

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

2281S Precision DC Supply and Battery Simulator Quick Start Guide



A GREATER MEASURE OF CONFIDENCE

KEITHLEY
A Tektronix Company

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 measurement, control, and data I/O connections, with low transient overvoltages and must not be directly connected to mains voltage or to voltage sources with high transient overvoltages. Measurement Category II (as referenced in IEC 60664) connections require protection for high transient overvoltages often associated with local AC mains connections. Certain Keithley measuring instruments may be connected to mains. These instruments will be marked as category II or higher.

Unless explicitly allowed in the specifications, operating manual, and instrument labels, do not connect any instrument to mains.

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.

For safety, instruments and accessories must be used in accordance with the operating instructions. If the instruments or accessories are used in a manner not specified in the operating instructions, the protection provided by 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 protective earth (safety 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 protective earth (safety 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.

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.

Safety precaution revision of January 2013.

Power and environmental specifications

For indoor use only.

Power supply	100 V AC/120 V AC/220 V AC/240 V AC, 50 Hz or 60 Hz
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Operating altitude	Maximum 2000 m (6562 ft.) above sea level
Operating temperature	0 °C to 40 °C (32 °F to 104 °F), full accuracy to 80 % relative humidity at up to 35 °C (95 °F), non-condensing
Storage temperature	-20 °C to 70 °C (-4 °F to 158 °F), 5 % to 95 % relative humidity at up to 40 °C (+104 °F) and 5 % to 60 % RH above 40 °C (+104 °F) up to 70 °C (+158 °F)
Pollution degree	2



CAUTION

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

Introduction

Thank you for choosing a Keithley Instruments product. The Model 2281S Precision DC Supply and Battery Simulator is a highly sensitive, accurate, programmable power supply that sources stable low-noise voltage, and monitors load currents over a wide dynamic range from amperes to nanoamperes. It can also test batteries and generate battery models to simulate batteries.

The high-resolution 4.3 inch color display shows numerous parameters that describe the state of the instrument to enable you to get the most information from your measurements.

You can generate and edit battery models on the display. In addition, the capacity and voltage changes are shown on the display during the battery simulation.

Model number	Description
2281S-20-6	Precision DC Supply and Battery Simulator, 20 V, 6 A

CD-ROM contents

The CD-ROM that is included with your instrument contains PDFs of the Reference Manual, Quick Start Guide, and accessory manuals.

For 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, standard accessories, CD-ROM, and cable housing.
4. Remove the packaging insert.
5. Remove the 2281S from the box.



CAUTION

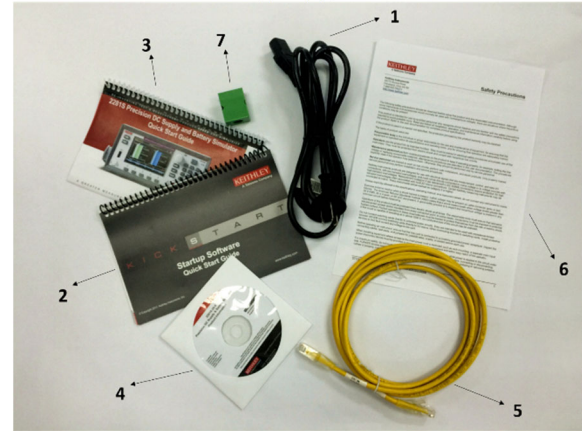
Do not lift the 2281S from the front bezel. Lifting the instrument by the front bezel can cause instrument damage.



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

You should have received the 2281S with the following accessories, shown in the photograph:

- 1 Power line cord
- 2 KKS-903-01C KickStart Quick Start Guide
- 3 2281S Quick Start Guide (this document)
- 4 2281S Precision DC Supply & Battery Simulator Product Information CD-ROM
- 5 Model CA-180-3A CAT5 Crossover Cable for Ethernet
- 6 071341100 User's Guide Safety Standards Conformance Information
- 7 Cable housing



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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 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, and safety interlocks 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. 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.

NOTE

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

Install the instrument

You can use the 2281S on a bench or in a rack. Please see the instructions that came with your rack-mount kit if you are installing the 2281S in a rack.

To prevent damaging heat build-up and ensure specified performance, make sure there is adequate ventilation and air flow around the instrument to ensure proper cooling. Do not cover the ventilation holes on the top, sides, or bottom of the instrument.

Make sure the instrument is positioned so that it is easy to reach any disconnecting devices, such as the power cord and the power switch.

Power up the instrument

The 2281S operates at 100 V, 120 V, 220 V, or 240 V with a frequency of 50 Hz or 60 Hz. Make sure that the AC line voltage indicator in the center of the rear-panel power module matches the AC line voltage in your facility. If it does not, refer to the "Maintenance" section of the *Model 2281 Reference Manual* to change the setting on the power entry module.

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The power cord supplied with the 2281S contains a separate protective earth (safety 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. In addition, a redundant protective earth connection is provided through a screw on the rear panel. This terminal should be connected to a known protective earth. In the event of a failure, not using a properly grounded protective earth and grounded outlet may result in personal injury or death due to electric shock. Do not replace detachable mains supply cords with inadequately rated cords. Failure to use properly rated cords may result in personal injury or death due to electric shock.

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 module on the rear panel.



CAUTION

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

3. Connect the plug of the power cord to a grounded AC outlet.
4. Turn on the instrument by pressing the front panel **POWER** switch to the on (I) position. The instrument powers up.

Connections for testing

Before making the connections, prepare the wires as described in the following table.

Usage	Specifications
Front panel binding posts	AWG 20 to AWG 12
Rear panel output terminals	AWG 20 to AWG 12



CAUTION

The wire must be heavy enough not to overheat while carrying the short-circuit output current of the unit. Please meet the wiring requirements described above.

Two-wire connection

Two-wire connections are used for basic operation when maximum accuracy is not required. Keep the wire as short as possible to reduce lead inductance and noise pickup. If you want to compensate for the voltage drop in the load leads, use a four-wire sense connection.

NOTE

When making two-wire connections with the 2281S, you must short both Output Hi and Sense Hi and Output Lo and Sense Lo with the shorting jumpers. If you do not do this, the display will show incorrect voltage output readings.

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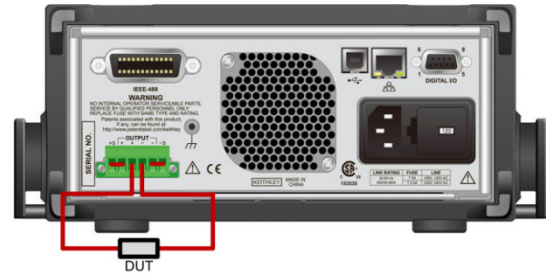
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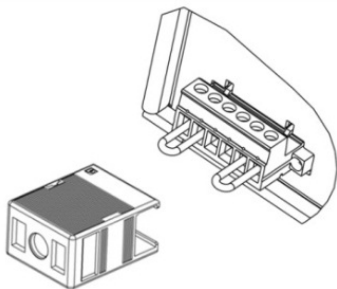
Two-wire (local sensing) DUT connection to front panel



Two-wire (local sensing) DUT connection to rear panel



After making the connections, slide the cable housing over the output mating connector and wires.



WARNING

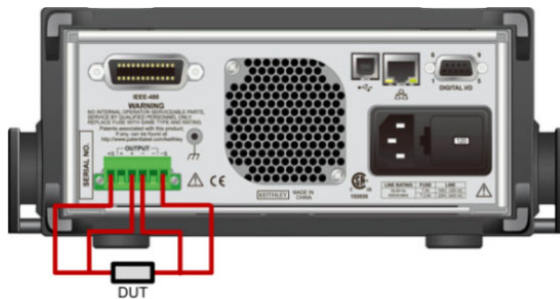
Failure to install the cable housing may result in personal injury or death due to electric shock.

Four-wire remote sense connection

Using four-wire remote sensing connections ensures that the programmed voltage is applied to the load and compensates for the voltage drop in the leads between the power supply and the load.

As shipped, the sense terminals are connected to the output terminals by shorting jumpers. Before connecting the wire, make sure the shorting jumpers have been removed. When you connect the power supply for remote sensing, the overprotection (OVP) circuit senses the voltage at the sensing points (load) and not the output terminals.

Four-wire (remote sensing) DUT connection to rear panel



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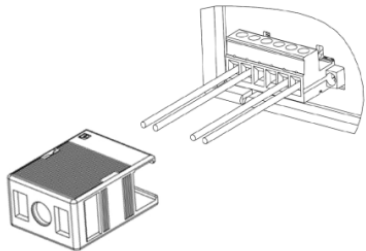
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After making the connections, slide the cable housing over the output mating connector and wires.



⚠ WARNING

Failure to install the cable housing may result in personal injury or death due to electric shock.

Overview of the front-panel options



The front panel of the 2281S allows you to set up most instrument functions and features and perform sourcing and measuring operations. The front panel includes:

- A high-resolution color display that allows you to access instrument settings and measurement readings
- Keys that select menu options and start measurement operations
- A navigation control that can be used to select screen options
- An output ON/OFF switch that turns the source output on or off
- Front-panel binding posts for output connections

ENTER and EXIT keys

The **ENTER** key selects a highlighted option. In most cases, it opens the menu or dialog box that allows you to change settings for that option.

The **EXIT** key returns to the previous menu or closes a dialog box. For example, if you are in the Menu screen, pressing **EXIT** returns you to the Home screen.

TRIGGER key

The action of the **TRIGGER** key depends on the trigger method that is selected:

- If manual triggering is selected, TRIGGER causes the instrument to make a measurement.
- If the trigger model is in idle, TRIGGER initiates the trigger model.

Front-panel user interface overview

The front-panel user interface gives you quick access to source settings, measure settings, system configuration, instrument status, reading buffer information, and other instrument functionality.

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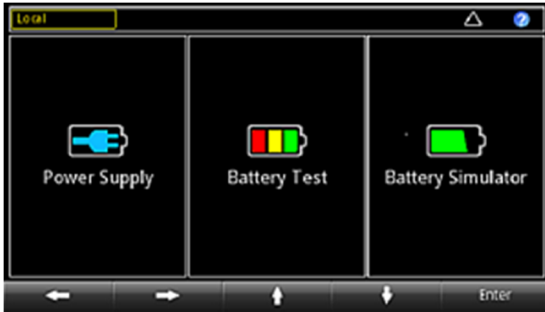
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Startup screen

When you turn on the 2281S, you will see the following startup screen.



As you can see from the figure, 2281S has three functions:

- High-precision power supply: Supplies 20 V, 6 A DC power
- Battery test: Conducts battery charging and discharging test to calculate the capacity and resistance of the battery and create a battery model
- Battery simulator: Simulates a battery to determine what effect the battery has on the Device Under Test (DUT) in different states

You can choose a function by turning the navigation control or pressing the soft keys and pressing Enter to access the respective home screens of the function.

Home screen overview

Home screen for power supply:



The above figure is the home screen 1 for the power supply function. You can enter this screen by choosing the power supply function in the startup screen. You can also visit other home screens by pressing **Next**.

The top row on the Home screen displays the status and event indicators. You can select these options to open dialog boxes that provide additional information about the status or event.

The OUTPUT view area of the Home screen displays the value of the present outputs and status indicators. The outputs show dashed lines until the output is turned on.

The setting area of the Home screen is located in the lower left corner of the OUTPUT view area. It shows the presently set measure range, voltage, and current limit.

The soft-key area is located on the bottom of the Home screen. It shows the present setting values. You can change these values by pressing the buttons below the screen.

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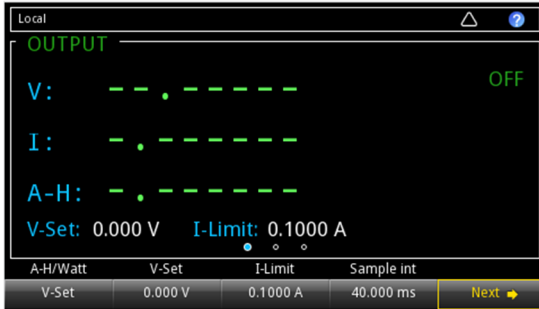
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Home screen for battery test:



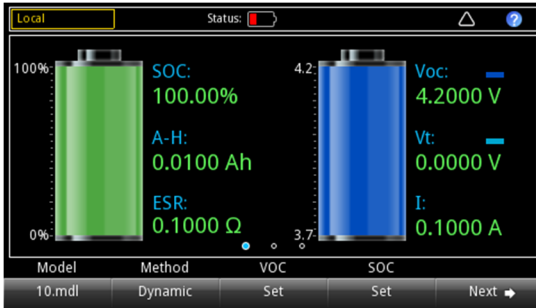
The above figure is the home screen 1 for the battery test function. You can enter this screen by choosing the battery test function in the startup screen. You can also visit other home screens by pressing **Next**.

The top row on the Home screen displays the status and event indicators. You can select these options to open dialog boxes that provide additional information about the status or event.

The OUTPUT view area of the Home screen displays the values of the battery under test.

The soft-key area is located on the bottom of the Home screen. It shows the present setting values. You can change these values by pressing the buttons below the screen.

Home screen for battery simulator:



The above figure is the home screen 1 for the battery simulation function. You can enter this screen 1 by choosing the battery simulation function in the startup screen. You can also visit other home screens by pressing **Next**.

The top row on the Home screen displays the status and event indicators. You can select these options to open dialog boxes that provide additional information about the status or event.

The OUTPUT view area of the Home screen displays the values and status of the battery simulator.

The soft-key area is located on the bottom of the Home screen. It shows the present setting values. You can change these values by pressing the buttons below the screen.

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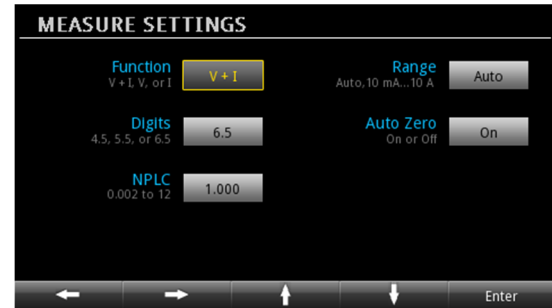
Menu screen overview

In any function, when you press the **MENU** key on the front panel, the Menu screen is displayed. The following section uses the menu for power supply as an example.



From this screen, you can select source, measure, graph, trigger, and system setup menus. These menus allow you to choose options to set up your instrument for your applications. Select a setup item by either scrolling the navigation control or using the arrow keys to highlight an icon. Then press **ENTER**.

An example of the options that are available when you select the Settings option under Measure is shown below.



Simple voltage output and current measurement

The following example demonstrates how to configure a voltage output and perform a precision voltage and current measurement using the default instrument configuration in the power supply function.

Connect the DUT (for this example, a 1 k Ω resistor) to the output binding post on the front panel. For details, refer to [Two-wire connection](#). You can also use four-wire connections to compensate for voltage drops on the load leads.

To set the voltage and current limit on the front panel:

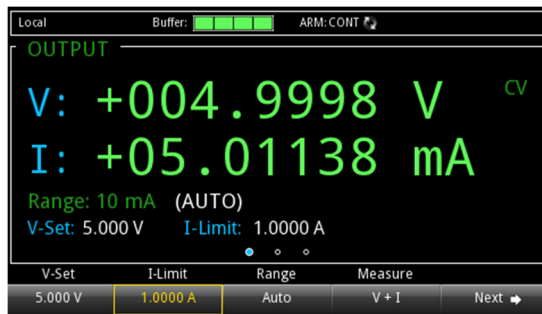
1. Press the **Home** key. The Home screen is displayed.
2. Press the **V-Set** soft key. The editing window is displayed at the bottom.
3. Set the voltage to 5 V. Enter 5 using the numerical keys on the right of the front panel. You can also change the value using either the arrows keys or navigation control.
4. Press the **I-Limit** soft key. The editing window is displayed at the bottom.
5. Set the current limit to 1 A. Press **ENTER**.



CAUTION

When the output is turned on, changing the value with the navigation control can source voltage and current instantly. Make sure the output does not damage your device under test (DUT).

6. Press the **OUTPUT** switch to turn the output on.



See the "General operation" section of the *2281S Reference Manual* for additional details and remote interface examples.

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Select a measure function

The 2281S allows you to perform the following measure functions in the power supply function.

Measure functions	What the instrument measures
Concurrent (V + I)	Measure voltage and current at the same time
Voltage (V)	Only measure voltage
Current (I)	Only measure current

To set the measure function from the Menu screen:

1. Press the **Menu** key.
2. Under Measure, select **Settings**.
3. Select the button next to **Function** and press the **ENTER** key. The selection window is displayed.
4. Select a measure function.

To set the measure function from the Home screen:

1. Press the **Measure** soft key. The selection window is displayed.
2. Select a measure function.

See the "General operation" section of the Reference Manual for additional details and remote interface examples.

Specify a measurement range

You can set ranges for the measurement values in the power supply function. You can set specific ranges or allow the instrument to choose the ranges automatically.

The measurement range determines the full-scale input for the measurement. The measurement range also affects the accuracy of the measurements and the maximum signal that can be measured.

The 2281S has multiple current measurement ranges and one voltage range. The ranges are listed in the following table.

To set the ranges from the Home screen:

1. Press the **HOME** key and select **Range** button. The Range dialog box is displayed.
2. Use the up and down arrow soft keys to select the range. The Home page is updated with the new range setting. Press **ENTER** or **EXIT** to close the Range dialog box.

To set the ranges from the Menu screen:

1. Press the **MENU** key.
2. Highlight the **Settings** icon under Measure using either the navigation control or the softkeys. Press **ENTER**.
3. On the MEASURE SETTINGS page, select the button next to **Range**. The Range dialog box is displayed.
4. Select the range. You are returned to the MEASURE SETTINGS screen.

Model number	Current measurement range	Voltage measurement range
2281S-20-6	10 A	20 V
	1 A	
	100 mA	
	10 mA	

See the "General operation" section of the *Reference Manual* for additional details and remote interface examples.

Application examples

Battery test

The following example demonstrates how to conduct a battery test and generate a battery model with 2281S-20-6.

In this application, we will use the Model 2281S to charge a lithium-ion battery from empty to full, and measure battery capacity (amp-hour), battery resistance, charging curve (voltage/current), and finally generate a battery model based on the test results.

For achieving a full-charge cycle, we need to use 2281S to discharge the battery to an empty state first, then charge the battery from empty to full state and measure voltage, current, resistance, and amp-hour. After the charging process is done, the Model 2281S generate a battery model automatically based on the results.

Equipment required:

- One 2281S Battery Simulator
- Rechargeable batteries
- Wires

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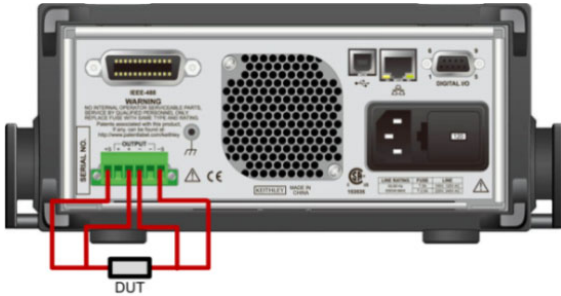
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The battery under test and the Model 2281S-20-6 can be connected by two-wire sense connections. However, four-wire sense connections, as shown in the following figure, is recommended because it cancels out the wire resistance.



To measure the battery capacity and generate a battery model in the battery test function:

After connecting the battery to the instrument, to test a battery and generate a battery model using the front panel:

1. Select the battery test function in the startup screen.
2. Press the **MENU** key.

3. Under **Source**, select **(dis)charge** to conduct settings for discharging the battery to the empty state first.

⚠ WARNING

2281S always absorb current at its maximum capacity, which is approximately 1 A. This sink current is not programmable. If the maximum output current of the battery under test is less than 1 A, you should connect a resistor between the instrument and the battery to prevent the battery from switching into protection mode or being damaged.

4. Set the target voltage next to **V-Set**. For example, for a Li-Ion battery that works in the range of 3.8 V to 4.2 V, you need to set the target voltage slightly lower than 3.8 V to make sure the battery will be discharged fully.
5. Set the end current next to **End condition** as 10 mA. When the discharging current is lower than this value, 2281S will stop the discharging and turn off **OUTPUT**.
6. Turn **OUTPUT** on in the front panel to discharge the battery. Then wait until the discharging is over and 2281S turns off **OUTPUT**.
7. Under **Measure**, select **A-H**. Starting from this step, 2281S will charge the battery, measure its capacity, and generate a battery model.
8. Set the target voltage next to **V-Full**. If the battery works in the range of 3.8 V to 4.2 V, set this value slightly higher than 4.2 V.
9. Set the maximum charging limit next to **Source I-Limit**. This value is set based on the battery specification. The current larger than the maximum current of the battery may cause damage.
10. Set the end current to 10 mA next to **End condition**. When the charging current is lower than this value, 2281S will stop the charging and turn off **OUTPUT**.
11. Return to the battery test home screen by pressing **HOME** on the front panel.
12. Select **Measure AH** in the soft key area 3.
13. Set the state to **On**. Charging starts with the measurement result (voltage/current/Amp-Hour) displayed on the screen.
14. Select **Model: Generate** after entering the soft key **Measure AH** when the charging is finished.
15. Set the Voc range for the battery model.
16. Assign a name to the battery model.
17. Select **Yes** to save the battery model. The Model 2281S-20-6 can save up to 9 battery models.

NOTE

You can view the charging process by selecting Graph or Data Sheet in the soft key area 2 when the charging is in progress.

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Battery simulation test

The following example demonstrates the procedure of simulating a battery with Model 2281S-20-6.

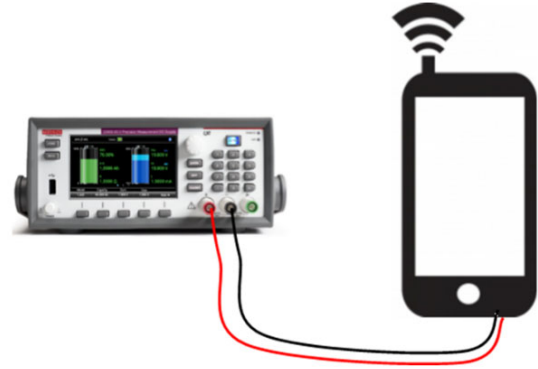
This example shows how to use a Model 2281S to replace a real battery to power your device and test the device in different battery states more efficiently.

Equipment required:

- One 2281S battery simulator
- A cellphone supplied by a battery
- Wires

The device under test and 2281S-20-6 can be connected by a two-wire sense connection, as shown in the following figure. However, four-wire sense connection is recommended because it can cancel out

the wire resistance.



To simulate a battery with 2281S-20-6 using the front panel:

1. Select the battery simulator function in the startup screen.
2. Select **Model** in the soft key area 1.
3. Choose 10.mdl, since it is the model of a cellphone Li-Ion battery normally seen in the market with a voltage range of 3.7 V to 4.2 V.
4. Press the **MENU** key.
5. Under **Battery**, select **Settings**.
6. Set **Method** to **Dynamic**. The Voc and SOC of the simulated battery will change according to the charging and discharging states, just like a real battery.
7. Set **Full V** and **Empty V** as the range of the simulated battery. Default Full V and Empty V are minimum and maximum Voc values. When 2281S works in battery simulator mode, the Voc value ranges within Full V and Empty V.
8. Return to the battery simulator home screen by pressing **HOME** on the front panel.
9. Select **I-Limit** in the soft key area 2. The maximum current from 2281S to the DUT cannot be set higher than 3 A.
10. Set **SOC** to 80% and **Voc** to 4.1234 V in the soft key area 1. The value of Voc must be within the **Empty V** and **Full V**. The value of **SOC** changes according to the value of **Voc**, and vice versa.
11. Set **Capacity** to 200 mAh in soft key area 2. This capacity is set to accelerate the charging and discharging for better efficiency of the test.
12. 14. On the front panel, turn **OUTPUT** on to start the battery simulation.

Next steps

For more information, refer to the Product Information CD-ROM, which includes the 2281S Reference Manual. It provides detailed information about all features of the instrument.

Also see the Keithley Instruments website, www.keithley.com for support and additional information about the instrument.

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