Series 2400 SourceMeter®

Quick Start Guide

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KEITHLEY

Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the user documentation for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product warranty may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the user documentation. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

Keithley Instruments products are designed for use with electrical signals that are rated Measurement Category I and Measurement Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Measurement Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Measurement Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the user documentation.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

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

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance-limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, ensure that the line cord is connected to a properly-grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions, or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If a  screw is present, connect it to safety earth ground using the wire recommended in the user documentation.

The  symbol on an instrument means caution, risk of danger. The user should refer to the operating instructions located in the user documentation in all cases where the symbol is marked on the instrument.

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

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

The  symbol indicates a connection terminal to the equipment frame.

If this  symbol is on a product, it indicates that mercury is present in the display lamp. Please note that the lamp must be properly disposed of according to federal, state, and local laws.

The **WARNING** heading in the user documentation explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in the user documentation explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits - including the power transformer, test leads, and input jacks - must be purchased from Keithley Instruments. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. Other components that are not safety-related may be purchased from other suppliers as long as they are equivalent to the original component (note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water-based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., a data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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Section 1

Introduction

Quick start topics

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Introduction

This guide is designed to familiarize users with fundamental operation (front panel and remote) of the Keithley 2400 Series SourceMeters. For comprehensive information on all aspects of SourceMeter operation, refer to the 2400 Series SourceMeter User's Manual.

Operation information in this guide is divided into four parts; (1) Fundamental source-measure operations, (2) Settings to optimize performance, (3) Features to enhance DUT testing and (4) More testing techniques. This format allows a new user to easily progress from basic simple operation to more complex procedures.

Remote command programming - For the various SourceMeter operating modes covered in this guide, the related SCPI commands for remote operation are summarized in tables. Most commands have a query form. For example, :OUTPut ON turns the output on, while :OUTPut? requests the present state of the output. Note that the SourceMeter must be addressed to talk after sending a query command.

For operations where command sequence is important, programming examples are provided. The exact programming syntax will depend on the test program language.

Source-measure capabilities

Model 2400:

- Source voltage from 5µV to 210V; measure voltage from 1µV to 211V.
- Source current from 50pA to 1.05A; measure current from 10pA to 1.055A.
- Measure resistance from 100µΩ (<100µΩ in manual ohms) to 211MΩ
- Maximum source power is 22W.

Model 2400-LV and 2401:

- Source voltage from 5µV to 21V; measure voltage from 1µV to 21V.
- Source current from 50pA to 1.05A; measure current from 10pA to 1.055A.
- Measure resistance from 100µΩ (<100µΩ in manual ohms) to 211MΩ
- Maximum source power is 22W.

NOTE The Model 2401 does not use the digital output lines of the Digital I/O port. Therefore, it cannot be used with a component handler to perform binning operations.

Model 2410:

- Source voltage from 5µV to 1100V; measure voltage from 1µV to 1100V.
- Source current from 50pA to 1.05A; measure current from 10pA to 1.055A.
- Measure resistance from 100µΩ (<100µΩ in manual ohms) to 211MΩ
- Maximum source power is 22W.

Model 2420:

- Source voltage from 5µV to 63V; measure voltage from 1µV to 63.3V.
- Source current from 500pA to 3.15A; measure current from 100pA to 3.165A.
- Measure resistance from 10µΩ (<10µΩ in manual ohms) to 21.1MΩ
- Maximum source power is 66W.

Model 2425:

- Source voltage from 5µV to 105V; measure voltage from 1µV to 105.5V.
- Source current from 500pA to 3.15A; measure current from 100pA to 3.165A.
- Measure resistance from 10µΩ (<10µΩ in manual ohms) to 21.1MΩ
- Maximum source power is 110W.

Model 2430:

- Source DC or pulse voltage from 5µV to 105V; measure voltage from 1µV to 105.5V.
- Source DC current from 500pA to 3.15A; measure DC current from 100pA to 3.165A.
- Source pulse current from 500pA to 10.5A; measure pulse current from 100pA to 10.55A.
- Measure resistance from 10µΩ (<10µΩ in manual ohms) to 21.1MΩ
- Maximum DC source power is 110W.
- Maximum pulse source power is 1.1kW.

Model 2440:

- Source voltage from 5µV to 42V; measure voltage from 1µV to 42V.
- Source current from 500pA to 5.25A; measure current from 100pA to 5.25A.
- Measure resistance from 10µΩ (< 10µΩ in manual ohms) to 21.1 M¾.
- Maximum source power is 55W.

Front and rear panels

The front and rear panels of the Model 2400 SourceMeter are shown in Figures 1 and 2. The front and rear panels of the other SourceMeter models are similar. The use of the various instrument controls and connectors will be explained throughout this guide.

Figure 1-1
Front Panel