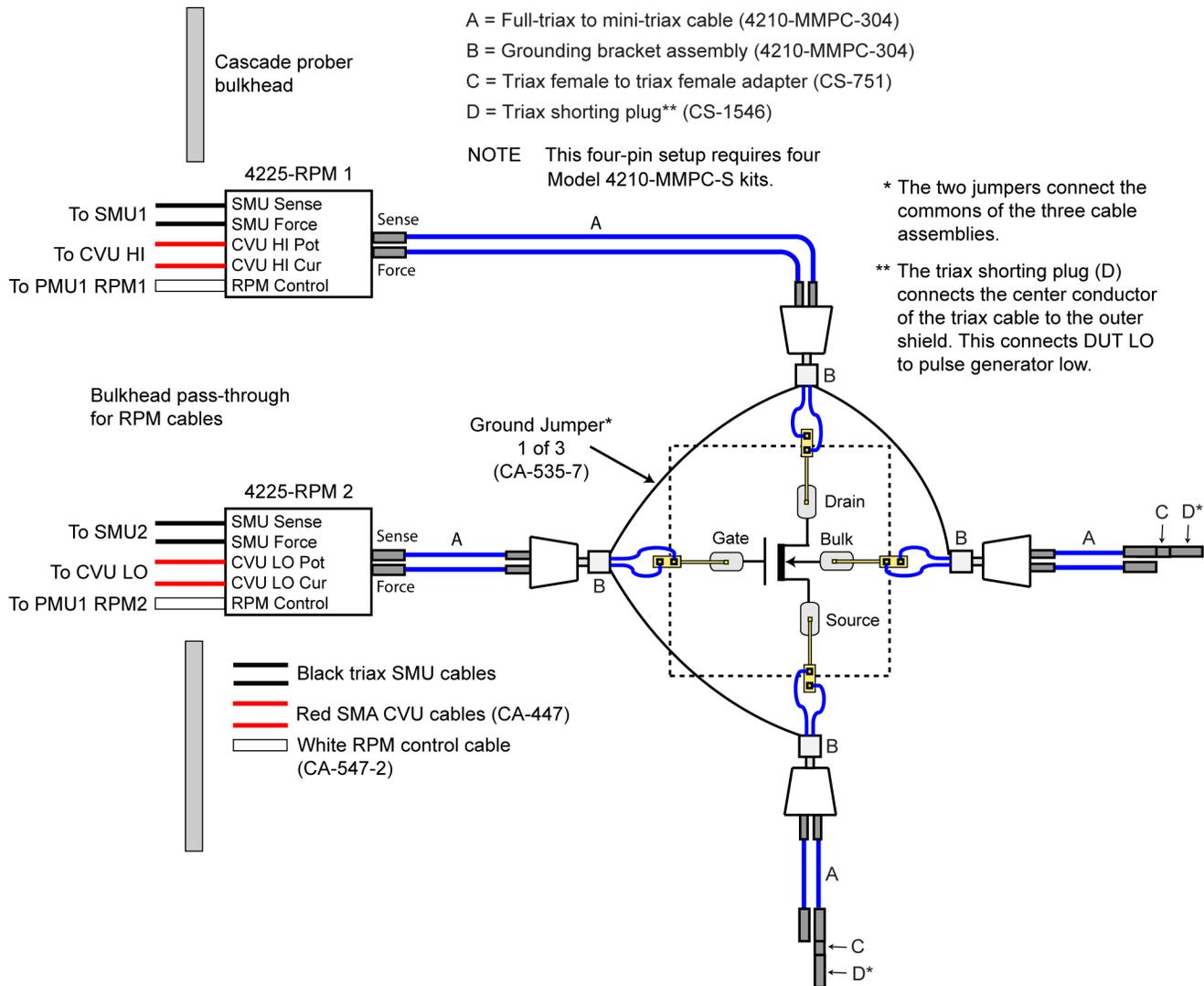
## 2 Channel I-V or Pulse I-V Setup

For most I-V and pulse I-V testing, only two source/measure channels are typically used. The two active signals are connected to the gate and drain, and the source (and bulk, if present) is connected to ground (see Figures 17 and 18). For the C-V test setup shown in Figure 19, all four source/measure channels are used.

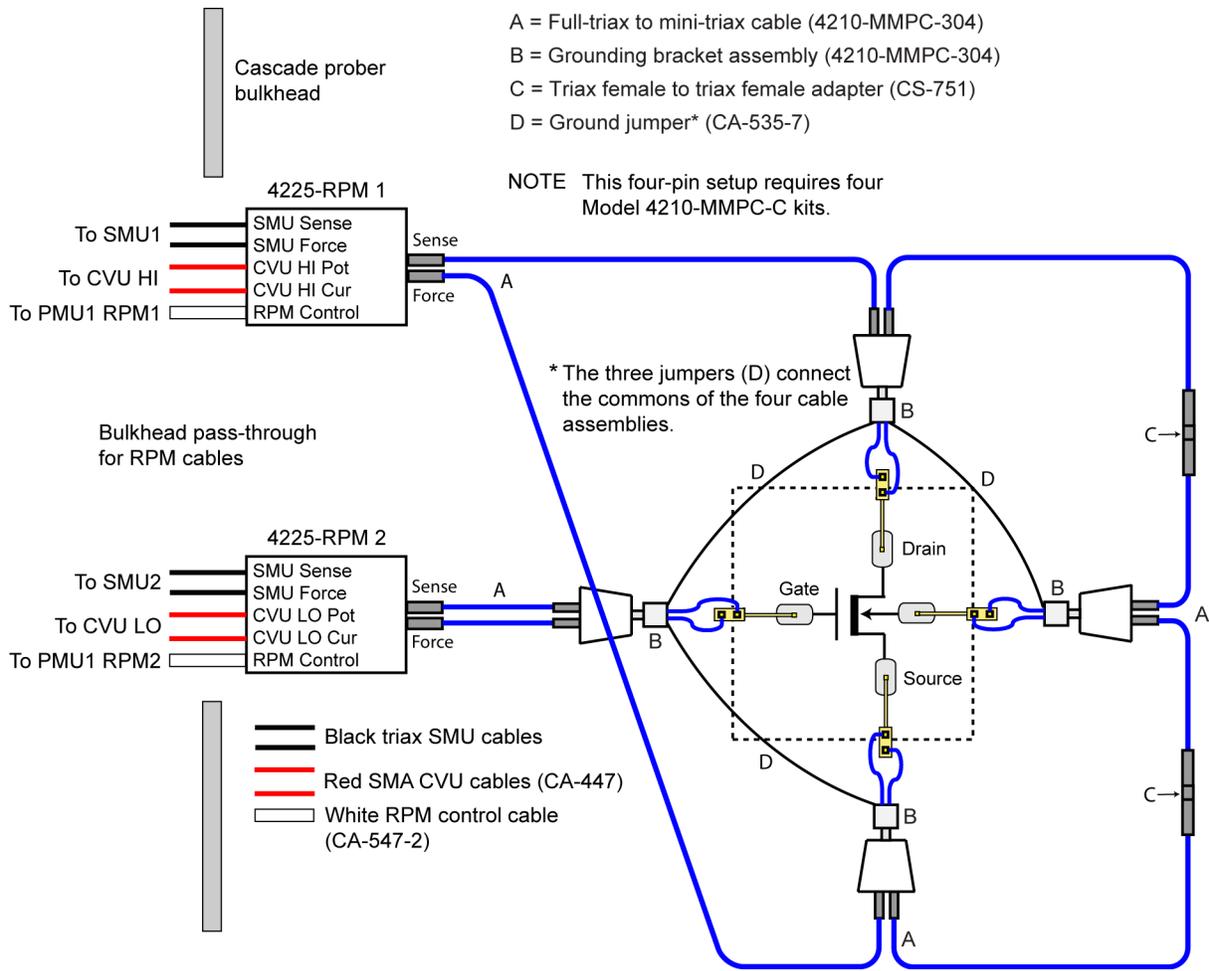
**Figure 17: Test setup for three-pin device using two-channel I-V and Pulse I-V**



**Figure 18: Test setup for four-pin device using two-channel I-V and Pulse I-V**



**Figure 19: Test setup for four-terminal C-V testing**



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 measurement, control, and data I/O connections, with low transient overvoltages, and must not be directly connected to mains voltage or to voltage sources with high transient overvoltages. Measurement Category II (as referenced in IEC 60664) connections require protection for high transient overvoltages often associated with local AC mains connections. Certain Keithley Instruments measuring instruments may be connected to mains. These instruments will be marked as category II or higher.

Unless explicitly allowed in the specifications, operating manual, and instrument labels, do not connect any instrument to mains.

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.

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.

For safety, instruments and accessories must be used in accordance with the operating instructions. If the instruments or accessories are used in a manner not specified in the operating instructions, the protection provided by the equipment may be impaired.

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

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

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. The detachable mains power cord provided with the instrument may only be replaced with a similarly rated power cord. 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.

Unless otherwise noted in product-specific literature, Keithley Instruments instruments are designed to operate indoors only, in the following environment: Altitude at or below 2,000 m (6,562 ft); temperature 0 °C to 50 °C (32 °F to 122 °F); and pollution degree 1 or 2.

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.

Safety precaution revision as of March 2016.