

RE-INVENTING TEST & MEASUREMENT THROUGH *SPEED* AND *SIMPLICITY*

Model 2651A High Power System SourceMeter® Instrument Quick Start Guide



A GREATER MEASURE OF CONFIDENCE

KEITHLEY

Safety precautions

Observe the following safety precautions 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 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 overvoltages. Measurement Category II connections require protection for high transient overvoltages 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. Main supply voltage fluctuations not to exceed $\pm 10\%$ of the nominal voltage.

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 V DC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 V, no conductive part of the circuit may be exposed.

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.



This 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.



This symbol on an instrument means caution, risk of electric shock. Use standard safety precautions to avoid personal contact with these voltages.



This symbol on an instrument shows that the surface may be hot. Avoid personal contact to prevent burns.



This symbol indicates a connection terminal to the equipment frame.



If the mercury 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.

WARNING This 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.

CAUTION This 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.

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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, remove power from the 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 and servicing.

Power and environmental specifications

For indoor use only.

Supply voltage range	100 V to 240 V AC, 50 Hz to 60 Hz (auto sensing), 550 VA maximum
Altitude	Maximum 2000 m above sea level
Operating	0° C to 50° C, 70% R.H. up to 35° C. Derate 3% R.H./° C, 35° C to 50° C
Storage	-25° C to 65° C

Pollution degree	1 or 2		
DC source output	202 W maximum ±40 V DC maximum ± 5.05 A at ± 40 V DC ± 10.1 A at ± 20 V DC ± 20.2 A at ± 10 V DC		
Pulse region 7 (see full specifications for other pulse regions)	Region maximums	Max pulse width	Max duty cycle
	50 A at 40 V	300 µs	1%
Measurement input	Measurement category I Voltage: 40 V DC maximum Hi to Lo, 250 V DC Lo to ground Current: 5.05 A at 40 V; 10.1 A at 20 V; 20.2 A at ± 10 V Impedance: Variable		



CAUTION

Carefully consider and configure the appropriate output-off state, and source and compliance levels before connecting the Model 2651A SourceMeter instrument to a device that can deliver energy. Failure to consider the output-off state, and source and compliance levels may result in damage to the instrument or to the device under test.

Introduction to the Model 2651A High Power System SourceMeter® Instrument

The Model 2651A System SourceMeter® Instrument is a high-power source-measure unit (SMU) that simplifies test processes by combining source and measure capabilities in a single instrument. A Model 2651A is a scalable, high-throughput, cost-effective solution for precision DC, pulse, and low-frequency AC source-measure testing.

The Model 2651A documentation includes:

- **Quick Start Guide:** Shows you how to unpack and set up the instrument to determine that the instrument is functional.
- **User's Manual:** Provides a starting point for creation of applications with a variety of application-based examples.
- **Reference Manual:** Provides comprehensive information about the instrument's features and programming commands.

The User's and Reference manuals are in PDF format on the CD-ROM that is included with the instrument. If you do not have Adobe Reader® to view the files, you can download a free copy of it at <http://get.adobe.com/reader/>.

CD-ROM contents

The CD-ROMs that are included with your instrument contain:

- The Test Script Builder (TSB) Software and Model 2651A TSB add-in, which is a software tool you can use to create, modify, debug, and store Test Script Processor (TSP®) test scripts
- Product documentation, including PDFs of this Quick Start Guide, User's Manual, Reference Manual, the product data sheet, product specifications, and rack-mount kit instructions
- IVI Instrument Driver, driver for National Instruments LabVIEW™, and related release notes
- J2SE™ Runtime Environment
- Keithley I/O layer and release notes

For the latest drivers and additional support information, see <http://www.keithley.com/support>.

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Unpack and inspect the instrument

To unpack and inspect the instrument:

1. Inspect the box for damage.
2. Open the top of the box.
3. Remove the bag that contains the documentation, accessories, and CD-ROMs.
4. Remove the packaging insert.



- Carefully lift the instrument out of the box.

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instrument



- Inspect the instrument for any obvious signs of physical damage. Report any damage to the shipping agent immediately.



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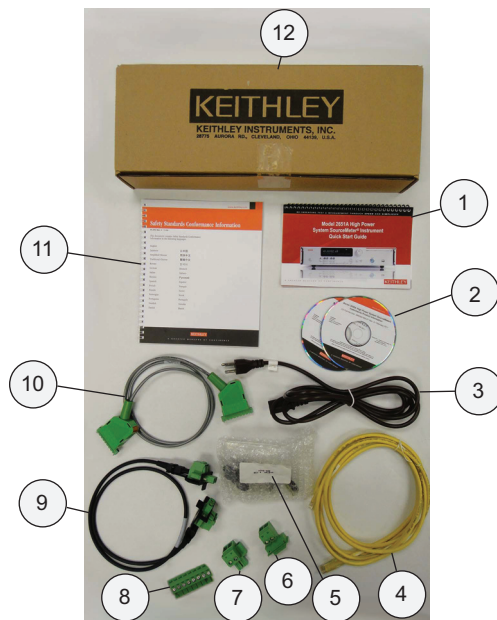
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In addition to the Model 2651A High Power System SourceMeter[®] Instrument, you should have received:

- 1 Model 2651A Quick Start Guide
- 2 Model 2651A Product Information and Test Script Builder CD-ROMs
- 3 Power line cord
- 4 RJ45 LAN crossover cable
- 5 Interlock DB-25 male connector kit hardware
- 6 Female terminal block extender for use with the Model 2651A-KIT-1
- 7 Male direct plug-in connector for low-impedance/high-current output
- 8 Female terminal block extender for use with 8-pin signal control cable
- 9 Model 2651A-KIT-1 (low-impedance/high-current coaxial cable)
- 10 8-pin signal control cable
- 11 Safety Standards Conformance Information
- 12 Optional rack-mount kit

Refer to the packing list for additional items that might have shipped with your instrument.



Connect the instrument

Important test system safety information

This product is sold as a stand-alone instrument that may become part of a system that could contain hazardous voltages and energy sources. It is the responsibility of the test system designer, integrator, installer, maintenance personnel, and service personnel to make sure the system is safe during use and is operating properly.

You must also realize that in many test systems a single fault, such as a software error, may output hazardous signal levels even when the system indicates that there is no hazard present.

It is important that you consider the following factors in your system design and use:

- The international safety standard IEC 61010-1 defines voltages as hazardous if they exceed 30 V RMS and 42.4 V peak, or 60 V DC for equipment rated for dry locations. Keithley Instruments, Inc. products are only rated for dry locations.
- Read and comply with the specifications of all instruments in the system. The overall allowed signal levels may be constrained by the lowest rated instrument in the system. For example, if you are using a 500 V power supply with a 300 V DC rated switch, the maximum allowed voltage in the system is 300 V DC.
- Make sure any test fixture connected to the system protects the operator from contact with hazardous voltages, hot surfaces, and sharp objects. Use shields, barriers, insulation, safety interlocks, and so on to accomplish this.
- Cover the device under test (DUT) to protect the operator from flying debris in the event of a system or DUT failure.
- Double-insulate all electrical connections that an operator can touch. Double insulation ensures the operator is still protected even if one insulation layer fails. Refer to IEC 61010-1 for specific requirements.
- Make sure all connections are behind a locked cabinet door or other barrier. This protects the system operator from accidentally removing a connection by hand and exposing hazardous voltages.

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- Use high-reliability fail-safe interlock switches to disconnect power sources when a test fixture cover is opened.
- Where possible, use automatic handlers so operators are not required to access the DUT or other potentially hazardous areas.
- Provide training to all users of the system so they understand all potential hazards and know how to protect themselves from injury.
- In many systems, during power up, the outputs may be in an unknown state until they are properly initialized. Make sure the design can tolerate this situation without causing operator injury or hardware damage.

To keep users safe, always read and follow all safety warnings provided with each of the instruments in your system.

Install the instrument

The Model 2651A can be used on a bench or in a rack. Please see the instructions that came with your rack-mount kit if you are installing the Model 2651A in a rack.

Note that the air intakes for the fan are located on the top cover and side panels of the Model 2651A. The space around these areas should be free from obstruction to ensure proper fan operation.

Connect line power

The Model 2651A operates from a line voltage of 100 V to 240 V at a frequency of 50 Hz or 60 Hz. Line voltage is automatically sensed (there are no switches to set). Make sure the operating voltage in your area is compatible.



WARNING

The power cord supplied with the Model 2651A contains a separate ground wire for use with grounded outlets. When proper connections are made, the instrument chassis is connected to power line ground through the ground wire in the power cord. Failure to use a grounded outlet may result in personal injury or death due to electric shock.

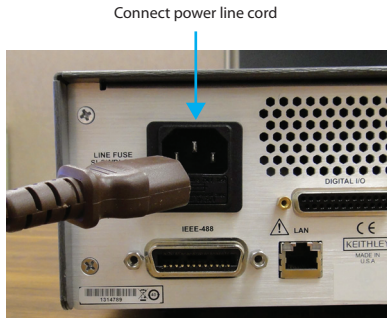


CAUTION

Operating the instrument on an incorrect line voltage may cause damage to the instrument, possibly voiding the warranty.

To connect line power:

1. Make sure the front panel power switch is in the off (0) position.
2. Connect the socket of the supplied power cord to the power connection on the rear panel.



3. Connect the plug of the power cord to a grounded AC outlet.

Turn on the instrument

Turn on the instrument by pressing the front panel **POWER** switch to the on (I) position.



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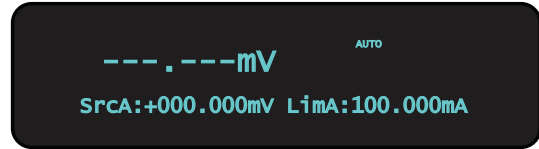
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Power-up sequence

When the instrument is turned on, you should see:

- Three dots
- All segments of the display light
- A brief display showing “KEITHLEY Model 2651A”
- Line frequency detection and other startup checks

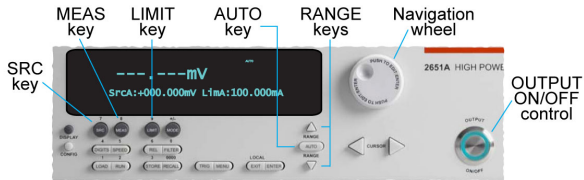
The entire power-up process takes approximately 30 seconds to complete. When initialization is complete, you will see the default display screen, as shown below.





Test the instrument


The following test verifies basic operation of the Model 2651A. In this test, you will use the front-panel controls shown below to source a voltage and measure the voltage output.

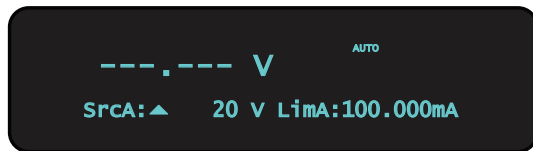
You do not need to connect a device-under-test (DUT) for this test.



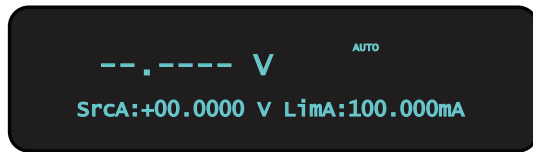
Step 1: Set source function, range, and level



1. Press the **SRC**  key. You will see a blinking character in the SrcA value field. Confirm that mV is displayed; if not, press the **SRC**  key again.

2. While that character is still blinking, press the up or down **RANGE**  keys until 20 V is displayed.



The main display screen reappears:



3. Press the **CURSOR**  keys to move the cursor to the 10s digit.
4. Press the navigation wheel  to enter EDIT mode. The EDIT indicator appears in the upper left corner of the display.

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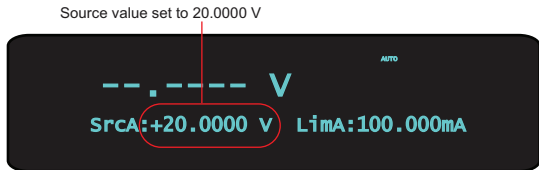
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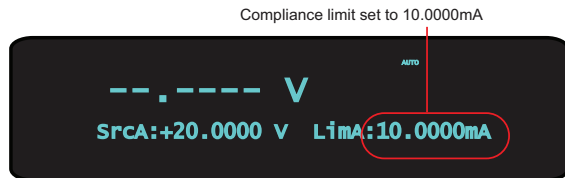
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- Turn the navigation wheel  to set the source value to **20.0000 V**, and then press the navigation wheel  to enter the selection and exit EDIT mode.




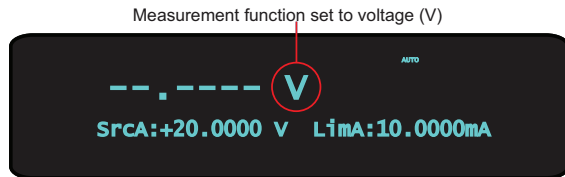
Step 2: Set the compliance limit


- Press the **LIMIT**  key. You will see a blinking character in the LimA value field.
- While that character is still blinking, press the down **RANGE**  keys as needed to select the **10 mA** limit range. Verify that the compliance limit value in the LimA field is 10.0000 mA.

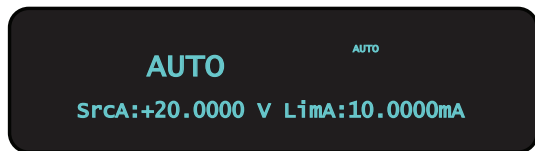


Step 3: Set measurement function and range


- Press the **MEAS**  key as many times as needed to select the **V** (voltage) measurement function. In the following figure, the measurement function has been set to "V".



2. Press the **AUTO**  key as many times as needed to select the **AUTO** range function. When AUTO is selected, the Model 2651A automatically selects the best range for the measured value. You will briefly see the display shown below, and then the main display screen reappears.



Step 4: Turn output on

Turn the output on by pressing the **OUTPUT ON/OFF**  control. The ON/OFF indicator LED lights and measurements begin.

Step 5: Observe measurements

Observe the measured voltage on the main area of front panel display. The readings should be very close to the 20 V source value.

Step 6: Turn output off

When you finish making measurements, turn the output off by pressing the **OUTPUT ON/OFF**  control. The output indicator LED turns off.

These steps confirm basic functionality of your Model 2651A. Please turn instrument power OFF now.

The examples in the Model 2651A User's Manual are designed to demonstrate increasing levels of Model 2651A functionality. We strongly recommend first-time users complete the examples in the manual.

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What should I do if I see an error message when I turn the instrument on?

If an error message is displayed, press the **EXIT (LOCAL)** key. The Model 2651A will return to the default display screen. For detailed information about error messages, see “Errors and status messages” in the Model 2651A Reference Manual.

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Model 2651A User’s Manual

Refer to the Model 2651A User’s Manual. It contains application-based examples that will help familiarize you with the instrument. This manual is on the Product Information CD-ROM that came with your instrument.

Model 2651A Reference Manual

Refer to the Model 2651A Reference Manual for detailed information about all features of the instrument. This manual is on the Product Information CD-ROM that came with your instrument.

Keithley Instruments website

See www.keithley.com for support and additional information about the instrument.

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