Protection Module User's Guide

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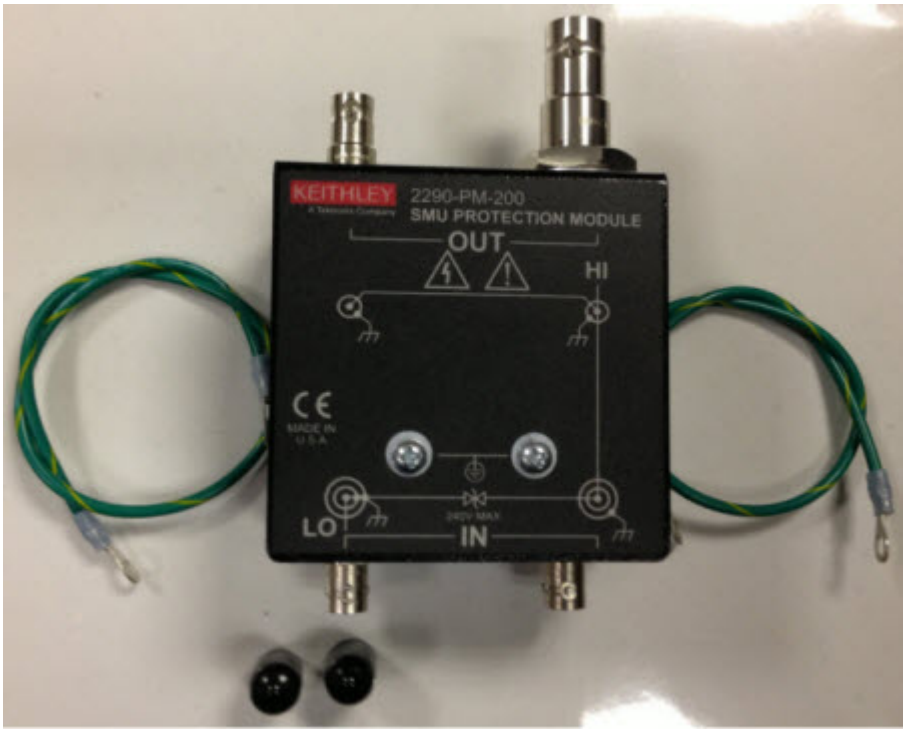
Model 2290-PM-200

Description

The Model 2290-PM-200 protection module (PM) is a stand-alone module that protects certain lower-voltage source-measure units (SMUs) that are part of a testing configuration from damage by voltage sources that are greater than 220 V.

Figure 1: Model 2290-PM-200



The protection module is designed for use with the following lower-voltage SMUs:

- Model 2611B Single-Channel System SourceMeter® Instrument
- Model 2612B Dual-Channel System SourceMeter Instrument
- Model 2635B Single-Channel System SourceMeter Instrument
- Model 2636B Dual-Channel System SourceMeter Instrument
- Model 4200-SCS Semiconductor Characterization System SMUs:
  a. Model 4200-SMU Medium Power Source-Measure Unit (with or without the Model 4200-PA Remote PreAmp Option)
  b. Model 4210-SMU High Power Source-Measure Unit (with or without the Model 4200-PA Remote PreAmp Option)

The protection module is intended for use in applications where a device breakdown, or other potential failure, could connect the high voltage output of the Model 2290-5 or Model 2290-10 high voltage power supply Instrument to a lower voltage SMU.

⚠ CAUTION

The Model 2290-PM-200 does not protect the Model 2601B Single-Channel System SourceMeter Instrument or the Model 2602B Dual-Channel System SourceMeter Instrument. Do not use the protection module with these source-measure instruments

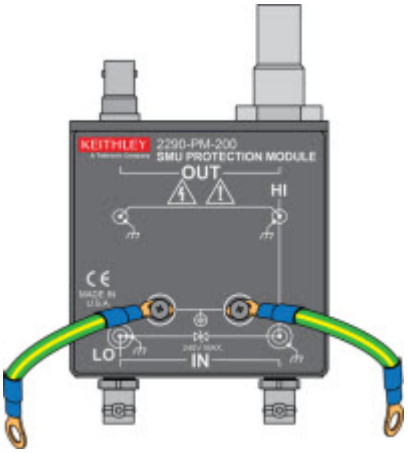
⚠ CAUTION

To prevent damage to the Model 2290-PM-200, in the case of device failure, the current from all power sources, including SoureMeter instruments and power supplies, should be limited to 1.5 A or less.

⚠ WARNING

The Model 2290-PM-200 protection module must be connected to protective earths (safety grounds) using the supplied green-yellow ground cables (Model CA-568). Connection of ground cables to protective earths is necessary for safety.

Figure 2: Model 2290-PM-200 grounding



The standard triaxial IN connectors are used to connect the SMU. Maximum clamped voltage on the IN connectors is 240 VDC.

- The center conductor of the LO connector inner shield is connected to LO. The outer shield (shell) is chassis ground.
- The center conductor of the HI connector is HI and the inner shield is guard. The outer shield (shell) is chassis ground.

There are two high voltage coaxial connectors used for connection to the device under test (DUT).

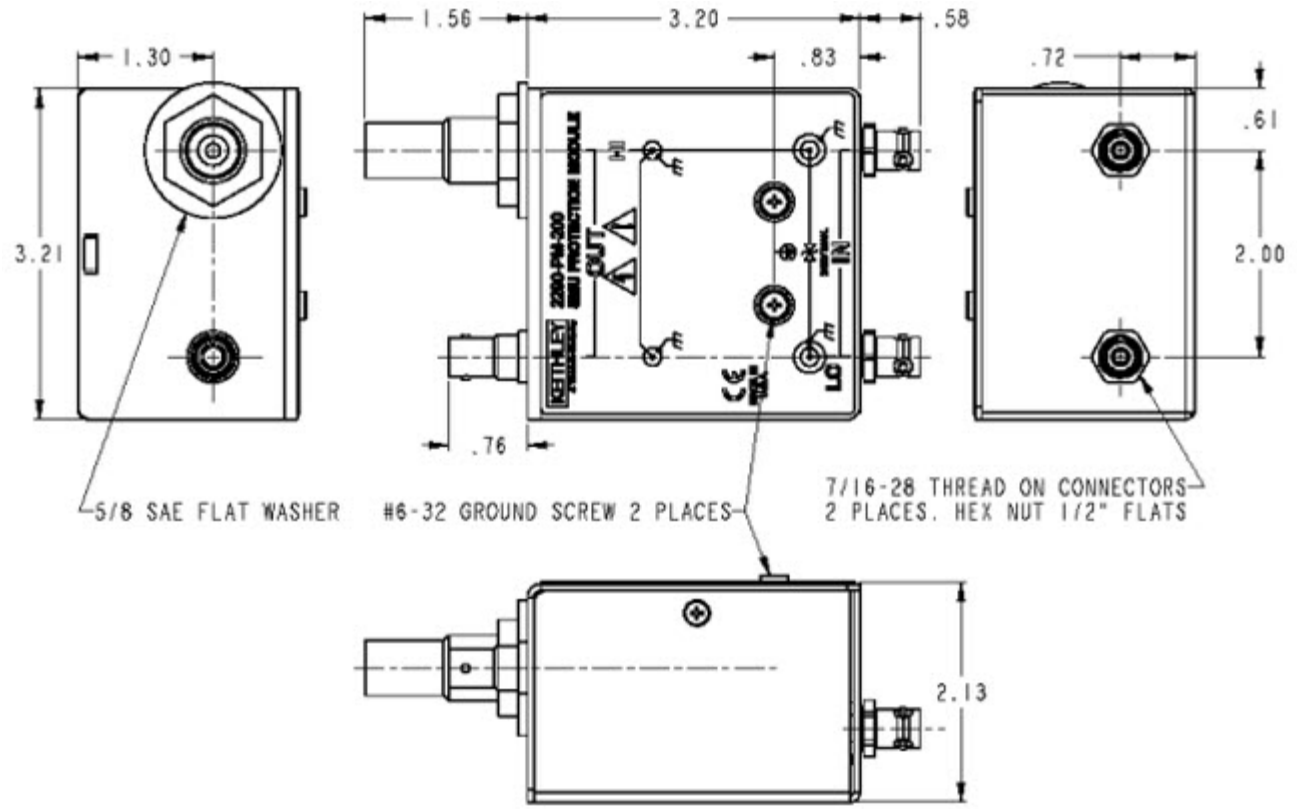
- The smaller OUT connector is intended for use in applications involving the Model 2290-5 high voltage power supply only. This connector is rated to 5000 V.
- The larger OUT connector is intended for use in applications involving the Model 2290-5 high voltage power supply only. This connector is rated to 10000 V.

Electrical characteristics

- Leakage: < 10 pA at 200 V typical
- DC current carrying capability: 1.5 A maximum in unclamped condition
- Pulsed current carrying capability: 10 A maximum at 1% duty cycle in unclamped condition
- Maximum protection active current: you must limit current to <1.5 A in clamped condition (~230 V)
- Protection voltage:
  - Minimum: 220 VDC
  - Typical: 230 VDC
  - Maximum: 240 VDC

Mechanical dimensions

Figure 3: Model 2290-PM-200 dimensions



Connections using a Model 2611B or 2612B SMU

Required accessories:

- One Model 2600-TRIAX adapter per channel
- Two standard triaxial cables (either Model 7078-TRX or 4200-TRX) per source-measure unit (SMU) channel
- One high voltage (HV) coaxial cable
  a. Use Model 2290-5-SHV or 2290-5-MHV if you are using the 2290-5 high voltage power supply
  b. Use Model 2290-10-SHVUC or 2290-10-SHV if you are using the 2290-10 high voltage power supply

Connection summary

Refer to the next figure on how to connect the Model 2611B or 2612B source-measure unit (SMU) channels to the Model 2290-PM-200.

Only 2-wire applications are supported.

NOTE

Connecting the Model 2600-TRIAX to the Model 2290-PM-200 connects the LO terminal of the Model 2611B or 2612B to protective earth (safety ground).

⚠ CAUTION

Do not convert triaxial cables to BNC cables. Using BNC cables may compromise overvoltage protection and can result in damage to the SMU. You must use triaxial cables to connect to the lower-voltage SMU.

Figure 4: Model 2290-PM-200 Connections for Model 261xB using Model 2290-5 power supply

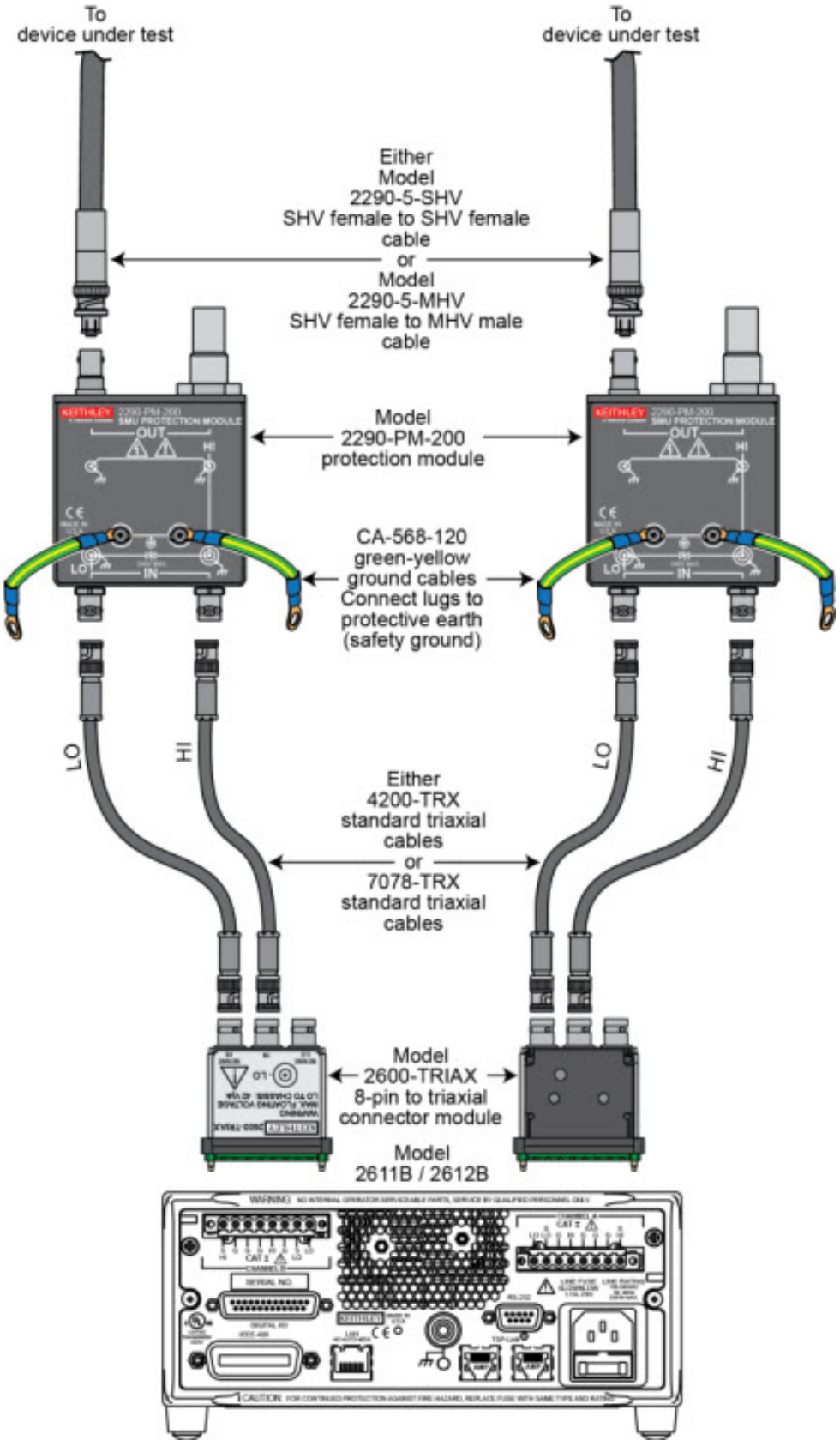
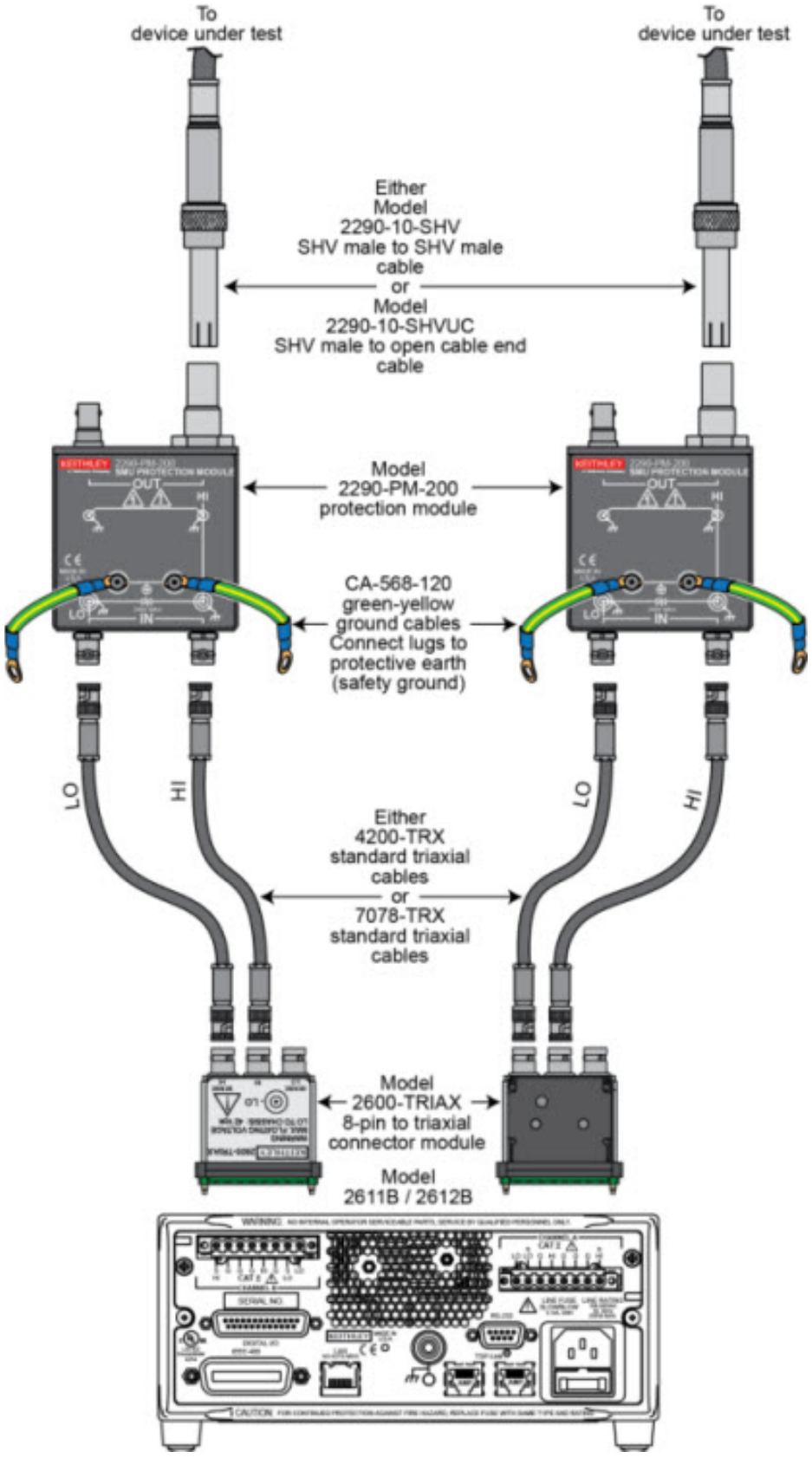


Figure 5: Model 2290-PM-200 Connections for Model 261xB using Model 2290-10 power supply



Connections using a Model 2635B or 2636B SMU

Required accessories:

- Two standard triaxial cables (either Model 7078-TRX or 4200-TRX) per source-measure unit (SMU) channel
- One high voltage (HV) coaxial cable
  a. Use Model 2290-5-SHV or 2290-5-MHV if you are using the 2290-5 high voltage power supply
  b. Use Model 2290-10-SHVUC or 2290-10-SHV if you are using the 2290-10 high voltage power supply

Connection summary

Refer to the next figure on how to connect source-measure unit (SMU) channels of the Model 2635B or 2636B to the Model 2290-PM-200.

Only 2-wire applications are supported.

⚠ CAUTION

Do not convert triaxial cables to BNC cables. Using BNC cables may compromise overvoltage protection and can result in damage to the SMU. You must use triaxial cables to connect to the lower-voltage SMU.

Figure 6: Model 2290-PM-200 Connections for Model 263xB using Model 2290-5 power supply

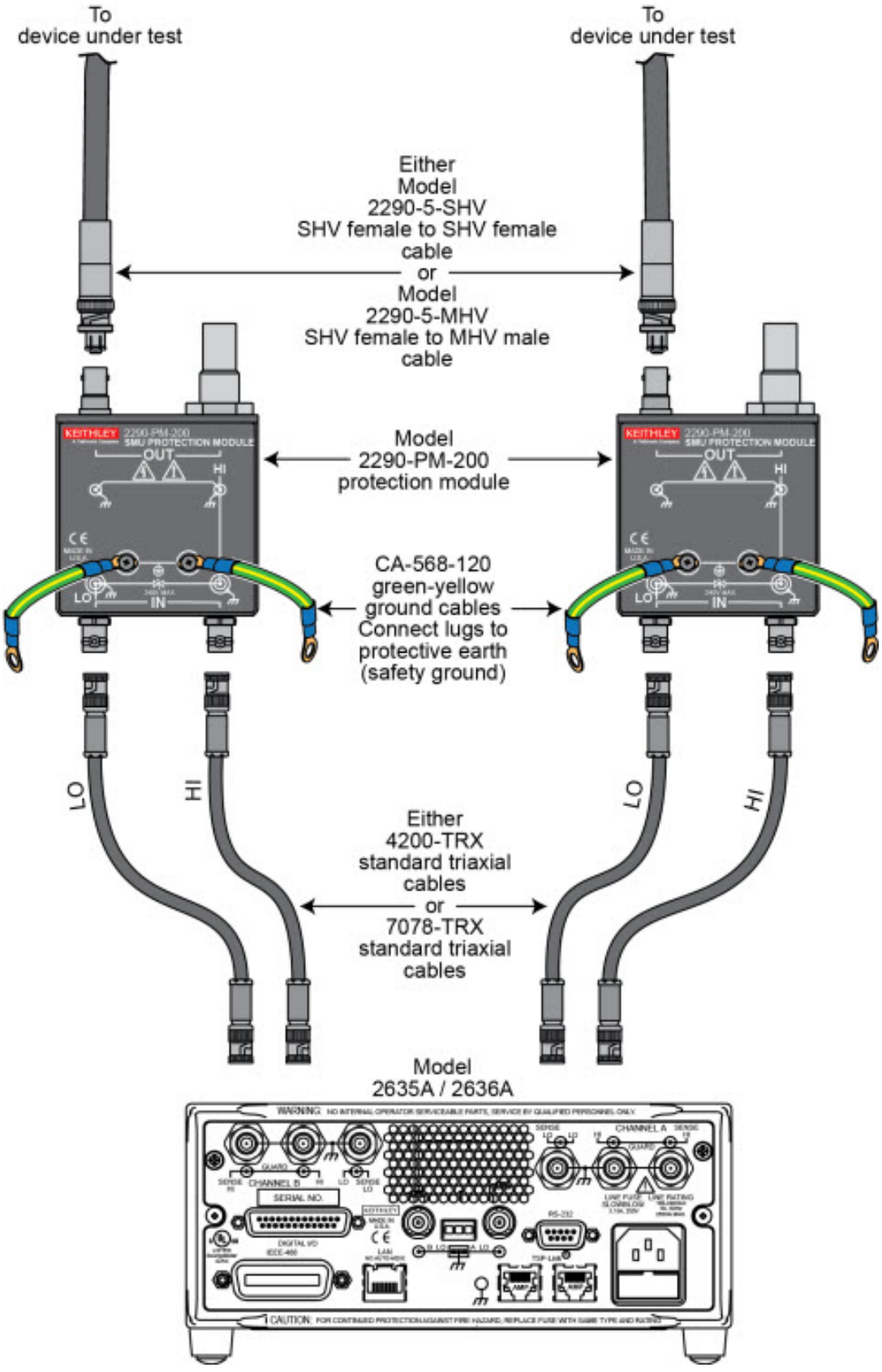
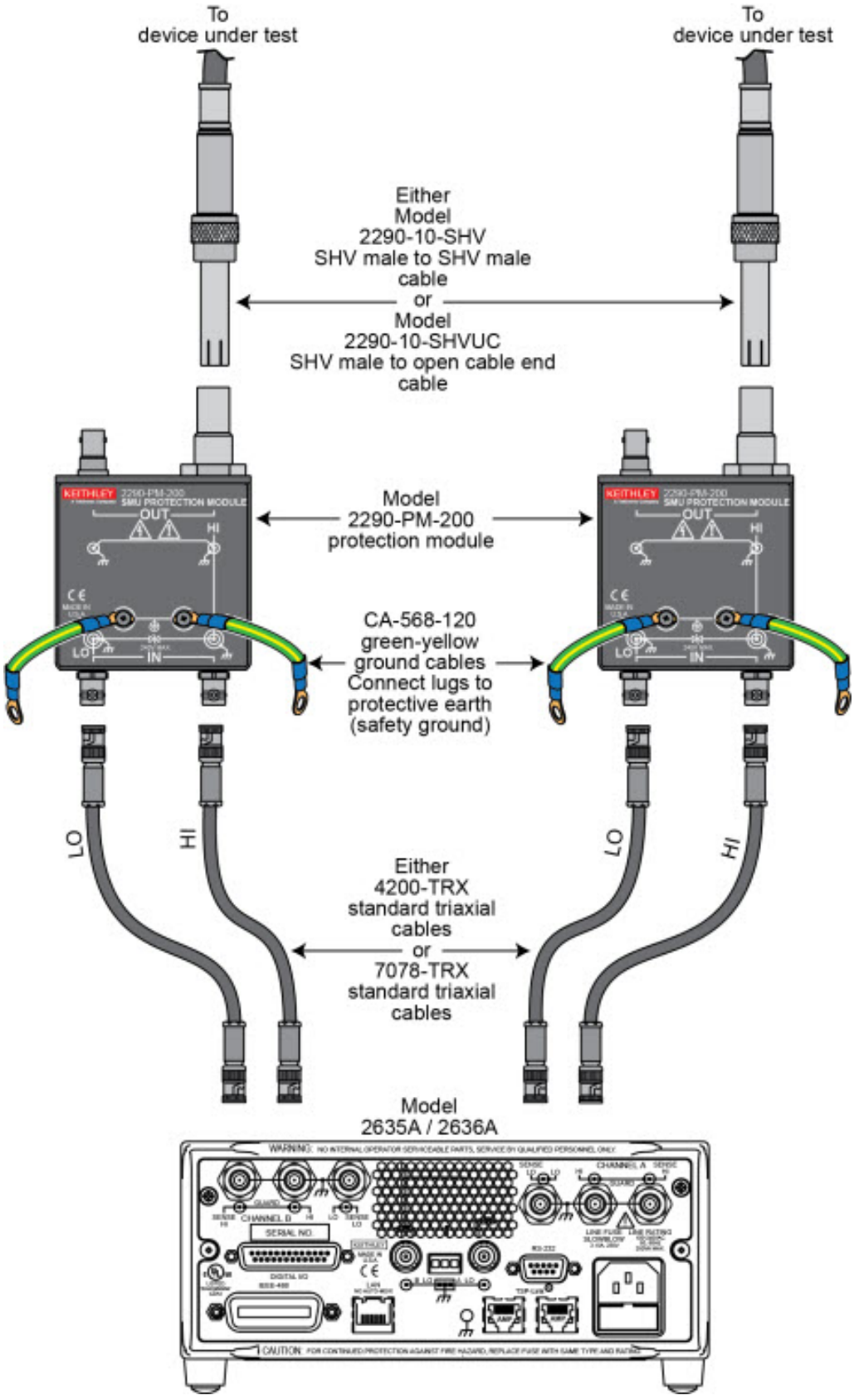


Figure 7: Model 2290-PM-200 Connections for Model 263xB using Model 2290-10 power supply



Connections using a Model 4200-SCS SMU (with Model 4200-PA)

If ordered, a Model 4200-PA remote preamplifier (preamp) for a source-measure unit (SMU) is installed at the factory when the Model 4200-SCS is ordered.

Required accessories to connect one Model 4200-SMU or 4210-SMU (with the Model 4200-PA):

- Two Model 4200-TRX cables
- One high voltage (HV) coaxial cable
  a. Use Model 2290-5-SHV or 2290-5-MHV if you are using the 2290-5 high voltage power supply
  b. Use Model 2290-10-SHVUC or 2290-10-SHV if you are using the 2290-10 high voltage power supply

Connection summary

Refer to the next figure on how to connect a Model 4200-PA preamp and the GNDU (ground unit) to the Model 2290-PM-200. Make sure to use the IN connectors of the Model 2290-PM-200 for connection to the Model 4200-SCS and use the OUT connector for connection to the DUT.

Only 2-wire applications are supported.

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).

Connecting the Model 4200-SMU or 4210-SMU to the Model 2290-PM-200 connects the LO terminal of the SMU to protective earth (safety ground).

⚠ CAUTION

Do not convert triaxial cables to BNC cables. Using BNC cables removes protection from the Model 4200-SCS SMU and may result in damage to the SMU. You must use triaxial cables to connect to the lower-voltage SMU.

Figure 8: Model 2290-PM-200 Connections for Model 4200-SCS SMU with 4200-PA using Model 2290-5 power supply

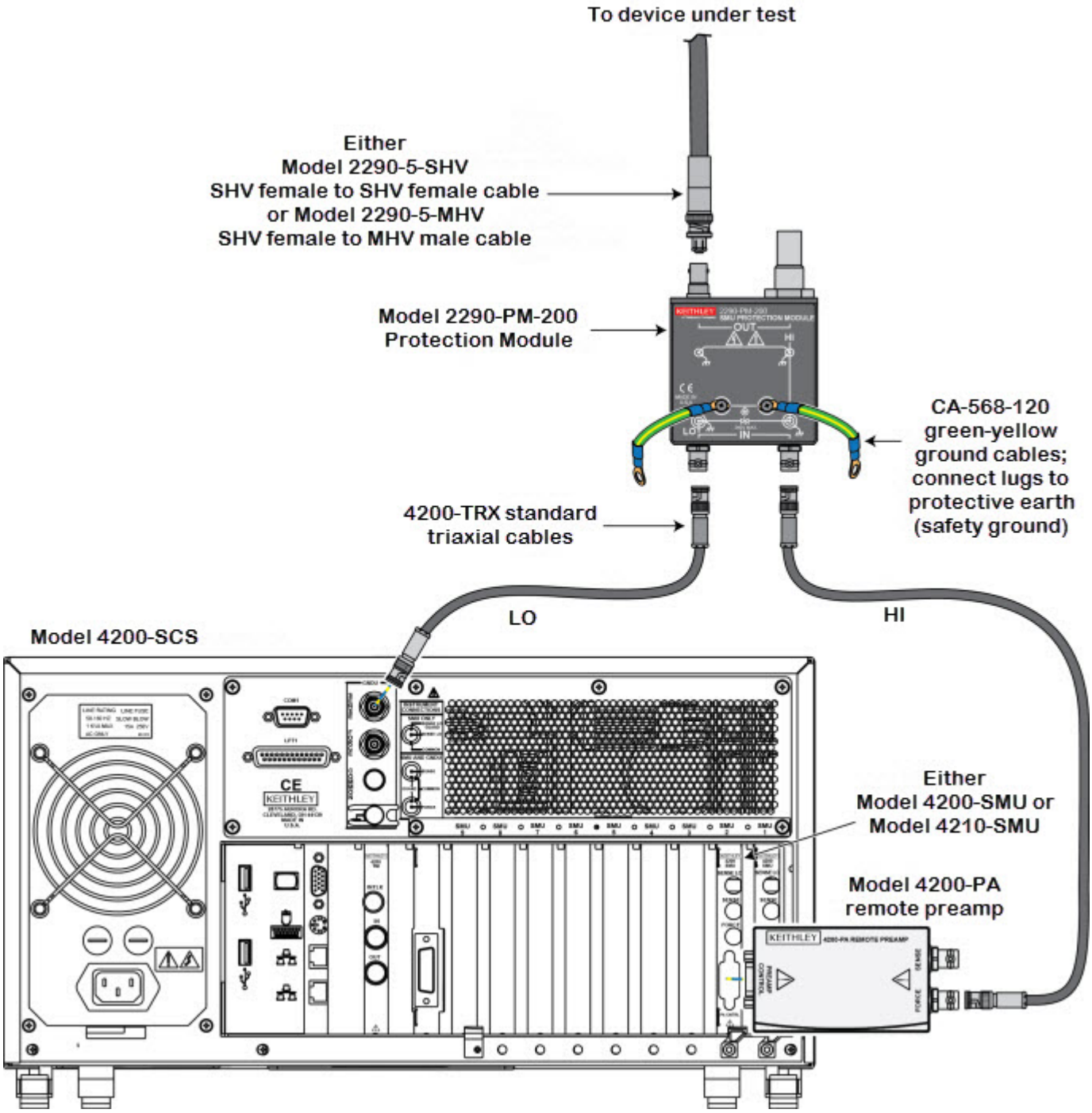
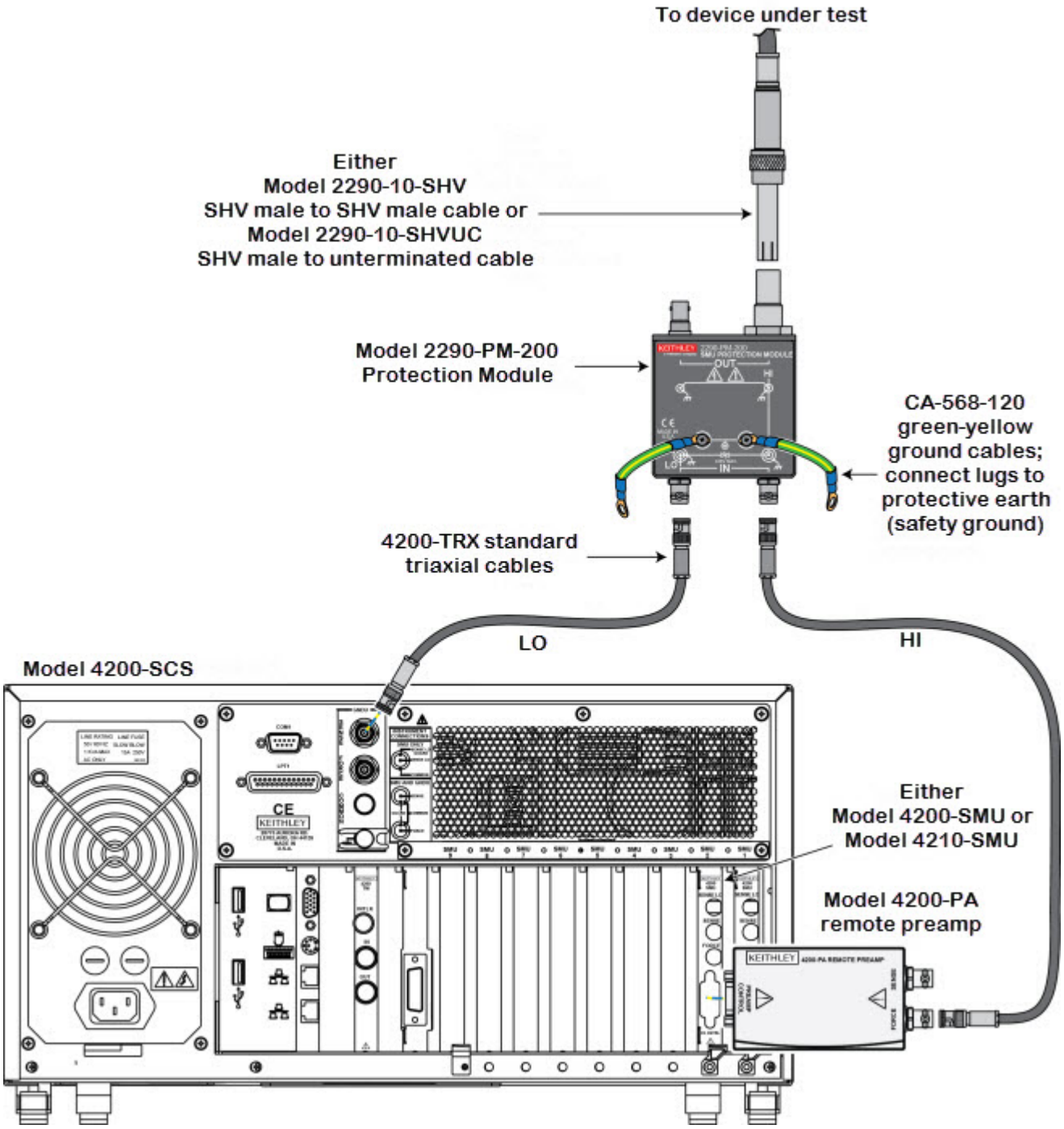


Figure 9: Model 2290-PM-200 Connections for Model 4200-SCS SMU with 4200-PA using Model 2290-10 power supply



Connections using a Model 4200-SCS SMU

Required accessories to connect one Model 4200-SMU or 4210-SMU (without the Model 4200-PA Remote PreAmp):

- One Model 4200-TRX cable
- One Model 4200-MTRX cables
- One high voltage (HV) coaxial cable
  a. Use Model 2290-5-SHV or 2290-5-MHV if you are using the 2290-5 high voltage power supply
  b. Use Model 2290-10-SHVUC or 2290-10-SHV if you are using the 2290-10 high voltage power supply

Connection summary

Refer to the next figure on how to to connect a Model 4200-SMU or 4210-SMU and the GNDU (ground unit) to the Model 2290-PM-200. Make sure to use the IN connectors of the Model 2290-PM-200 for connection to the Model 4200-SCS and use the OUT connector for connection to the device DUT.

Only 2-wire applications are supported.

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).

Connecting the Model 4200-SMU or 4210-SMU to the Model 2290-PM-200 connects the LO terminal of the SMU to protective earth (safety ground).

Figure 10: Model 2290-PM-200 Connections for Model 4200-SCS SMU using Model 2290-5 power supply

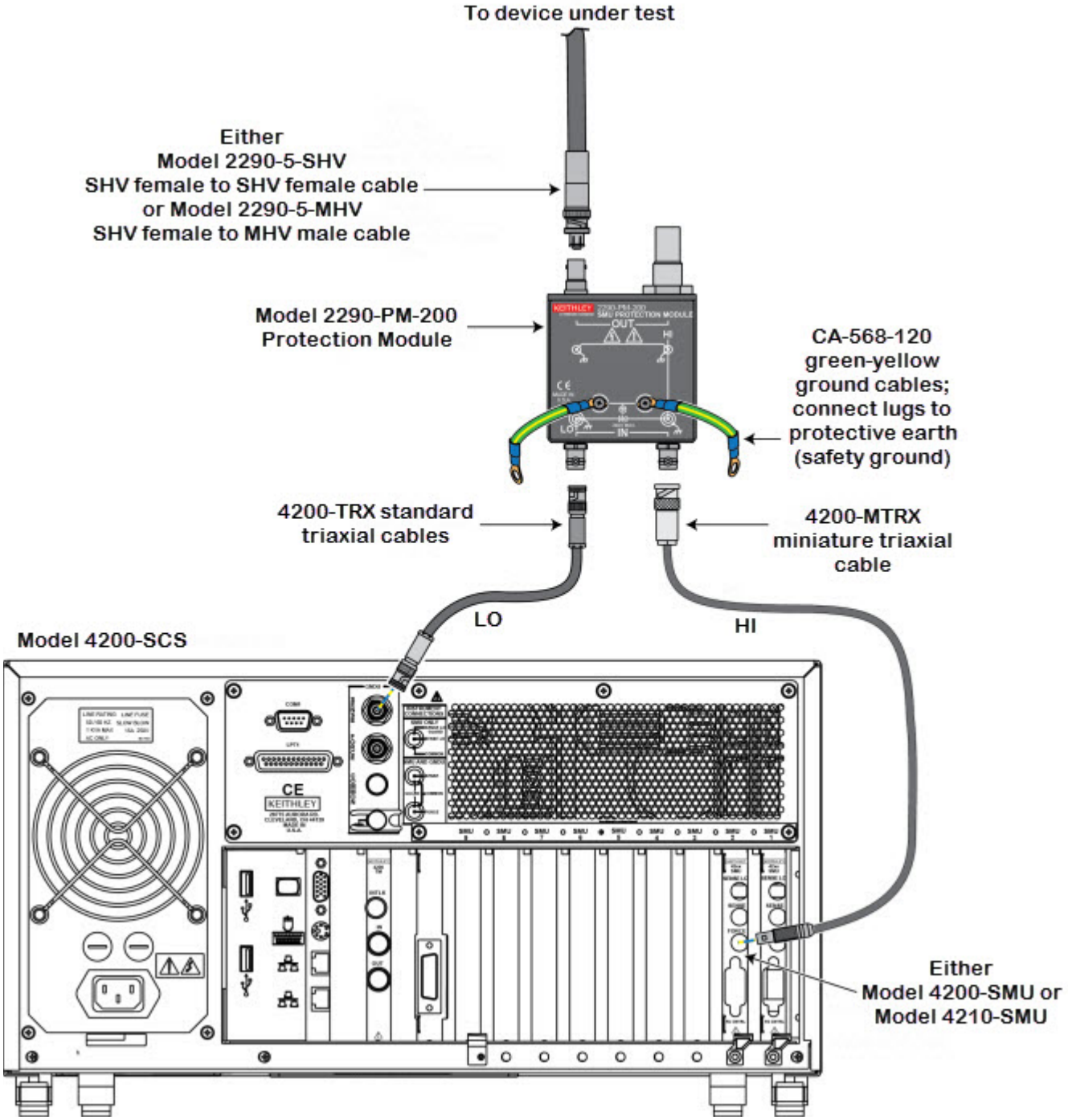
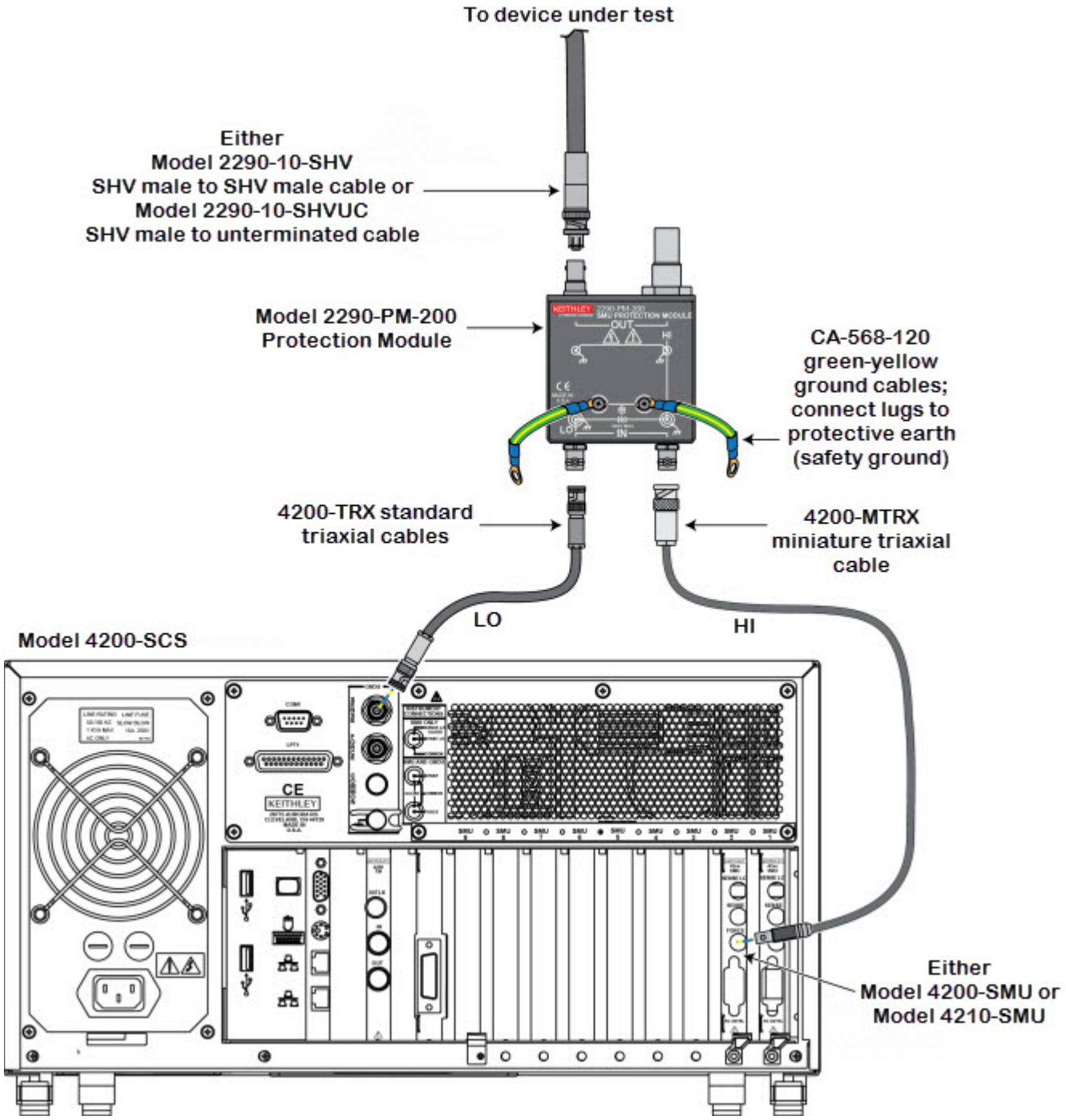


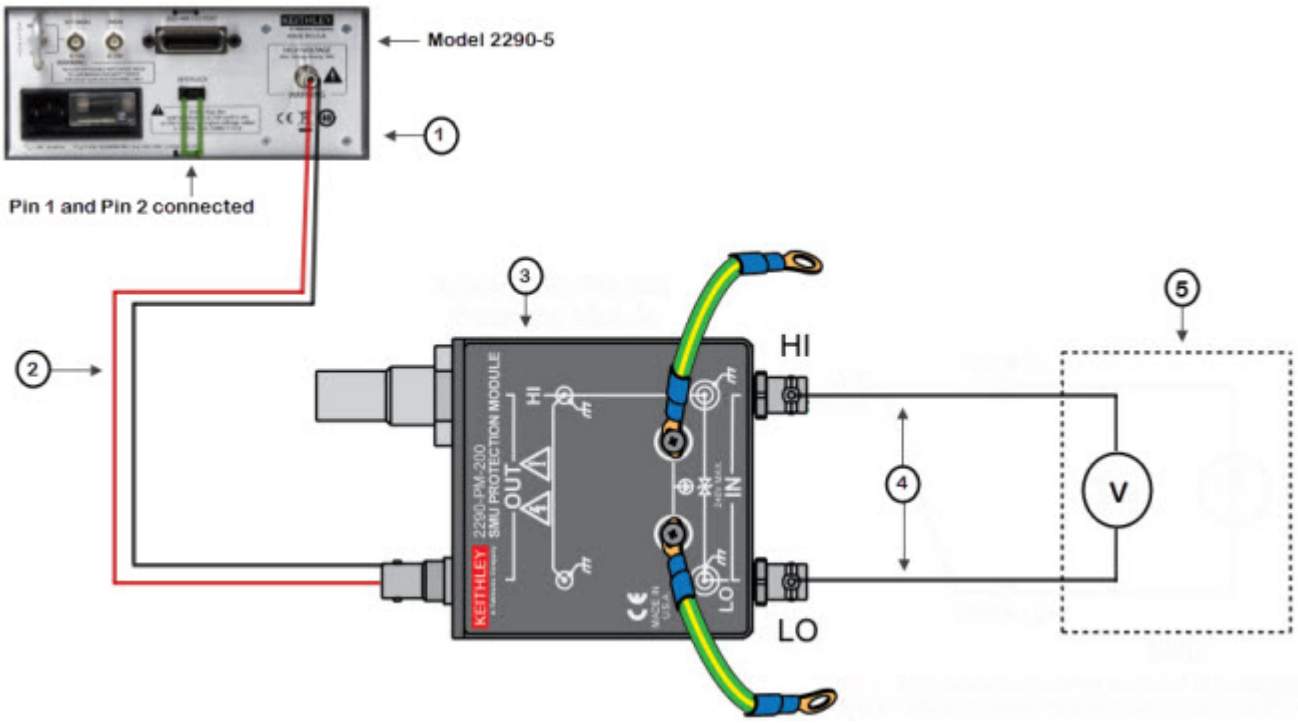
Figure 11: Model 2290-PM-200 Connections for Model 4200-SCS SMU 7 using Model 2290-10 power supply



Model 2290-PM-200 verification

A Keithley SourceMeter instrument capable of sourcing 100 V @10 mA and 1 A @>10 V and a high voltage power supply are required for verification purposes. The next figure should be referenced when performing Verify module continuity (on page 16), Verify the HI to LO leakage of the Model 2290-PM-200 (on page 17), and Verify module clamp voltage (on page 17) steps in this section.

Figure 12: Model 2290-PM-200 Connections for verification procedures using a Model 2290-5 High Voltage Power Supply



Item	Description
1	Model 2290-5 or 2290-10 high voltage power supply
2	Model 2290-5 or 2290-10 SHV high voltage cable
3	Model 2290-PM-200 high voltage SMU Protection Module
4	Triaxial cables
5	Source-measure unit (SMU)

Verify module continuity

1. Make sure that the high voltage power supply is off.
2. Connect a high voltage cable to the protection module OUT terminal (see the previous figure).
3. Short the HI and LO conductors on the high voltage output cable.
4. Set SMU to source 10 V and program the current limit to 1 A.
5. Turn on SMU output and verify that SMU is in current limit.

Verify the HI to LO leakage of the Model 2290-PM-200

1. Turn off the high voltage power supply.
2. Remove the high voltage cable from the protection module.
3. As shown in the previous figure, connect the protection module inputs to Hi and Lo terminals of an SMU using two (2) triaxial cables.
4. Program the SMU to source 100 volts or greater.
5. Turn on SMU output and allow to settle for 10 seconds minimum.
6. Observe current measurement on the SMU.
7. Current indication should be below 10 pA module specification.

Verify module clamp voltage

1. Make sure that the high voltage power supply is off.
2. Turn the SMU output off and disconnect the triaxial cables (see the previous figure).
3. Connect a high voltage cable from the protection module OUT terminal to the high voltage supply.
4. Engage the interlock on the back of the high voltage power supply by connecting pin 1 to pin 2.

⚠ WARNING

The high voltage power supply is capable of sourcing hazardous live high voltages that can cause personal injury or death due to electric shock. This unit should be used only by qualified personnel who recognize the dangers of high voltages.

Make certain that the source is turned off and that high voltage is completely discharged before removing the high voltage cable. High voltage cables can store charge if they are disconnected from the supply while the high voltage is on. The charge on the cable can cause injury or damage even after the cable is disconnected from the unit.

The high voltage power supply is provided with an interlock circuit that must be engaged to allow high voltage output. The interlock helps facilitate safe operation of the equipment in a test system. Bypassing the interlock could expose the operator to hazardous voltages that could result in personal injury or death.

5. Turn on the high voltage power supply.
6. Set the current limit of the high voltage power supply to 1 mA.
7. Set the high voltage power supply for 300 V DC.
8. Turn the high voltage output on and verify that the high voltage power supply is in current limit.
9. Voltage should never exceed 250 V DC.