S530 Parametric Test System

Administrative Guide

PA-992 Rev. D / April 2012

KEITHLEY

Safety Precautions

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 over-voltages. Measurement Category II connections require protection for high transient over-voltages 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 1000V, 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.

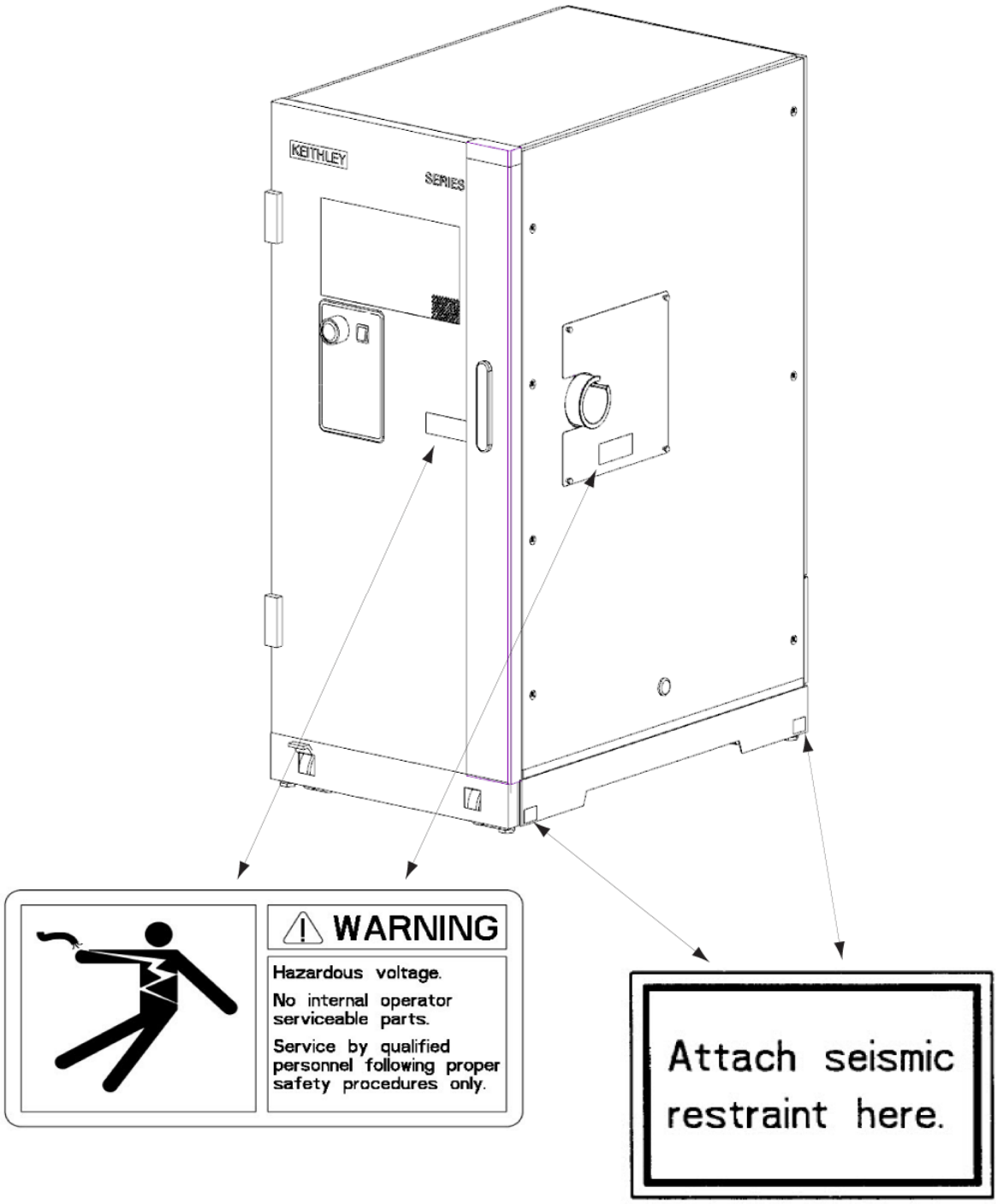
KEITHLEY

Safety Labels

S530 System

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139
1-888-KEITHLEY
www.keithley.com

This is the S530 System cabinet front view:



KEITHLEY

Safety Labels

S530 System

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139
1-888-KEITHLEY
www.keithley.com

This is the S530 System cabinet rear view:

This label will be on U.S. and Japanese systems.

MODEL S530
SERIAL NO.
VOLTS: 220-240V
FREQUENCY: 47-63Hz
AMPS: 10A
PHASE: SINGLE
POWER RATING: 2.4kVA
BREAKING CAPACITY: 10kA
SCCR: 5kA
Keithley Instruments, Inc. • 28775 Aurora Road • Cleveland, Ohio 44139 • 440-248-0400 • Made in U.S.A.
KEITHLEY
A GREATER MEASURE OF CONFIDENCE

This label will be on European systems.

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If you have any questions after reviewing this information, contact your local Keithley Instruments representative or call one of our applications engineers at 1-888-KEITHLEY (1-888-534-8453) within the U.S. and Canada. You can also visit the Keithley Instruments website at www.keithley.com for updated worldwide contact information.

System description

The Keithley Instruments S530 Parametric Test System is a configurable, instrument-based system for semiconductor parametric characterization and testing. There are two different S530 systems available:

- S530 low-current parametric test system
  - Consists of two to four (up to eight channels) source measure units (SMUs), one switching matrix, an optional capacitance/voltage (C-V) unit, and a LO patch panel.
  - Two-wire system (non-Kelvin), or, four-wire system (Kelvin).
- S530 high-voltage parametric test system
  - Consists of two to four (up to seven channels) SMUs, one switching matrix, one optional C-V unit, a LO patch panel, and a high-voltage safety interlock device.
  - Two-wire system (non-Kelvin), or, four-wire system (Kelvin).

NOTE The LO patch panel and the high-voltage safety interlocks are not visible from the front (see *Figure 1*).

The S530 systems have flexible hardware configurations that allow you to customize them to your specific needs. See *Table 1* for a description of the main system configuration options, and see *Figure 1* for an example of the S530 system (refer to the legend in the next Figure that shows where the instruments are located in the system).

Table 1: S530 system configuration options

DC source measure units (SMU)	• 2 to 8 maximum • Maximum number of units depends on other items in the system rack • Model 2410 high-voltage SMU

6-slot switching matrix	• Model 707B with either
	  - Model 7174A switch card
	  - Model 7072-HVF switch card
	  - Model 7530 switch card

Optional capacitance/voltage (C-V)	• 1 channel of C-V • Based on Model 4200-SCS with CVU card
Optional instruments	• DMM • Up to 3 dual-channel pulse cards • Frequency measurement option
Each system contains:	1. Computer inside cabinet 2. External 20-inch flat-panel monitor and keyboard mounted on exterior of cabinet 3. S530 system software – Keithley Tesh Environment (KTE) or Automated Characterization Suite (ACS)

Figure 1: S530 parametric test system configuration example

Optional accessories

Optional items and accessories that may accompany the S530 system:

1. Cables to connect to the test fixture or the probe card adapter
2. Model 9139A-PCA (probe card adapter)

Site preparation and installation

Site preparation checklist

The follwing table provides a site preparation checklist to help you prepare your site for the S530 system in your facility. If you find that an item listed is not valid for your site, then you can indicate it with “N/A.”

Table 2: S530 system preparation checklist

Site	**Item**
	Is adequate and proper electrical power available?
	Is something connected to the same power source that generates noise?
	Is something that requires substantial amounts of current connected to the same power source?
	Is it necessary to have lifting equipment?
	Is the flooring adequate and able to support the weight of the system while moving from receiving to the final destination?
	Are all of the corridors and hallways able to allow clearance for the system?
	Are stairways adequate for moving the system through?
	Are elevators needed to move equipment? Can they support the size and weight of the system?
	Are the doorways wide enough for the system?
Floor plan	**Item**
	Did you complete the system layout (see *Floor plan*)?
	Does your layout show all of the locations for all of the equipment?
	Does your system layout show the locations of all doors and aisles?
	Does you layout allow for the proper clearance of the system for the front, rear, and the keyboard/monitor arm (see *Figure 10*)?
	Is there enough space for personnel safety, comfort, and freedom of movement?
	Did you take future expansions into consideration?
	Is there sufficient space for any supplies or manuals?
Electrical power	**Item**
	Did you verify that your site’s power meets the power requirements for the system?
	Did you prepare power outlets for service, or testing, or maintenance?

Unpacking the S530 system

The Keithley field service engineer (FSE) is responsible for unpacking the S530 system cabinet and the accessories (which is in a separate box). However, it is recommended that the customer moves the crate and the accessories box to the area where the system is going to be used. Here is a list of tools needed for unpacking:

- Standard screw driver
- Socket wrench
- Socket head: 19 millimeters (mm)

The following information will help you when you begin to unpack your system.The system is shipped in a wooden crate (see *Figure 2*).

Figure 2: S530 system cabinet in shipping crate

Unpacking system components

Inspect the shock sensor located on the outside of the shipping box (see *Figure 3*). If the shock sensor indicates a shock condition, conduct a very thorough inspection of all components contained in the system cabinet. Also, check the “TIP N TELL” indicator to ensure that the crate has not been tipped over (see *Figure 4*). Report any damage to the shipping agent immediately. Carefully remove all system components from the crate. While unpacking, make sure there is no component damage. Please reuse or recycle packaging materials in accordance with your local requirements.

Figure 3: Crate shock sensor

Figure 4: Crate tipping indicator

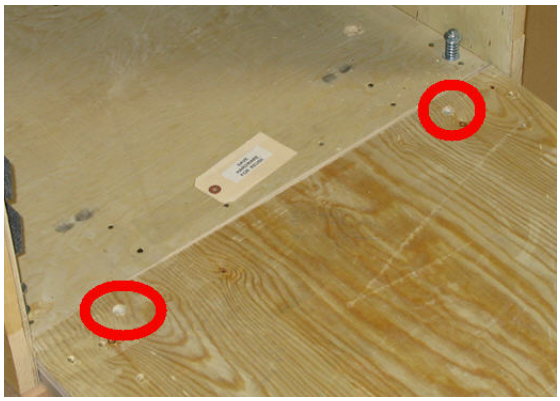
NOTE	You will need at least two people to unpack and move the S530 system cabinet.

1. Remove the clamps from the crate using a standard screwdriver:

2. Open the front of the crate:

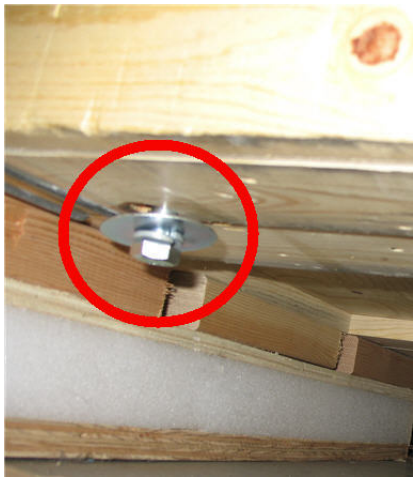
3. Make sure the ramp support is pulled away from the crate. It is held in place with Velcro.

4. Attach the ramp using the two bolts that are attached to the botom front part of the crate:



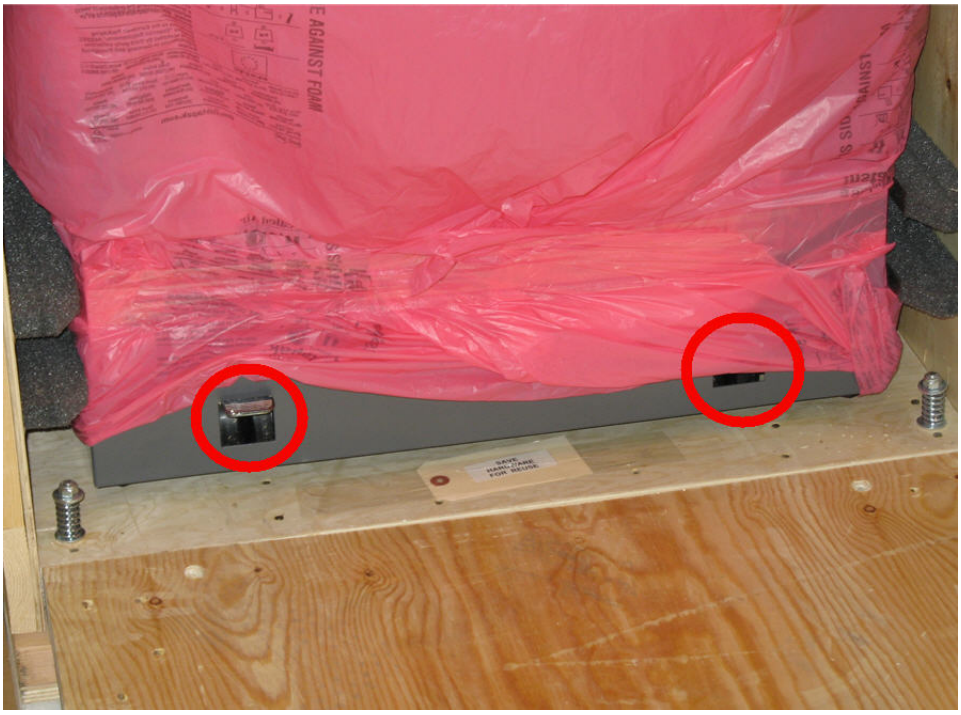
5. Remove the padding from the front of the S530 system cabinet:

6. Remove the four bolts from the bottom of the crate that are attached to the bottom of the S530 system cabinet using a 19mm socket head on a socket wrench:



7. Save the hardware (the four bolts and washers) that you remove from the bottom of the crate:

8. Unlock the two wheels (casters) that are on the front of the S530 system cabinet by moving the locks up:



9. With two people, slide the S530 system cabinet down the ramp:

10. Remove the tape from the packing material using scissors, taking care not to scratch the S530 sytstem cabinet:

11. Move the S530 system cabinet to its final destination:

The system cabinet is shipped from the factory with all of the instruments installed. Most equipment connections and wiring in the system's cabinet instruments were made at the factory. Note that the accessories that come with the system are in a separate container.

Unpacking the S530 system accessories

The accessories are shipped in a separate box (note there may be more than one depending on how many accessories are ordered)(see *Figure 5*).

Figure 5: S530 system accessories boxes

The accessories box contains a computer monitor, keyboard, and mouse. It also includes required installation hardware, USB extension cables, connectors for the keyboard and mouse, and any other accessories that may have been ordered with the system. You will also find all of the necessary documentation that is shipped with your order. Please reuse or recycle packaging materials in accordance with your local requirements (see *Figure 6*, *Figure 7*, *Figure 8*).

Figure 6: Typical S530 system accessories

Figure 7: Monitor arm accessory

Figure 8: Keyboard tray and arm accessory

Keithley FSE

The Keithley FSE will perform the following tasks:

- Install the keyboard arm and monitor arm to the system.
- Install the keyboard and the mouse on the keyboard arm, and the montior to the monitor arm.
- Install the probe card assembly (PCA)(if ordered), to the back of the system cabinet, and the 60190-PCA (probe card assembly) to the correct prober plate (customer supplied from prober company), which is attached to the prober.
- Plug in the system to the customer's power facilities (supplied by customer's facilities department at the final location for the S530 system cabinet) and power up the entire cabinet.
- Verify communications of all instruments and with the properly configured prober.
- Perform system diagnostics and confidence test of the entire S530 system, to include the 60190-PCA (if ordered).
- Record all of the information on the System Installation Form (see below for example).

EXAMPLE S530 System Installation Form

Company:		Sales Order #:	
Address:		Date:	
		QMO #:	
Contact:		Phone #:	

System Configuration:

System: ☐ Low-Current ☐ High-Voltage

Software: ☐ ACS Version: _____ ☐ KTE Version: _____

4210-CVU: ☐ Yes ☐ No

Matrix Configuration: ☐ 2-wire ☐ matrix
☐ Kelvin (4-wire)

9139A PCA: ☐ Yes, ☐ No

# of pins wired _____

Serial Numbers:

Low-Current SMU (2636A) #1/#2: _____

Low-Current SMU (2636A) #3/#4: _____

Low-Current SMU (2636A): #5/#6: _____

Low-Current SMU (2636A) #7/#8: _____

Computer: _____

4200-SCS: _____

4220-PGU pulse card: _____

4200-SCP2HR scope card: _____

2410 High Voltage SMU: _____

2010 DMM: _____

707B Switch System: _____

Other System Options or Noteworthy Details:

_____

_____

_____

_____

Installation complete?	☐ Yes	☐ No
System Diagnostics passed?	☐ Yes	☐ No

Deficiencies	**Resolution**	**Due Date**

Notes:

Installation Signatures:

Keithley Instruments Date

Customer Date

System cabinet size and weight

The size and weight specifications for the system cabinet are listed in *Table 3*. See the *Floor plan* topic later in this document for details about designing a floor plan for the system cabinet.

Table 3: System cabinet size and weight

Size (width x depth x height)	Weight	
	Minimum configuration	Maximum configuration
23.7 in. x 35.9 in. x 49.9 in. (60.2 cm x 91.2 cm x 126.7 cm)	325 lb (147.4 kg)	525 lb (238.1 kg)

Power and operating conditions

Line power requirements

Nominal line power: 100 V, 115 V, 220 V, 240 V (50 Hz, 60 Hz)

Short-circuit current rating: 5 kA

Power consumption: Rated at 2.4 kVA for the 2 kW power distribution unit

Heat generation: Quiescent heat of 1720 BTU (1815 kJ) to maximum heat of 8191 BTU (8642 kJ).

WARNING ***Severe personal injury or death due to electric shock or electrocution or equipment damage may occur if you do not have the correct circuit amperage.***

For S530 systems that are configured to operate between 100 V and 120 V, a 20 A circuit must be used and systems that are configured to operate between 200 V and 240 V, a 15 A circuit must be used.

System power dissipation

The total power dissipated by the S530 depends on the type and number of instruments in the test system. For instance, the power distribution unit (PDU) limits the incoming power to these instruments. While the PDU ensures electrical safety and compliance to the required standards, it does not prevent the system from overheating.

When a Series 2600A instrument detects an excessive heat condition, the unit turns the output off to minimize power dissipation. This safeguard prevents damage to individual Series 2600A instruments, but may result in test instability. For instance, if you continuously source more than 1 A from all the SMUs for more than 100 seconds, it may trigger a temperature error in one or more of the Series 2600A instruments. However, an average output of less than 1 A for an indefinite period of time will not cause a temperature error.

For additional information about the Keithley Instruments Series 2600A SourceMeter instruments, refer to the supplied documentation that is located on the Keithley Instruments Complete Reference CD-ROM that was shipped with your purchase.

Operating environment conditions

The S530 will not perform within specifications if operated outside of the following environmental conditions:

Temperature: 23° C ±5° C (73.4° F ±9° F)

Operating humidity: 30% to 60% relative humidity, noncondensing, after a two hour warm up time.

Vibration: High ambient vibration levels may require isolation pads or the repositioning of equipment.

Air quality: The S530 system is compatible for use in a Class 10 clean room.

Audible system noise: dB level is 65.

Air flow: The S530 system is configured for top to bottom air flow.

Altitude: Less than 6,561 feet (2000 m) above sea level.

Noise interference: To prevent electrical noise from interfering with measurements, the ambient AC magnetic field must not exceed 2 x 10-3 Gauss (2 x 10^{-7} T).

- Avoid locating the S530 next to plasma etchers, large motors, magnets, RF transmitters, equipment with flash lamps, and other potential sources of interference
- Run power lines in a grounded conduit
- Position equipment to avoid routing signal and power cables near sources of electrical noise

Triax connector handling and contamination

Keep source-measure triax cable connectors (if applicable) clean and free of any foreign contaminants. Do not touch the connector pins of the triax connectors. Contamination can cause current leakage in the source-measure signal paths to the DUT, which can significantly degrade the test results.

CAUTION	Do not touch any connector pins or the areas adjacent to the electrical contacts of the triax connectors; contamination will degrade the performance of the test system.

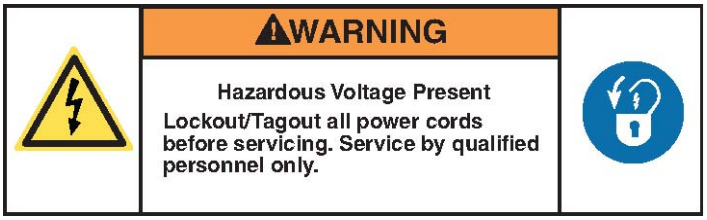
Cleaning: Clean contaminated connectors with methanol or isopropyl alcohol, and then blow-dry them with nitrogen gas. After blowing dry, wait several minutes before using.

Optional 9139A-PCA vacuum requirement: 20 inch (50.80 cm) Hg (which is the same as 40.73 PSI), with a hose connection of 1/4 inch (.64 cm) outside diameter and 1/8 inch (.32) inside diameter.

Lockout/Tagout

For maximum safety, always perform a lockout and tagout procedure by removing power from the entire test system and discharge capacitors before connecting or disconnecting cables or any instrument, including the device under test, while power is applied. When you perform lockout and tagout procedures, make sure that you note all warning labels on the cabinet and instruments (see *Figure 9*).

Figure 9: Hazardous warning label



WARNING	***Severe personal injury or death due to electric shock or electrocution may result if power is not removed before working inside the cabinet. Always disconnect the cabinet line cords from the AC line power receptacles before opening the system cabinet. Also, never turn on the system until all connections and safety grounds are installed.***

When you perform removal and installation procedures, or maintenance on the system, lockout by placing a padlock through the bracket by the PDU breaker and tagout as appropriate (see the *Remove system power* topic for more information).

Remove system power

1. You must shut down the software, and remove all power from the computer and the system (see *Shut down using ACS* or *Shut down using KTE*).

WARNING	***Before proceeding, you must make sure the power indicator on the front door is NOT illuminated.***

2. Place the power switch for the PDU to the OFF position. The location of the PDU is at the back of the cabinet below the rear door.
3. If you are working in the system cabinet, disconnect the system cabinet line cord from the AC line power receptacles.

WARNING	***When you remove power, make sure that you disconnect all system cabinet line cords from AC line power receptacles.***

4. Verify that all power has been removed and discharged from the system cabinet by switching the main power switch to the ON position (located on the front door of the cabinet) and verify that the green light does not illuminate. If the light does not come on, the power is off. Turn main power switch back to the OFF position.
5. Lockout and tagout the system source power connection in accordance with your company's lockout/tagout policy.

Installation and connections

WARNING	***The following installation and connection procedures should be performed by trained site installers who are familiar with the associated physical and electrical hazards. Also, you should never turn on the system until all connections and safety grounds are installed.***

Position the system cabinet

The system cabinet contains the controller and instrumentation for the test system. The cabinet is on casters, which allows you to easily roll on a hard floor surface. The two steering casters in the rear are swivel type, while the two casters at the front are in fixed positions.

To position the system cabinets:

1. Carefully roll the system cabinet to its desired location next to the prober. Allow approximately 23.5 inches (597 mm, nominal) of clearance between the cabinet and other instrumentation.
2. Lock the casters by pushing down on the caster-locking mechanisms located near the front-bottom of the cabinet.
3. Adjust the height of the four legs so that the weight of the cabinet is on the legs and not on the casters. Adjust the legs so that the cabinet is level and does not move (see the *Seismic securement* topic).

WARNING ***Seismic securement is required for safety of the S530 system and for personnel. You must bolt the legs adjacent to the four casters to the floor. See the Seismic securement topic in this document for details.***

Floor plan

NOTE The following floor plan information is for the system cabinet only. Refer to the documentation for the prober or other test fixture equipment to determine its floor space requirements.

The system cabinet requires a floor space of approximately 4 ft x 7 ft (1.2 m x 2.1 m). *Figure 10* shows a top view of the floor plan. *Table 3* lists the dimensions and weight of the system cabinet. Also, *Figure 11* shows the typical S530 system cabinet weitght distribution and center of gravity.

NOTE The typical weight distribution and the center of gravity will be dependent upon the options of the system and the specific installatuion configuration.

Figure 10: S530 floor plan, top view

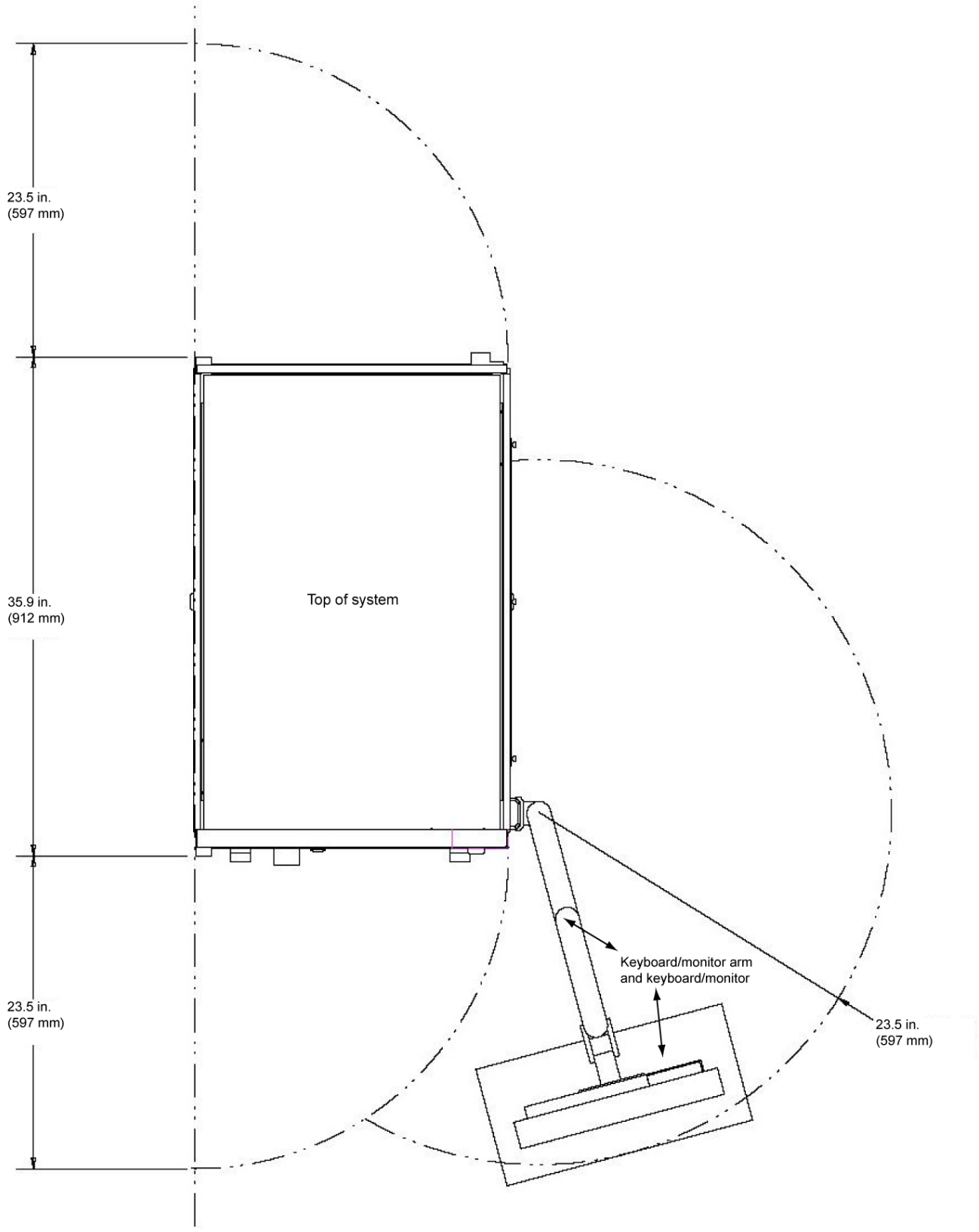
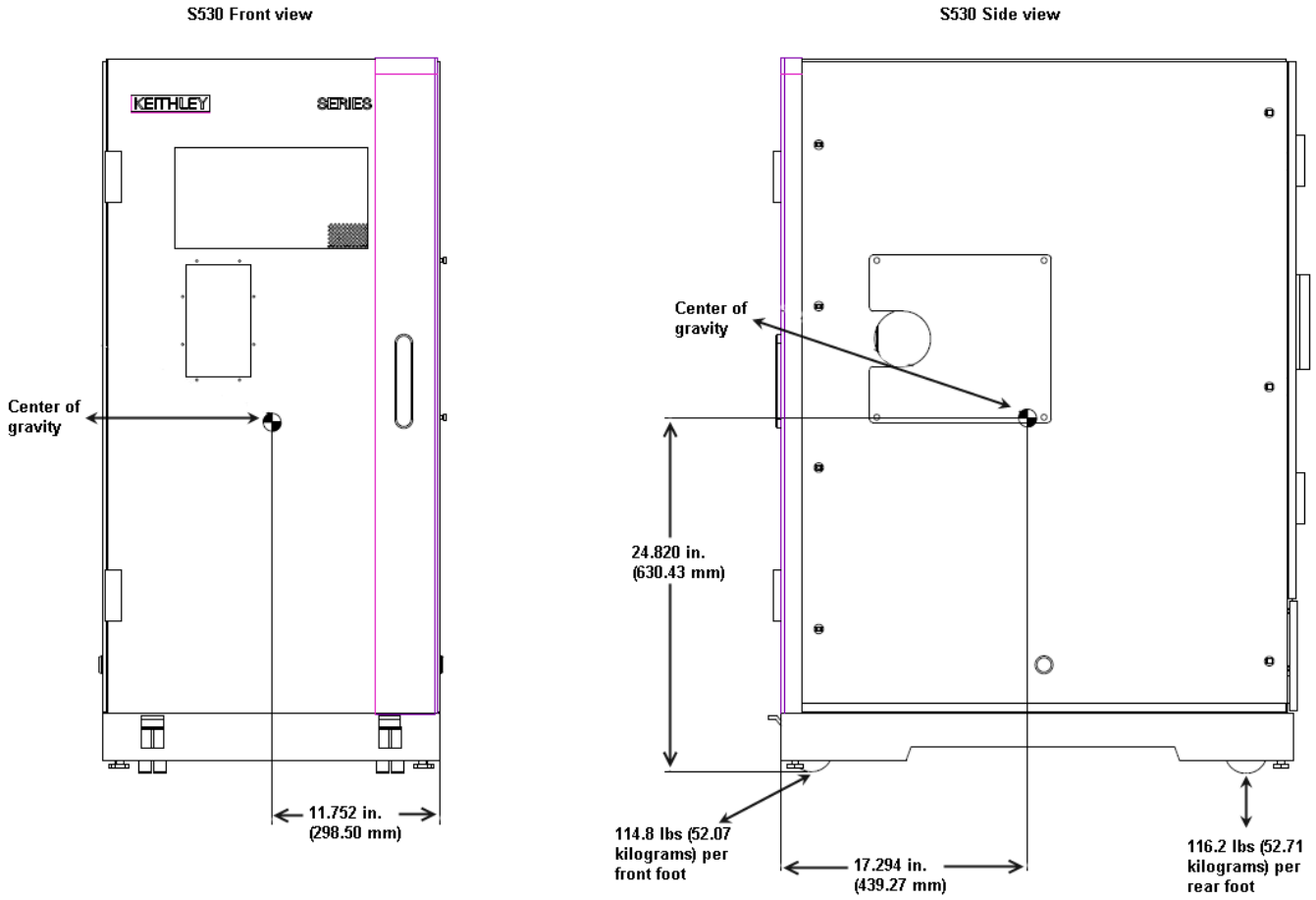


Figure 11: S530 weight distribution and center of gravity



Seismic securement

Seismic securement is required for the S530 system cabinet. You must bolt down the system to the floor for safety purposes and to ensure the cabinet will not tip over. In *Figure 12*, you will see a label that indicates a tip-over hazard located on the keyboard tray. The maximum weight capacity for the keyboard tray is 25 pounds (12 kilograms).

Figure 12: S530 system keyboard tray tip-over hazard

Figure 13 shows the restraint brackets and bolt installation dimensions for the system cabinet.

Figure 13: Seismic system cabinet restraints

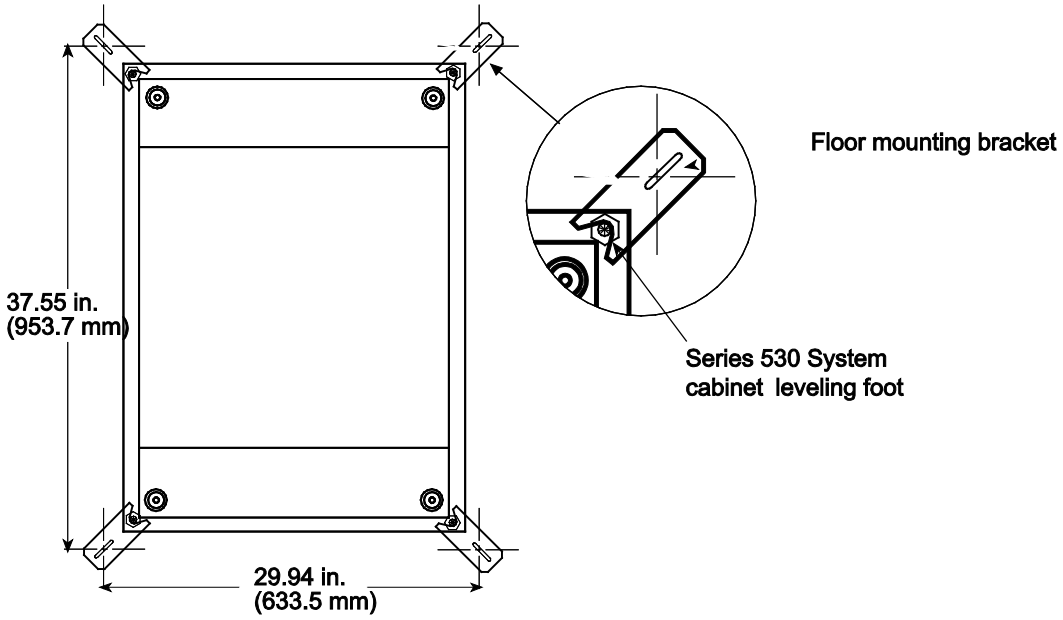
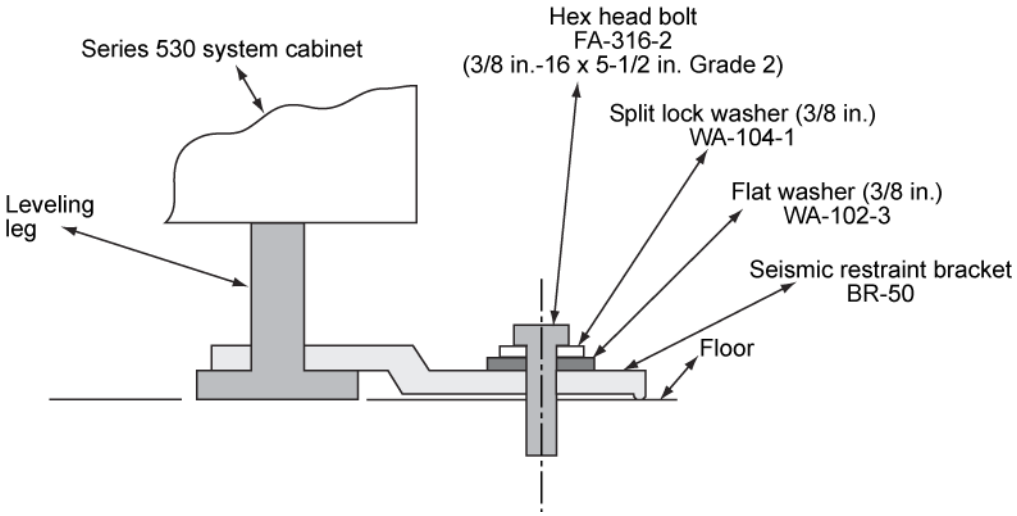


Figure 14 shows how a floor mounting bracket is installed. Keithley part numbers are included for the required hardware.

Figure 14: Floor mounting bracket installation

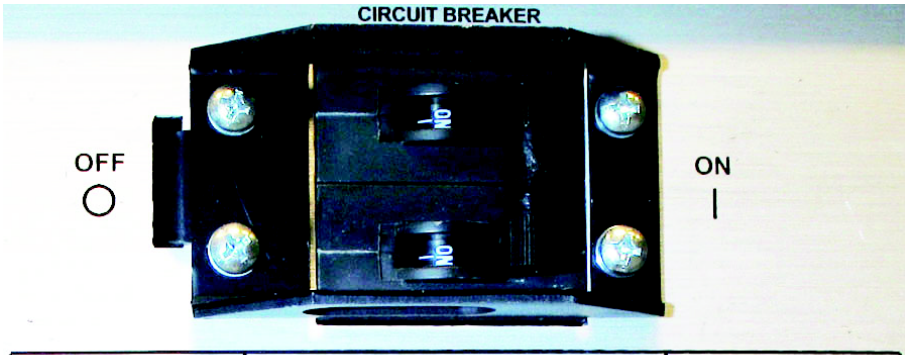


Equipment startup

All of the instruments in the equipment rack are connected to one power distribution unit (PDU), which is located at the back of the cabinet.

- Check that all line cords for the system cabinet are connected to AC power line receptacles.
- Make sure the PDU circuit breaker on the back of the cabinet is in the **ON** position (see *Figure 15*). If the circuit breaker is tripped, turn it **OFF** and then turn it back **ON**.

Figure 15: S530 PDU circuit breaker



MODEL	LINE RATING			CIRCUIT BREAKER
42000-PDU	100-120 VAC	50/60 Hz	1.8k WATTS	15 AMP
42000-PDU/E	208-240 VAC	50/60 Hz	1.8k WATTS	7.5 AMP
42000-PDU-2K	100-120 VAC	50/60 Hz	2.4k WATTS	20 AMP
42000-PDU/E-2K	208-240 VAC	50/60 Hz	2.4k WATTS	10 AMP

On the front of the system, turn the **POWER** switch to the **ON** position. The **POWER** switch is located on the front door of the cabinet (see *Figure 17*). Make sure the system computer and monitor are also turned on before attempting to use the S530 system and any software.

Initial equipment startup

1. Check that all line cords for the system cabinet are connected to AC power.
2. Make sure that the circuit breaker on the PDU is in the ON position.
3. Press the power/standby button on the computer and monitor.
4. Set the power button on the front door of the system to the ON position (see *Figure 17*).

System startup

1. Make sure that the power switch on the PDU is set to on.
2. Set the power button on the front door of the system to the ON position.
3. If the computer has not started to boot, then open the front cabinet door and press the Power/STANDBY switch on the host computer.
4. Wait for all the instruments to power up.
5. Login to your computer and start the KTE or ACS software.

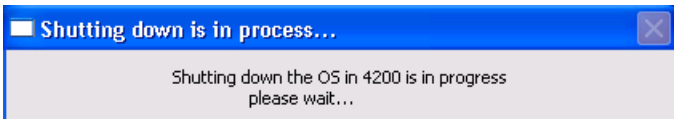
Shut down using ACS

NOTE	You must have administrator rights in ACS software in order to shut down the S530 system.

1. Double-click the Shutdown icon on the computer desktop. On the dialog box that opens, click Yes that you want to Shutdown the S530 Tester.

NOTE	The following message opens after you click Yes to Shutdown the S530 (see *Figure 16*). You must wait until the Model 4200-SCS and the system computer shut down before you press the power button on the system cabinet. It may take several minutes for the system to shut down.

Figure 16: Shut down the S530



2. Once the ACS host computer has shut down, press the power button on the front door of the system cabinet (see *Figure 17*).

Shut down using KTE

On the LINUX console,

1. Change to the 'root' user
   # su
   <enter 'root' password>
2. Enter the following command:
   # $KIBIN/shutdown_S530.pl
3. Wait for the system to stop (NOTE: the IC process will stop, the 4200 will shut down, and then the work station will shut down. The console screen will be blank when it's stopped).
4. Turn off power to the cabinet.

Emergency OFF (EMO) button

An Emergency OFF (EMO) button is located on the system cabinet door (see *Figure 17*). If you push the Emergency OFF button, it removes power to all of the system instruments. However, it will not remove power to the host computer.

The EMO TRIPPED indicator light (located on the cabinet door) turns on when the system has undergone an emergency shut down.

Emergency shut down procedure

Press the red Emergency OFF Button on the front of the system cabinet. The instruments will power down and a red Emergency OFF indicator will illuminate. Also, the red indicator will illuminate when the system recovers from as sudden power loss.

Recovering from an emergency shut down

1. Verify that a hazardous condition or emergency situation is no longer present.
2. Rotate the Emergency OFF button to release it.
3. Toggle the power switch from ON to OFF, and then back to ON again. All of the system instruments should power up.
4. Open the front cabinet door and press the Power/STANDBY switch on the host computer.

Figure 17: S530 system cabinet front view

Safety interlocks

For operator safety, the S530 has interlocks on both the front and back cabinet doors and at the device under test (DUT). If you open a cabinet door or open the DUT interlock while instruments are sourcing, the interlock is activated causing the output from the source-measure instruments to output no voltage (0 volts; in a safe state).

Both the ACS and KTE software immediately notifies you (the operator) of the interlock activation. Once the interlock has been activated, you will need to clear the cause of the interlock activation:
Follow the instructions on the computer.

1. Make sure the front and rear doors are closed.
2. Make sure the DUT interlock is properly set for safe operation.
3. Close the DUT safety shield.
4. The software will then need recover before you can continue normal operation (you may need to re-run your tests).

WARNING ***Failure to make sure that the safety interlock and safety shields / guards are properly installed and arranged as indicated will put personnel in severe danger. Severe personal injury or death due to electric shock or electrocution may result.***

For the safety interlock to function properly, the DUT interlock sensor must be installed near the DUT connections and the interlock magnet must be installed on the safety shield. It must be set up so that when the magnet is near the switch (interlock closed) the operator CANNOT touch voltage-carrying conductors. If not properly installed, it will render the interlock inoperative and place personnel at severe risk.

Network information

1. System controller network interface: Ethernet port (10, 100, or 1000 Base T capable using RJ-45.
2. Supplied cables: one Ethernet crossover cable (connects the computer to the tester).
3. One 10-Base T patch cable (connects to your network).
4. IP addresses are determined by you (the customer).

Before starting system software

[1]For more information about the ACS software setup procedures, refer to the Automated Characterization Suite (ACS) Reference Manual (document number ACS-901-01). For more information about the KTE software setup procedures, refer to the KTE S530 Release Notes (document number: PA-1036) that is located on the KTE Software for the S530 CD (CD part number: S530-850-01).

1. You must make sure that all of the instruments are connected with the appropriate interface cable and a TSP-Link™ connection between any Series 2600A System SourceMeter® instruments.
2. Assign GPIB or TCP/IP addresses (as appropriate) and node numbers to the hardware and instruments.
3. Make sure that all of the instruments are turned on and self-testing is finished.

NOTE Make sure that all of the instruments are completely powered up before starting the system software.

[1] The S530 system includes one of two system software options:
1. Automated Characterization Suite (ACS)
2. Keithley Test Environment (KTE)

CAUTION	**ERROR POSSIBLE.** To avoid errors to instruments, never start the system software until all of the instruments have finished self-testing.

Ensure that the instruments are connected to the appropriate ports on the switching matrix per *Figure 19*, *Figure 20*, *Figure 21*, or *Figure 22*. Note: As the S530 ships from the factory, all instruments are already connected to the correct ports on the switching matrix.

Maintenance

Hardware replacement

WARNING	***The information in this section is intended only for qualified service personnel. Some of these procedures may cause exposure to hazardous voltages that could result in personal injury or death. Do not attempt to perform these procedures unless you are qualified to do so.***

This section contains information about removal and installation of system cabinet components, and instructions for replacing components determined to be faulty.

Handling and cleaning precautions

CAUTION	Always grasp cards by the side edges and shields to avoid contamination, which will degrade the performance of the components. Do not touch the connectors, the board surfaces, or components. On plugs and receptacles, do not touch areas adjacent to the electrical contacts.

Because of high impedance areas, take care when handling or servicing to prevent possible contamination, which could degrade performance. Take the following precautions when servicing any system component:

- Do not store or operate the system in an environment where dust could settle on the components.
- Use dry nitrogen gas to clean dust off the components, if necessary.
- Handle cards only by the side edges and shields.
- Do not touch any board surfaces, components, or connectors.
- Do not touch areas adjacent to electrical contacts.
- Wear clean cotton gloves when servicing any component.
- If necessary, make solder repairs on a circuit board using an OA-based (organically activated) flux. Remove the flux from the work areas when the repair is complete. Use pure water and clean cotton swabs or a clean, soft brush to remove the flux. Take care not to spread the flux to other areas of the components. Once the flux is removed, swab only the repaired area with methanol or isopropyl alcohol, then blow-dry the board with dry nitrogen gas.
- After cleaning, place the components in a 50° C low-humidity environment for several minutes before use.

Special handling of static-sensitive devices

CAUTION	System components can be damaged by electrostatic discharge (ESD). Wear a ground strap and attach the clip lead to the grounding bar in the test head or the system cabinet frame before working on the unit. Assume all parts are static sensitive.

High-impedance devices are subject to possible static discharge damage because of the high-impedance levels involved. When handling such devices, assume all parts are static sensitive:

- Static-sensitive components should be transported and handled only in containers specially designed to prevent or dissipate static buildup. Typically, these components are received in anti-static containers made of plastic or foam. Keep these parts in their original containers until ready for installation or use.
- Remove the components from their protective containers only at a properly grounded workstation. Also, ground yourself with an appropriate wrist strap while working with these components.
- Handle the connectors only by their bodies. Do not touch the boards, pins, or terminals.
- Any printed circuit board into which the device is to be inserted must first be grounded to the bench or table.
- Use only anti-static type de-soldering tools and grounded-tip soldering irons.

Electrical hazard tasks

This section contains a listing, by type, of energized, electrical “hot work” tasks for type 3 or higher electrical hazards task.

For additional information about diagnostics, troubleshooting, or maintenance of specific Keithley instruments, refer to that instrument’s documentation for details before attempting to repair it. Also, refer to the supplied documentation that is located on the Keithley Instruments Complete Reference CD-ROM that was shipped with your purchase.

Type 4 or Type 5: Live circuit tests

Live circuit tests are classified as Type 4 or Type 5 energized electrical “hot work” dependent on the particular circuit tested.

Live circuit type	Description
4	Equipment is energized, live circuits are exposed and accidental contact is possible. Voltage potentials are greater than 30 volts RMS, 42.2 volts peak, 240 volt-amps, 20 joules or contains radio frequency (RF).
5	Equipment is energized and measurements and adjustments require physical entry into the equipment or equipment configuration will not allow the use of clamp-on probes.

Repair and replacement

Keithley Instruments, Inc. offers a fee-based service agreement with all S530 systems; a field service engineer will either repair or replace equipment. For more information about this service agreement, contact Keithley Instruments at 1-888-534-8453.

For additional information about specific parts, operations, and maintenance of Keithley instruments, refer to the instrument’s documentation for details before attempting to replace or repair any equipment. Also, refer to the supplied documentation that is located on the Keithley Instruments Complete Reference CD-ROM that was shipped with your purchase.

Heavy instrument removal/installation

When installing or removing equipment heavier than 50 lbs, use a mechanical lifting device. If there is an instrument mounted below the heavy instrument, it must be removed to provide clearance for the lifting forks. Refer to the lifting device operating manual for proper usage.

Removing system power

WARNING	***Severe personal injury or death due to electrical shock or electrocution may result if power is not removed before moving, removing, or installing equipment. Do not attempt to perform these procedures unless you are qualified to do so.*** ***Make sure the system and instruments that are being installed, moved, or removed are turned off with all power source/cables unplugged.***

To remove system power before performing maintenance or replacement of components:

CAUTION	Follow precautions for removing hazardous voltage from the probe or other types of test fixture before handling.

1. Close any software that is open on the computer.
2. Shut down the system computer per the instructions in either *Shut down using ACS* or *Shut down using KTE* in this guide.
3. Place the system cabinet power switch, on the front-panel door to the **OFF** position.
4. Place the main circuit breaker on the PDU (on the back of the cabinet) to the **OFF** position.
5. Disconnect the source power to the S530 system (power cord on back of PDU).
6. Place the lock and tag on the main circuit breaker of the PDU.
7. Wait five minutes before accessing any high-voltage units.

General replacement procedure

WARNING	***Severe personal injury or death due to electric shock or electrocution may result if power is not removed before working inside the cabinet. Always disconnect the cabinet line cords from the AC line power receptacles before opening the system cabinet. Also, never turn on the system until all connections and safety grounds are installed.***

1. Remove power and lockout/tagout the system (see the *Lockout/Tagout* topic).
2. Disconnect and tag cabling to the unit requiring removal. Do not change cable routing or securement.
3. Properly supporting unit, remove it from the system cabinet.

Calibration

Keithley Instruments offers a fee-based calibration service with all S530 systems; a field service engineer will calibrate instrumentation and perform system confidence checks according to the system typical specifications. For more information about this calibration agreement, contact Keithley Instruments at 1-888-534-8453.

For additional information about calibration of specific Keithley Instruments, refer to that instrument's documentation before attempting to calibrate equipment. Also, refer to the supplied documentation that is located on the Keithley Instruments Complete Reference CD-ROM that was shipped with your purchase.

Restoring system power

Restore system power after properly performing the required maintenance or replacement of components; make sure that all connections are secure and connected correctly.

1. Remove the lock and tag placed on the main circuit breaker of the PDU.
2. Connect the source power to the S530 system (power cord on back of PDU).

3. Place the main circuit breaker on the PDU (on the back of the cabinet) in the **ON** position.
4. Close the rear cabinet door.
5. Make sure the system computer and all instrument power switches are in the **ON** position.
6. Close the front cabinet door.

NOTE	With the system cabinet POWER switch in the **OFF** position, the EMO light should be off. If the EMO light stays on, the power is not restored. To restore power, it may be necessary to push in and hold the **Remote EMO Bypass** switch until power has been restored to all units in the system. The **Remote EMO Bypass** switch is located on the PDU panel on the back of the system cabinet.

7. Place the system cabinet POWER switch (on the front-panel door) in the **ON** position.
8. Make sure the computer is turned on.
9. Start the computer and the system software.

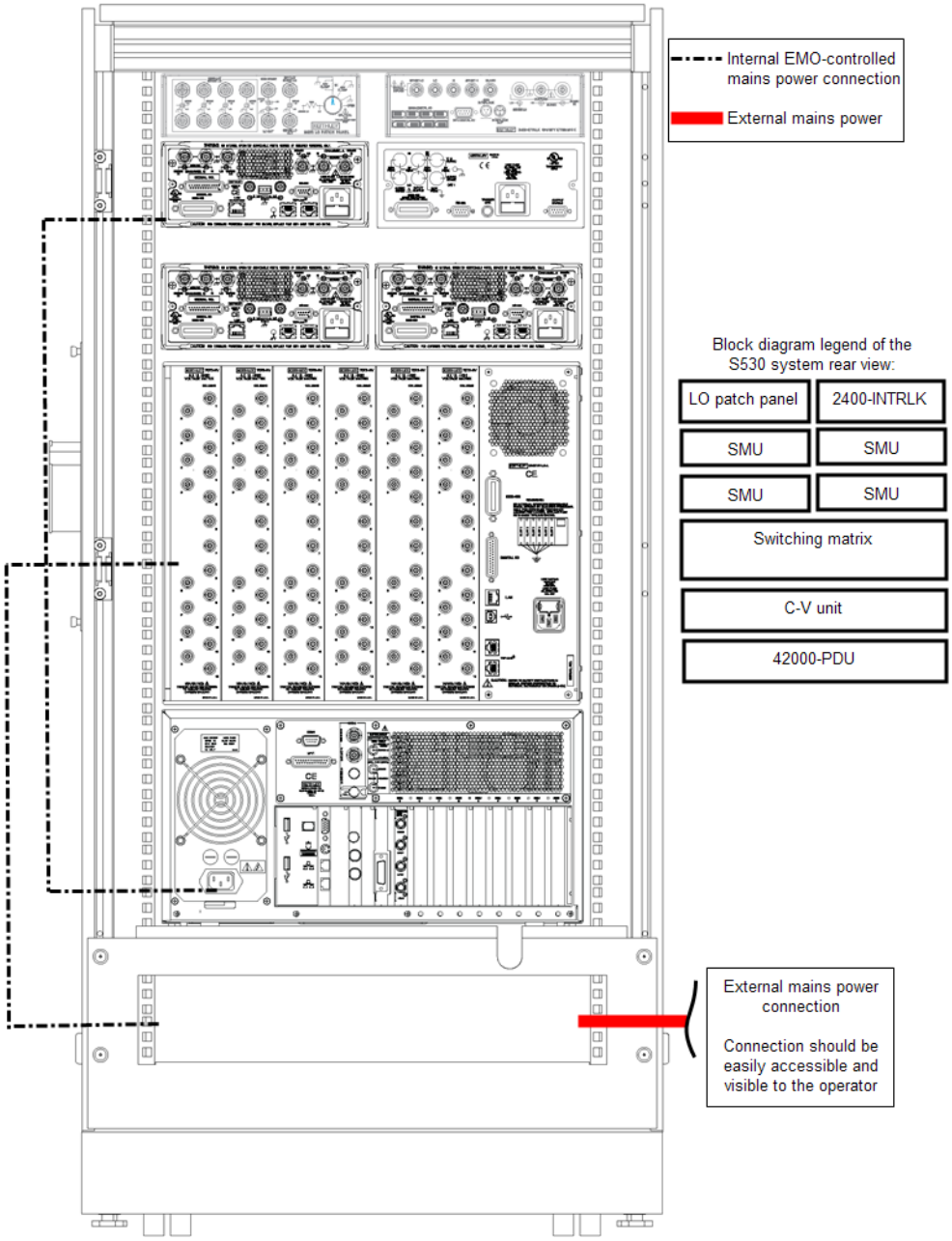
Fuses

Refer to the applicable instrument documentation that is included with the product for fuse replacement.

Power distribution and emergency off

Figure 18 contains simplified connection schematics for the various components of the S530 (the LO patch panel and the Interlock are shown for reference only; they are located behind the SMUs).

Figure 18: S530 system cabinet rear view



Power distribution unit connections and power distribution basics

The Model 42000-PDU consists of:

- 24 V DC output to Emergency OFF (EMO) circuits and cabinet fans with power
- 24 V DC output through banana jacks
- Two specially-switched power outlets (factory configuration: always on)
- Three switched four-outlet (off only with EMO condition)
- Control through a 25-pin D-sub connector

WARNING ***Properly lockout/tagout the system before beginning installation or connection. Also, never turn on the system until all connections and safety grounds are installed. Make sure the main circuit breaker on the PDU is placed in the OFF position before making or breaking any connections.***

Table 4 provides a detailed description of the available connections in the Model 42000-PDU. Information about the EMO circuit's connection and operation is also in *Table 4*.

For more detail regarding the different systems and the interconnect wiring for each, see the following figures:

Figure 19: S530 low-current two-wire diagram

Figure 20: S530 high-voltage two-wire diagram

Figure 21: S530 low-current four-wire diagram

Figure 22: S530 high-voltage four-wire diagram

Table 4: Model 42000-PDU connection descriptions

Connection	Description
Specially switched outlets	Two power outlets located on the PDU rear panel.
	WARNING ***Severe personal injury or death due to electric shock or electrocution may result if power is not removed before working inside the cabinet. Do not use power outlets for accessories (for example, a soldering iron, or drill). Use for instruments that do not have hazardous voltages and do not need to have power removed through the EMO circuit (for example, a computer). In the factory default configuration, these outlets have dedicated power and will remain live even if power is removed through the EMO circuit.***
	The specific configuration is marked on the PDU rear panel[2].
To PDU box DB-25 cable connector	Connector providing control of the PDU box. Connect the PDU box to the EMO box with the supplied DB-25 male-to-female cable.
Switched outlets	Twelve power outlets located on the PDU rear panel. Do not use power outlets for accessories (for example, soldering iron, drill, etc.). Use for equipment with hazardous voltages that need to be removed with the EMO circuitry. [2]
Ground connection (optional)	Connect to a quality ground within your facility with 18 AWG wire.
External fan connection	Connector providing 24 V DC to cabinet fans.
External EMO/shorting plug connection	DB-25 providing connection to external EMO devices. Make sure the shorting plug is installed if the system is not configured for external EMO.
To EMO box DB-25 cable connector	Connector providing control of the PDU box. Connect EMO box to the PDU box with the supplied DB-25 male-to-female cable.
24 VDC (-) banana plug	Banana plug providing 24VDC (-) power connection.
24 VDC (+) banana plug	Banana plug providing 24VDC (+) power connection.

[2] Outlet connector description:
- Class 1 applications (42000-PDU (PDU/E)(PDU/E-2K) 15 A and 42000-PDU-2K 20 A.
- Type: Push-in mount mates with IEC standard 320 C20 (20 A) or the IEC standard 320 C14 (15 A) power cords.

Patch panel

The LO patch panel on the Series 530 cabinet is used to provide a common reference point for all instrument lows. This reference point can be switched to safety ground directly through a 42V clamp, a clamp with a parallel 1kOhm resistor, or left open (floating; not recommended for anything except internal testing). The patch panel also provides a common connection for sense low terminals of all SMUs if 4-wire configurations are used. Additionally, a 100kOhm resistor between the low and sense-low enables auto-sensing. The default position is the clamp with the parallel 1k Ohm resistor.

Interlock

The 2400-INTRLK is used to provide a safety interlock for the Model 2410 (with mechanical relays) and an interlock signal distribution for other instruments located in the Series 530 cabinet. For example, the Series 2600A instruments and the Model 4200.

Protection modules

Depending on specific components used within each protection module, it can be used to provide functional protection from high voltage and (or) high current to various SMUs or CVUs. For example, the Series 2600A instruments and the Model 4200.

Instrument specifications and documentation

For more information about instruments used in the S530 Parametric Test System, refer to the documentation for each specific Keithley Instruments model:

- Model 4200-SCS
- Model 4220-PGU pulse card
- Model 4200-SCP2HR scope card
- Model 707B switching matrix
- Model 2410 high-voltage SourceMeter
- Model 2010 DMM
- Series 2600A system SourceMeter

Also, refer to the supplied documentation that is located on the Keithley Instruments Complete Reference CD-ROM that was shipped with your purchase. You can also visit the Keithley Instruments website at www.keithley.com to search for updated information by model number.

NOTE Example wiring diagrams for the S530 test system are shown on the following pages.

Model 7530 matrix cards

The S530 System can now support Model 7530 matrix cards, which can provide Kelvin connection for up to 48 pins to the probe card adaptor (PCA). The following diagrams show typical matrix connections for both standard and optional instrumentation.

Standard instrumentation

Typical matrix connections for standard instrumentation is shown in *Figure 23*. The first two slots are used for instrument cards. The remaining four slots can be used for pin cards. This will provide Kelvin connections for 24 instrument terminals and 48 pin terminals.

Optional instrumentation

KTE v5.4.0 supports several optional instruments:

- Model 2010 DMM (used as a sensitive DC-voltmeter only)
- Model 4220-PGU pulse card
- Model 4200-SCP2HR card (used for ring oscillator measurement)

The following diagrams show examples of how these instruments can be connected to the matrix. Please note the cards/columns of each instrument connection shown in the following diagrams may differ from your actual system. The flexibility of the S530 configuration allows for various numbers and combinations of instruments. Attempting to show examples of every possible scenario would be prohibitive.

Figure 24: S530 low-current using Model 2010 DMM

Figure 25: S530 high-voltage system using Model 2010 DMM

NOTE	The Model 2010 DMM is only connected to the “Force” side of the matrix, however, both the force and sense connections need to be configured in the icconfig_<QMO>.ini file.

Figure 26: S530 low-current using Model 4220-PGU pulse generator card

Figure 27: S530 high-voltage system using Model 4220-PGU pulse generator card

Figure 28: S530 low-current using Model 4200-SCP2HR scope card

Figure 29: S530 high-voltage system using Model 4200-SCP2HR scope card

S530 KTE communication diagram

The S530 KTE System uses both Ethernet and GPIB to communicate with and control the instruments. The diagrams shown in *Figure 30* show how the instruments are connected to each other and what type of communications is used.

Figure 19: S530 low-current two-wire diagram

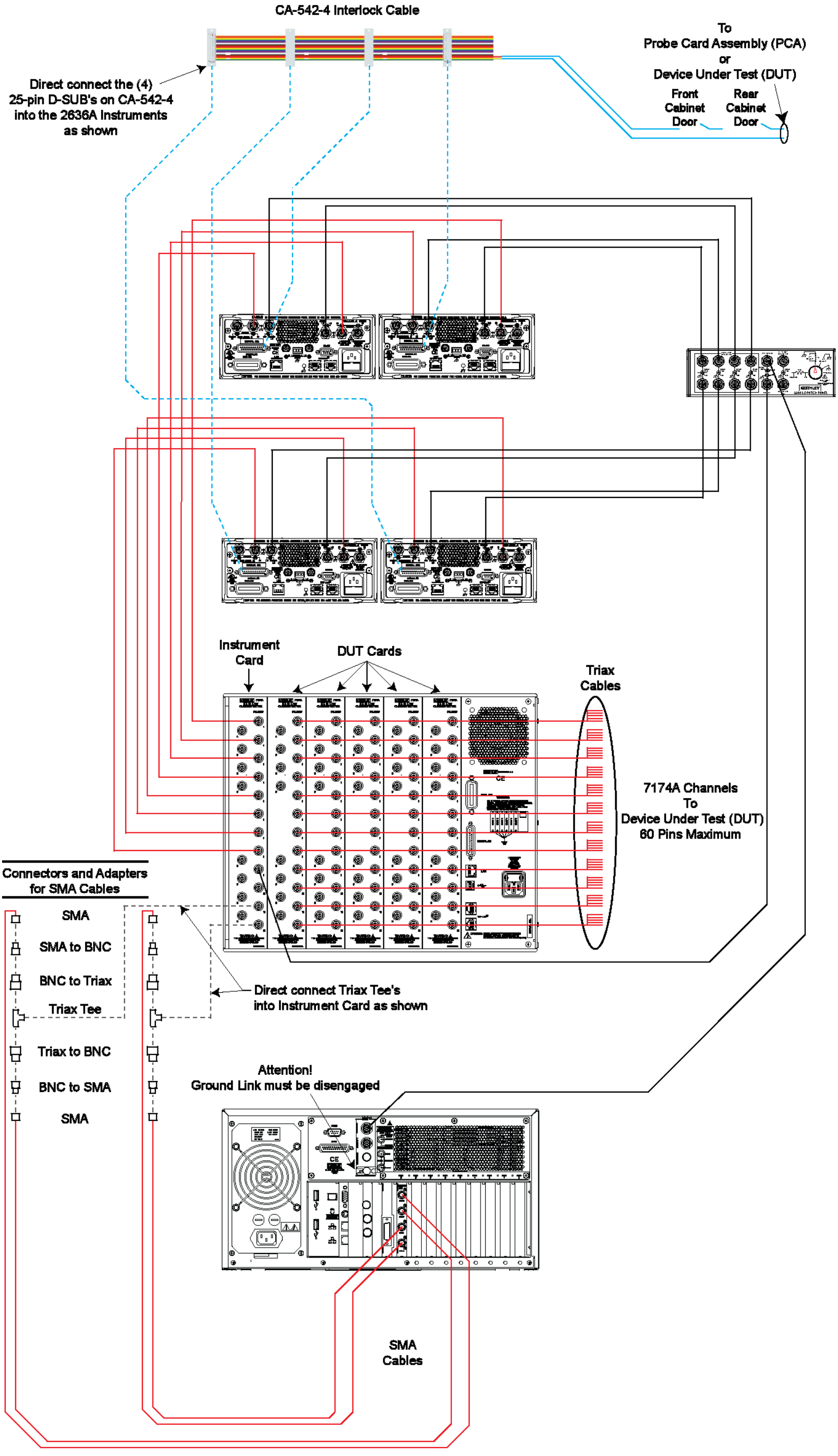


Figure 20: S530 high-voltage two-wire diagram

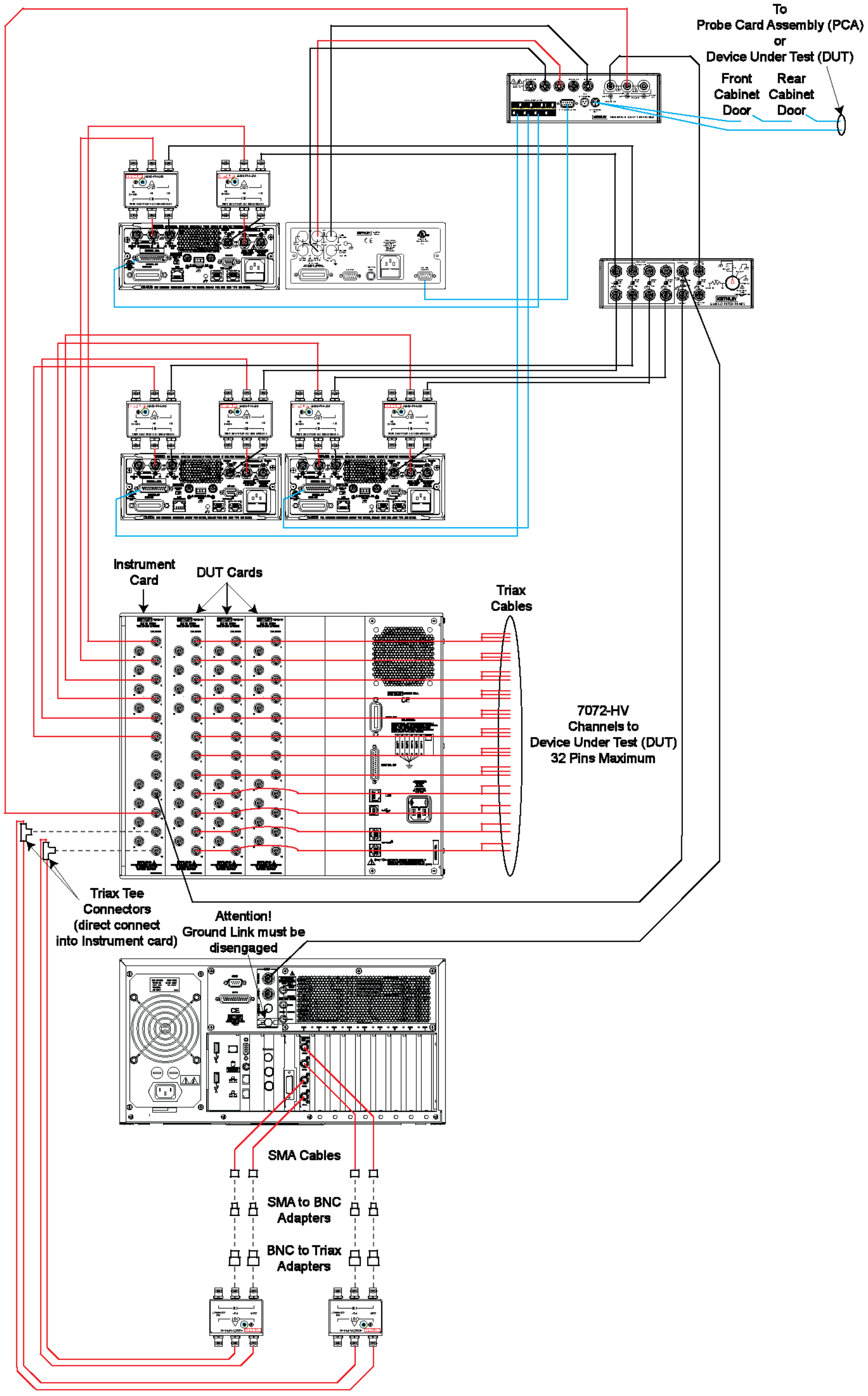


Figure 21: S530 low-current four-wire diagram

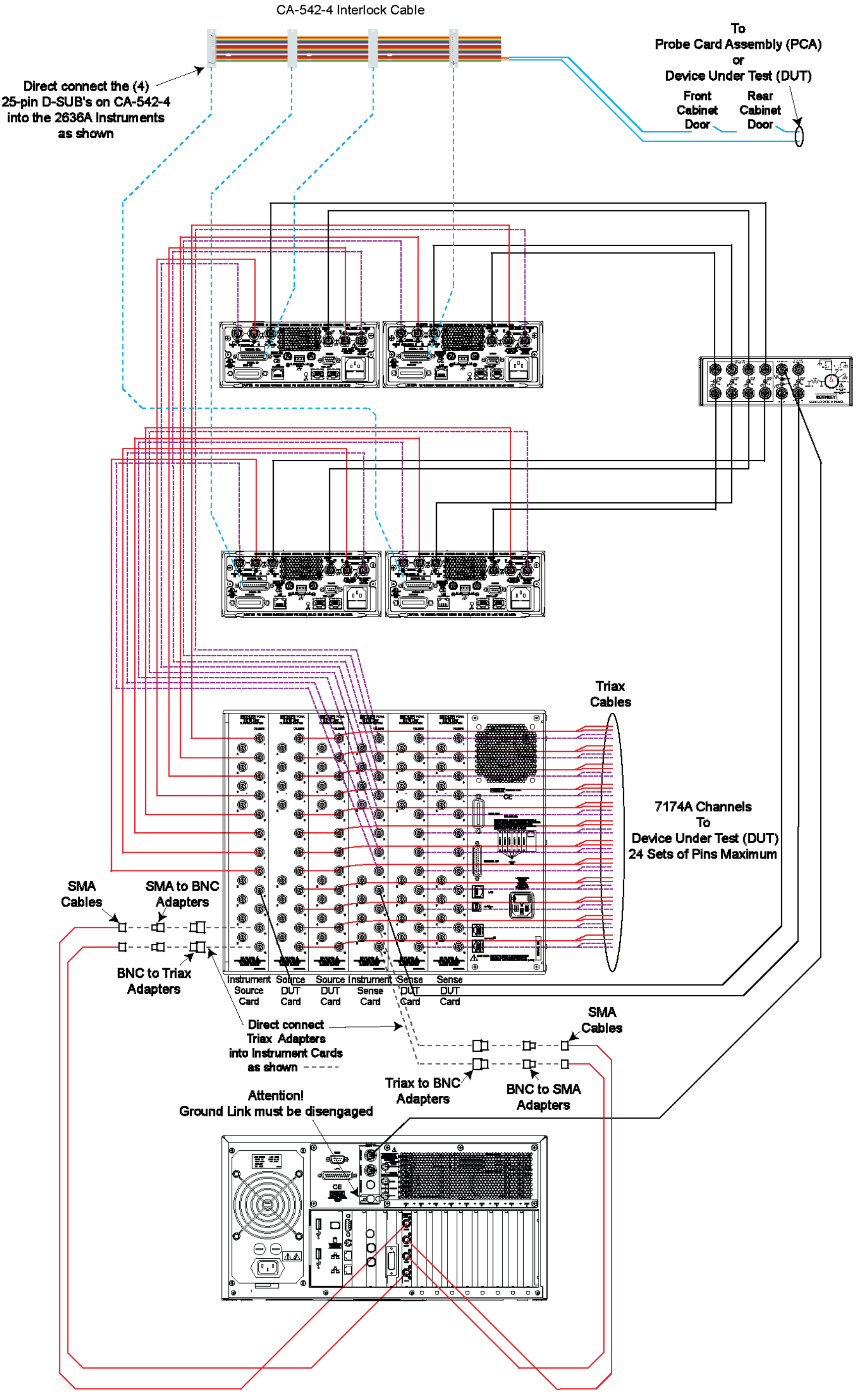


Figure 22: S530 high-voltage four-wire diagram

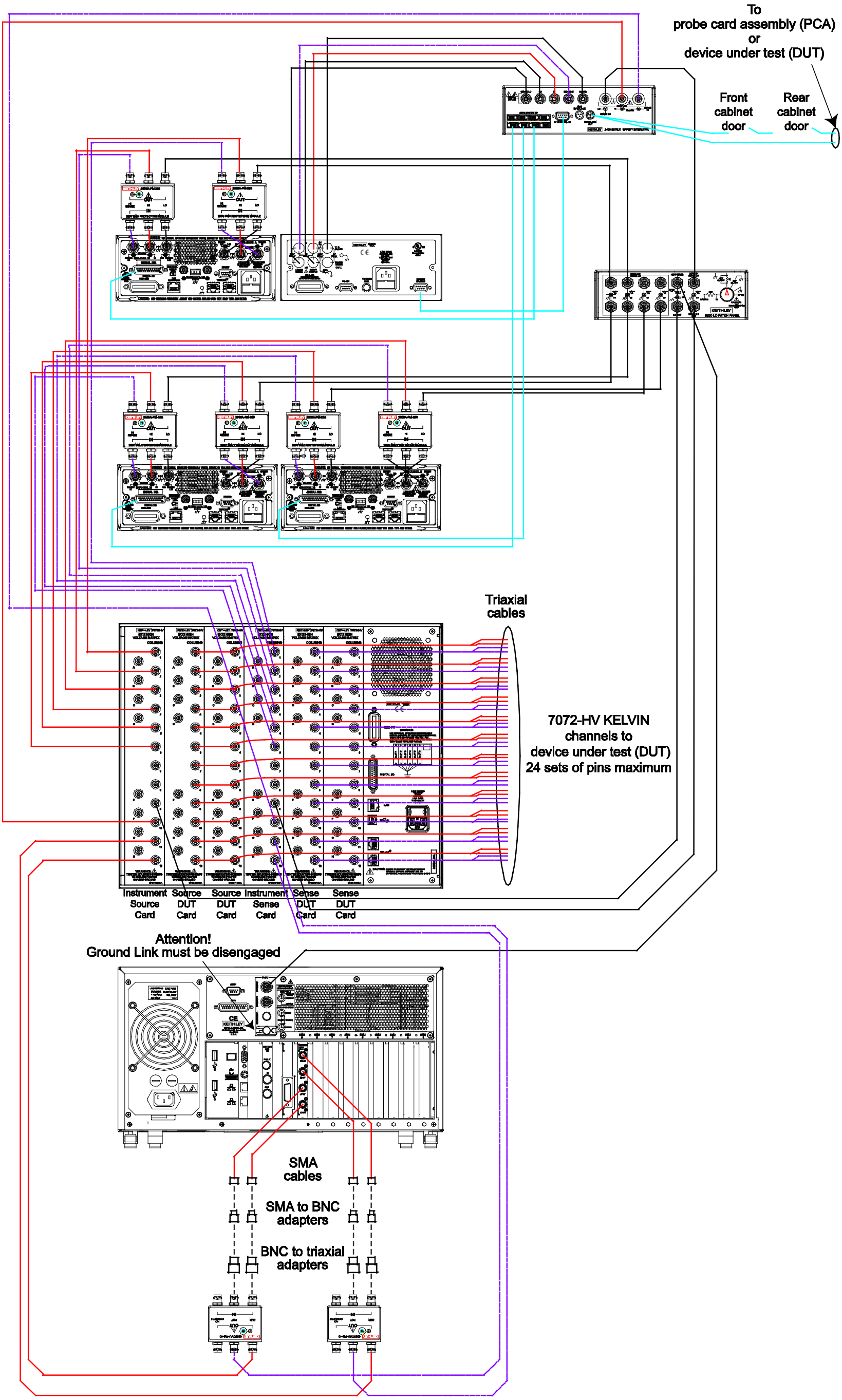


Figure 23: S530 standard 4-wire low-current

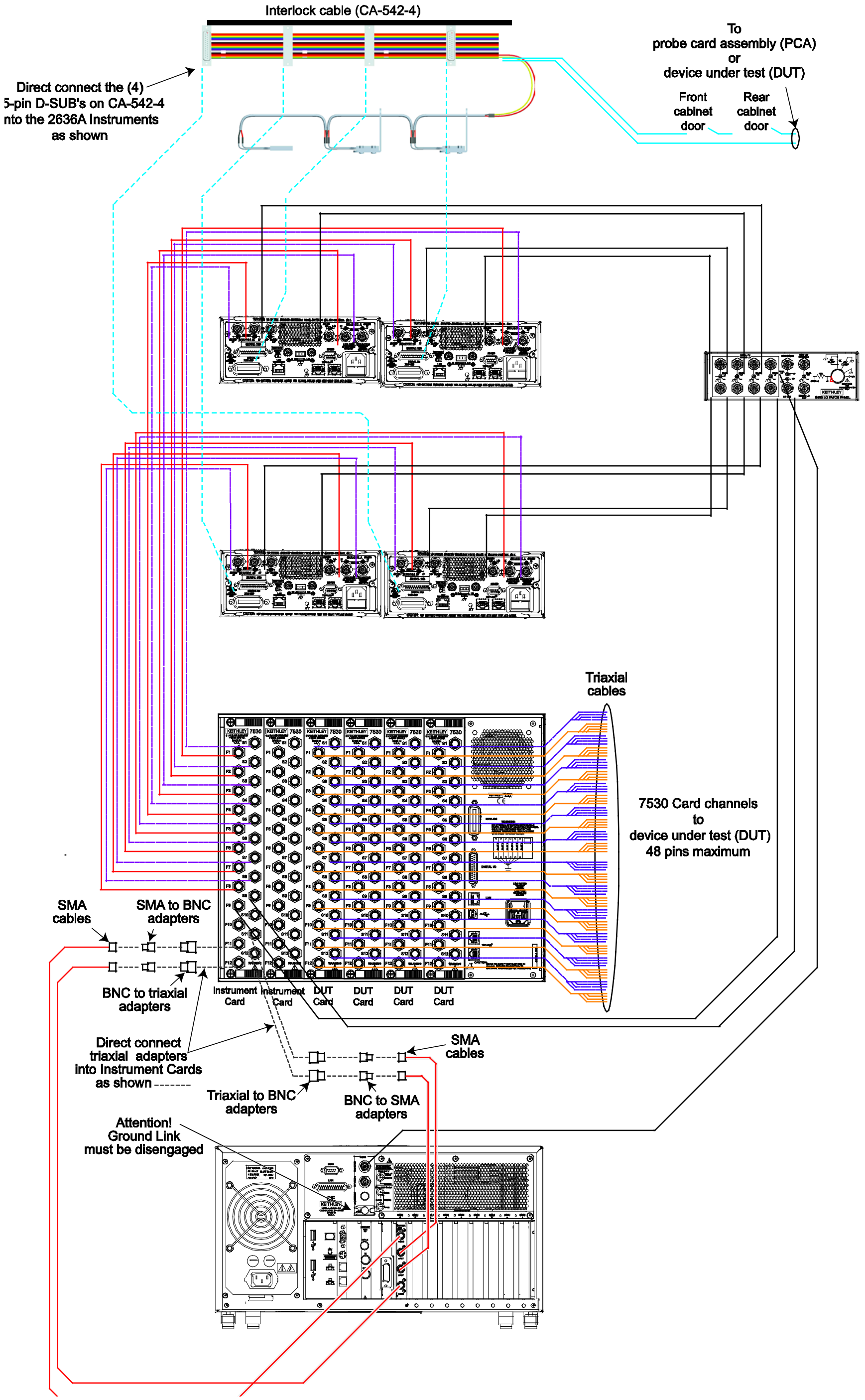


Figure 24: S530 low-current using Model 2010 DMM

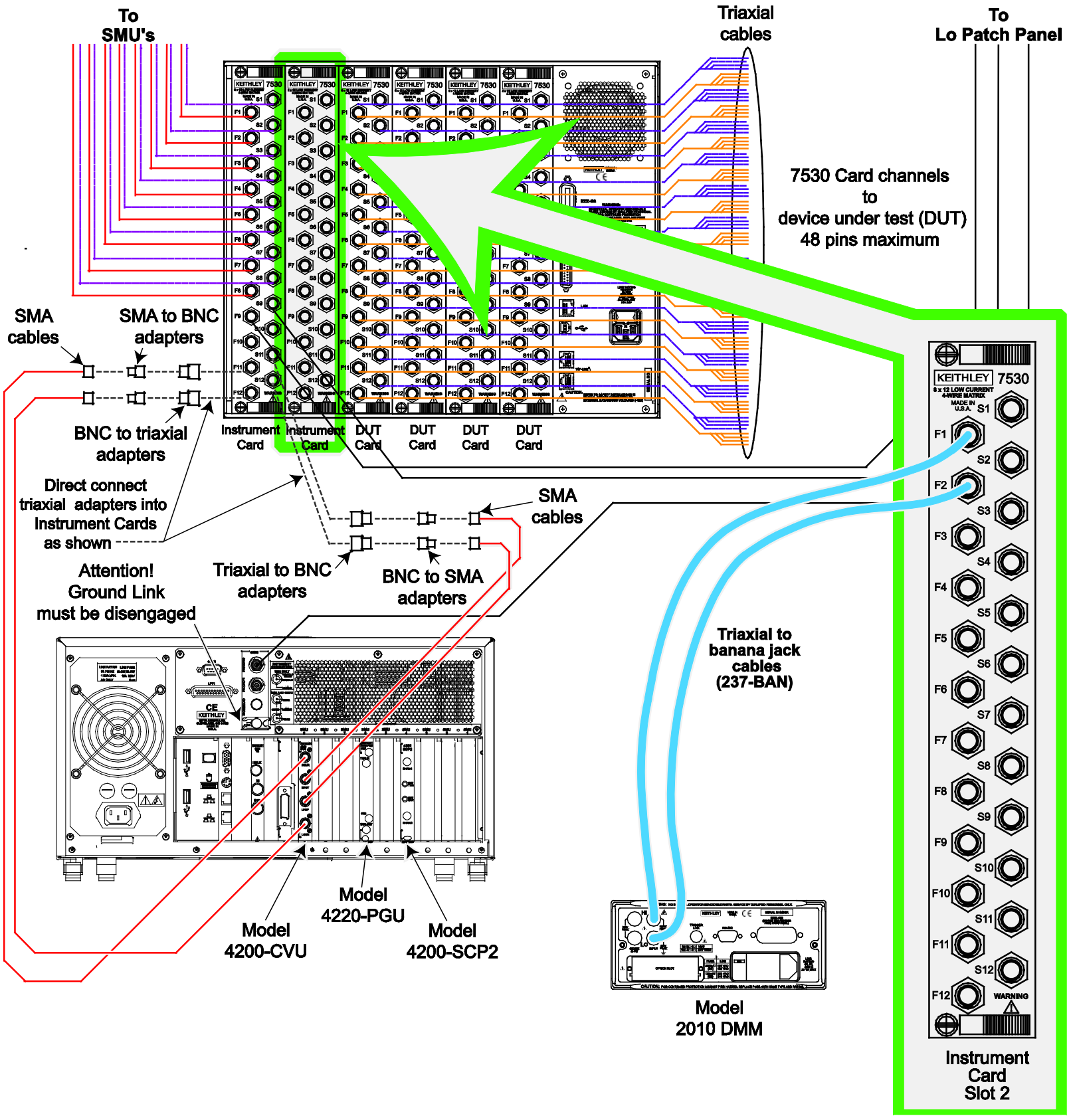


Figure 25: S530 high-voltage system using Model 2010 DMM

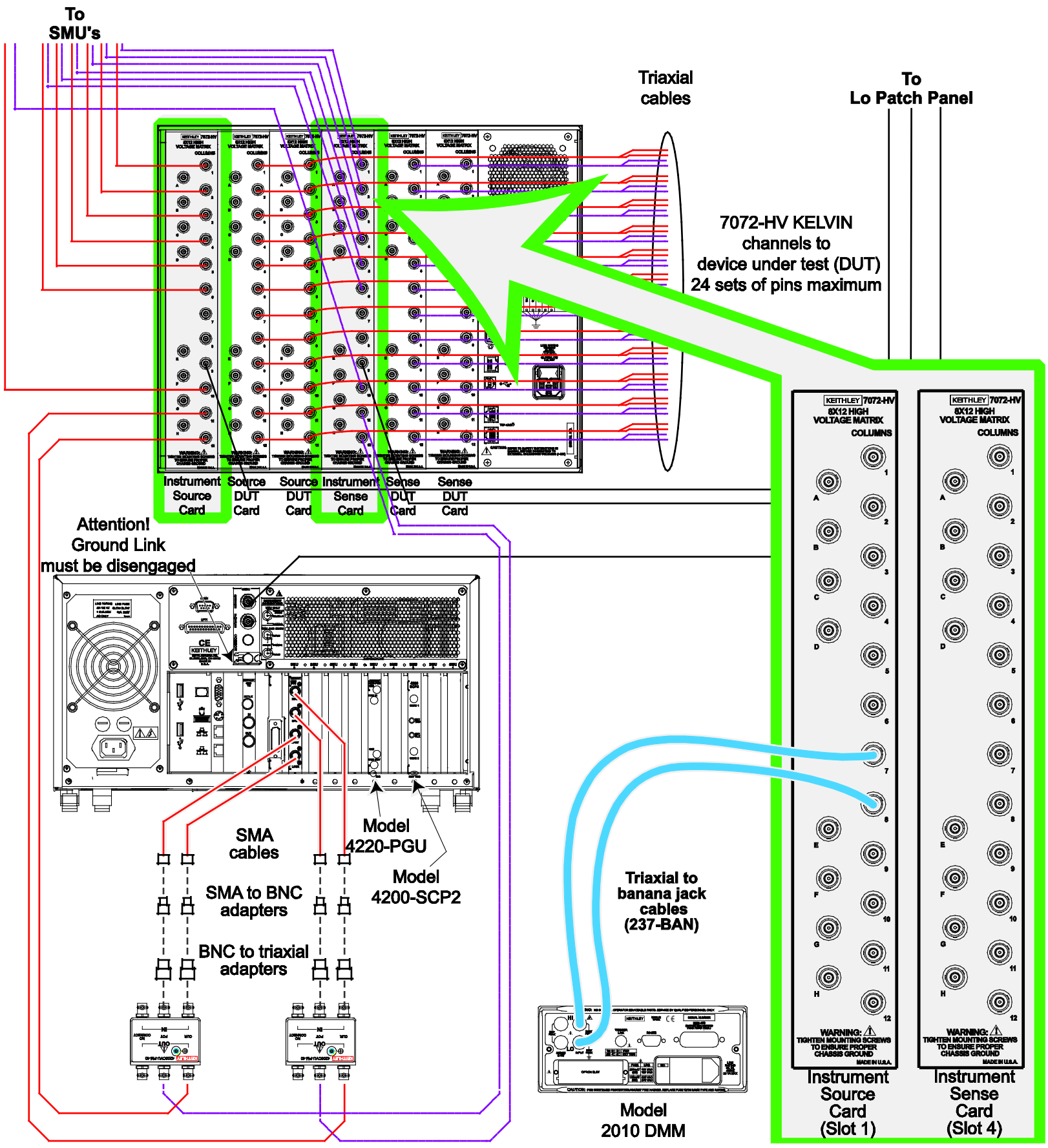


Figure 26: S530 low-current using Model 4220-PGU pulse generator card

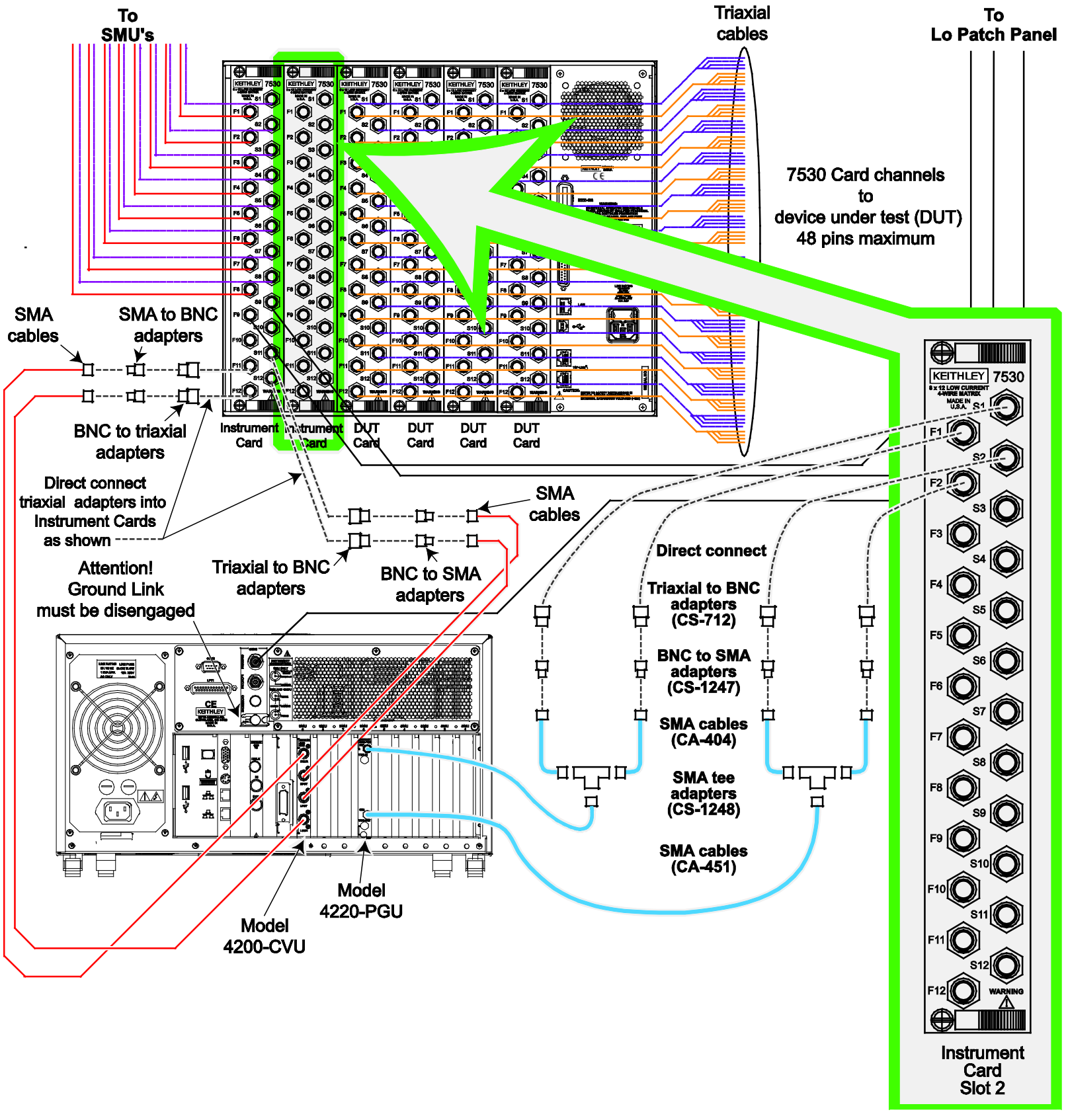


Figure 27: S530 high-voltage system using Model 4220-PGU pulse generator card

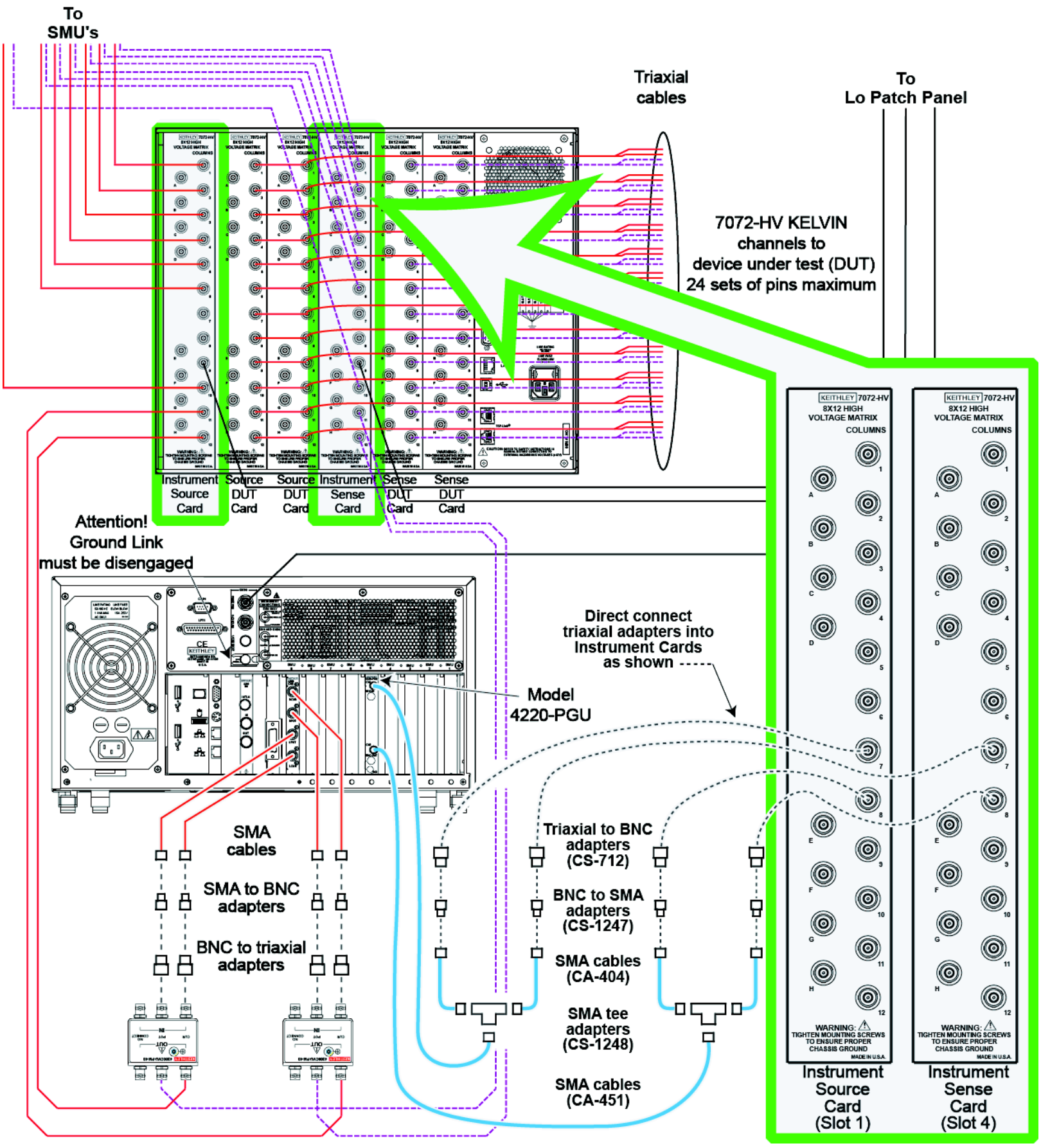


Figure 28: S530 low-current using Model 4200-SCP2HR scope card

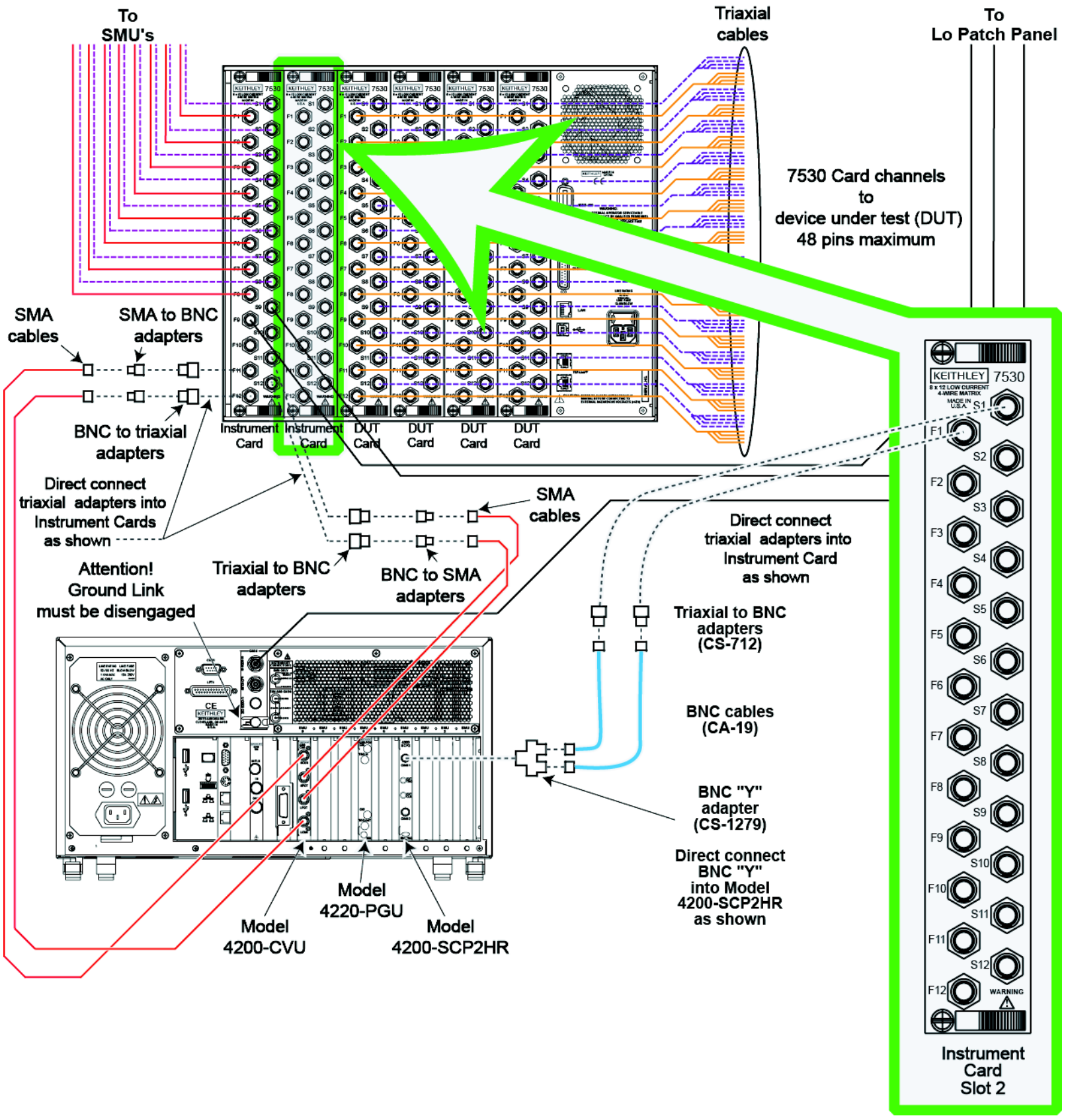


Figure 29: S530 high-voltage system using Model 4200-SCP2HR scope card

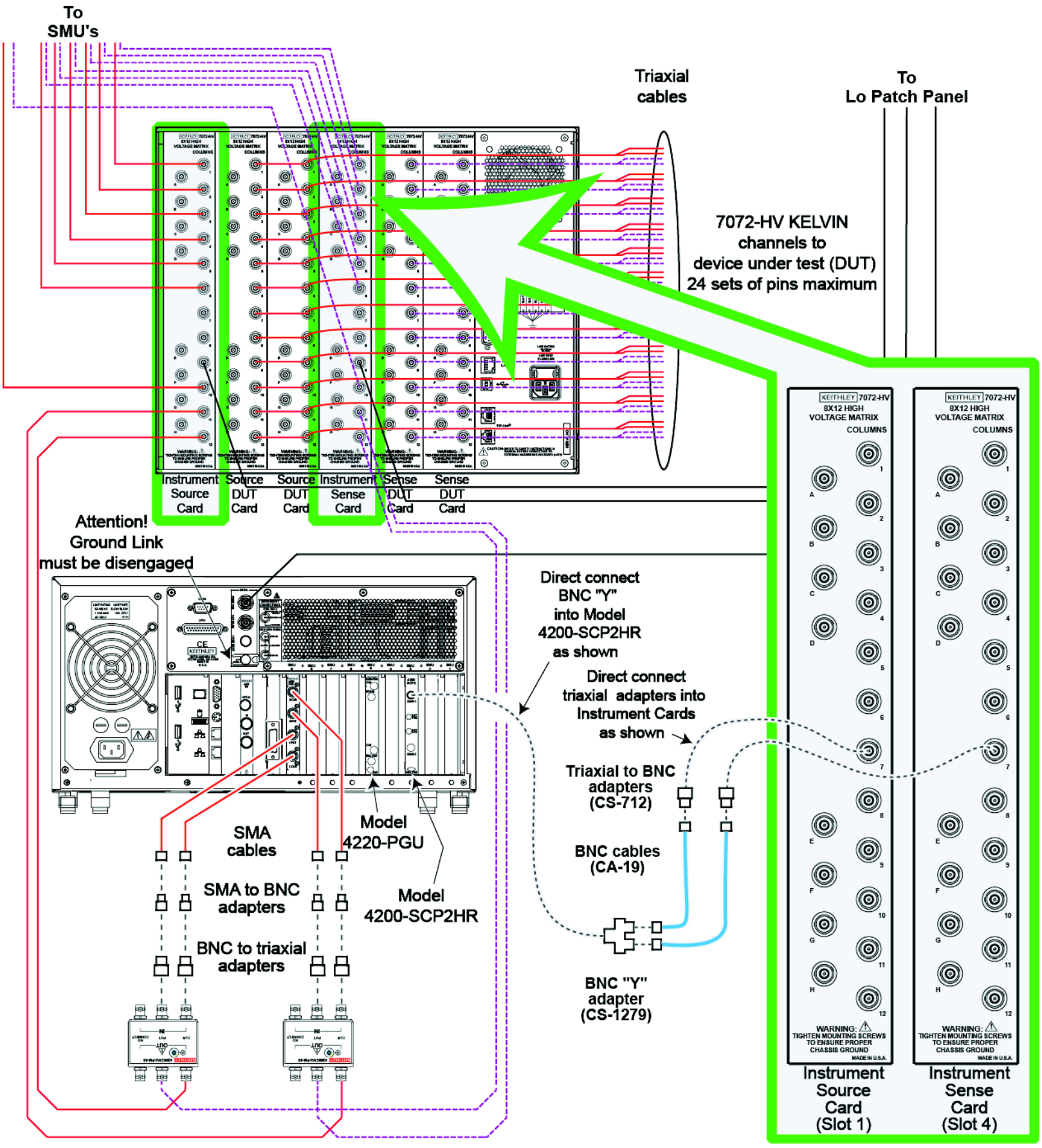
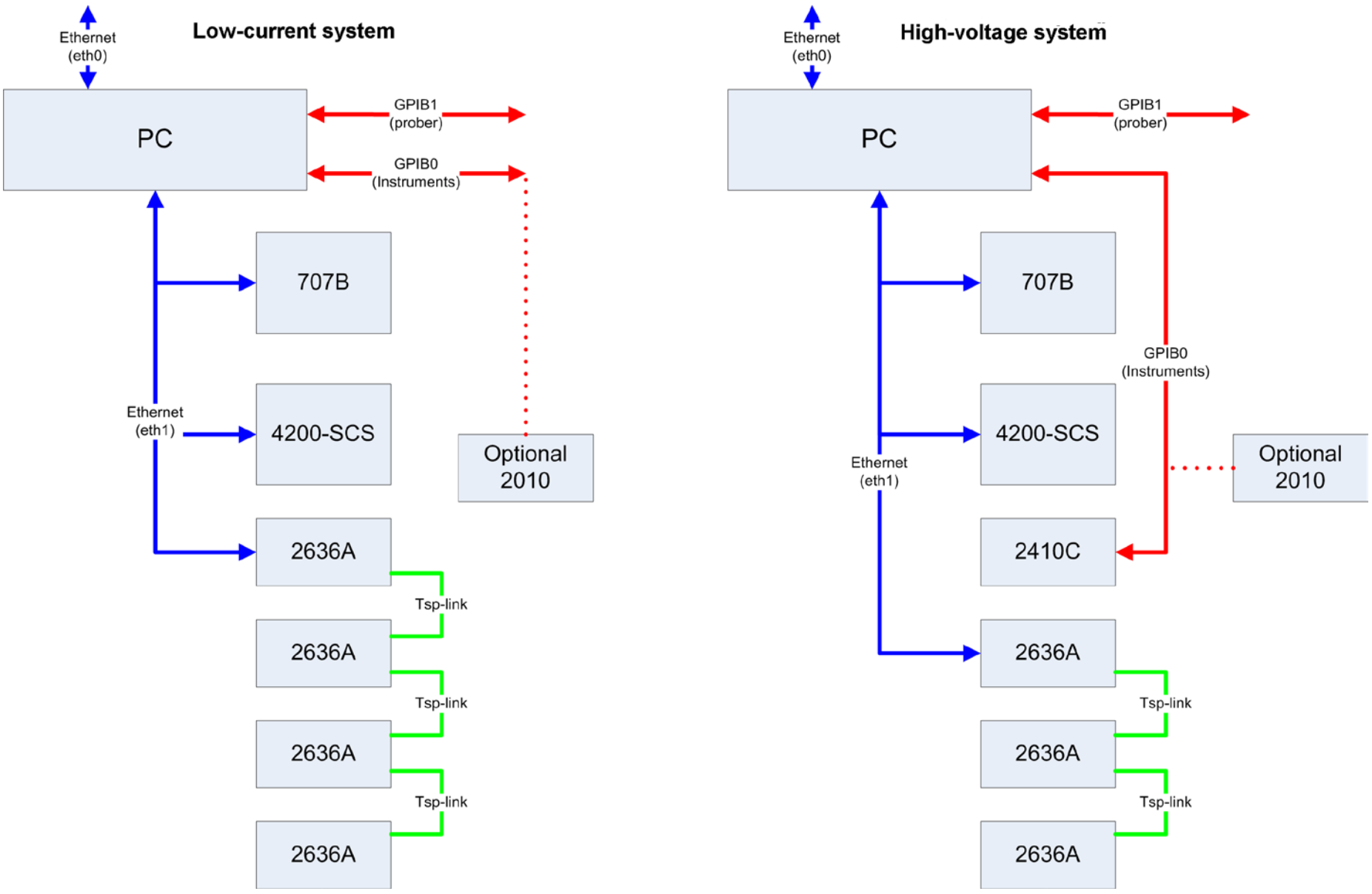


Figure 30: S530 KTE communications diagram



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