KEITHLEY
A Tektronix Company

S500 Integrated Test System

Administrative Guide

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

System Description

The S500 Integrated Test System is an instrument-based system configuration from Keithley Instruments used primarily for semiconductor parametric characterization testing. The S500 has a wide degree of hardware flexibility, allowing users to configure a system best suited for their applications. Table 1 lists general S500 configuration options, while Table 2 lists configurations used specifically for High Voltage and/or High Current testing of high-power semiconductor devices.

Table 1
S500 system configuration choices

Series 2600 System SourceMeter® Instruments	• 0 to 22* • Any combination of 2612s or 2636s
Model 4200-SCS/C Semiconductor Characterization System	• 0 to 4* • With 4200-SMUs, 4210-SMUs, 4210-CVU, 4220-PGUs, 4225-PMUs, or 4200-PAs • /F or /C chassis (with or without flat panel display, respectively)
Switching	One of the following four choices: • None • 0 to 4 ea. 708B*. Choice of switching card: a) 1 ea. 7072, or b) 1 ea. 7072-HV, or c) 1 ea. 7174A • 0 to 3 ea. 707B*. Choice of switching cards: a) 1 to 6 ea. 7072, or b) 1 to 6 ea. 7072-HV, or c) 1 to 6 ea. 7174A • 0 to 6 ea. 3706A*. Choice of switching cards (per mainframe): a) 1 to 6 ea. 3720, or b) 1 to 6 ea. 3721, or c) 1 to 6 ea. 3722, or d) 1 to 6 ea. 3723, or e) 1 to 6 ea. 3730, or f) 1 to 6 ea. 3740
Cabinet selection	• 37U with or without vented front door • 37U with or without advanced seismic reinforcement • 23U with or without partially-vented front door
Computer selection – Industrial PC with RAID Linux® or Microsoft Windows® operating system	• None • Internal computer
Flat panel display selection	• None • Monitor with support arm • Monitor installed externally
Other options	• Adjustable cable support arm

*Maximum number depends on system cabinet height of 37U as well as other items selected.

Table 2
S500 high power semiconductor testing configuration choices

Series 2600 System SourceMeter® Instruments	• 0 to 3 • Either 2612s or 2636s
2657A High Power SourceMeter® Instruments	• 0 to 2 • (not in series or parallel)
2651A High Power SourceMeter® Instruments	• 0 to 2 • (2 units allow 100 A parallel operation)
CV Meter (4200-SCS-NOSMU with 4210-CVU)	• 0 to 1 • /F or /C chassis (with or without flat panel display, respectively)
8020 High Power Interface Panel	• 0 to 2 • Optional 3 kV CV hardware • Choice of output connectors (Keithley high-voltage triaxial, standard triaxial, SHV, or Agilent high-voltage triaxial) • Optional unit support arm
8010 High Power Device Test Fixture	• 0 to 2
Cabinet selection	• 23U with or without vented front door
Computer selection – Industrial PC with RAID (Linux or Windows operating system)	• 0 to 1. However, if the 4200-SCS (Semiconductor Characterization System) is included, this unit serves as the system computer. • Internal or external computer
Flat panel display selection	• None (with 4200-SCS/F-NOSMU option) • Monitor with support arm • Monitor installed externally

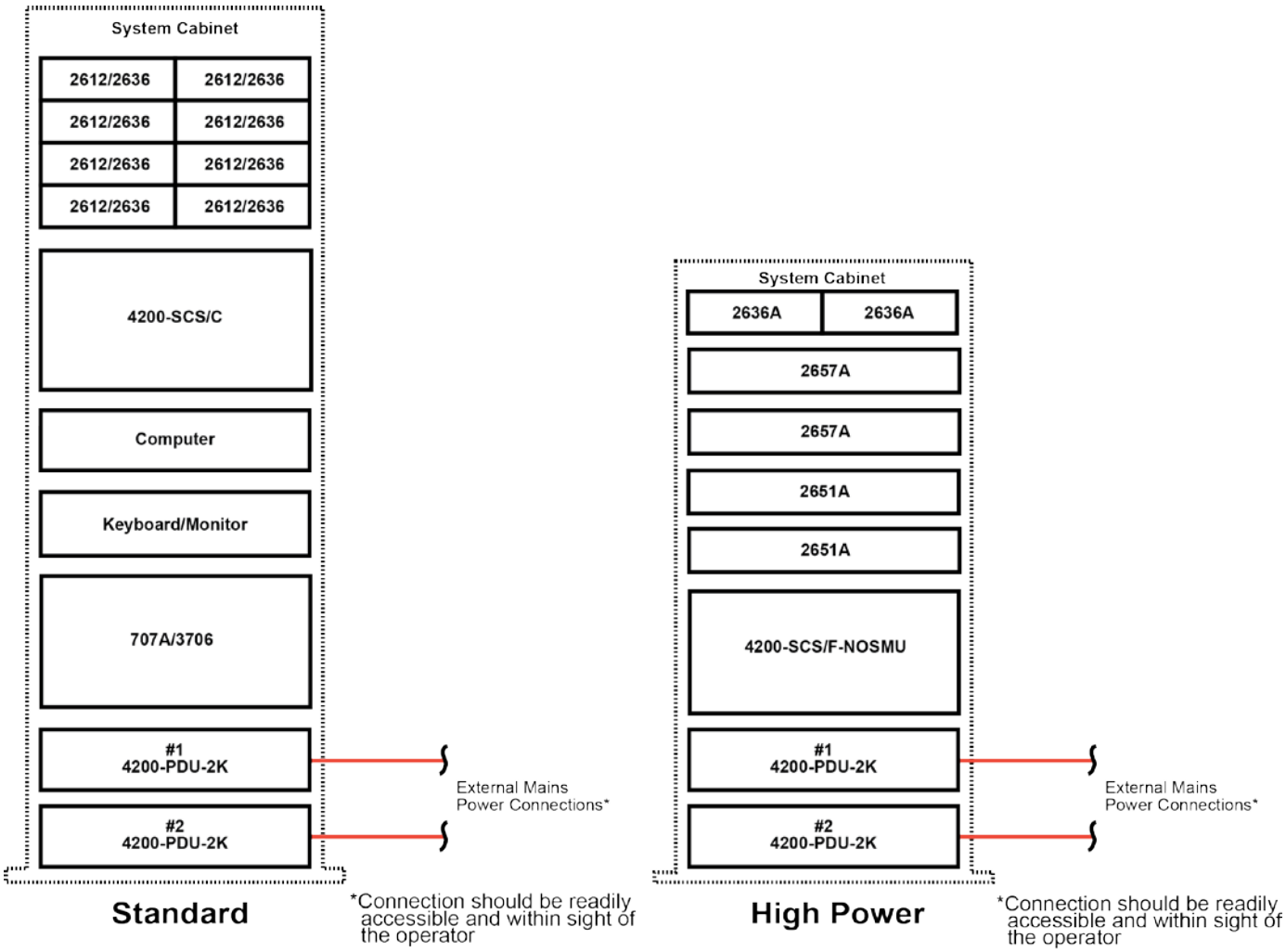
Examples of other items and accessories to accompany the S500 system:

- Cables (from system to probe station)
- 9139A Probe Card Adapter
- Other Keithley instruments

System software options for the S500

- Keithley Instruments offers the Automated Characterization Suite (ACS) for test and prober automation and parametric device characterization. For 2600-series wafer level reliability (WLR) testing, the optional ACS-2600-RTM can be used with ACS for single device or parallel device testing.
- ACS Basic Edition can be used when prober automation is not required.
- Independently-developed software can also be used.

Figure 1: Block diagram for a typical Standard and High Power S500 configuration



Power distribution unit (PDU) connections and power distribution basics

The Model 42000-PDU consists of a 24 V DC output to supply EMO circuitry with power. This supply also provides 24 V DC out through banana jacks. Additional outlets provided are two specially switched power outlets (factory configuration: Always on), and three strips of four switched outlets (off only with EMO condition). Control is through a 25-pin D-sub connector.

Site Preparation & Installation

Unpacking the S500 system

The Keithley field service engineer (FSE) is responsible for unpacking the S500 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:

- Safety glasses
- Gloves
- Standard screwdriver
- Socket wrench
- Socket head: 19 mm (or 3/4 in.)

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

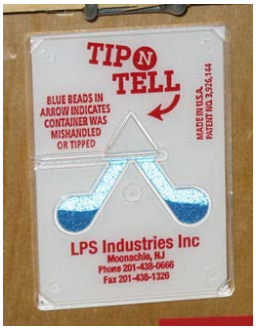
Figure 2: S500 system cabinet in shipping crate

Unpacking system components

Inspect the shock sensor located on the outside of the shipping box (see next figure). 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 the appropriate figure). 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: S500 Crate shock sensor

Figure 4: S500 Crate tipping indicator



NOTE

You will need at least two people to unpack and move the S500 system cabinet.

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

Figure 5: Removing the clamps

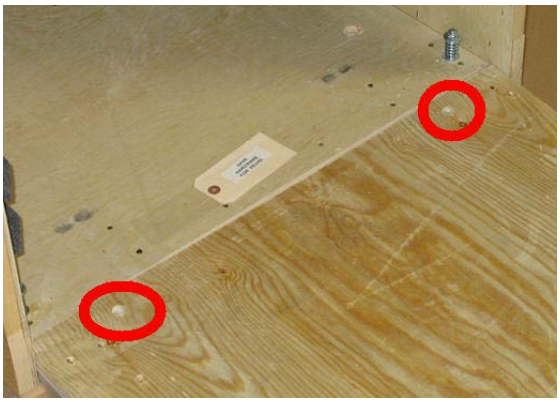
2. Open the front of the crate. The front is identified by the wooden ramp support attached across the panel (see next figure).

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

Figure 6: Opening the front of the crate

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

Figure 7: Front of crate with ramp down



5. Remove the padding from the front of the S500 system cabinet.

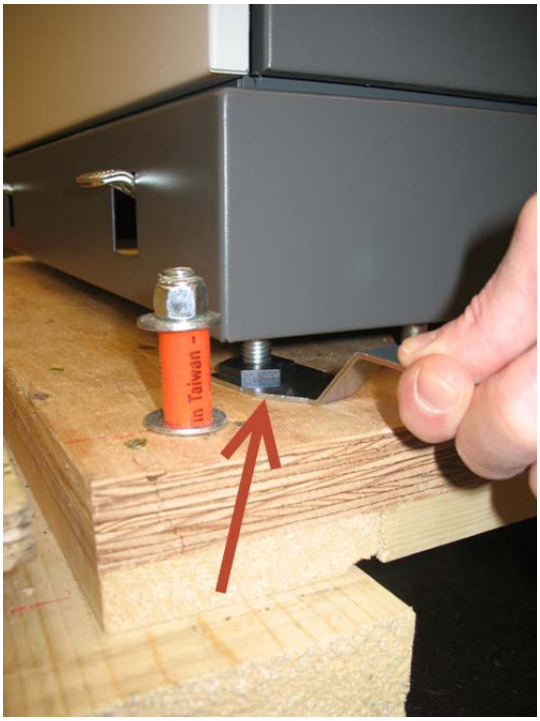
Figure 8: Removing padding from cabinet

6. Remove clamps and slide the outer box cover off of the crate.

Figure 9: Front of crate outer box off

7. Make sure that you retract the leveling feet on the bottom of the system (next to the casters), in order to put weight on the casters and prepare the system so that it can be rolled down the ramp.

Figure 10: Leveling feet



8. Remove the four bolts from the bottom of the crate that are attached to the bottom of the S500 system cabinet using a 19 mm socket head on a socket wrench.

Figure 11: S500 system bolted to crate

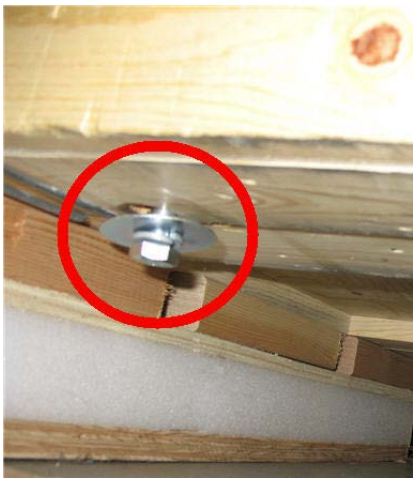
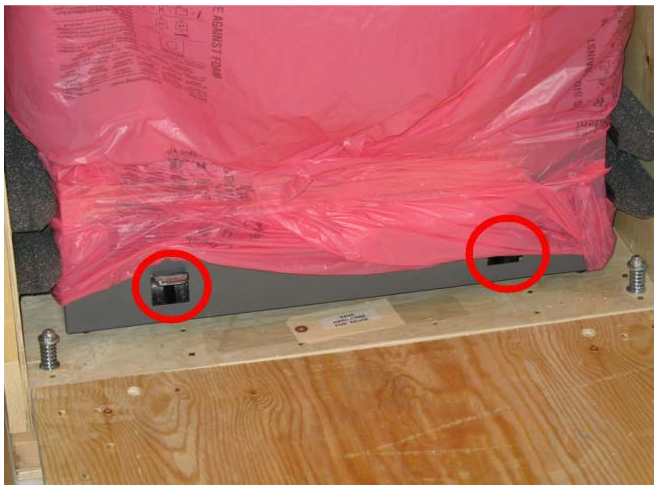


Figure 12: Removing bolts from crate

Figure 13: S500 system crate hardware

9. Unlock the two wheels (casters) that are on the front of the S500 system cabinet by moving the locks up.

Figure 14: Cabinet caster locks moved up



10. With two people, slide the S500 system cabinet down the ramp.

Figure 15: S500 sliding down ramp

11. Remove the tape from the packing material using scissors, taking care not to scratch the S500 system cabinet.

Figure 16: Cuting the wrap off the system

12. Move the S500 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 S500 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 next figure).

Figure 17: S500 system accessories box

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, for example, cables to connect to the test fixture or probe card adapter, Model 9139A-PCA, heavy duty seismic kit, or the rear cable support arm. You will also find all of the necessary documentation that is shipped with your order. See the following figures. Please reuse or recycle packaging materials in accordance with your local requirements.

Figure 18: Typical S500 system accessories

Figure 19: S500 monitor arm accessory

Figure 20: 8020 support arm accessory (S500 high power units only)

Figure 21: S500 keyboard tray and arm accessory

Keithley Field Service Engineer (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 monitor to the monitor arm.
- Install the Model 8020 High Power Interface Panel
- Install the Model 8020 support arm (high power S500 units only)
- 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 S500 system cabinet) and power up the entire cabinet.
- Verify communications of all instruments and with the properly configured prober.
- Perform diagnostics and system verification tests on the entire S500 system, to include the 60190-PCA (if ordered).
- Record all of the information on the System Installation Form.

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 S500 systems that are configured to operate between 100 V and 120 V, a 20 A circuit must be used, and for 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 S500 depends on the type and number of instruments in the test system. 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 26XXB instrument detects an excessive heat condition, the unit turns the output off to minimize power dissipation. This safeguard prevents damage to individual Series 26XXB 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 26XXB 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 26XXB SourceMeter® instruments, refer to the supplied documentation that is located on the Keithley Instruments CD-ROM that was shipped with your purchase.

Operating environment conditions

The S500 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 percent to 60 percent 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 S500 system is compatible for use in a Class 10 clean room.

Audible system noise: dB level is 65.

Air flow: The S500 system is configured for top to bottom air flow.

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

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

- Avoid locating the S500 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.

Triaxial connector handling and contamination

Keep source-measure triaxial cable connectors (if applicable) clean and free of any foreign contaminants. Do not touch the connector pins of the triaxial 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 triaxial 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

A 50.80 cm (20 in.) Hg (which is the same as 40.73 PSI), with a hose connection of .64 cm (1/4 in.) outside diameter and .32 cm (1/8 in.) 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 next figure).

Figure 22: 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.

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 (on page 25).

⚠ 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 597 mm (23.5 in.) 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 in this document).

⚠ WARNING

Seismic securement is required for safety of the S500 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 1.2 m x 2.1 m (4 ft. x 7 ft.). The next figures show a top view of the floor plan for the S500 37U and 23U and an overall cabinet dimension diagram for both units.

Figure 23: S500 37U system floor plan, top view

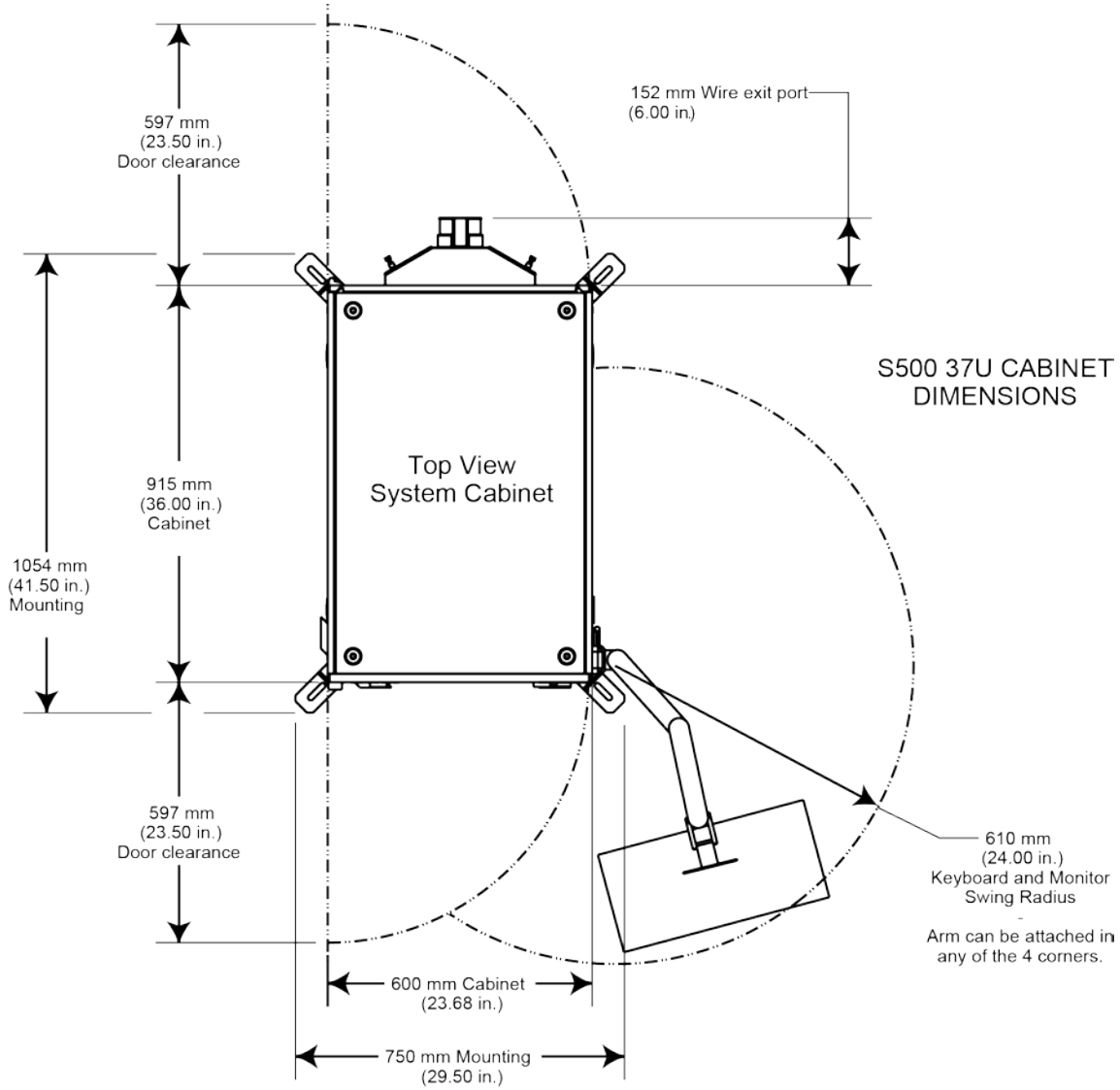


Figure 24: S500 23U system floor plan, top view

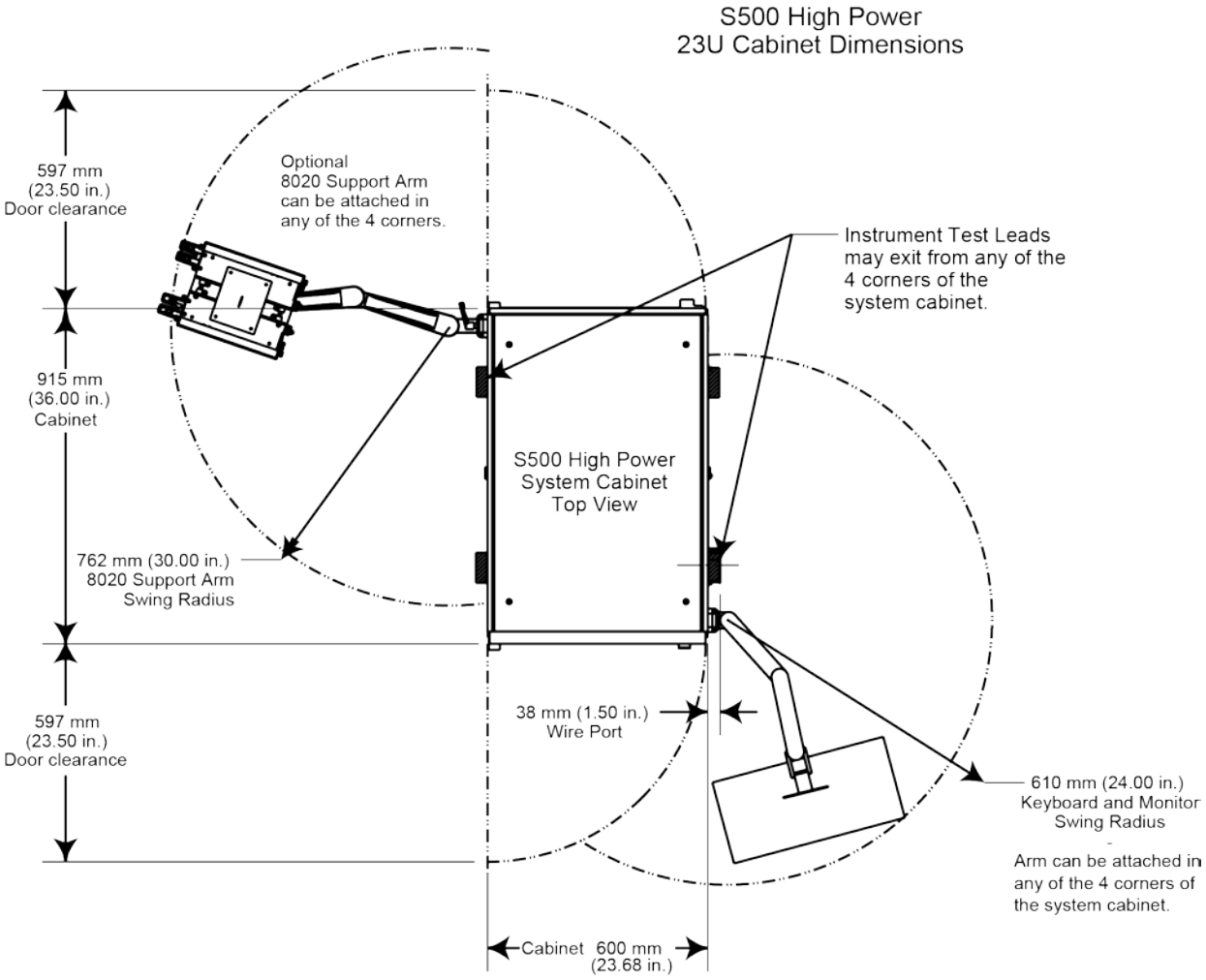


Figure 25: S500 37U cabinet dimensions

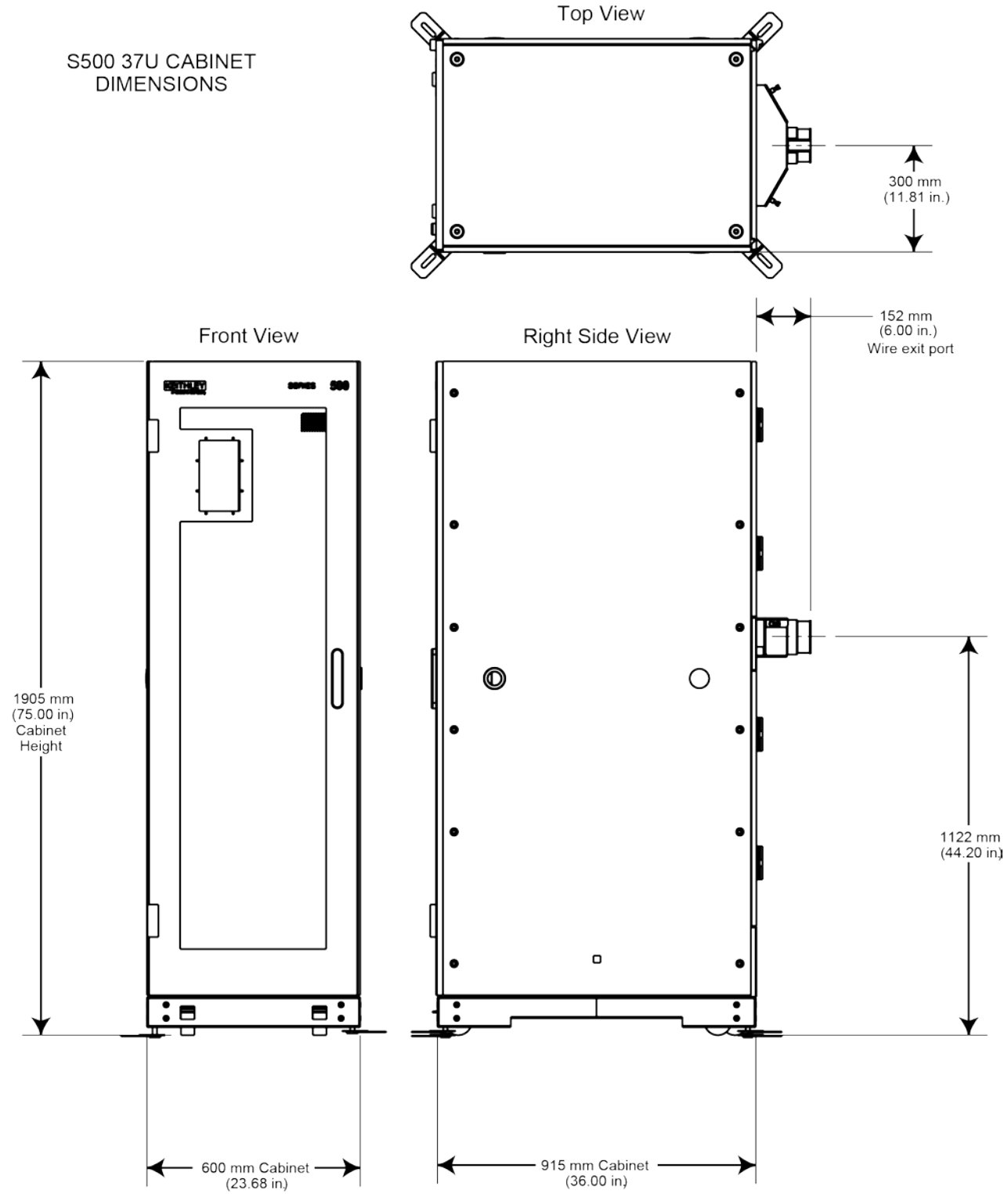
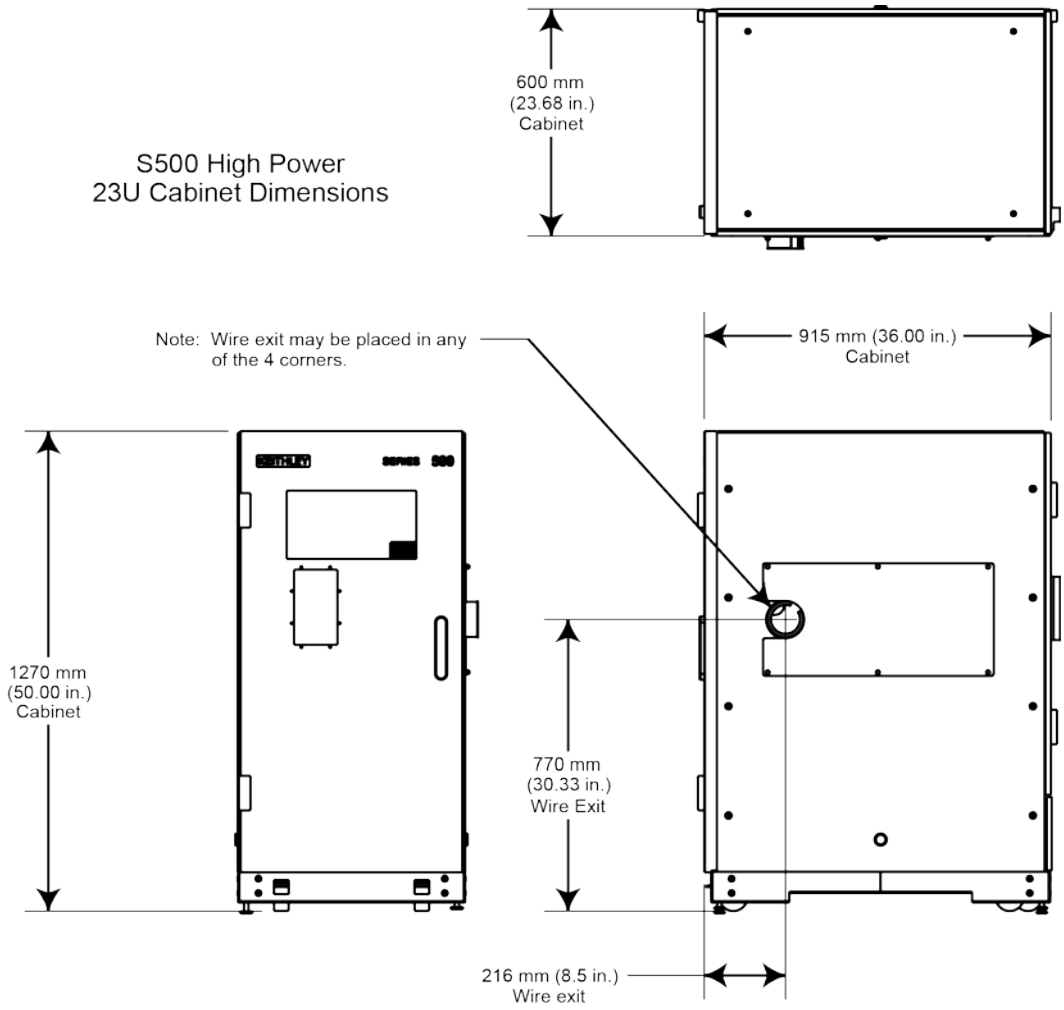


Figure 26: S500 High Power 23U cabinet dimensions



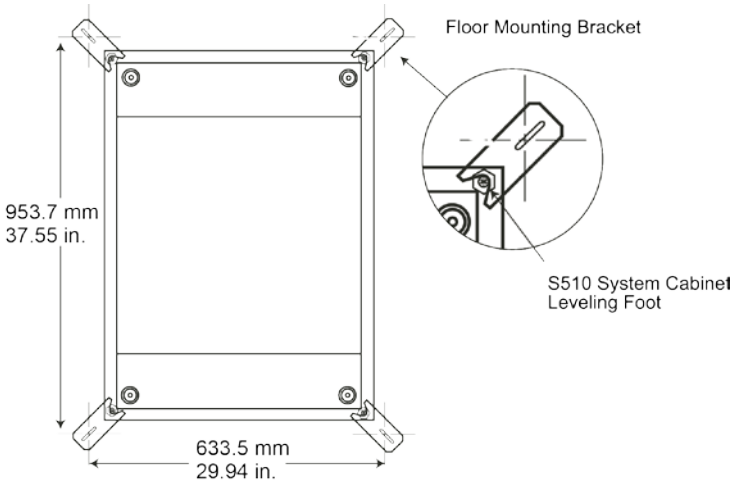
Seismic securement

Seismic securement is required for the S500 system cabinet. You must bolt down the system to the floor for safety purposes and to ensure the cabinet will not tip over. In the next figure, 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 27: S500 system keyboard tray tip-over hazard

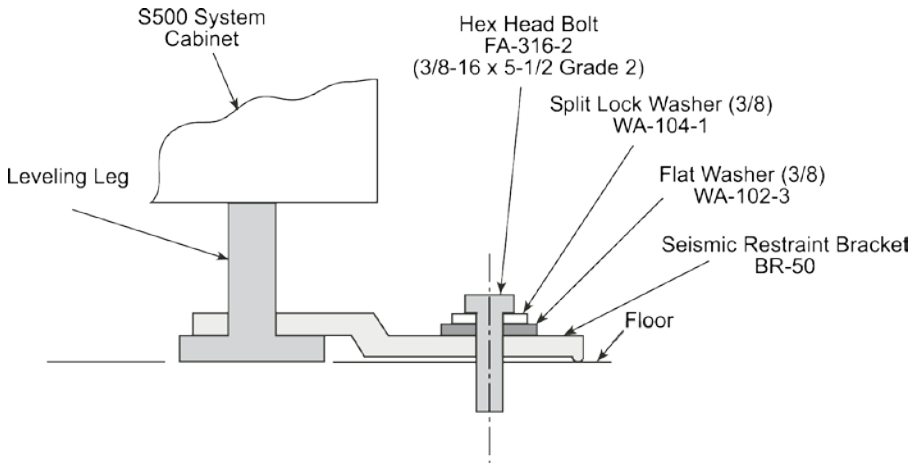
The next figure shows the restraint brackets and bolt installation dimensions for the system cabinet.

Figure 28: S500 system seismic securement dimensions



The next figure shows how a floor mounting bracket is installed. Keithley part numbers are included for the required hardware.

Figure 29: S500 system cabinet floor mount



Optional advanced seismic securement

If you ordered a system with the advanced seismic fastening, follow these mounting instructions.

1. Position the cabinet in the desired location on a smooth, level floor.
2. Place the floor mounting brackets at the corners and make sure you have enough room for proper placement.
3. To properly place the mounting brackets, the cabinet must be lifted by the leveling legs.

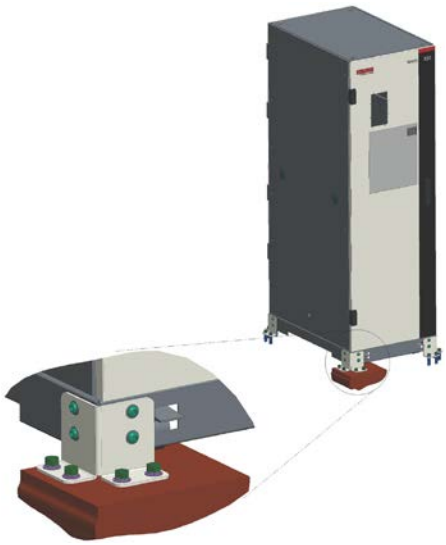
NOTE

Lifting the cabinet will allow the holes in the mounting brackets to line up with the holes in the plinth.

4. Temporarily attach the mounting brackets to each corner with the provided screws (see next figure).

The next figure shows the restraint brackets and bolt installation for the system cabinet.

Figure 30: S500 seismic restraints



5. Transfer the mounting hole locations to the floor with a marker.
6. Remove the mounting brackets and also mark the location of the cabinet leveling legs.
7. Lower the cabinet and move as needed for drilling and installing the customer supplied floor anchors.

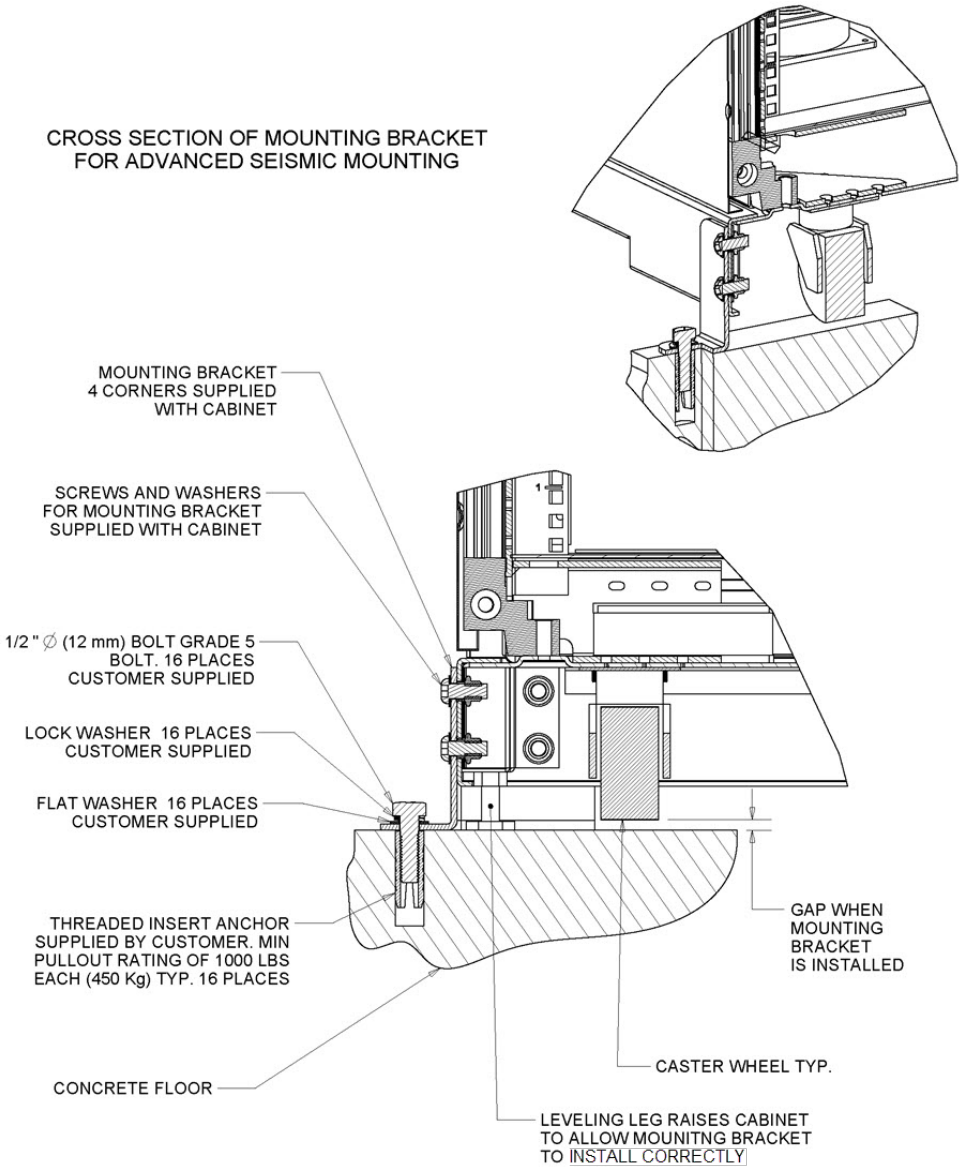
NOTE

Anchors should have a minimum pullout rating of 1000 pounds each (450 Kg). Install 16 anchors for maximum protection.

8. Return the cabinet to marked locations on the floor and lift the cabinet with leveling legs to the proper height.
9. Attach the mounting brackets to the corners with the mounting hardware provided (16 screws and washers).
10. Fasten brackets to the floor with the washers and at minimum grade five bolts (these are customer supplied)(see next figure).

The next figure shows how a floor mounting bracket is installed. Keithley part numbers are included for the required hardware.

Figure 31: S500 advanced cabinet floor mount



System cabinet size and weight

The size and weight specifications for the system cabinet are listed in Table 3.

Table 3
System cabinet size and weight

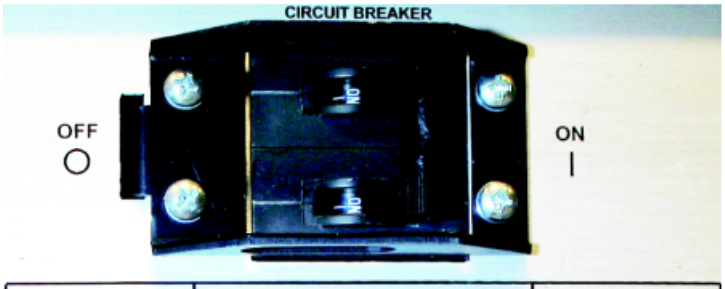
		Weight (typical)	
Model	**Size (width x depth x height)**	**Low End (min.) configuration**	**High End configuration**
37U	60.1 cm x 92 cm x 192 cm 23.7 in. x 36.2 in. x 75.7 in.	273.3 kg 600 lbs.	364.4 kg 800 lbs.
23U	60.1 cm x 92 cm x 130 cm 23.7 in. x 36.2 in. x 51.2 in.	136.1 kg 300 lbs.	272.2 kg 600 lbs.

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 next figure). If the circuit breaker is tripped, turn it OFF and then turn it back ON.

Figure 32: S500 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 the next figure). Make sure the system computer and monitor are also turned on before attempting to use the S500 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 next figure).

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. Log in to your computer and start the ACS software.

Start ACS software

To start the ACS software, log in to the computer and double-click the ACS icon.

Shut down using ACS

NOTE

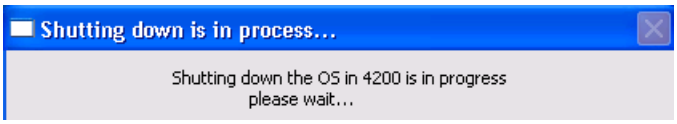
You must have administrator rights in ACS software in order to shut down the S500 system.

1. Double-click the Shutdown icon on the computer desktop. On the dialog box that opens, click Yes that you want to Shut down the S500 Tester.

NOTE

The following message opens after you click Yes to Shutdown the S500 (see next figure). 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 33: S500 Shut down the S500



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

Emergency OFF (EMO) button

An Emergency OFF (EMO) button is located on the system cabinet door (see next figure). 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 shutdown.

Emergency shutdown 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 a sudden power loss.

Recovering from an emergency shut down

1. Verify that the 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 34: S500 system cabinet front view

Safety interlocks

For operator safety, the S500 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).

The ACS 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.

1. Make sure the front and rear doors are closed.
2. Follow the instructions on the computer.
3. Make sure the front and rear doors are closed.
4. Make sure the DUT interlock is properly set for safe operation.
5. Close the DUT safety shield.
6. 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.

NOTE

When using the Model 8010 or Model 8020, all instruments connected to the interlock must either be powered on or disconnected from the interlock if powered off.

Network information

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

Before starting system software

For more information about the ACS software setup procedures, refer to the Automated Characterization Suite (ACS) Reference Manual (document number ACS-901-01).

NOTE

The S500 systems may include one of two system software options:

1. Automated Characterization Suite (ACS).
2. ACS Basic Edition

- 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.
- Assign GPIB or TCP/IP addresses (as appropriate) and node numbers to the hardware and instruments.
- 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.

⚠ CAUTION

Error possible. To avoid errors to instruments, never start the system software until all of the instruments have finished self-testing.

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 tasks.

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 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 offers a fee-based service agreement with all S500 systems; a field service engineer will either repair or replace equipment. For more information about this service agreement, contact Keithley Instruments at 1-800-935-5595.

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 CD-ROM that was shipped with your purchase.

Heavy instrument removal/installation

When installing or removing equipment heavier than 50 pounds, 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.

Remove 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 Shut down using ACS (on page 25) 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 S500 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 recommends calibration of the individual system instruments on an annual basis and offers this as an on-site service. An FSE will calibrate instrumentation and perform system verification according to the warranted system specifications. For more information about calibration or other S500 services, contact your local Keithley office. Note that you can also perform system verification as described in the S500 Parametric Test System Diagnostics and System Verification manual. For information regarding instrument-level calibration, refer to documentation for each of the system instruments located on the Keithley Instruments Complete Reference CD-ROM that was shipped with your purchase.

Restore 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 S500 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.

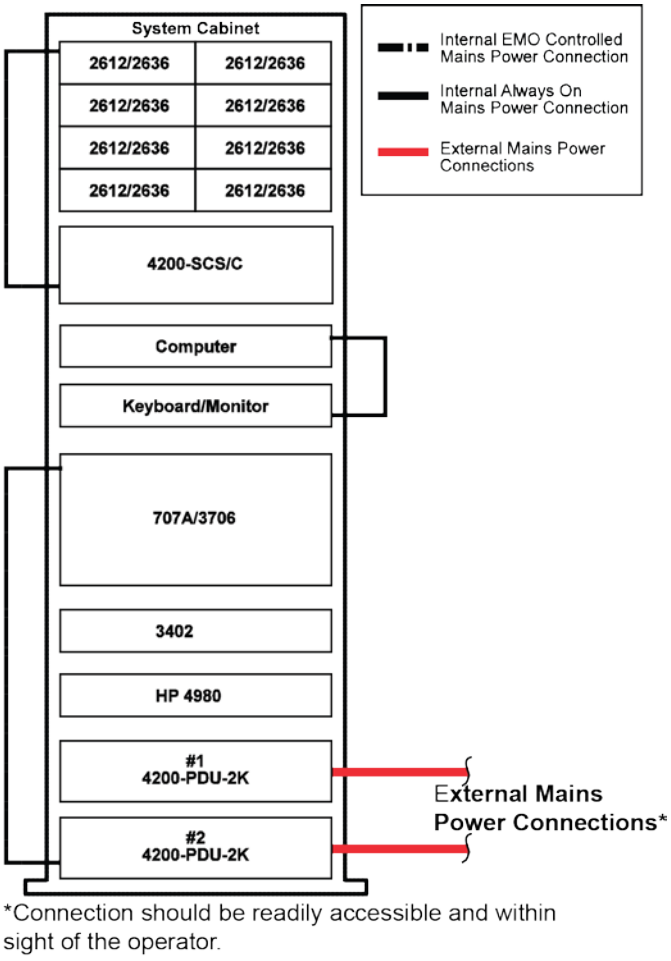
Fuses

Refer to the Keithley Instruments website (www.keithley.com) for the applicable instrument documentation for fuse replacement guidelines.

Power distribution and emergency off

The next figure contains simplified connection schematics for the various components of the S500 (the LO patch panel and the Interlock are shown for reference only; they are located behind the SMUs).

Figure 35: Block diagram of typical S500 configuration



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-outlets (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.

The next table 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 the table.

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

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, or others). 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 V DC (-) banana plug	Banana plug providing 2 4V DC (-) power connection.
24 V DC (+) banana plug	Banana plug providing 24 V DC (+) 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 optional LO patch panel in the S500 system provides a common reference point for all the instrument low side connections. In 4-wire systems it also provides a common connection for the sense low terminals of the SMUs. In addition, the LO patch panel connects low to sense low using a 100k Ω resistor to enable Auto-sensing. Finally, the LO patch panel provides several alternate ways to tie low to earth ground. See the Interlock (on page 33) topic for more details.

Interlock

The S500 must have a single, direct connection between instrument lows and safety (earth) ground. Keithley recommends that a high quality, low impedance connection between low and safety ground be made at the prober used with the S500. Because this is not always possible, the LO patch panel provides alternative connections, as listed in the next table.

LO patch panel switch setting	Purpose
42 volt clamp with parallel 1k Ω resistor. Normal Setting	Default setting to be used when connection between low and safety ground is made within the prober. This is the recommended configuration.
Direct connection to safety ground	Use when there is no connection between low and safety ground at the prober or elsewhere in the system.
42 volt clamp to safety ground with no parallel resistor	For temporary use only by qualified service personnel as a diagnostic aid. Switch should not be left in this position during normal operation.
Open (no connection between low and safety ground)	When this position is used, the system interlock must be intentionally tripped to ensure safety. It is for use only by qualified service personnel for certain rare diagnostic tests.

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 26XXB instruments and the Model 4200.

Figure 36: 4200-PDU simplified schematic