

Safely Using the Interlock on the Keithley Model 4200-SCS

WARNING Use the safety interlock circuit to avoid personal injury or death caused by hazardous voltages.

Safety interlock connections

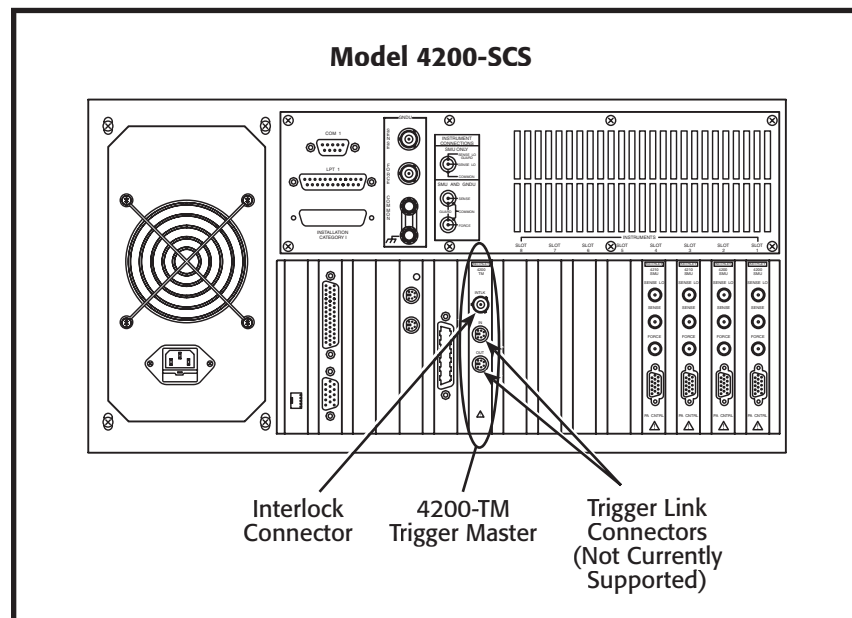
The safety interlock feature on the Model 4200-SCS should be used to avoid possible shock hazards. It provides a means by which the outputs of the Model 42XX-SMUs can be automatically placed in a safe state, regardless of the state of the Model 4200-SCS operating software. When the safety interlock signal is asserted (connected to +12V), all of the voltage ranges of the SMUs will be functional. However, when the safety interlock signal is not asserted, the 200V range on the SMUs will be disabled, limiting the nominal output to $\pm 20V$. Under these conditions, all SMU and PreAmp signal terminals will be non-hazardous. Component test fixtures and probe station dark boxes typically have a safety switch that can be interfaced to the Model 4200-SCS safety circuit as outlined in the following paragraphs.

Interlock connector

Figure 1 shows the location of the safety interlock connector.

NOTE The 4200-TM IN and OUT terminals shown in Figure 1 are not currently supported. Connecting cables to these terminals can cause unexpected system operation.

Figure 1 Interlock connector location



Model 4200-SCS Rear Panel

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Interlock cables

Use the supplied interlock cable (236-ILC-3) or an equivalent one to make interlock connections whenever possible.

Test fixtures

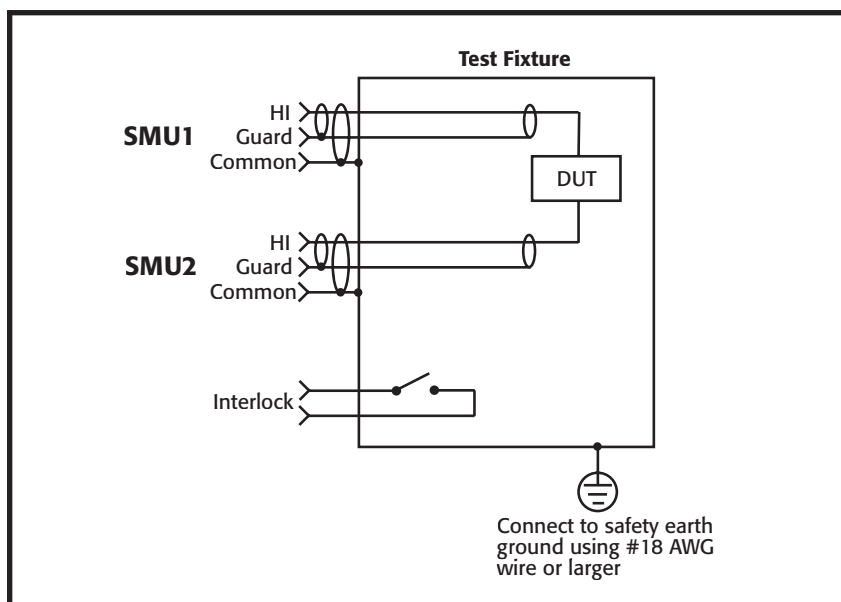
There are two types of test fixtures for the Model 4200-SCS: low voltage (less than $\pm 20V$) and high voltage (greater than $\pm 20V$). High voltage fixtures require extra precautions to ensure there are no shock hazards. Whenever the interlock of the Model 4200-SCS is asserted, the FORCE and GUARD terminals of the SMUs and PreAmps should be considered hazardous voltages, even if they are programmed to a non-hazardous voltage and/or current.

Testing with less than $\pm 20V$

For testing discrete devices, a test fixture equipped with three-lug triax connectors is necessary to allow the Model 4200-SCS to be connected to the discrete device. **Figure 2** shows a basic test fixture to test a two-terminal device. The test fixture's exterior enclosure should be constructed of metal and the metal should be connected to COMMON. The DUT should be mounted on test terminals that are insulated using a high resistivity material, such as Teflon[®]. Guarding will improve the quality of the measurement by reducing leakage and parasitic capacitance. Keithley's *Low Level Measurements Handbook* provides an in-depth discussion on guarding and other techniques that are useful for building quality test fixtures. Contact a Keithley sales or service office to obtain a copy.

NOTE The Model 4200-SCS will function on all current ranges and up to $\pm 20V$ without the interlock being asserted. The maximum voltage on the SMU and PreAmp terminals is not hazardous when the interlock is not asserted.

Figure 2 Typical Test Fixture Connections



Testing with more than ±20V

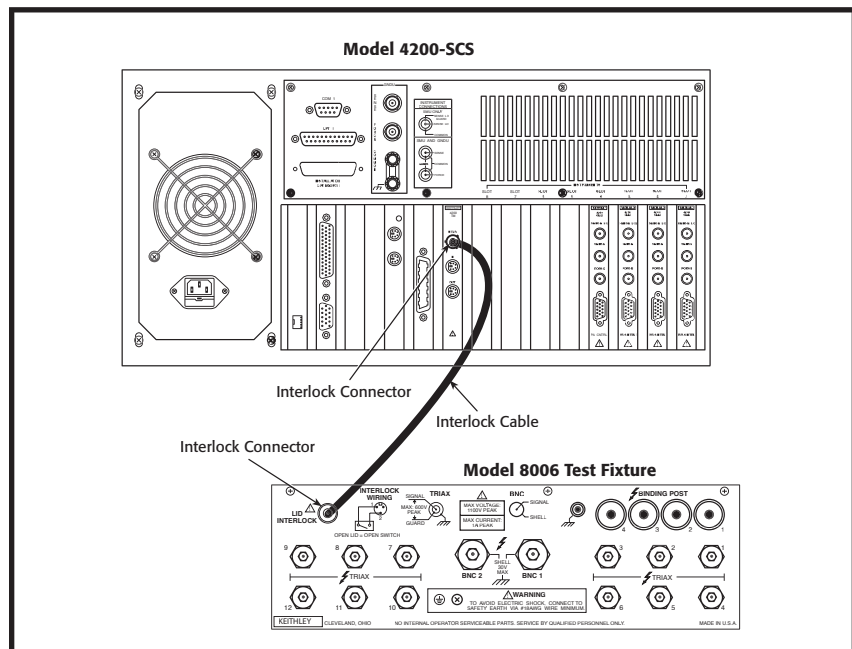
If voltages greater than ±20V are needed for testing, follow the steps outlined in the “Testing with less than 20V” section, as well as those discussed in this section. An interlock switch must be added to the fixture to ensure hazardous voltages are not present when the fixture’s exterior enclosure is open and to enable the Model 4200-SCS to output higher voltages when the fixture’s exterior enclosure is closed. In addition, the exterior enclosure must be connected to COMMON and/or safety ground using #18 AWG wire or greater. Care must be taken to ensure the wiring (FORCE, GUARD, and SENSE) within the fixture does not electrically contact the exterior enclosure. For more details on the Model 4200-SCS interlock system, see the Reference Manual section on “Control and data connections,” page 4-23.

WARNING Asserting the interlock will allow the SMU and PreAmp terminals to source hazardous level voltages. SMU and PreAmp terminals should be considered hazardous even if the outputs are programmed to be low voltage. Precautions must be taken to prevent a shock hazard by surrounding the test device and any unprotected leads (wiring) with double insulation for 250V, Category I. See EN61010-1 safety standards for details.

Typical interlock connections

Figure 3 shows typical interlock connections. In this example, the Model 4200-SCS is connected to a component test fixture with a safety interlock switch connected to its lid. When the lid is closed, the interlock circuit is closed (asserted), and SMU ±200V ranges are enabled. Conversely, the interlock circuit is open (de-asserted) when the lid is open, and the SMU ±200V ranges are disabled. A safety interlock cable is supplied with the 4200-SCS, allowing it to interface directly with the interlock circuits of Keithley Model 8006 and Model 8007 test fixtures.

Figure 3 Typical interlock connections



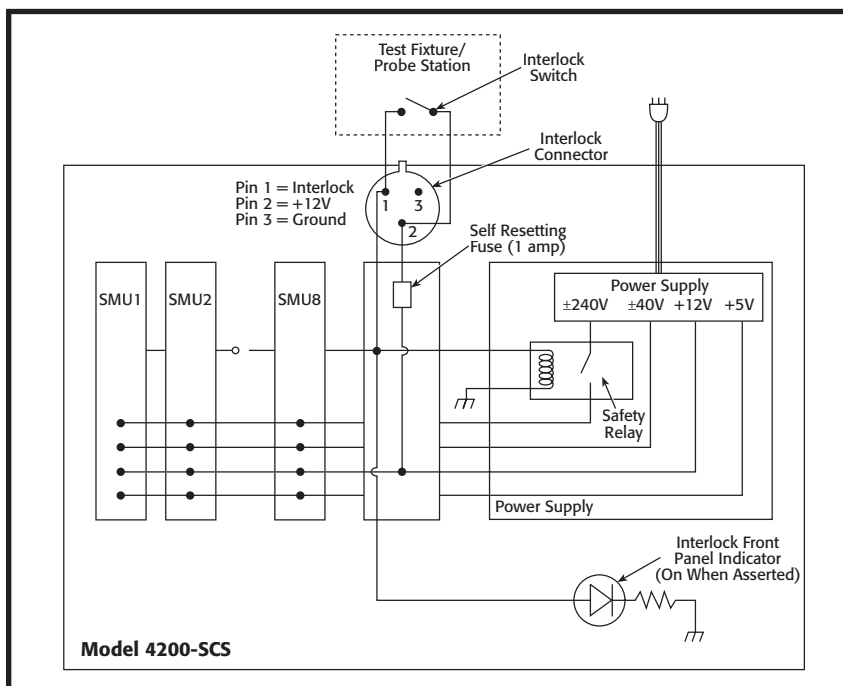
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Interlock connector wiring

Figure 4 shows typical interlock connector wiring. Note that a normally open switch should be used. An open interlock condition occurs when the switch is open.

WARNING Be sure the interlock switch is operating correctly to ensure proper, safe interlock operation. As shown in **Figure 4**, an indicator is provided on the 4200's front panel to verify correct operation.

Figure 4 Interlock connector wiring



NOTE Older versions of the Model 4200-SCS Reference Manual may indicate Pin 3 = NC. Please be aware that Pin 3 is actually connected to Ground. Inadvertently shorting Pin 1 or Pin 3 to Ground may result in damage to the interlock circuit.

Making custom connections to the interlock

From **Figure 4**, notice that:

- Pin 1 = Interlock
- Pin 2 = +12V
- Pin 3 = Ground

CAUTION Avoid making electrical contact between Pin 3 and the other two pins. Connecting either Pin 1 or Pin 2 to Ground (Pin 3) will result in damage to the interlock circuit. A self-resetting fuse is provided in the interlock power supply to protect the circuit from damage if it is shorted to ground. If the current limit from the interlock circuit is exceeded, the fuse will open and may not reset for several minutes. If the fuse does not reset and the interlock no longer operates, immediately contact a Keithley representative for repairs.

WARNING **Do not create a permanent link between Pins 1 and 2 to effectively disable the interlock feature of the Model 4200-SCS.**

When making any connections to the interlock connector, take care not to make electrical contact between either Pin 1 or Pin 2 and Pin 3. If you accidentally connect Pin 2 to Pin 3, you are connecting 12V directly to Ground, which may damage the interlock circuit.

WARNING **When making modifications to the interlock connector or cabling, ensure that the 4200-SCS is powered off and all cables are removed from the rear panel. Accidentally shorting the interlock pins while making the modifications may result in damage to the interlock circuit.**

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