

Series 2200

Multichannel Programmable DC Power Supplies

Declassification and Security Instructions

2220S-901-01 Rev. B / December 2013

Series 2220

Multichannel Programmable DC Power Supplies

Declassification and Security Instructions

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Cleveland, Ohio, U.S.A.

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Safety precautions

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

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

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

The types of product users are:

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

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

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

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

Keithley Instruments products are designed for use with electrical signals that are 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 VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 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.

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

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

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

The  symbol indicates a connection terminal to the equipment frame.

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

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

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

Instrumentation and accessories shall not be connected to humans.

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

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

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

Safety precaution revision of January 2013.

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Preface

Welcome

Thank you for using a Keithley Instruments product. The Series 2200 Multichannel Programmable DC Power Supplies are flexible DC sources designed to power a wide range of applications. The model 2230-30-1 and its variants offer three power channels and the model 2220-30-1 and its variants provide two channels. The output channels on both models are independent and isolated, allowing you to power circuits with different references or polarities. Each channel can be enabled or disabled as your application requires. All outputs feature remote sense capability which can be used to reduce the effect of lead resistance, delivering 0.03% basic voltage accuracy even when using long leads. Basic current accuracy is 0.1% for all channels and linear regulation delivers low noise – less than 3 mVp-p. Flexible display modes make it easy to use the two 30 V outputs in combination, and the USB interface makes it easy to build PC-based systems without converters or special cables. The G versions of each model include a GPIB interface in combination with the USB interface.

These compact power supplies cover a wide range of applications without covering a lot of bench space. Versions of these power supplies are available for use at 100 VAC nominal line voltage which is common in Japan. These versions are indicated by the "J" suffix.

Products

This manual contains information about the following products:

Model	Description
2220-30-1	Programmable Dual Channel DC Power Supply
2220G-30-1	Programmable Dual Channel DC Power Supply with GPIB Interface
2220J-30-1	Programmable Dual Channel DC Power Supply for Japan
2220GJ-30-1	Programmable Dual Channel DC Power Supply with GPIB Interface for Japan
2230-30-1	Triple Channel Programmable DC Power Supply
2230G-30-1	Programmable Triple Channel DC Power Supply with GPIB Interface
2230J-30-1	Triple Channel Programmable DC Power Supply for Japan
2230GJ-30-1	Programmable Triple Channel DC Power Supply with GPIB Interface for Japan

Extended Warranty

Additional years of warranty coverage are available on many products. These valuable contracts protect you from unbudgeted service expenses and provide additional years of protection at a fraction of the price of a repair. Extended warranties are available on new and existing products. Contact your local Keithley Instruments representative for details.

Contact Information

If you have any questions after reviewing this information, please use the following sources:

1. Keithley Instruments website (<http://www.keithley.com>)
2. Keithley web forum (<http://forum.keithley.com>)
3. Call Keithley Instruments corporate headquarters (toll-free inside the U.S. and Canada only) at 1-888-KEITHLEY (1-888-534-8453), or from outside the U.S. at +1-440-248-0400. For worldwide contact numbers, visit the Keithley Instruments website (<http://www.keithley.com>).

Terms

The following terms may be used in this document:

- **Clear.** This removes data on media/memory before reusing it in a secured area. All reusable memory is cleared to deny access to previously stored information by standard means of access.
- **Erase.** This is equivalent to clear.
- **Media storage/data export device.** Any of several devices that can be used to store or export data from the instrument, such as a USB port.
- **Nonvolatile memory.** Data is retained when the instrument is powered off.
- **Power off.** Some instruments have a “Standby” mode, in which power is still supplied to the instrument. For the purpose of clearing data, putting the instrument in Standby mode does not qualify as powering off. For these products, you will need to either press a rear-panel OFF switch or remove the power source from the instrument.
- **Remove.** This is a physical means to clear the data by removing the memory device from the instrument. Instructions are available in the product Service Manual.
- **Sanitize.** This eradicates the data from media/memory so that the data cannot be recovered by other means or technology. This is typically used when the device will be moved (temporarily or permanently) from a secured area to a non-secured area.
- **Scrub.** This is equivalent to sanitize.
- **User-modifiable.** The user can write to the memory device during normal instrument operation, using the instrument interface or remote control.
- **Volatile memory.** Data is lost when the instrument is powered off.

Clear and Sanitize Procedures

Memory Devices

The following tables list nonvolatile and volatile memory devices. Detailed procedures to sanitize or clear these devices are shown after the tables.

Table 1: Nonvolatile memory devices

Type and minimum size	Function	User modifiable	Data input method	Location	To clear	To sanitize
EEPROM, 8k x 8 bit	Current setup, saved setups, and calibration constants	Yes	Firmware operations and user input	Main board		See Clear Flash and EEPROM Procedure following this table
Flash 8k x bit	ListData	Yes	Firmware operations and user input	Main board		See Clear Flash and EEPROM Procedure following this table
AT91SAM7X256, 256k Flash		No	Firmware update	CPU board		
STM32F103C8, 64k – 128k Flash		No	Firmware update	Main board		

Table 2: Volatile memory devices

Type and minimum size	Function	User modifiable	Data input method	Location	To clear	To sanitize
AT91SAM7X256, 64k SRAM		No	Firmware operations	CPU board	Cycle power with a minimum of 15 seconds off	
STM32F103C8, 20k SRAM		No	Firmware operations	Main board	Cycle power with a minimum of 15 seconds off	

Clear Flash and EEPROM Procedure

1. Press the front-panel **Shift** button.
2. Press the front-panel **.** button.
3. Press the front-panel **2** button.

Clear STM32F103 and AT91SAM Procedure

1. Press the front-panel power button to turn the instrument off.
2. Wait at least 15 seconds before turning the instrument back on.

Data Export Device

The following table lists the data export devices. There are no procedures to disable these devices.

Table 3: Data export devices

Type and minimum size	Function	User modifiable	Data input method	Location	To disable
USB device port	Supports remote control and data transfer to a PC	Yes	Remote control through USBTMC	Rear-panel of instrument	Cannot be disabled
GPIB port	Supports remote control and data transfer to a PC	Yes	Remote control through IEEE 488	Rear-panel of instrument	Cannot be disabled

Troubleshooting

How to Clear or Sanitize a Nonfunctional Instrument

To sanitize a nonfunctional instrument, remove the Main and CPU boards and return the instrument to Tektronix for installation of replacement boards.

How to Recover from Sanitizing the Nonvolatile Memory of the Instrument

After performing the Clear Flash and EEPROM Procedure, the power supply will return to the factory default setting. Therefore, a recovery procedure is not necessary.