

MP5103 Mainframe

Power Supply Unit (PSU) Modules

Verification and Adjustment Manual

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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 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.

Tektronix 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 Tektronix 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. Maximum signal levels are defined in the specifications and operating information and shown on the instrument panels, test fixture panels, and switching cards.

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 hazard. 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 warning, 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.

Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



The  symbol indicates that this product complies with the applicable European Union requirements according to Directives 2012/19/EU and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Tektronix Web site (www.tek.com/productrecycling).

The **WARNING** heading in the user documentation explains hazards 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.

The **CAUTION** heading with the  symbol in the user documentation explains hazards that could result in moderate or minor injury or damage the instrument. Always read the associated information very carefully before performing the indicated procedure. Damage to the instrument 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 Tektronix. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. The detachable mains power cord provided with the instrument may only be replaced with a similarly rated power cord. 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 Tektronix to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call a Tektronix office for information.

Unless otherwise noted in product-specific literature, Tektronix instruments are designed to operate indoors only, in a non-residential location, in the following environment: Altitude at or below 2,000 m (6,562 ft); temperature 0 °C to 50 °C (32 °F to 122 °F); and pollution degree 1 or 2.

To clean an instrument, use a cloth dampened with deionized water 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.

This product may contain a small installed lithium metal button cell. Please properly dispose of or recycle the cell at its end of life according to local government regulations.

This product may contain one or more type CR lithium batteries. According to the state of California, CR lithium batteries are classified as perchlorate materials and require special handling. See <http://www.dtsc.ca.gov/hazardouswaste/perchlorate> for additional information.

If present, the small lithium primary button cell contained in this equipment does not exceed 1 gram of lithium metal content per cell, and the cell type has been shown by the manufacturer to comply with the applicable requirements of the UN Manual of Tests and Criteria Part III, Sub-section 38.3. Consult your carrier to determine which lithium battery transportation requirements are applicable to your configuration, including to its re-packaging and re-labeling, prior to reshipment of the product by any mode of transport.

Introduction

Welcome

Thank you for choosing a Tektronix product. Verification and adjustment procedures for the following power supply unit (PSU) designed for use with the MP5103 Modular Precision Test System is covered in this manual:

- **MPSU50-2ST:** 2-channel 50 W, 50 V, 5 A

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 Tektronix office, sales partner, or distributor for details.

Contact information

If you have any questions after you review the information in this documentation, please contact your local Tektronix office, sales partner, or distributor. You can also call the Tektronix corporate headquarters (toll-free inside the U.S. and Canada only) at 1-800-833-9200. For worldwide contact numbers, visit [tek.com/contact-us](https://www.tek.com/contact-us).

Overview of available documentation

The documentation available for the MP5000 Series Modular Precision Test System is available from [tek.com](https://www.tek.com). The documentation includes:

- **User Manual:** Provides initial setup instructions, installation, a description of the instrument controls and connections, basic maintenance, and operational validation procedures.
- **Programmer Manual:** Contains command descriptions for controlling the MP5103 and available modules as well as information on building trigger models, TSP-Link and TSP-Net, and reading buffers.
- **Reference Manuals:** Include advanced operation topics, hardware configuration, additional maintenance information, troubleshooting procedures, and guidelines for measurement considerations and optimization.
- **TSP Toolkit Quick Start Guide:** Provides instructions for the Tektronix TSP™ Toolkit extension for Microsoft™ Visual Studio Code™.
- **Code examples for the MP5000 Series and modules:** [Tektronix GitHub Programmatic Control Examples Repository](#).
- **Accessories information:** Documentation for accessories available for the MP5103 and modules.

In addition to documentation, the website also provides the latest instrument firmware and additional support information.

Communicating with the mainframe and modules

Web interface

You can use the MP5103 web interface to change module settings for verification and adjustment. Some of the module settings you can change through the web interface include:

- Source levels and limits
- Overvoltage and overcurrent protection values
- Turning the power output on and off

See the "Remote communications" section of the *MP5103 Mainframe Reference Manual* for additional details on using the web interface.

TSP commands

Some procedures in this manual require using remote TSP commands to perform adjustment on modules installed in the MP5103 mainframe. Tektronix recommends that these procedures be performed only by trained personnel with knowledge of remote TSP command operation.

See the "Introduction" and "Introduction to TSP" sections of the *MP5000 Series Programmer Manual* for details on configuring your mainframe and module for remote access as well as for information on using TSP commands to configure and control your instruments. Details on the TSP commands used in the verification and adjustment procedures in this manual can be found in [TSP calibration commands](#) (on page 46).

Verification

Verification information

WARNING: The information in this section is intended for qualified service personnel only, as described by the types of product users in the [Safety precautions](#) (on page 5) pages provided at the beginning of this document. Do not attempt these procedures unless you are qualified to do so.

Some of these procedures may expose you to hazardous voltages, that if contacted, could cause personal injury or death. Use appropriate safety precautions when working with hazardous voltages.

Use the procedures in this section to verify that the accuracy of a module is within the limits stated in the instrument specifications. Verification is suggested:

- After receiving the instrument, to ensure that it was not damaged during shipment
- To verify that the instrument meets factory specifications
- To confirm an adjustment procedure

NOTE: If a verification process fails, the equivalent adjustment procedure must be performed.

Verification test conditions and requirements

The verification tests should be performed:

- After installation in an MP5103 Modular Precision Test System
- When the module is in a new test environment
- When the module and mainframe have been warmed-up for at least 30 minutes
- In an indoor, non-residential location
- Out of direct sunlight
- In a dust-free environment
- In a room with a relative humidity less than 70%
- Between temperatures of +18 to 28 °C (64 to 82 °F)
- Remote sense operation enabled

Verification equipment

The following is a list of the recommended verification equipment.

Type	Specifications	Device or instrument
Precision, fixed, resistive loads	0.1 Ω 1 Ω 2 Ω 50 Ω	Various manufacturers, 1% tolerance
Electronic load	150 V, 60 A, 300 W per channel Dual-channel Constant current, constant voltage, constant resistance, and constant power modes	Various manufacturers of programmable DC power supplies for electronic loads
Modular test system	Tektronix MP5103	Tektronix MP5103
Oscilloscope	Analog bandwidth: 100 MHz Sample rate: 2.5 GS/s	Tektronix MDO32 or equivalent
Digital multimeter	DC V: 10 nV to 1010 V 2-wire resistance: 1 $\mu\Omega$ to 1.2 G Ω 4-wire resistance: 100 n Ω to 1.2 G Ω	Keithley DMM7510 or equivalent

WARNING: The input/output connectors of the PSU modules are rated for connection to circuits rated Measurement Category 0 only, with transients rated less than 1500 V_{PEAK}. Do not connect the module terminals to CAT II, CAT III, or CAT IV circuits. Connections of the input/output terminals to circuits higher than CAT 0 can cause damage to the equipment or expose the operator to hazardous voltages.

Voltage verification tests

There are three voltage verification tests. These tests verify:

- Output voltage and measurement accuracy
- Output voltage load regulation
- Voltage output noise

Output voltage and measurement accuracy verification

This test verifies that the voltage output and measurement functions of the module are within specifications. This procedure applies to both CH1 and CH2 of the module.

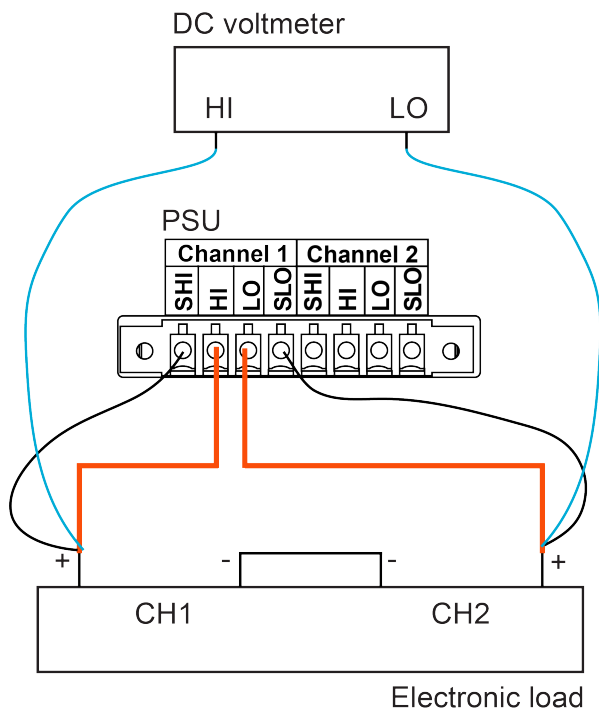
When using TSP commands, you must specify the module slot and channel. For example, to reset channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].reset()
```

WARNING: Hazardous voltages may be present on all output and guard terminals. To prevent electrical shock that could cause injury or death, never make or break connections while the instrument is powered on. Turn off the equipment from the front panel or disconnect the main power cord before handling cables. Putting the equipment into standby does not guarantee that the outputs are powered off if a hardware or software fault occurs.

Use the following graphic to set up your instruments for verification.

NOTE: The following graphic shows instruments configured for verifying channel 1 of the PSU. Change the output connections to channel 2 before performing verification on that channel.



See [Output voltage and voltage measurement accuracy test record](#) (on page 60) for limits and to record results.

To perform output voltage and measurement accuracy verification:

1. Reset the DC voltmeter and the electronic load.
2. Reset the module. Send

```
slot[1].psu[1].reset()
```
3. Configure the electronic load:
 - **Channel:** See table. Turn off unused channel.
 - **Regulation mode:** See table
 - **Power and current:** See table
4. Configure the DC voltmeter:
 - **Function:** DC volts
 - **Range:** See table
 - **Resolution:** 6.5 digits
 - **Measurement count:** 10
5. Set the module output voltage level and current limit to the values shown in the table for the next verification test step. Send the following commands, where valueV and valueI are the voltage and current levels, respectively.

```
slot[1].psu[1].source.levelv = valueV
slot[1].psu[1].source.limiti = valueI
```
6. Enable the module output, then set a delay of 2000 ms. Send

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
delay(2)
```
7. Make 10 voltage measurements using the DC voltmeter and record the readings.
8. Calculate the mean value of the measurements (total of measurements / 10). This value is DVM_{MEAN} .
9. Make 10 voltage measurements using the PSU.

```
slot[1].psu[1].measure.v(vReadingBuffer)
slot[1].psu[1].measure.count = 10
```
10. Calculate the mean value of the measurements (total of measurements / 10). This value is UUT_{VMEAS} .
11. Compare DVM_{MEAN} to the low and high test limits shown in the table. If DVM_{MEAN} falls within these limits, the voltage source is accurate.
12. Calculate the limits for the PSU DC voltage measurement accuracy using the below equations.
 - Voltage measurement high limit = $(DVM_{MEAN} \times 1.001) + 0.02$
 - Voltage measurement low limit = $(DVM_{MEAN} \times 0.999) - 0.02$
13. Compare UUT_{VMEAS} to these limits. If UUT_{VMEAS} falls within these limits, the verification passes.
14. Turn off the module output. Send

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```
15. Turn off the electronic load input.

Step name	Module settings			E-load settings		DC voltmeter settings	Test limits	
	CH	Current limit (A)	Output (V)	CH	Power / current	Range (V)	Low (V)	High (V)
Set and read DC voltage accuracy +1% FS	1	5	0.5	1	25 W	0.1	0.4795	0.5205
Set and read DC voltage accuracy +20% FS, 100% Pwr	1	5	10	1	4.97 A	10	9.97	10.03

	Module settings			E-load settings		DC voltmeter settings	Test limits	
Step name	CH	Current limit (A)	Output (V)	CH	Power / current	Range (V)	Low (V)	High (V)
Set and read DC voltage accuracy +25% FS, 100% Pwr	1	4	12.5	1	3.97 A	100	12.4675	12.5325
Set and read DC voltage accuracy +50% FS, 100% Pwr	1	2	25	1	1.97 A	100	24.955	25.045
Set and read DC voltage accuracy +75% FS, 100% Pwr	1	1.333	37.5	1	1.303 A	100	37.4425	37.5575
Set and read DC voltage accuracy +100% FS, 100% Pwr	1	1	50	1	0.97 A	100	49.93	50.07
Set and read DC voltage accuracy -1% FS	1	5	-0.5	2	25 W	0.1	-0.5205	-0.4795
Set and read DC voltage accuracy -20% FS, 100% Pwr	1	5	-10	2	4.97 A	10	-10.03	-9.97
Set and read DC voltage accuracy -25% FS, 100% Pwr	1	4	-12.5	2	3.97 A	100	-12.5325	-12.4675
Set and read DC voltage accuracy -50% FS, 100% Pwr	1	2	-25	2	1.97 A	100	-25.045	-24.955
Set and read DC voltage accuracy -75% FS, 100% Pwr	1	1.333	-37.5	2	1.303 A	100	-37.5575	-37.4425
Set and read DC voltage accuracy -100% FS, 100% Pwr	1	1	-50	2	0.97 A	100	-50.07	-49.93
Set and read DC voltage accuracy +1% FS	2	5	0.5	1	25 W	0.1	0.4795	0.5205
Set and read DC voltage accuracy +20% FS, 100% Pwr	2	5	10	1	4.97 A	10	9.97	10.03
Set and read DC voltage accuracy +25% FS, 100% Pwr	2	4	12.5	1	3.97 A	100	12.4675	12.5325
Set and read DC voltage accuracy +50% FS, 100% Pwr	2	2	25	1	1.97 A	100	24.955	25.045
Set and read DC voltage accuracy +75% FS, 100% Pwr	2	1.333	37.5	1	1.303 A	100	37.4425	37.5575
Set and read DC voltage accuracy +100% FS, 100% Pwr	2	1	50	1	0.97 A	100	49.93	50.07

	Module settings			E-load settings		DC voltmeter settings	Test limits	
Step name	CH	Current limit (A)	Output (V)	CH	Power / current	Range (V)	Low (V)	High (V)
Set and read DC voltage accuracy -1% FS	2	5	-0.5	2	25 W	0.1	-0.5205	-0.4795
Set and read DC voltage accuracy -20% FS, 100% Pwr	2	5	-10	2	4.97 A	10	-10.03	-9.97
Set and read DC voltage accuracy -25% FS, 100% Pwr	2	4	-12.5	2	3.97 A	100	-12.5325	-12.4675
Set and read DC voltage accuracy -50% FS, 100% Pwr	2	2	-25	2	1.97 A	100	-25.045	-24.955
Set and read DC voltage accuracy -75% FS, 100% Pwr	2	1.333	-37.5	2	1.303 A	100	-37.5575	-37.4425
Set and read DC voltage accuracy -100% FS, 100% Pwr	2	1	-50	2	0.97 A	100	-50.07	-49.93

Output voltage load regulation verification

This test measures the change in output voltage resulting from a change in loading. This procedure applies to both CH1 and CH2 of the module.

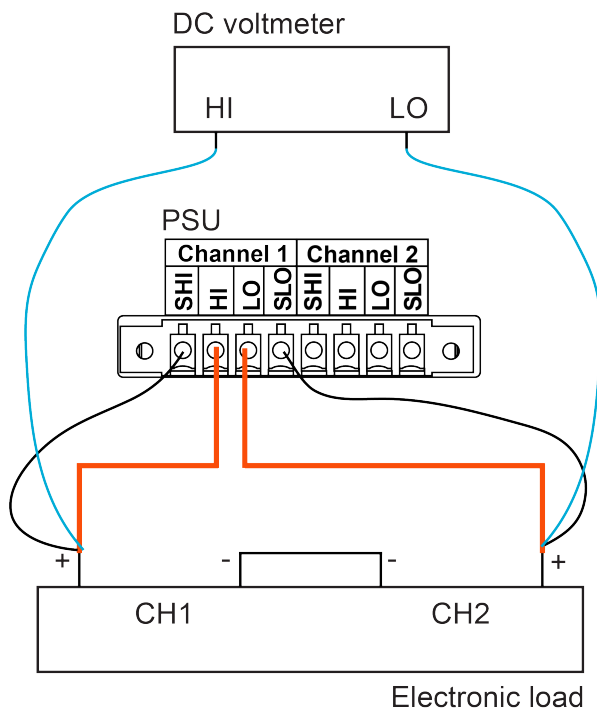
When using TSP commands, you must specify the module slot and channel. For example, to reset channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].reset()
```

WARNING: Hazardous voltages may be present on all output and guard terminals. To prevent electrical shock that could cause injury or death, never make or break connections while the instrument is powered on. Turn off the equipment from the front panel or disconnect the main power cord before handling cables. Putting the equipment into standby does not guarantee that the outputs are powered off if a hardware or software fault occurs.

Use the following graphic to set up your instruments for verification.

NOTE: The following graphic shows instruments configured for verifying channel 1 of the PSU. Change the output connections to channel 2 before performing verification on that channel.



10 V regulation verification

See [Output voltage load regulation verification test record](#) (on page 63) for limits and to record results.

To perform the 10 V regulation verification test:

1. Reset the DC voltmeter and the electronic load.
2. Reset the module. Send

```
slot[1].psu[1].reset()
```
3. Configure the electronic load as follows:
 - **Input channel:** CH1 for positive voltage verification, CH2 for negative voltage verification
 - **Regulation mode:** Constant current
 - **Input current:** 2.5 A
4. Configure the DC voltmeter as follows:
 - **Function:** DC volts
 - **Range:** 10 V
 - **Resolution:** 6.5 digits
 - **Measurement count:** 100
5. Set the module output voltage level to 10 V and current limit to 5 A. Send

```
slot[1].psu[1].source.levelv = 10
slot[1].psu[1].source.limiti = 5
```
6. Enable the module output, then set a measurement delay of 2000 ms. Send

```
slot[1].psu[1].source.output = ON
delay(2)
```
7. Make 100 measurements using the DC voltmeter and record the readings.
8. Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}). This value is V_{REF} .

9. Repeat the previous steps with the electronic load set as follows:

- **Channel:** CH1
- **Regulation mode:** Current
- **Input current:** 0.0 A

10. Record DVM_{MEAN} as $V_{MINILOAD}$.

11. Repeat steps 1 through 7 with the load set as follows:

- **Channel:** CH1
- **Regulation mode:** Constant current
- **Input current:** 4.95 A

12. Record DVM_{MEAN} as $V_{MAXLOAD}$.

13. Calculate the test upper and lower limits as follows:

- Upper limit = $V_{REF} + (V_{REF} * 0.0001) + 0.004$
- Lower limit = $V_{REF} - (V_{REF} * 0.0001) - 0.004$

14. Verify that $V_{MINILOAD}$ and $V_{MAXLOAD}$ are within the upper and lower limits.

15. Turn off the module output. Send

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

16. Turn off the electronic load input.

50 V regulation verification

See [Output voltage load regulation verification test record](#) (on page 63) for limits and to record results.

To perform the 50 V regulation verification test:

1. Reset the DC voltmeter and the electronic load.

2. Reset the module. Send

```
slot[1].psu[1].reset()
```

3. Configure the electronic load:

- **Input channel:** CH1 for positive voltage verification, CH2 for negative voltage verification
- **Regulation mode:** Constant current
- **Input current:** 0.5 A

4. Configure the DC voltmeter:

- **Function:** DC volts
- **Range:** 100 V
- **Resolution:** 6.5 digits
- **Measurement count:** 100

5. Set the module output voltage level to 50 V and current limit to 1 A. Send

```
slot[1].psu[1].source.levelv = 50
slot[1].psu[1].source.limiti = 1
```

6. Enable the module output. Send

```
slot[1].psu[1].source.output = ON
```

7. Make 100 measurements using the DC voltmeter and record the readings.

8. Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}). This value is V_{REF} .

9. Repeat the previous steps with the electronic load set as follows:

- **Channel:** CH1
- **Regulation mode:** Current
- **Input current:** 0.0 A

10. Record DVM_{MEAN} as $V_{MINILOAD}$.

11. Repeat steps 1 through 7 with the electronic load set as follows:

- **Channel:** CH1
- **Regulation mode:** Constant current
- **Input current:** 1.0 A

12. Record DVM_{MEAN} as $V_{MAXLOAD}$.

13. Calculate the test upper and lower limits as follows:

- Upper limit = $(V_{REF} \times 1.0001) + 0.004$
- Lower limit = $(V_{REF} \times 0.9999) - 0.004$

14. Verify that $V_{MINILOAD}$ and $V_{MAXLOAD}$ are within the upper and lower limits.

15. Turn off the module output. Send

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

16. Turn off the electronic load input.

Voltage output noise verification

This test measures the AC component of the module output voltage using a 20 MHz bandwidth. This procedure applies to both CH1 and CH2 of the module.

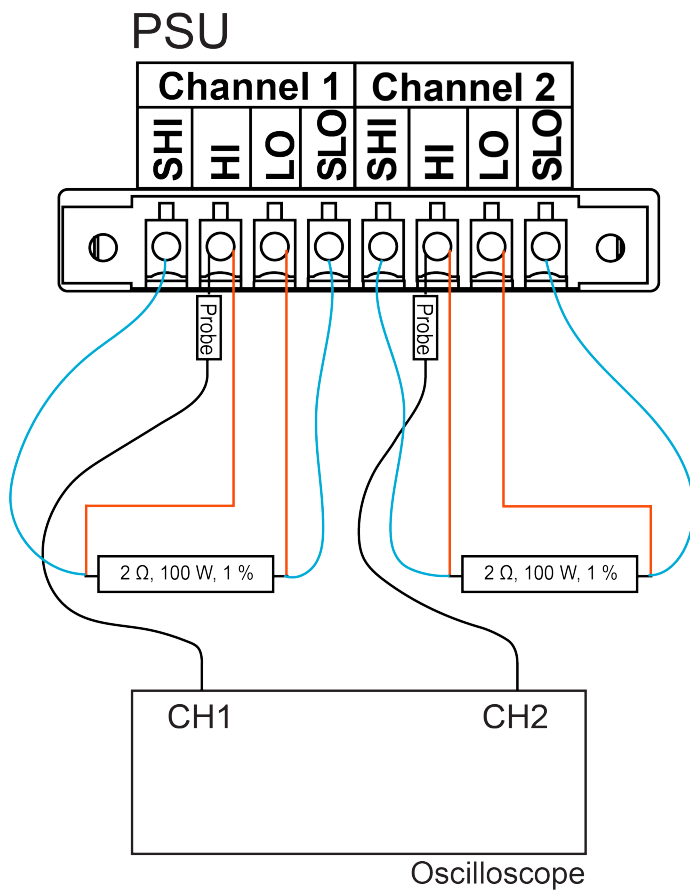
When using TSP commands, you must specify the module slot and channel. For example, to reset channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].reset()
```

WARNING: Hazardous voltages may be present on all output and guard terminals. To prevent electrical shock that could cause injury or death, never make or break connections while the instrument is powered on. Turn off the equipment from the front panel or disconnect the main power cord before handling cables. Putting the equipment into standby does not guarantee that the outputs are powered off if a hardware or software fault occurs.

Use the following graphic to set up your instruments for verification.

NOTE: The following graphic shows instruments configured to verify both channels of the PSU.



See [Voltage output noise verification test record](#) (on page 64) for limits and to record results.

To perform voltage output noise verification:

1. Reset the oscilloscope.
2. Reset the module. Send


```
slot[1].psu[1].reset()
```
3. Configure the oscilloscope:
 - **Vertical scale**
 - Coupling: AC
 - Input impedance: 1 MΩ
 - Vertical scale: 10 mV/div
 - Bandwidth: 20 MHz
 - **Horizontal scale**
 - Scale: 40 usec/div
 - Sample rate: 250 MS/s
 - Record length: 100000

- **Trigger configuration**
 - Trigger source: CH1
 - Trigger type: Edge
 - Trigger slope: Rising
 - Trigger level: 0 mV
 - Trigger coupling: AC
 - **Acquisition mode**
 - Mode: Sample
4. Set the module output voltage level to 10 V and current limit to 5 A. Send


```
slot[1].psu[1].source.levelv = 10
slot[1].psu[1].source.limiti = 5
```
 5. Enable the module output, then set a measurement delay of 10 s. Send


```
slot[1].psu[1].source.output = ON
delay(10)
```
 6. Using the oscilloscope, measure the peak-to-peak ripple of the input signal. A typical unit will have a signal ≤ 20 mV_{PEAK-PEAK}, but this may not always be the case.
 7. Using the oscilloscope, measure the RMS ripple of the input signal. A typical unit will have a signal ≤ 5 mV_{RMS}, but this may not always be the case.

Current verification tests

There are four current verification tests. These tests verify:

- Current load regulation
- Current measurement accuracy
- Current limit accuracy
- Current noise verification

Current load regulation verification

This test verifies current regulation over a range of output voltages. This procedure applies to both CH1 and CH2 of the module.

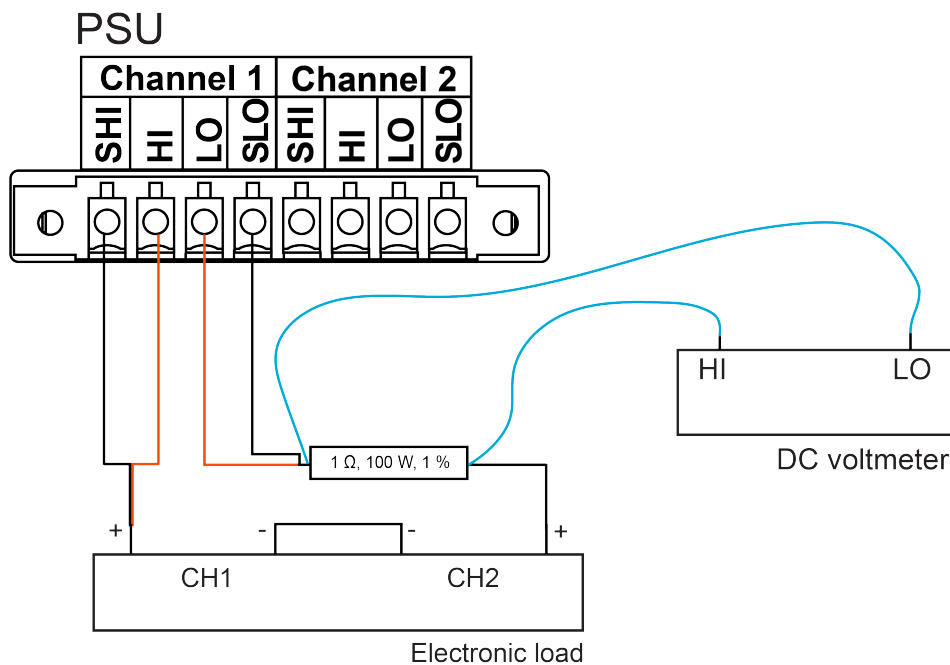
When using TSP commands, you must specify the module slot and channel. For example, to reset channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].reset()
```

WARNING: Hazardous voltages may be present on all output and guard terminals. To prevent electrical shock that could cause injury or death, never make or break connections while the instrument is powered on. Turn off the equipment from the front panel or disconnect the main power cord before handling cables. Putting the equipment into standby does not guarantee that the outputs are powered off if a hardware or software fault occurs.

Use the following graphic to set up your instruments for verification.

NOTE: The following graphic shows instruments configured for verifying channel 1 of the PSU. Change the output connections to channel 2 before performing verification on that channel.



See [Current load regulation verification test record](#) (on page 65) for limits and to record results.

To perform current load regulation verification:

- Reset the electronic load, then set the following parameters:
 - Regulation Mode:** Constant resistance
 - Input resistance:** 25 Ω
- Configure the DC voltmeter:
 - Function:** DC volts
 - Range:** 10 V
 - Resolution:** 6.5 digits
 - Measurement count:** 100
- Set the module output voltage to 50 V and current output to 1 A.


```
slot[1].psu[1].source.levelv = 50
slot[1].psu[1].source.limiti = 1
```
- Enable the module output, then set a delay of 2000 ms.


```
slot[1].psu[1].source.output = slot[1].psu[1].ON
delay(2)
```
- Enable the electronic load input, then set a delay of 3000 ms.
- Make 100 voltage measurements with the DC voltmeter and record the readings.
- Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}), then divide the result by the characterized value of the 1 Ω resistor to obtain I_{REF} .
- Change the electronic load resistance to 12.5 Ω.
- Make 100 voltage measurements with the DC voltmeter and record the readings.
- Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}), then divide the result by the characterized value of the 1 Ω resistor to obtain $I_{MAXLOAD}$.
- Change the electronic load resistance to 45 Ω.
- Make 100 voltage measurements from the DC voltmeter and record the readings.

13. Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}), then divide the result by the characterized value of the 1 Ω resistor to obtain I_{MINLOAD} .
14. Turn off the module output. Send

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```
15. Turn off the electronic load input.
16. Calculate the test upper and lower limits as follows:
 - Upper limit = $I_{\text{REF}} + (I_{\text{REF}} * 0.0001) + 0.002$
 - Lower limit = $I_{\text{REF}} - (I_{\text{REF}} * 0.0001) - 0.002$
17. Compare I_{MINLOAD} and I_{MAXLOAD} to the upper and lower limits. If I_{MINLOAD} and I_{MAXLOAD} are within these limits, the test passes.

Current measurement accuracy verification

This test verifies the current measurement accuracy. These procedures apply to both CH1 and CH2 of the module.

Current measurement accuracy is verified by comparing the current measured by the power supply to the current measured by an external DMM over a shunt resistor. For the best accuracy, ensure that the DMM and shunt resistor are sufficiently accurate.

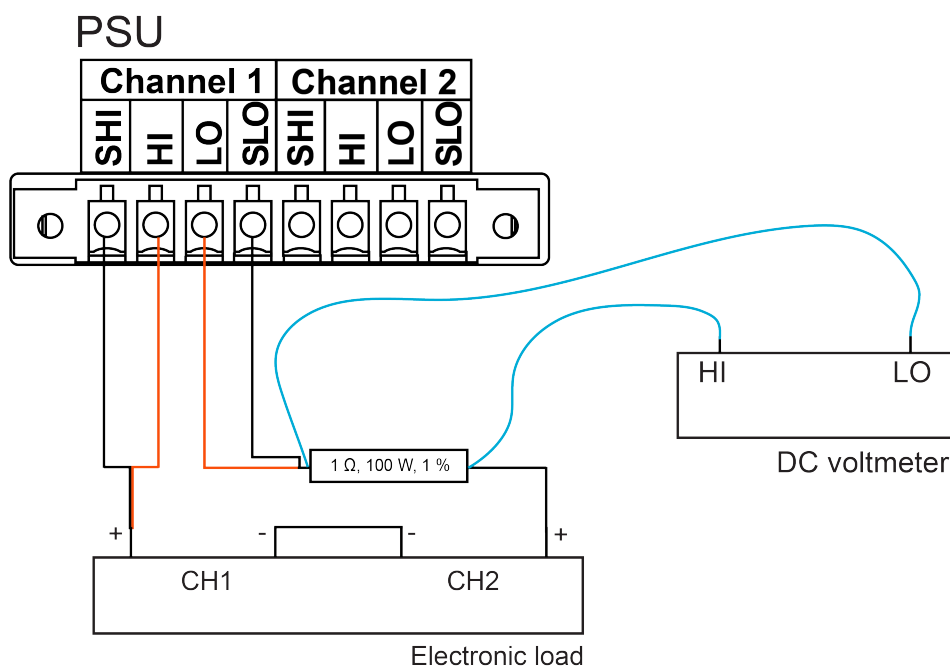
When using TSP commands, you must specify the module slot and channel. For example, to reset channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].reset()
```

WARNING: Hazardous voltages may be present on all output and guard terminals. To prevent electrical shock that could cause injury or death, never make or break connections while the instrument is powered on. Turn off the equipment from the front panel or disconnect the main power cord before handling cables. Putting the equipment into standby does not guarantee that the outputs are powered off if a hardware or software fault occurs.

Use the following graphic to set up your instruments for verification.

NOTE: The following graphic shows instruments configured for verifying channel 1 of the PSU. Change the output connections to channel 2 before performing verification on that channel.



See [Current measurement accuracy verification test record](#) (on page 66) for limits and to record results.

To perform current measurement accuracy verification:

- Configure the electronic load:
 - Channel:** See table
 - Regulation mode:** Constant current
 - Constant current value:** See table. For electronic load constant current values ≥ 5 A, reduce the current setting by 0.5 A.
- Configure the DC voltmeter:
 - Function:** DC volts
 - Range:** See table
 - Resolution:** 6.5 digits
 - Measurement count:** 10
- Set the module output voltage and current limits to the values shown in the table for the next test step. Send the following commands, where valueV and valueI are the voltage and current levels, respectively.


```
slot[1].psu[1].source.levelv = valueV
slot[1].psu[1].source.limiti = valueI
```
- Enable the module output, then set a delay of 2000 ms. Send


```
slot[1].psu[1].source.output = slot[1].psu[1].ON
delay(2)
```
- Enable the electronic load input. If the constant current value in the table is ≥ 5 A, set a measurement delay of 5000 ms and increase the load constant current value by 0.5A. Otherwise, set a delay of 500 ms.
- Make 10 voltage measurements using the DC voltmeter across the characterized resistor and record the readings.
- Calculate the mean value (total of measurements / 10). This value is $LOAD_{IMEAN}$.
- Make 10 current measurements using the PSU.


```
slot[1].psu[1].measure.i(iReadingBuffer)
slot[1].psu[1].measure.count = 10
```
- Calculate the mean value of the measurements (total of measurements / 10). This value is UUT_{IMEAS} .
- Turn off the module output. Send


```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```
- Turn off the electronic load input.
- Calculate the limits for DC current measurement accuracy as follows:
 - Measurement HI Limit = $(LOAD_{IMEAN} * 1.001) + 0.005$
 - Measurement LO Limit = $(LOAD_{IMEAN} * 0.999) - 0.005$
- Compare UUT_{IMEAS} to the calculated limits. If UUT_{IMEAS} is within these limits, the test passes.

Step name	PSU settings			Electronic load settings		DMM Settings
	CH	Current limit (A)	Voltage (V)	CH	Current	Range
Read DC current accuracy 100% FS, 100% Pwr	1	5.1	9.75	1	5	10
Read DC current accuracy 75% FS, 100% Pwr	1	4	12.5	1	3.75	10
Read DC current accuracy 50% FS, 100% Pwr	1	3.3	15	1	2.5	10

	PSU settings			Electronic load settings		DMM Settings
Step name	CH	Current limit (A)	Voltage (V)	CH	Current	Range
Read DC current accuracy 100% FS, 100% Pwr	1	5.1	9.75	1	5	10
Read DC current accuracy 25% FS, 100% Pwr	1	1.4	35	1	1.25	10
Read DC current accuracy 20% FS, 100% Pwr	1	1.1	45	1	1	1
Read DC current accuracy 1% FS, 50% Pwr	1	1	50	1	0.05	1
Read DC current accuracy -100% FS, 100% Pwr	1	5.1	-9.75	2	5	10
Read DC current accuracy -75% FS, 100% Pwr	1	4	-12.5	2	3.75	10
Read DC current accuracy -50% FS, 100% Pwr	1	3.3	-15	2	2.5	10
Read DC current accuracy -25% FS, 100% Pwr	1	1.4	-35	2	1.25	10
Read DC current accuracy -20% FS, 100% Pwr	1	1.1	-45	2	1	1
Read DC current accuracy -1% FS, 50% Pwr	1	1	-50	2	0.05	1
Read DC current accuracy 75% FS, 100% Pwr	2	4	12.5	1	3.75	10
Read DC current accuracy 50% FS, 100% Pwr	2	3.3	15	1	2.5	10
Read DC current accuracy 25% FS, 100% Pwr	2	1.4	35	1	1.25	10
Read DC current accuracy 20% FS, 100% Pwr	2	1.1	45	1	1	1
Read DC current accuracy 1% FS, 50% Pwr	2	1	50	1	0.05	1
Read DC current accuracy -100% FS, 100% Pwr	2	5.1	-9.75	2	5	10
Read DC current accuracy -75% FS, 100% Pwr	2	4	-12.5	2	3.75	10
Read DC current accuracy -50% FS, 100% Pwr	2	3.3	-15	2	2.5	10
Read DC current accuracy -25% FS, 100% Pwr	2	1.4	-35	2	1.25	10
Read DC current accuracy -20% FS, 100% Pwr	2	1.1	-45	2	1	1
Read DC current accuracy -1% FS, 50% Pwr	2	1	-50	2	0.05	1

Current limit accuracy verification

This test verifies the accuracy of the current limit setting. This procedure applies to both CH1 and CH2 of the module.

Current limit accuracy is verified by comparing the limit setting of the power supply to the current measured by an external DMM and shunt resistor. For best accuracy, ensure the DMM and shunt resistor are sufficiently accurate.

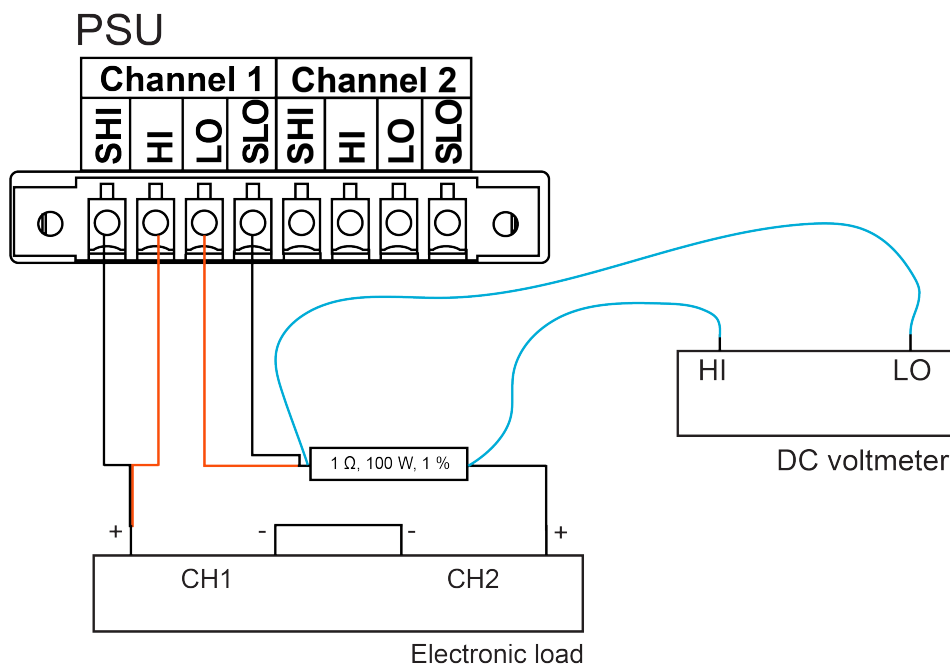
When using TSP commands, you must specify the module slot and channel. For example, to reset channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].reset()
```

WARNING: Hazardous voltages may be present on all output and guard terminals. To prevent electrical shock that could cause injury or death, never make or break connections while the instrument is powered on. Turn off the equipment from the front panel or disconnect the main power cord before handling cables. Putting the equipment into standby does not guarantee that the outputs are powered off if a hardware or software fault occurs.

Use the following graphic to set up your instruments for verification.

NOTE: The following graphic shows instruments configured for verifying channel 1 of the PSU. Change the output connections to channel 2 before performing verification on that channel.



See [Current limit accuracy verification test record](#) (on page 68) for limits and to record results.

To perform current limit accuracy verification:

1. Reset the electronic load, then set the following parameters:
 - **Regulation mode:** Constant resistance (CR)
 - **Input resistance:** See table. For positive input voltages short input 2, for negative input voltages short input 1.
 - **Resistance slew rate:** 1 Ω/sec

2. Configure the DC voltmeter:

- **Function:** DC volts
- **Range:** See table
- **Resolution:** 6.5 digits
- **Measurement count:** 100

3. Set the module output voltage and current limits to the values shown in the table for the next test step. Send the following commands, where valueV and valueI are the voltage and current levels, respectively.

```
slot[1].psu[1].source.levelv = valueV
slot[1].psu[1].source.limiti = valueI
```

4. Enable the module output, then set a delay of 2000 ms.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
delay(2)
```

5. Enable the electronic load input, then delay 3000 ms.

6. Measure the module output current by measuring the voltage across the 1 Ω precision resistor with the DC voltmeter.7. Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}), then divide the result by the characterized value of the 1 Ω resistor to obtain $I_{\text{OUTPUTMEAN}}$.

8. Turn the module output off.

9. Turn the electronic load input off. Send

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

10. Calculate the test limits as follows:

- Upper limit = (Current limit setting $\times$ 1.001) + 0.02
- Lower limit = (Current limit setting $\times$ 0.999) - 0.02

11. Compare $I_{\text{OUTPUTMEAN}}$ to the calculated limits. If $I_{\text{OUTPUTMEAN}}$ is within these limits, the test passes.

	PSU settings			Electronic load settings		Voltmeter Settings
Step name	CH	Current limit (A)	Voltage (V DC)	CH	Resistance	Range
Current limit accuracy 0.01 A	1	0.01	50	1	20	1 V
Current limit accuracy 0.05 A	1	0.05	50	1	20	1 V
Current limit accuracy 0.5 A	1	0.5	50	1	75	1 V
Current limit accuracy 4.5 A	1	4.5	10	1	2	10 V
Current limit accuracy 5.0 A	1	5	10	1	1.75	10 V
Current limit accuracy -0.01 A	1	0.01	-50	2	20	1 V
Current limit accuracy -0.05 A	1	0.05	-50	2	20	1 V
Current limit accuracy -0.5 A	1	0.5	-50	2	75	1 V
Current limit accuracy -4.5 A	1	4.5	-10	2	2	10 V

	PSU settings			Electronic load settings		Voltmeter Settings
Step name	CH	Current limit (A)	Voltage (V DC)	CH	Resistance	Range
Current limit accuracy -5.0 A	1	5	-10	2	1.75	10 V
Current limit accuracy 0.01 A	2	0.01	50	1	20	1 V
Current limit accuracy 0.05 A	2	0.05	50	1	20	1 V
Current limit accuracy 0.5 A	2	0.5	50	1	75	1 V
Current limit accuracy 4.5 A	2	4.5	10	1	2	10 V
Current limit accuracy 5.0 A	2	5	10	1	1.75	10 V
Current limit accuracy -0.01 A	2	0.01	-50	2	20	1 V
Current limit accuracy -0.05 A	2	0.05	-50	2	20	1 V
Current limit accuracy -0.5 A	2	0.5	-50	2	75	1 V
Current limit accuracy -4.5 A	2	4.5	-10	2	2	10 V
Current limit accuracy -5.0 A	2	5	-10	2	1.75	10 V

Current noise verification

This test measures the inherent AC component of the DC output when it is near maximum rating. Noise is measured in a 20 MHz bandwidth. This procedure applies to both CH1 and CH2 of the module.

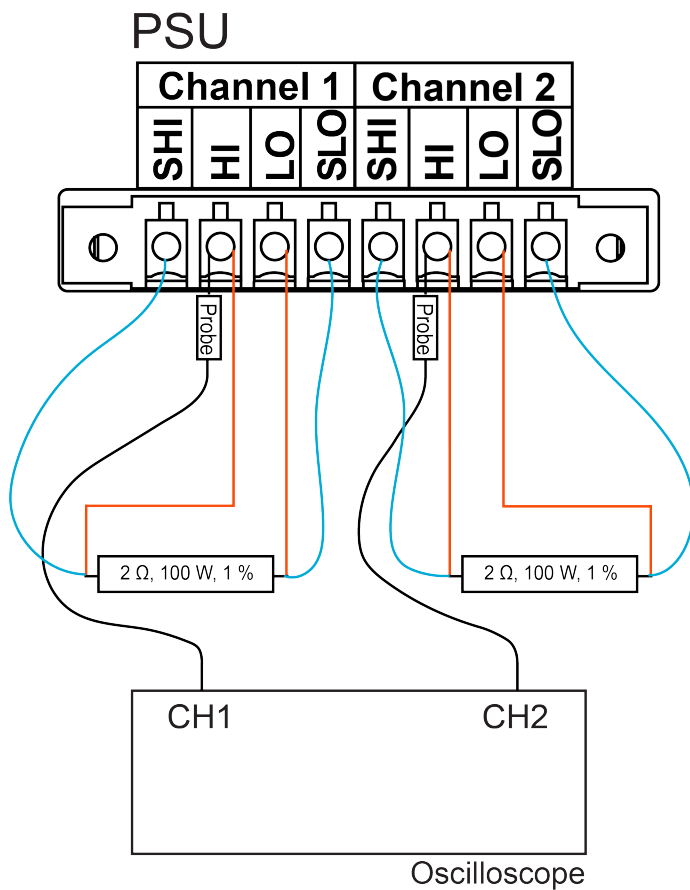
When using TSP commands, you must specify the module slot and channel. For example, to reset channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].reset()
```

WARNING: Hazardous voltages may be present on all output and guard terminals. To prevent electrical shock that could cause injury or death, never make or break connections while the instrument is powered on. Turn off the equipment from the front panel or disconnect the main power cord before handling cables. Putting the equipment into standby does not guarantee that the outputs are powered off if a hardware or software fault occurs.

Use the following graphic to set up your instruments for verification.

NOTE: The following graphic shows instruments configured for verifying channel 1 of the PSU. Change the output connections to channel 2 before performing verification on that channel.



See [Current noise verification test record](#) (on page 69) for limits and to record results.

To perform constant current noise verification:

1. Reset the oscilloscope.
2. Reset the module

```
slot[1].psu[1].reset()
```
3. Configure the oscilloscope as follows:
 - **Vertical**
 - Coupling: AC
 - Input impedance: 1 MΩ
 - Vertical scale: 10 mV/div
 - Bandwidth: 20 MHz
 - **Horizontal**
 - Scale: 40 usec/div
 - Sample rate: 250 MS/s
 - Record length: 100000

- **Trigger**

- Trigger source: CH1
- Trigger type: Edge
- Trigger slope: Rising
- Trigger level: 0 mV
- Trigger coupling: AC

- **Acquisition mode**

- Mode: Sample

4. Set the module output voltage limit to 10 V and current limit to 4.75 A. Send

```
slot[1].psu[1].source.levelv = 10  
slot[1].psu[1].source.limiti = 4.75
```

5. Enable the module output, then set a measurement delay of 10 s. Send

```
slot[1].psu[1].source.output = ON  
delay(10)
```

6. Using the oscilloscope, measure the peak-to-peak noise of the input signal and divide this value by the load resistance. If the signal is $\leq 5 \text{ mA}_{\text{RMS}}$, the test passes.
7. Using the oscilloscope, measure the RMS noise of the input signal. If the signal is $\leq 1 \text{ mA}_{\text{RMS}}$, the test passes.

Adjustment

Adjustment information

WARNING: The information in this section is intended for qualified service personnel only, as described by the types of product users in the Safety precautions pages, provided at the beginning of this document. Do not attempt these procedures unless you are qualified to do so.

Some of these procedures may expose you to hazardous voltages, that if contacted, could cause personal injury or death. Use appropriate safety precautions when working with hazardous voltages.

This section contains details on adjustment of the module voltage source and measure functions.

Voltage adjustments

The module is set to four pre-defined voltage calibration points. At each point, the output voltage is measured with no load applied. The measured value is then written back to the module as the voltage calibration point. The voltage calibration points are:

CP1 = +0.5V

CP2 = +45.0V

CP3 = -0.5V

CP4 = -45.0V

Current adjustments

The module is set to four pre-defined current calibration points. At each point, the output current is determined by measuring the voltage across a 1 Ω , 100 W, 1% characterized resistor ($I=V_r/R$). The measured value is written back to the module as the current calibration point. The current calibration points are:

CP1 = +0.012A

CP2 = +4.5A

CP3 = -0.012A

CP4 = -4.5A

Current adjustment also includes a temperature compensation adjustment. For this adjustment, the module is configured in an off state (power on, output off) to allow for temperature stabilization. Once the temperature is stabilized, the module is configured to output 5 A in current compliance mode. The module output current is determined by measuring the voltage across a 0.1 Ω , 100 W, 1% characterized resistor ($I=V_r/R$). The measured current and module compensation (temperature) values are recorded. The module is then allowed to output 5A for approximately 1 minute, after which the measurements are made again and all the values written to the module as temperature calibration points.

Adjustment conditions and requirements

The following conditions are required when performing adjustment:

- A stable ambient temperature controlled to vary less than ± 1 °C during the period of adjustment
- A calibration adjustment temperature (T_{CAL}) of 23 °C. If a different nominal temperature is used, it should be noted on the calibration report
- A relative humidity of less than or equal to 40 %, unless otherwise noted.
- No direct airflow on the input terminals.

Adjustment equipment

The following is a table of the recommended equipment used for adjusting the MPSU50-2ST.

Type	Specifications	Recommended instrument
Precision, fixed, resistive loads	0.1 Ω 1 Ω	Various manufacturers, 1% tolerance
Electronic load	150 V, 60 A, 300 W per channel Dual-channel Constant current, constant voltage, constant resistance, and constant power modes	Various manufacturers of programmable DC power supplies for electronic loads
Modular test system	Tektronix MP5103	Tektronix MP5103
Digital multimeter	DC V: 10 nV to 1010 V 2-wire resistance: 1 $\mu\Omega$ to 1.2 G Ω 4-wire resistance: 100 n Ω to 1.2 G Ω	Keithley DMM7510 or equivalent

WARNING: The input/output connectors of the PSU modules are rated for connection to circuits rated Measurement Category 0 only, with transients rated less than 1500 V_{PEAK}. Do not connect the module terminals to CAT II, CAT III, or CAT IV circuits. Connections of the input/output terminals to circuits higher than CAT 0 can cause damage to the equipment or expose the operator to hazardous voltages.

Adjust the output voltage

This procedure applies to both CH1 and CH2 of the module.

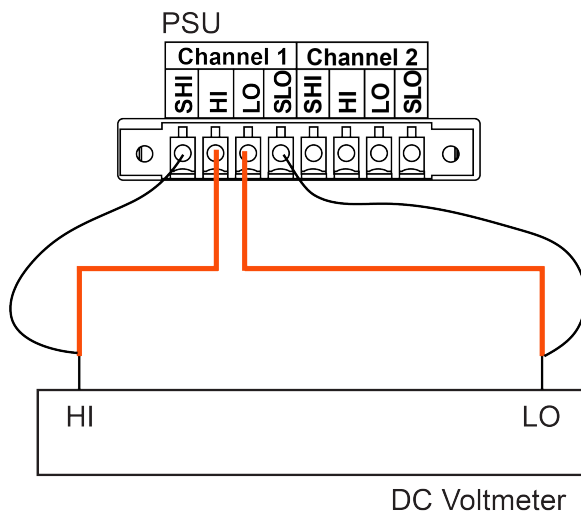
When using TSP commands, you must specify the module slot and channel. For example, to unlock calibration for channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].cal.unlock()
```

NOTE: Before activating the calibration constants in the following procedure, check validity. The values for points CP1 and CP3 should be within ± 0.5 V of their setpoints (+0.5 V and -0.5 V). The values for points CP2 and CP4 should be within ± 1 V of their setpoints (+45 V and -45 V).

Use the following graphic to set up your instruments for adjustment.

NOTE: The following graphic shows instruments configured for adjusting channel 1 of the PSU. Change the output connections to channel 2 before performing adjustment on that channel.



+50 V output range adjustment

To adjust the +50 V output voltage:

1. Reset the DC voltmeter and the electronic load.
2. Configure the DC voltmeter as follows:
 - **Function:** DC volts
 - **Range:** 100 V for points CP2 and CP4, 1 V for points CP1 and CP3
 - **Resolution:** 6.5 digits
3. Unlock calibration for the module.


```
slot[1].psu[1].cal.unlock()
```
4. Load and activate the nominal calibration set.


```
slot[1].psu[1].cal.restore.(slot[1].psu[1].CALSET_NOMINAL)
```
5. Configure the module output adjustment settings. The voltage value is `cp1Expected`.


```
slot[1].psu[1].source.levelv = .5
slot[1].psu[1].source.limiti = 5
```
6. Set the module calibration polarity to positive.


```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_POSITIVE
```
7. Enable the module output.


```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```
8. Measure the output voltage with the DC voltmeter. This value is `cp1Reference`.
9. Turn off the module output.


```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```
10. Re-configure the module output adjustment settings. The voltage value is `cp2Expected`.


```
slot[1].psu[1].source.levelv = 45
slot[1].psu[1].source.limiti = 1
```
11. Turn the output on.


```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```
12. Measure the output voltage with the DMM. This value is `cp2Reference`.
13. Turn off the module output.


```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

14. Activate the calibration constants.

```
slot[1].psu[1].source.calibratev(range, cp1Expected, cp1Reference, cp2Expected, cp2Reference)
```

15. Continue to the next adjustment procedure or see [Save and lock adjustments](#) (on page 45) if you are finished.

-50 V output range adjustment

To adjust the -50 V output voltage:

1. Reset the DC voltmeter and the electronic load.

2. Configure the DC voltmeter as follows:

- **Function:** DC volts
- **Range:** 100 V for points CP2 and CP4, 1 V for points CP1 and CP3
- **Resolution:** 6.5 digits

3. Unlock calibration for the module.

```
slot[1].psu[1].cal.unlock()
```

4. Load and activate the nominal calibration set.

```
slot[1].psu[1].cal.restore.(slot[1].psu[1].CALSET_NOMINAL)
```

5. Configure the module output adjustment settings. The voltage value is cp3Expected.

```
slot[1].psu[1].source.levelv = -.5  
slot[1].psu[1].source.limiti = 5
```

6. Set the module calibration polarity to negative.

```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_NEGATIVE
```

7. Enable the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

8. Measure the output voltage with the DC voltmeter. This value is cp3Reference.

9. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

10. Re-configure the module output adjustment settings. The voltage value is cp4Expected.

```
slot[1].psu[1].source.levelv = -45  
slot[1].psu[1].source.limiti = 1
```

11. Turn the output on.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

12. Measure the output voltage with the DMM. This value is cp4Reference.

13. Turn the output off.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

14. Activate the calibration constants.

```
slot[1].psu[1].source.calibratev(range, cp3Expected, cp3Reference, cp4Expected, cp4Reference)
```

15. Continue to the next adjustment procedure or see [Save and lock adjustments](#) (on page 45) if you are finished.

Adjust voltage measurement

This procedure applies to both CH1 and CH2 of the module.

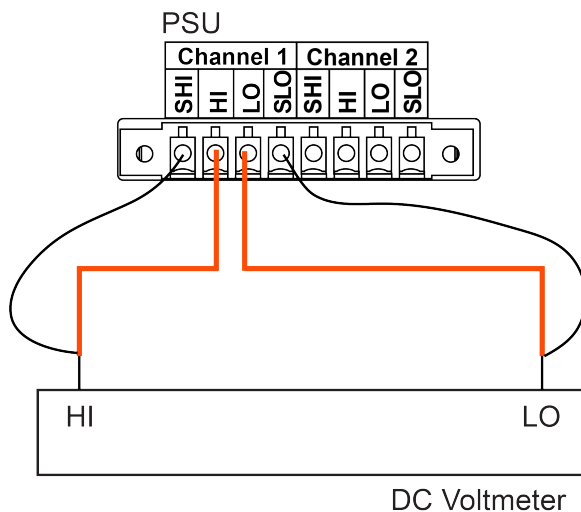
When using TSP commands, you must specify the module slot and channel. For example, to unlock calibration for channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].cal.unlock()
```

NOTE: Before activating the calibration constants in the following procedure, check validity. The values for points CP1 and CP3 should be within ± 0.5 V of their setpoints (+0.5 V and -0.5 V). The values for points CP2 and CP4 should be within ± 1 V of their setpoints (+45 V and -45 V).

Use the following graphic to set up your instruments for adjustment.

NOTE: The following graphic shows instruments configured for adjusting channel 1 of the PSU. Change the output connections to channel 2 before performing adjustment on that channel.



+50 V measurement range adjustment

To adjust the +50 V voltage measurement function:

1. Reset the DC voltmeter and the electronic load.
2. Configure the DC voltmeter as follows:
 - **Function:** DC volts
 - **Range:** 100 V for points CP2 and CP4, 1 V for points CP1 and CP3
 - **Resolution:** 6.5 digits
 - **Measurement count:** 100
3. Unlock calibration.


```
slot[1].psu[1].cal.unlock()
```
4. Load and activate the nominal calibration set.


```
slot[1].psu[1].cal.restore.(slot[1].psu[1].CALSET_NOMINAL)
```
5. Configure the module output adjustment settings.


```
slot[1].psu[1].source.levelv = .5
slot[1].psu[1].source.limiti = 5
```

6. Set the module calibration polarity to positive.

```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_POSITIVE
```

7. Enable the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

8. Measure the output voltage with the DC voltmeter. This value is `cp1Reference`.9. Make 100 voltage measurements using the PSU, storing the results in a buffer named `voltageValue`.

```
voltageValue = slot[1].psu[1].makebuffer(100)
voltageValue.clear()
slot[1].psu[1].measure.count = 100
slot[1].psu[1].measure.v(voltageValue)
```

10. Display the 100 measurements.

```
printbuffer(1, voltageValue.n, voltageValue)
```

11. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

12. Calculate the mean value of the measurements (total of measurements / 100). This value is `cp1Measured`.

13. Reconfigure the module output adjustment settings.

```
slot[1].psu[1].source.levelv = 45
slot[1].psu[1].source.limiti = 1
```

14. Turn on the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

15. Measure the module output voltage with the DC voltmeter. This value is `cp2Reference`.16. Make 100 voltage measurements using the PSU, storing the results in a buffer named `voltageValue`.

```
voltageValue = slot[1].psu[1].makebuffer(100)
voltageValue.clear()
slot[1].psu[1].measure.count = 100
slot[1].psu[1].measure.v(voltageValue)
```

17. Display the 100 measurements.

```
printbuffer(1, voltageValue.n, voltageValue)
```

18. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

19. Calculate the mean value of the measurements (total of measurements / 100). This value is `cp2Measured`.

20. Activate the calibration constants.

```
slot[1].psu[1].measure.calibratev(range, cp1Measured, cp1Reference, cp2Measured, cp2Reference)
```

21. Continue to the next adjustment procedure or see [Save and lock adjustments](#) (on page 45) if you are finished.

-50 V measurement range adjustment

To adjust the -50 V voltage measurement function:

1. Reset the DC voltmeter and the electronic load.
2. Configure the DC voltmeter as follows:
 - **Function:** DC volts
 - **Range:** 100 V for points CP2 and CP4, 1 V for points CP1 and CP3
 - **Resolution:** 6.5 digits
 - **Measurement count:** 100

3. Unlock calibration. Send

```
slot[1].psu[1].cal.unlock()
```

4. Load and activate the nominal calibration set.

```
slot[1].psu[1].cal.restore.(slot[1].psu[1].CALSET_NOMINAL)
```

5. Configure the module output adjustment settings.

```
slot[1].psu[1].source.levelv = -.5
```

```
slot[1].psu[1].source.limiti = 5
```

6. Set the module calibration polarity to negative.

```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_NEGATIVE
```

7. Enable the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

8. Measure the output voltage with the DC voltmeter. This value is cp3Reference.**9. Make 100 voltage measurements using the PSU, storing the results in a buffer named voltageValue.**

```
voltageValue = slot[1].psu[1].makebuffer(100)
```

```
voltageValue.clear()
```

```
slot[1].psu[1].measure.count = 100
```

```
slot[1].psu[1].measure.v(voltageValue)
```

10. Display the 100 measurements.

```
printbuffer(1, voltageValue.n, voltageValue)
```

11. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

12. Calculate the mean value of the measurements (total of measurements / 100). This value is cp3Measured.**13. Reconfigure the module output adjustment settings.**

```
slot[1].psu[1].source.levelv = -45
```

```
slot[1].psu[1].source.limiti = 1
```

14. Turn on the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

15. Measure the module output voltage with the DC voltmeter. This value is cp4Reference.**16. Make 100 voltage measurements using the PSU, storing the results in a buffer named voltageValue.**

```
voltageValue = slot[1].psu[1].makebuffer(100)
```

```
voltageValue.clear()
```

```
slot[1].psu[1].measure.count = 100
```

```
slot[1].psu[1].measure.v(voltageValue)
```

17. Display the 100 measurements.

```
printbuffer(1, voltageValue.n, voltageValue)
```

18. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

19. Calculate the mean value of the measurements (total of measurements / 100). This value is cp4Measured.**20. Activate the calibration constants.**

```
slot[1].psu[1].measure.calibratev(range, cp3Measured, cp3Reference, cp4Measured, cp4Reference)
```

21. Continue to the next adjustment procedure or see [Save and lock adjustments](#) (on page 45) if you are finished.

Adjust the current limit

This procedure applies to both CH1 and CH2 of the module.

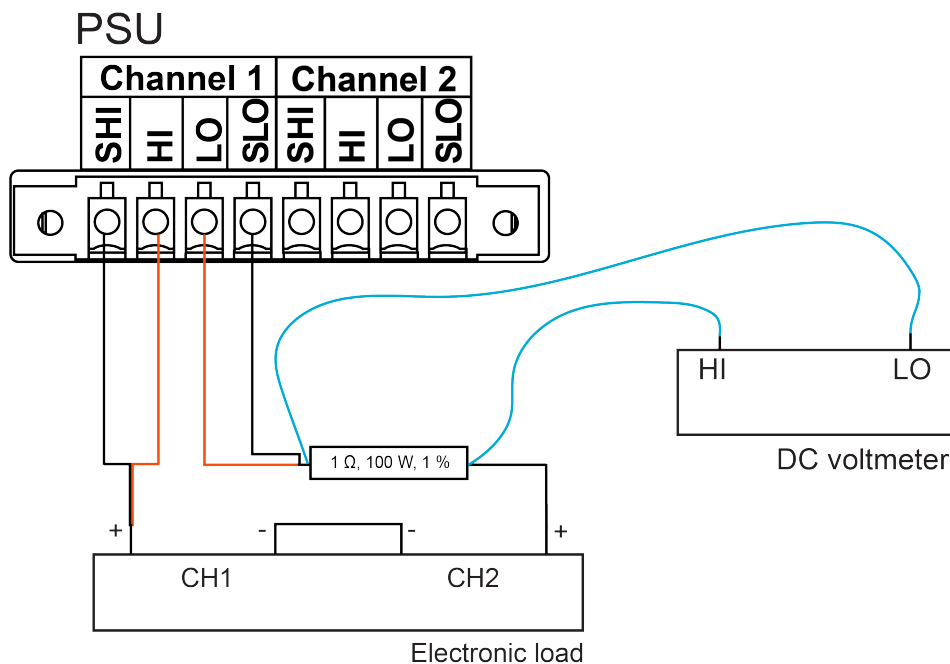
When using TSP commands, you must specify the module slot and channel. For example, to unlock calibration for channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].cal.unlock()
```

NOTE: Before activating the calibration constants in the following procedure, check validity. The values for points CP1 and CP3 should be between +0.05 A and -0.05 A. The values for points CP2 and CP4 should be within ± 0.6 A of their setpoints (+4.5 A and -4.5 A).

Use the following graphic to set up your instruments for adjustment.

NOTE: The following graphic shows instruments configured for adjusting channel 1 of the PSU. Change the output connections to channel 2 before performing adjustment on that channel.



+5 A limit adjustment

To adjust the +5 A limit:

1. Reset the DC voltmeter and the electronic load.
2. Configure the electronic load:
 - **Channel:** Channel 1. Short channel 2.
 - **Regulation mode:** Constant resistance, 1 Ω
3. Configure the DC voltmeter:
 - **Function:** DC volts
 - **Range:** 0.1 V for points CP1 and CP3, 10 V for points CP2 and CP4
 - **Resolution:** 6.5 digits

4. Unlock calibration for the module.

```
slot[1].psu[1].cal.unlock()
```

5. Load and activate the nominal calibration set.

```
slot[1].psu[1].cal.restore.(slot[1].psu[1].CALSET_NOMINAL)
```

6. Configure the module output adjustment settings. This current value is `cp1Expected`.

```
slot[1].psu[1].source.levelv = 10
```

```
slot[1].psu[1].source.limiti = .05
```

7. Set the module calibration polarity to positive.

```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_POSITIVE
```

8. Enable the module output, then delay 1.75 seconds.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

```
delay(1.75)
```

9. Enable the electronic load input, then delay 3000 ms.

```
delay(1.75)
```

10. Determine if the PSU is in compliance by sending the following command. If the PSU is in compliance, the command returns `true`.

```
print(slot[1].psu[1].source.constantcurrent)
```

11. Make 100 measurements using the DC voltmeter across the resistor and record the readings.

12. Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}) and calculate the current using this average. This value is I_{REF} .

13. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

14. Configure the electronic load:

- **Channel:** Channel 1. Short channel 2.
- **Regulation mode:** Constant resistance, 8 Ω

15. Configure the module output adjustment settings. This current value is `cp2Expected`.

```
slot[1].psu[1].source.levelv = 10
```

```
slot[1].psu[1].source.limiti = 4.5
```

16. Set the module calibration polarity to positive.

```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_POSITIVE
```

17. Enable the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

18. Enable the electronic load input.

19. Determine if the PSU is in compliance by sending the following command. If the PSU is in compliance, the command returns `true`.

```
print(slot[1].psu[1].source.constantcurrent)
```

20. Make 100 measurements using the DC voltmeter across the resistor and record the readings.

21. Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}) and calculate the current using this average. This value is I_{REF} .

22. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

23. Turn off the electronic load input.

24. Activate the calibration constants.

```
slot[1].psu[1].source.calibratei(range, cp1Expected, cp1Reference, cp2Expected, cp2Reference)
```

25. Continue to the next adjustment procedure or see [Save and lock adjustments](#) (on page 45) if you are finished.

-5 A limit adjustment

To adjust the -5 A limit:

1. Reset the DC voltmeter and the electronic load.

2. Configure the electronic load:

- **Channel:** Channel 1. Short channel 2.
- **Regulation mode:** Constant resistance, 1 Ω

3. Configure the DC voltmeter:

- **Function:** DC volts
- **Range:** 0.1 V for points CP1 and CP3, 10 V for points CP2 and CP4
- **Resolution:** 6.5 digits

4. Unlock calibration for the module.

```
slot[1].psu[1].cal.unlock()
```

5. Load and activate the nominal calibration set.

```
slot[1].psu[1].cal.restore.(slot[1].psu[1].CALSET_NOMINAL)
```

6. Configure the module output adjustment settings. This current value is `cp1Expected`.

```
slot[1].psu[1].source.levelv = -10
slot[1].psu[1].source.limiti = .05
```

7. Set the module calibration polarity to negative.

```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_NEGATIVE
```

8. Enable the module output, then delay 1.75 seconds.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
delay(1.75)
```

9. Enable the electronic load input, then delay 3 seconds.

```
delay(3)
```

10. Determine if the PSU is in compliance by sending the following command. If the PSU is in compliance, the command returns `true`.

```
print(slot[1].psu[1].source.constantcurrent)
```

11. Make 100 measurements using the DC voltmeter across the resistor and record the readings.

12. Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}) and calculate the current using this average. This value is I_{REF} .

13. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

14. Configure the electronic load:

- **Channel:** Channel 1. Short channel 2.
- **Regulation mode:** Constant resistance, 8 Ω

15. Configure the module output adjustment settings. This current value is `cp2Expected`.

```
slot[1].psu[1].source.levelv = -10
slot[1].psu[1].source.limiti = 4.5
```

16. Set the module calibration polarity to negative.

```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_NEGATIVE
```

17. Enable the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

18. Enable the electronic load input.

19. Determine if the PSU is in compliance by sending the following command. If the PSU is in compliance, the command returns `true`.

```
print(slot[1].psu[1].source.constantcurrent)
```

20. Make 100 measurements using the DC voltmeter across the resistor and record the readings.

21. Calculate the mean value of the measurements (total of measurements / 100 = DVM_{MEAN}) and calculate the current using this average. This value is I_{REF} .

22. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

23. Turn off the electronic load input.

24. Activate the calibration constants.

```
slot[1].psu[1].source.calibratei(range, cp1Expected, cp1Reference, cp2Expected, cp2Reference)
```

25. Continue to the next adjustment procedure or see [Save and lock adjustments](#) (on page 45) if you are finished.

Adjust current measurement

This procedure applies to both CH1 and CH2 of the module.

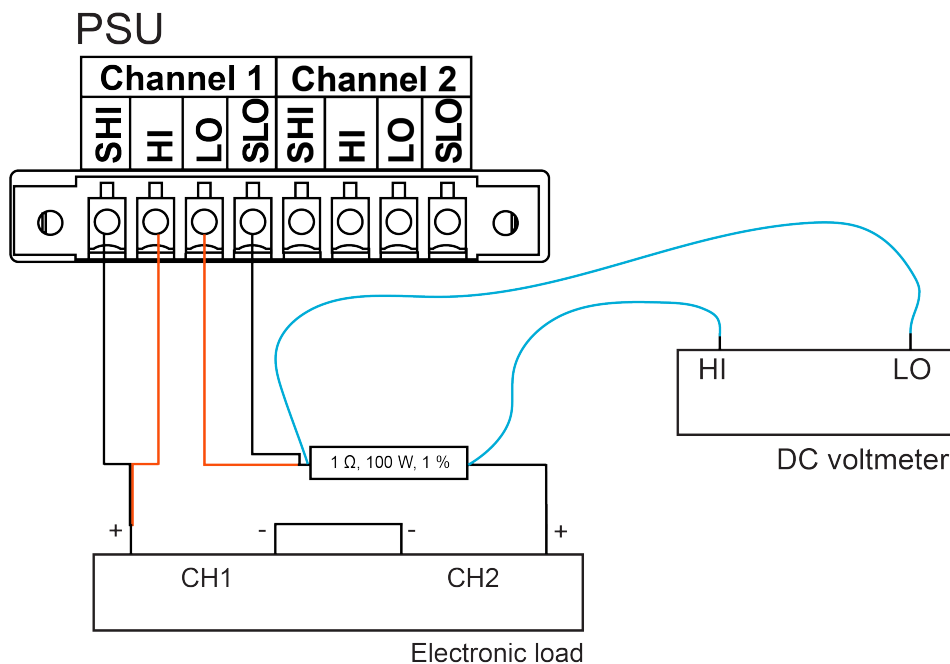
When using TSP commands, you must specify the module slot and channel. For example, to unlock calibration for channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].cal.unlock()
```

NOTE: Before activating the calibration constants in the following procedure, check validity. The values for points CP1 and CP3 should be between 0 A and 0.036 A. The values for points CP2 and CP4 should be within ± 0.5 A of their setpoints (+4.5 A and -4.5 A).

Use the following graphic to set up your instruments for adjustment.

NOTE: The following graphic shows instruments configured for adjusting channel 1 of the PSU. Change the output connections to channel 2 before performing adjustment on that channel.



+5 A measurement range adjustment

To adjust the +5 A current measurement range:

1. Reset the DC voltmeter and the electronic load.
2. Configure the electronic load:
 - **Channel:** Channel 1. Short channel 2
 - **Regulation mode:** Constant current
 - **Current value:** For CP3, 0.012 A. For CP4, 4.5 A
3. Configure the DC voltmeter:
 - **Function:** DC volts
 - **Range:** For CP3, 100 mV. For CP4, 10 V
 - **Resolution:** 6.5 digits
 - **Measurement count:** 100
4. Unlock calibration for the module.


```
slot[1].psu[1].cal.unlock()
```
5. Turn off temperature compensation for the module.


```
slot[1].psu[1].measure.tempcomp = slot[1].psu[1].DISABLE
```
6. Configure the module output adjustment settings.


```
slot[1].psu[1].source.levelv = 10
slot[1].psu[1].source.limiti = 4.5
```
7. Set the module calibration polarity to positive.


```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_POSITIVE
```
8. Enable the module output.


```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```
9. Set the electronic load to 0.012 A (CP3).
10. Measure the output current across the 1 Ω precision resistor with the DC voltmeter. This value is `cp1Reference`.

11. Make 10 measurements using the PSU.

```
currentValue = 0
compValue = 0
for i=1,10 do current, comp = slot[1].psu[1].measure.i()
currentValue = currentValue + current
compValue = compValue + comp
end
```

12. Calculate cp1Measured and cp1Compensation.

```
cp1Measured = currentValue / 10
cp1Compensation = compValue / 10
```

13. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

14. Reconfigure the module output adjustment settings.

```
slot[1].psu[1].source.limiti = 5
```

15. Enable the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

16. Set the electronic load to 4.5 A (CP4).

17. Measure the output current across the 1 Ω precision resistor with the DC voltmeter. This value is cp2Reference.

18. Calculate cp2Measured and cp2Compensation.

```
cp2Measured = currentValue / 10
cp2Compensation = compValue / 10
```

19. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

20. Activate the calibration constants.

```
slot[1].psu[1].measure.calibratei(range, cp1Measured, cp1Reference, cp1Compensation,
cp2Measured, cp2Reference, cp2Compensation)
```

21. Continue to the next adjustment procedure or see [Save and lock adjustments](#) (on page 45) if you are finished.

-5 A measurement range adjustment

To adjust the -5 A current measurement range:

1. Reset the DC voltmeter and the electronic load.
2. Configure the electronic load:
 - **Channel:** Channel 2. Short channel 1.
 - **Regulation mode:** Constant current
 - **Current value:** For CP1, -0.012 A. For CP2, -4.5 A
3. Configure the DC voltmeter:
 - **Function:** DC volts
 - **Range:** For CP1, -100 mV. For CP2, -10 V
 - **Resolution:** 6.5 digits
 - **Measurement count:** 100

4. Unlock calibration for the module.

```
slot[Z].psu[X].cal.unlock()
```

5. Configure the module output adjustment settings.

```
slot[1].psu[1].source.levelv = 10
slot[1].psu[1].source.limiti = 4.5
```

6. Set the module calibration polarity to negative.

```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_NEGATIVE
```

7. Enable the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

8. Set the electronic load to -0.012 A (CP1).**9. Measure the output current across the 1 Ω precision resistor with the DC voltmeter. This value is cp3Reference.****10. Make 10 measurements using the PSU.**

```
currentValue = 0
compValue = 0
for i=1,10 do current, comp = slot[1].psu[1].measure.i()
currentValue = currentValue + current
compValue = compValue + comp
end
```

11. Calculate cp1Measured and cp1Compensation.

```
cp1Measured = currentValue / 10
cp1Compensation = compValue / 10
```

12. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

13. Reconfigure the module output adjustment settings.

```
slot[1].psu[1].source.limiti = 5
```

14. Enable the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

15. Set the electronic load to -4.5 A (CP2).**16. Measure the output current across the 1 Ω precision resistor with the DC voltmeter. This value is cp3Reference.****17. Make 10 measurements using the PSU.**

```
currentValue = 0
compValue = 0
for i=1,10 do current, comp = slot[1].psu[1].measure.i()
currentValue = currentValue + current
compValue = compValue + comp
end
```

18. Calculate cp3Measured and cp3Compensation.

```
cp3Measured = currentValue / 10
cp3Compensation = compValue / 10
```

19. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

20. Reconfigure the module output adjustment settings.

```
slot[1].psu[1].source.limiti = 5
```

21. Enable the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].ON
```

22. Set the electronic load to -4.5 A (CP4).**23. Measure the output current across the 1 Ω precision resistor with the DC voltmeter. This value is cp4Reference.**

24. Make 10 measurements using the PSU.

```

currentValue = 0
compValue = 0
for i=1,10 do current, comp = slot[1].psu[1].measure.i()
currentValue = currentValue + current
compValue = compValue + comp
end

```

25. Calculate cp4Measured and cp4Compensation.

```

cp4Measured = currentValue / 10
cp4Compensation = compValue / 10

```

26. Turn off the module output.

```
slot[1].psu[1].source.output = slot[1].psu[1].OFF
```

27. Activate the calibration constants.

```

slot[1].psu[1].measure.calibratei(range, cp3Measured, cp3Reference, cp3Compensation,
cp4Measured, cp4Reference, cp4Compensation)

```

28. Continue to the next adjustment procedure or see [Save and lock adjustments](#) (on page 45) if you are finished.

Adjust temperature compensation

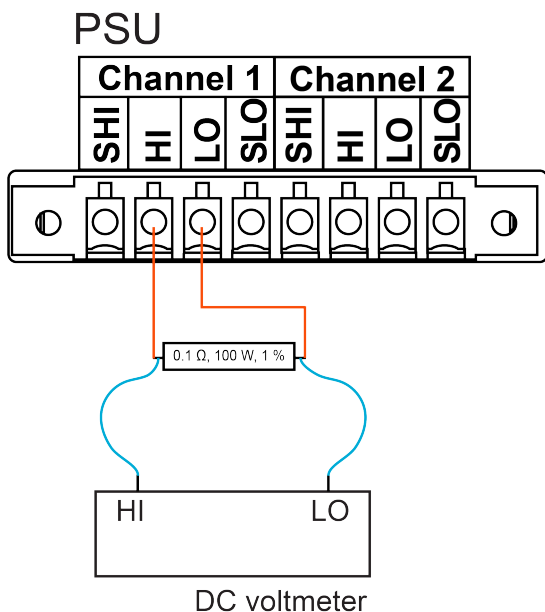
This procedure applies to both CH1 and CH2 of the module.

When using TSP commands, you must specify the module slot and channel. For example, to unlock calibration for channel 1 of the module installed in slot 1 of the mainframe, send

```
slot[1].psu[1].cal.unlock()
```

Use the following graphic to set up your instruments for adjustment.

NOTE: The following graphic shows instruments configured for adjusting channel 1 of the PSU. Change the output connections to channel 2 before performing adjustment on that channel.



To adjust the temperature compensation:

1. Reset the DC voltmeter.
2. Configure the DC voltmeter:
 - **Function:** DC volts
 - **Range:** 1 V
 - **Resolution:** 6.5 digits
 - **Measurement count:** 100
3. Unlock calibration.
`slot[Z].psu[X].cal.unlock()`
4. Turn off temperature compensation for the module.
`slot[1].psu[1].measure.tempcomp = slot[1].psu[1].DISABLE`
5. Configure the temperature compensation adjustment settings.
`slot[1].psu[1].source.levelv = 9.9`
`slot[1].psu[1].source.limiti = 5`
6. Set the module calibration polarity to positive.
`slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_POSITIVE`
7. Enable the module output.
`slot[1].psu[1].source.output = slot[1].psu[1].ON`
8. Make 10 measurements across the 0.1 Ω precision resistor using the PSU, then calculate the average. This is `cp1Measured`.

```
currentValue = 0
compValue = 0
for i=1,10 do current, comp = slot[1].psu[1].measure.i()
currentValue = currentValue + current
compValue = compValue + comp
cp1Measured = currentValue / 10
end
```
9. Make 100 voltage measurements using the DC voltmeter, then calculate the average. This is `cp1Reference`.
10. Wait at least one minute.
11. Make 10 measurements across the 0.1 Ω precision resistor using the PSU, then calculate the average. This is `cp2Measured`.

```
currentValue = 0
compValue = 0
for i=1,10 do current, comp = slot[1].psu[1].measure.i()
currentValue = currentValue + current
compValue = compValue + comp
cp2Measured = currentValue / 10
end
```
12. Make 100 voltage measurements using the DC voltmeter, then calculate the average. This is `cp2Reference`.
13. Turn off the module output.
`slot[1].psu[1].source.output = slot[1].psu[1].OFF`
14. Activate the calibration constants.
`slot[1].psu[1].measure.calibratetc(range, cp1Measured, cp1Reference, cp1Compensation, cp2Measured, cp2Reference, cp2Compensation)`
15. Continue to the next adjustment procedure or see [Save and lock adjustments](#) (on page 45) if you are finished.

Save and lock adjustments

Once all adjustments are done, set the adjustment date, then save and lock the calibration data to the module.

Replace the `slot` and `psu` values with the applicable module slot and channel that you have adjusted. Each module channel must be independently adjusted, saved, and locked.

```
slot[1].psu[1].cal.date = os.time()
slot[1].psu[1].cal.save()
slot[1].psu[1].cal.lock()
```

TSP calibration commands

Calibration commands

The TSP commands available for calibrating PSU modules are listed in alphabetical order.

slot[Z].psu[X].cal.adjustdate

This attribute stores the date of the last calibration adjustment.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Attribute (RW)	Yes	PSU calibration restore	PSU nonvolatile memory	Initially set to factory calibration date

Usage

```
adjustDate = slot[Z].psu[X].cal.adjustdate  
slot[Z].psu[X].cal.adjustdate = adjustDate
```

<i>adjustDate</i>	Date of the last adjustment
<i>Z</i>	Module slot number
<i>X</i>	Module channel

Details

This attribute stores the adjustment date associated with the active calibration set. The adjustment date can be read at any time but can only be assigned a new value when calibration has been enabled with

```
slot[Z].psu[X].cal.unlock().
```

You cannot change the adjustment date without first making a change to the calibration constants.

Once you change any calibration constants, you must set the adjustment date before you can save the calibration data to the nonvolatile memory of the module.

This attribute is stored with the active calibration set. If a different calibration set is restored, this attribute reflects the date stored with that set.

Set `slot[Z].psu[X].cal.adjustdate` to the date the adjustment was performed using the UTC time and date. The date is stored as the number of seconds since UTC, 12:00 AM January 1, 1970.

Example

```
slot[1].psu[2].cal.adjustdate = os.time()
```

Sets the adjustment date of channel 2 of the module installed in slot 1 to the current time of the mainframe.

Also see

[slot\[Z\].psu\[X\].cal.date](#) (on page 47)

[slot\[Z\].psu\[X\].cal.due](#) (on page 48)

slot[Z].psu[X].cal.count

This attribute returns the number of times a calibration set has been written to nonvolatile memory.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Attribute (R)	Yes			

Usage

```
count = slot[Z].psu[X].cal.count
```

<i>count</i>	Number of times a calibration set has been written to nonvolatile memory
<i>Z</i>	Module slot number
<i>X</i>	Module channel

Details

This read-only attribute indicates the number of times a calibration set has been written to nonvolatile memory. A 0 indicates that no calibration has been performed.

Example

```
print(slot[1].psu[2].cal.count)
```

Returns the number of times a calibration set has been written to channel 2 of the module installed in slot 1.

Also see

[slot\[Z\].psu\[X\].cal.restore\(\)](#) (on page 50)

[slot\[Z\].psu\[X\].cal.save\(\)](#) (on page 51)

slot[Z].psu[X].cal.date

This attribute stores the calibration date of the active calibration set.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Attribute (RW)	Yes	PSU calibration restore	PSU nonvolatile memory	Initially set to factory calibration date

Usage

```
calDate = slot[Z].psu[X].cal.date
slot[Z].psu[X].cal.date = calDate
```

<i>calDate</i>	Date of the last adjustment
<i>Z</i>	Module slot number
<i>X</i>	Module channel

Details

This attribute stores the calibration date that is associated with the active calibration set. The calibration date can be read at any time but can only be assigned a new value when calibration has been enabled with `slot[Z].psu[X].cal.unlock()`. It is typically set to the date when the instrument was calibrated.

This attribute is stored with the active calibration set. If a different calibration set is restored, this attribute reflects the date stored with that set.

Set `slot[Z].psu[X].cal.date` to the date the calibration was performed using the UTC time and date. The date is stored as the number of seconds since UTC 12:00 AM, January 1, 1970.

Example

```
slot[1].psu[2].cal.date = os.time()
```

Sets the calibration date of channel 2 of the module installed in slot 1 to the current time of the mainframe.

Also see

[slot\[Z\].psu\[X\].cal.adjustdate](#) (on page 46)

[slot\[Z\].psu\[X\].cal.due](#) (on page 48)

slot[Z].psu[X].cal.due

This attribute stores the calibration due date for the next calibration.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Attribute (RW)	Yes	PSU calibration restore	PSU nonvolatile memory	Initially set to factory calibration date

Usage

```
calDue = slot[Z].psu[X].cal.due
slot[Z].psu[X].cal.due = calDue
```

<i>calDue</i>	Date of the last adjustment (0 indicates that no date is set)
<i>Z</i>	Module slot number
<i>X</i>	Module channel

Details

This attribute stores the calibration date that is associated with the active calibration set. The calibration due date can be read at any time but can only be assigned a new value when calibration has been enabled with `slot[Z].psu[X].cal.unlock()`. It is typically set to the date when the next calibration should be performed.

This attribute is stored with the active calibration set. If a different calibration set is restored, this attribute reflects the date stored with that set.

Set `slot[Z].psu[X].cal.due` to the date the calibration was performed using the UTC time and date. The date is stored as the number of seconds since UTC 12:00 AM, January 1, 1970.

Example

```
slot[1].psu[2].cal.due = os.time()
```

Sets the calibration date of channel 2 of the module installed in slot 1 equal to one year from the present time set on the mainframe.

Also see

[slot\[Z\].psu\[X\].cal.adjustdate](#) (on page 46)

[slot\[Z\].psu\[X\].cal.date](#) (on page 47)

slot[Z].psu[X].cal.lock()

This function disables the commands that change calibration settings.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

```
slot[Z].psu[X].cal.lock()
```

<i>Z</i>	Module slot number
<i>X</i>	Module channel

Details

This function disables the calibration functions and attributes that change the calibration settings. The calibration constants must be written to nonvolatile memory, or a previous calibration set must be restored prior to locking calibration.

Example

<pre>slot[1].psu[2].cal.lock()</pre>
Locks calibration for channel 2 of the module installed in slot 1 of the mainframe.

Also see

[slot\[Z\].psu\[X\].cal.save\(\)](#) (on page 51)

[slot\[Z\].psu\[X\].cal.unlock\(\)](#) (on page 52)

slot[Z].psu[X].cal.polarity

This attribute controls which polarity calibration constants are used for all subsequent measurements.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Attribute (RW)	Yes	PSU reset PSU calibration lock	Not saved	0 (CAL_AUTO)

Usage

```
calPolarity = slot[Z].psu[X].cal.polarity
slot[Z].psu[X].cal.polarity = calPolarity
```

<i>calPolarity</i>	The polarity to use for measurements. Set to one of the following values: - slot[Z].psu[X].CAL_AUTO: Automatic polarity detection - slot[Z].psu[X].CAL_POSITIVE: Measure with positive polarity calibration constants - slot[Z].psu[X].CAL_NEGATIVE: Measure with negative polarity calibration constants
<i>Z</i>	Module slot number
<i>X</i>	Module channel

Details

This attribute controls which polarity calibration constants are used to make all subsequent measurements.

This attribute does not affect the `slot[Z].psu[X].measure.calibrateY()` command. The polarity for the measure calibrate command is dictated by its range parameters. The measure calibration commands require the measurements provided to have been made using the polarity being calibrated.

When making measurements for points far away from zero, the desired polarity constants are inherently used. However, when making measurements near zero, it is possible that the instrument could use the calibration constants from the wrong polarity. Setting `slot[Z].psu[X].cal.polarity` to positive or negative forces measurements to be made using the calibration constants for a given polarity, rather than basing the choice on the raw measurement data.

This attribute can only be set to positive or negative when calibration is unlocked. This attribute is automatically set to `slot[Z].psu[X].CAL_AUTO` when calibration is locked.

Example

```
slot[1].psu[1].cal.polarity = slot[1].psu[1].CAL_POSITIVE
```

Selects positive calibration constants for all subsequent measurements made on channel 1 of the module installed in slot 1.

Also see

[slot\[Z\].psu\[X\].cal.lock\(\)](#) (on page 49)

[slot\[Z\].psu\[X\].cal.unlock\(\)](#) (on page 52)

slot[Z].psu[X].cal.restore

This function loads and activates calibration constants stored in nonvolatile memory.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

```
slot[Z].psu[X].cal.restore(calset)
```

<i>Z</i>	Module slot number
<i>X</i>	Module channel
<i>calset</i>	The calibration set to load. Can be one of the following values: <code>slot[Z].psu[X].CALSET_DEFAULT</code>: The normal calibration set <code>slot[Z].psu[X].CALSET_PREVIOUS</code>: The calibration set prior to the latest overwrite of the normal calibration set. <code>slot[Z].psu[X].CALSET_NOMINAL</code>: Calibration constants that are sufficient to calibrate the instrument if all other calibration sets become unusable

Details

This function loads and activates calibration constants stored in nonvolatile memory.

This function is disabled until a successful call to `slot[Z].psu[X].cal.unlock()` is made.

Example

```
slot[1].psu[2].cal.restore(slot[Z].psu[X].CALSET_PREVIOUS)
```

Restores the set of calibration constants prior to the last overwrite of the normal calibration set to channel 2 of the module installed in slot 1.

Also see

[slot\[Z\].psu\[X\].cal.save\(\)](#) (on page 51)

[slot\[Z\].psu\[X\].cal.unlock\(\)](#) (on page 52)

slot[Z].psu[X].cal.save()

This function saves the active calibration constants to nonvolatile memory

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

```
slot[Z].psu[X].cal.save()
```

<i>Z</i>	Module slot number
<i>X</i>	Module channel

Details

This function will store the active set of calibration constants to nonvolatile memory. The previous calibration constants from the default calibration set will be copied to the previous calibration set (`slot[Z].psu[X].CALSET_PREVIOUS`) prior to overwriting the default calibration set.

This function will be disabled until a call to `slot[Z].psu[X].cal.unlock()` is made.

Example

```
slot[1].psu[2].cal.save()
```

Saves the active set of calibration constants to nonvolatile memory of channel 2 of the module installed in slot 1.

Also see

[slot\[Z\].psu\[X\].cal.restore\(\)](#) (on page 50)

[slot\[Z\].psu\[X\].cal.unlock\(\)](#) (on page 52)

slot[Z].psu[X].cal.state()

This attribute returns the present calibration state.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Attribute (R)	Yes			

Usage

```
calState = slot[Z].psu[X].cal.state
```

<i>calState</i>	The present calibration state. When reading this attribute, <i>calState</i> has one of the following values: <code>slot[Z].psu[X].CALSTATE_LOCKED</code>: Calibration is locked <code>slot[Z].psu[X].CALSTATE_CALIBRATING</code>: The calibration constants or dates have been changed but not yet saved to nonvolatile memory <code>slot[Z].psu[X].CALSTATE_UNLOCKED</code>: Calibration is unlocked but none of the calibration constants or dates have changed since the last save/restore
<i>Z</i>	Module slot number
<i>X</i>	Module channel

Details

This attribute indicates the calibration state of the instrument: Locked, calibrating, or unlocked.

Example

```
print(slot[1].psu[2].cal.state)
```

Reads the calibration state of channel 2 of the module installed in slot 1.

Also see

[slot\[Z\].psu\[X\].cal.restore\(\)](#) (on page 50)

[slot\[Z\].psu\[X\].cal.save\(\)](#) (on page 51)

slot[Z].psu[X].cal.unlock()

This function enables the commands that change the calibration settings.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

```
slot[Z].psu[X].cal.unlock()
```

<i>Z</i>	Module slot number
<i>X</i>	Module channel

Details

This function enables the calibration functions to change the calibration settings.

Example

```
slot[1].psu[2].cal.unlock()
```

Unlocks calibration for channel 2 of the module installed in slot 1.

Also see

[slot\[Z\].psu\[X\].cal.lock\(\)](#) (on page 49)

[slot\[Z\].psu\[X\].cal.save\(\)](#) (on page 51)

slot[Z].psu[X].measure.calibratetc()

This function generates and activates new temperature compensation measurement calibration constants.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

```
slot[Z].psu[X].measure.calibratetc(range, cp1Measured, cp1Reference, cp1Compensation, cp2Measured,
cp2Reference, cp2Compensation)
```

<i>Z</i>	Module slot number
<i>X</i>	Module channel
<i>range</i>	The measurement range to calibrate
<i>cp1Measured</i>	The value measured for calibration point 1
<i>cp1Reference</i>	The reference measurement for calibration point 1 as measured externally
<i>cp1Compensation</i>	The compensation value measured for calibration point 1
<i>cp2Measured</i>	The value measured for calibration point 2
<i>cp2Reference</i>	The reference measurement for calibration point 2 as measured externally
<i>cp2Compensation</i>	The compensation value measured for calibration point 2

Details

The procedure consists of sourcing a current PSU module and immediately making an external reference measurement and measurement from the PSU for calibration point 1. Allow at least 1 minute while the PSU module continues sourcing to allow the sense resistor to warm up. With the PSU sourcing the same current as it did for calibration point 1, a second set of measurements is made.

With calibration unlocked, making a current measurement with the PSU will return a compensation value, which is used for *cp1Compensation* and *cp2Compensation*.

The new calibration constants are activated immediately, but they are not written to nonvolatile memory. Use `slot[Z].psu[X].cal.save()` to save the new constants to nonvolatile memory. Otherwise, the active calibration constants persist until the instrument is power-cycled or a calibration set is loaded from nonvolatile memory with the `slot[Z].psu[X].cal.restore()` function.

This function is disabled until a successful call to `slot[Z].psu[X].cal.unlock()` is made.

Example

```
slot[1].psu[2].measure.calibratetc(5, 9.97e-1, 9.98e-1, 23, 9.99e-1, 1, 75)
```

Calibrates channel 1 of the PSU in mainframe slot 1 using the following values:

- 5 A calibration range
- 9.97e-1 for +zero PSU measurement reading
- 9.98e-1 for +zero external DMM measurement reading
- 23 for the +zero compensation value
- 9.99e-1 for +FS PSU measurement reading
- 1 for +FS external DMM measurement reading
- 75 for the +zero compensation value

Also see

[slot\[Z\].psu\[X\].cal.lock\(\)](#) (on page 49)

[slot\[Z\].psu\[X\].cal.restore\(\)](#) (on page 50)

[slot\[Z\].psu\[X\].cal.save\(\)](#) (on page 51)

[slot\[Z\].psu\[X\].cal.unlock\(\)](#) (on page 52)

[slot\[Z\].psu\[X\].source.calibrateY\(\)](#) (on page 54)

slot[z].psu[x].measure.calibrateY()

This function generates and activates new voltage and current measurement calibration constants.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

`slot[Z].psu[X].measure.calibrateY(range, cp1Measured, cp1Reference, cp2Measured, cp2Reference)`

<i>Z</i>	Module slot number
<i>X</i>	Module channel
<i>Y</i>	The measurement function; <i>v</i> = voltage, <i>i</i> = current
<i>range</i>	The measurement range to calibrate
<i>cp1Measured</i>	The value measured for calibration point 1
<i>cp1Reference</i>	The reference measurement for calibration point 1 as measured externally
<i>cp2Measured</i>	The value measured for calibration point 2
<i>cp2Reference</i>	The reference measurement for calibration point 2 as measured externally

Details

This function generates and activates new calibration constants for the given range.

The positive and negative polarities of the instrument must be calibrated separately. Use a positive value for *range* to calibrate the positive polarity, and a negative value to calibrate the negative polarity. Do not use 0.0 for a negative calibration point; 0.0 is considered to be a positive number.

Typically, the two calibration points that are used are near zero for calibration point 1 and 90% of full scale for calibration point 2.

All four measurements (*cp1Measured*, *cp1Reference*, *cp2Measured*, *cp2Reference*) must be made with the active calibration set. Do not change the active calibration set before issuing this command, as corruption of the calibration constants may result.

The new calibration constants are activated immediately, but they are not written to nonvolatile memory. Use `slot[Z].psu[X].cal.save()` to save the new constants to nonvolatile memory. Otherwise, the active calibration constants persist until the instrument is power-cycled or a calibration set is loaded from nonvolatile memory with the `slot[Z].psu[X].cal.restore()` function.

This function is disabled until a successful call to `slot[Z].psu[X].cal.unlock()` is made.

Example

```
slot[1].psu[1].measure.calibratev(6, 6e-4, 6e-5, 5.52, 5.418)
```

Calibrates channel 1 of the PSU in mainframe slot 1 using the following values:

- 50 V calibration range
- 6e-4 for +zero PSU measurement reading
- 6e-5 for +zero external DMM measurement reading
- 45.52 for +FS PSU measurement reading
- 45.418 for +FS external DMM measurement reading

Also see

[slot\[Z\].psu\[X\].cal.lock\(\)](#) (on page 49)

[slot\[Z\].psu\[X\].cal.restore\(\)](#) (on page 50)

[slot\[Z\].psu\[X\].cal.save\(\)](#) (on page 51)

[slot\[Z\].psu\[X\].cal.unlock\(\)](#) (on page 52)

[slot\[Z\].psu\[X\].source.calibratetc\(\)](#) (on page 53)

slot[Z].psu[X].measure.getcaltc()

This function returns the measurement calibration constants used for thermocouple calibration.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

```
gain = slot[Z].psu[X].measure.getcaltc(range)
```

<i>gain</i>	The gain calibration constant for the measurement range
<i>Z</i>	Module slot number
<i>X</i>	Module channel
<i>range</i>	The measure range: ▪ Current range: 5 A

Details

This function returns the gain calibration and offset constants for the thermocouple. This function is used for adjusting the temperature compensation.

Example

```
gain = slot[1].psu[1].measure.getcaltc(5)
```

Returns the gain calibration and offset constants for channel 1 of the module installed in slot 1 of the mainframe.

Also see

[slot\[Z\].psu\[X\].cal.restore\(\)](#) (on page 50)

slot[Z].psu[X].measure.getcalY()

This function returns the measurement calibration constants for the active calibration set.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

```
gain, offset = slot[Z].psu[X].measure.getcalY(range)
```

<i>gain</i>	The gain calibration constant for the measurement range
<i>offset</i>	The offset calibration constant for the measurement range
<i>Z</i>	Module slot number
<i>X</i>	Module channel
<i>Y</i>	The measurement function; <i>v</i> = voltage, <i>i</i> = current
<i>range</i>	The measure range: ▪ Voltage range: 50 V ▪ Current range: 5 A

Details

This function returns the gain and offset calibration constants for the active calibration set for a given range and measurement function.

The `range` parameter can be any valid measurement level. The best measurement range for that level will be used. The `range` parameter also determines the polarity of the calibration constants to return; if the `range` parameter is positive, the positive calibration constants will be returned, otherwise, the negative calibration constants will be returned.

The active calibration set can be changed using `slot[Z].psu[X].cal.restore()`.

Example

```
gain, offset = slot[1].psu[1].measure.getcali(0.004)
```

The positive gain and offset calibration constants are returned for the 5A measure range for channel 1 of the module installed in slot 1 of the mainframe, based on the active calibration set.

Also see

[slot\[Z\].psu\[X\].cal.restore\(\)](#) (on page 50)

slot[Z].psu[X].source.calibrateY()

This function generates and activates new voltage and current source calibration constants.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

```
slot[Z].psu[X].source.calibrateY(range, cp1Expected, cp1Reference, cp2Expected, cp2Reference)
```

<i>Z</i>	Module slot number
<i>X</i>	Module channel
<i>Y</i>	The source function; v = voltage, i = current
<i>range</i>	The source range to calibrate
<i>cp1Expected</i>	The source value set for calibration point 1
<i>cp1Reference</i>	The reference measurement for calibration point 1 as measured externally
<i>cp2Expected</i>	The source value set for calibration point 2
<i>cp2Reference</i>	The reference measurement for calibration point 2 as measured externally

Details

This function generates and activates new calibration constants for the given range.

The PSU module does not support sourcing current but the current source limit must still be calibrated. For example, sending `slot[Z].psu[X].source.calibratei()` will generate and activate the calibration constants for the source current limit.

The positive and negative polarities of the source must be calibrated separately. Use a positive value for *range* to calibrate the positive polarity, and a negative value for *range* to calibrate the negative polarity. Do not use 0.0 for a negative calibration point; 0.0 is considered to be a positive number.

Typically, the two calibration points used are near zero for calibration point 1 and 90% of full scale for calibration point 2. Full scale for calibration point 2 should be avoided if the source of the PSU module is substantially out of calibration.

Both reference measurements (*cp1Reference*, *cp2Reference*) must be made with the source using the active calibration set. Do not change the active calibration set before issuing this command, as corruption of the calibration constants may result.

The new calibration constants are activated immediately, but they are not written to nonvolatile memory. Use `slot[Z].psu[X].cal.save()` to save the new constants to nonvolatile memory. Otherwise, the active calibration constants persist until the instrument is power-cycled or a calibration set is loaded from nonvolatile memory with the `slot[Z].psu[X].cal.restore()` function.

This function is disabled until a successful call to `slot[Z].psu[X].cal.unlock()` is made.

Example

```
slot[1].psu[2].source.calibratev(50, 1.2e-2, 1.2e-3, 10.8 10.84)
```

PSU channel 2 in mainframe slot 1 calibrates the output source voltage using the following values:

- 50 V calibration range
- 1.2e-2 for +zero source output value
- 1.2e-3 for +zero external DMM measurement reading
- 45.8 for +FS source output value
- 45.84 for +FS external DMM measurement reading

Also see

[slot\[Z\].psu\[X\].cal.lock\(\)](#) (on page 49)

[slot\[Z\].psu\[X\].cal.restore\(\)](#) (on page 50)

[slot\[Z\].psu\[X\].cal.save\(\)](#) (on page 51)

[slot\[Z\].psu\[X\].cal.unlock\(\)](#) (on page 52)

[slot\[Z\].psu\[X\].measure.calibrateY\(\)](#) (on page 54)

slot[Z].psu[X].source.getcalY()

This function returns the source calibration constants for the active calibration set.

Type	TSP-Link accessible	Affected by	Where saved	Default value
Function	Yes			

Usage

```
gain, offset = slot[Z].psu[X].source.getcalY(range)
```

<i>gain</i>	The gain calibration constant for the measurement range
<i>offset</i>	The offset calibration constant for the measurement range
<i>Z</i>	Module slot number
<i>X</i>	Module channel
<i>Y</i>	The measurement function; <i>v</i> = voltage, <i>i</i> = current
<i>range</i>	The measure range: ▪ Voltage range: 50 V ▪ Current range: 5 A

Details

This function returns the gain and offset calibration constants for the active calibration set for a given range and source function.

The PSU module does not support sourcing current but the current source limit must still be calibrated. For example, sending `slot[Z].psu[X].source.calibratei()` will generate and activate the calibration constants for the source current limit.

The `range` parameter can be any valid source level. The best source range for that level will be used. The `range` parameter also determines the polarity of the calibration constants to return; if the `range` parameter is positive, the positive calibration constants will be returned, otherwise, the negative calibration constants will be returned.

The active calibration set can be changed using `slot[Z].psu[X].cal.restore()`.

Example

```
gain, offset = slot[1].psu[1].source.getcalv(-10)
```

Returns the negative gain and offset calibration constants for the 50 V source range for channel 1 of the module installed in slot 1 of the mainframe, based on the active calibration set.

Also see

[slot\[Z\].psu\[X\].cal.restore\(\)](#) (on page 50)

Verification test record forms

Output voltage and measurement accuracy verification test record

Model			
Serial number			
Verified by	Name:		
	Company and contact:		
	Year:	Month:	Day:
Environment	Temperature (C/F):	Humidity (%):	

Test Step	CH	Output voltage	Measurement result	Low test limit	High test limit	Pass/fail
Set DC voltage accuracy +1% FS	1	0.5		0.4795 V	0.5205 V	
Read DC voltage accuracy +1% FS	1	0.5		*	**	
Set DC voltage accuracy +20% FS, 100% Pwr	1	10		9.97 V	10.03 V	
Read DC voltage accuracy +20% FS, 100% Pwr	1	10		*	**	
Set DC voltage accuracy +25% FS, 100% Pwr	1	12.5		12.468 V	12.533 V	
Read DC voltage accuracy +25% FS, 100% Pwr	1	12.5		*	**	
Set DC voltage accuracy +50% FS, 100% Pwr	1	25.0		24.955 V	25.045 V	
Read DC voltage accuracy +50% FS, 100% Pwr	1	25.0		*	**	
Set DC voltage accuracy +75% FS, 100% Pwr	1	37.5		37.443 V	37.588 V	
Read DC voltage accuracy +75% FS, 100% Pwr	1	37.5		*	**	
Set DC voltage accuracy +100% FS, 100% Pwr	1	50.0		49.93 V	50.07 V	

Test Step	CH	Output voltage	Measurement result	Low test limit	High test limit	Pass/fail
Read DC voltage accuracy +100% FS, 100% Pwr	1	50.0		*	**	
Set DC voltage accuracy -1% FS	1	-0.5		-0.5205 V	-0.4795 V	
Read DC voltage accuracy -1% FS	1	-0.5		*	**	
Set DC voltage accuracy -20% FS, 100% Pwr	1	-10		-10.03 V	-9.97 V	
Read DC voltage accuracy -20% FS, 100% Pwr	1	-10		*	*	
Set DC voltage accuracy -25% FS, 100% Pwr	1	-12.5		-12.533 V	-12.468 V	
Read DC voltage accuracy -25% FS, 100% Pwr	1	-12.5		*	**	
Set DC voltage accuracy -50% FS, 100% Pwr	1	-25.0		-25.045 V	-24.955 V	
Read DC voltage accuracy -50% FS, 100% Pwr	1	-25.0		*	**	
Set DC voltage accuracy -75% FS, 100% Pwr	1	-37.5		-37.588 V	-37.443 V	
Read DC voltage accuracy -75% FS, 100% Pwr	1	-37.5		*	**	
Set DC voltage accuracy -100% FS, 100% Pwr	1	-50		-50.07 V	-49.93 V	
Read DC voltage accuracy -100% FS, 100% Pwr	1	-50		*	**	
Set DC voltage accuracy +1% FS	2	0.5		0.4795 V	0.5205 V	
Read DC voltage accuracy +1% FS	2	0.5		*	**	
Set DC voltage accuracy +20% FS, 100% Pwr	2	10		9.97 V	10.03 V	
Read DC voltage accuracy +20% FS, 100% Pwr	2	10				
Set DC voltage accuracy +25% FS, 100% Pwr	2	12.5		12.468 V	12.533 V	
Read DC voltage accuracy +25% FS, 100% Pwr	2	12.5		*	**	
Set DC voltage accuracy +50% FS, 100% Pwr	2	25.0		24.955 V	25.045 V	

Test Step	CH	Output voltage	Measurement result	Low test limit	High test limit	Pass/fail
Read DC voltage accuracy +50% FS, 100% Pwr	2	25.0		*	**	
Set DC voltage accuracy +75% FS, 100% Pwr	2	37.5		37.443 V	37.588 V	
Read DC voltage accuracy +75% FS, 100% Pwr	2	37.5		*	**	
Set DC voltage accuracy +100% FS, 100% Pwr	2	50.0		49.93 V	50.07 V	
Read DC voltage accuracy +100% FS, 100% Pwr	2	50.0		*	**	
Set DC voltage accuracy -1% FS	2	-0.5		-0.5205 V	-0.4795 V	
Read DC voltage accuracy -1% FS	2	-0.5		*	**	
Set DC voltage accuracy -20% FS, 100% Pwr	2	-10		-10.03 V	-9.97 V	
Read DC voltage accuracy -20% FS, 100% Pwr	2	-10		*	*	
Set DC voltage accuracy -25% FS, 100% Pwr	2	-12.5		-12.533 V	-12.468 V	
Read DC voltage accuracy -25% FS, 100% Pwr	2	-12.5		*	**	
Set DC voltage accuracy -50% FS, 100% Pwr	2	-25.0		-25.045 V	-24.955 V	
Read DC voltage accuracy -50% FS, 100% Pwr	2	-25.0		*	**	
Set DC voltage accuracy -75% FS, 100% Pwr	2	-37.5		-37.588 V	-37.443 V	
Read DC voltage accuracy -75% FS, 100% Pwr	2	-37.5		*	**	
Set DC voltage accuracy -100% FS, 100% Pwr	2	-50		-50.07 V	-49.93 V	
Read DC voltage accuracy -100% FS, 100% Pwr	2	-50		*	**	

* Set test result * 1.001 - 0.02

** Set test result * 1.001 + 0.02

Output voltage load regulation verification test record

Model			
Serial number			
Verified by	Name:		
	Company and contact:		
	Year:	Month:	Day:
Environment	Temperature (C/F):	Humidity (%):	

Test Step	CH	Measurement result	Low test limit	High test limit	Pass/Fail
10V reference measurement	1		9.97 V	10.03 V	
10V Regulation (Minimum load)	1		*	**	
10V Regulation (Maximum load)	1		*	**	
50V reference measurement	1		49.93 V	50.07 V	
50V Regulation (Minimum load)	1		*	**	
50V Regulation (Maximum load)	1		*	**	
10V reference measurement	2		9.97 V	10.03 V	
10V Regulation (Minimum load)	2		*	**	
10V Regulation (Maximum load)	2		*	**	
50V reference measurement	2		49.93 V	50.07 V	
50V Regulation (Minimum load)	2		*	**	
50V Regulation (Maximum load)	2		*	**	

*Ref Measurement + (reference measurement *.0001) + 0.004

** Ref Measurement + (reference measurement *.0001) - 0.004

Voltage output noise verification test record

Model			
Serial number			
Verified by	Name:		
	Company and contact:		
	Year:	Month:	Day:
Environment	Temperature (C/F):	Humidity (%):	

Test step	Channel	Measurement result	Low test limit	High test limit	Pass/fail
Voltage noise (peak-to-peak)	1		N/A	20 mV _{PP}	
Voltage noise (RMS)	1		N/A	5 mV _{RMS}	
Voltage noise (peak-to-peak)	2		N/A	20 mV _{PP}	
Voltage noise (RMS)	2		N/A	5 mV _{RMS}	

Current load regulation verification test record

Model			
Serial number			
Verified by	Name:		
	Company and contact:		
	Year:	Month:	Day:
Environment	Temperature (C/F):	Humidity (%):	

Test Step	Channel	Measurement result	Low test limit	High test limit	Pass/Fail
Current regulation reference measurement	1		0.979 A	1.021 A	
Current regulation (maximum load)	1		*	**	
Current regulation (minimum load)	1		*	**	
Current regulation reference measurement	2				
Current regulation (maximum load)	2		*	**	
Current regulation (minimum load)	2		*	**	

* Reference measurement + (reference measurement * 0.0001) + 0.002

** Reference measurement + (reference measurement * 0.0001) - 0.002

Current measurement accuracy verification test record

Current measurement accuracy is verified by comparing the limit setting of the power supply to the current measured by an external DMM and shunt resistor. For best accuracy, ensure the DMM and shunt resistor are sufficiently accurate.

Model			
Serial number			
Verified by	Name:		
	Company and contact:		
	Year:	Month:	Day:
Environment	Temperature (C/F):	Humidity (%):	

Test Step	CH	LoadI _{MEAN}	Measurement result	Low test limit	High test limit	Pass/fail
Read DCI accuracy 100% FS, 100% Pwr	1			*	**	
Read DCI accuracy 75% FS, 100% Pwr	1			*	**	
Read DCI accuracy 50% FS, 100% Pwr	1			*	**	
Read DCI accuracy 25% FS, 100% Pwr	1			*	**	
Read DCI accuracy 20% FS, 100% Pwr	1			*	**	
Read DCI accuracy 1% FS, 50% Pwr	1			*	**	
Read DCI accuracy -100% FS, 100% Pwr	1			*	**	
Read DCI accuracy -75% FS, 100% Pwr	1			*	**	
Read DCI accuracy -50% FS, 100% Pwr	1			*	**	
Read DCI accuracy -25% FS, 100% Pwr	1			*	**	
Read DCI accuracy -20% FS, 100% Pwr	1			*	**	
Read DCI accuracy -1% FS, 50% Pwr	1			*	**	
Read DCI accuracy 100% FS, 100% Pwr	2			*	**	
Read DCI accuracy 75% FS, 100% Pwr	2			*	**	

Test Step	CH	LoadI _{MEAN}	Measurement result	Low test limit	High test limit	Pass/fail
Read DCI accuracy 50% FS, 100% Pwr	2			*	**	
Read DCI accuracy 25% FS, 100% Pwr	2			*	**	
Read DCI accuracy 20% FS, 100% Pwr	2			*	**	
Read DCI accuracy 1% FS, 50% Pwr	2			*	**	
Read DCI accuracy -100% FS, 100% Pwr	2			*	**	
Read DCI accuracy -75% FS, 100% Pwr	2			*	**	
Read DCI accuracy -50% FS, 100% Pwr	2			*	**	
Read DCI accuracy -25% FS, 100% Pwr	2			*	**	
Read DCI accuracy -20% FS, 100% Pwr	2			*	**	
Read DCI accuracy -1% FS, 50% Pwr	2			*	**	

* (LoadI_{MEAN} * 0.999) – 0.005

** (LoadI_{MEAN} * 1.001) + 0.005

Current limit accuracy verification test record

Current limit accuracy is verified by comparing the limit setting of the power supply to the current measured by an external DMM and shunt resistor. For best accuracy, ensure the DMM and shunt resistor are sufficiently accurate.

Model			
Serial number			
Verified by	Name:		
	Company and contact:		
	Year:	Month:	Day:
Environment	Temperature (C/F):	Humidity (%):	

Test step	CH	Measurement result	Low test limit	High test limit	Pass/fail
Current limit accuracy 0.01 A	1		0 A	0.03001 A	
Current limit accuracy 0.05 A	1		0.02995 A	0.07005 A	
Current limit accuracy 0.5 A	1		0.4795 A	0.5205 A	
Current limit accuracy 4.5 A	1		4.4755 A	4.5245 A	
Current limit accuracy 5.0 A	1		4.975 A	5.025 A	
Current limit accuracy -0.01 A	1		-0.03001 A	0 A	
Current limit accuracy -0.05 A	1		-0.07005 A	-0.02995 A	
Current limit accuracy -0.5 A	1		-0.5205 A	-0.4795 A	
Current limit accuracy -4.5 A	1		-4.5245 A	-4.4755 A	
Current limit accuracy -5.0 A	1		-5.025 A	-4.975 A	
Current limit accuracy 0.01 A	2		0 A	0.03001 A	
Current limit accuracy 0.05 A	2		0.02995 A	0.07005 A	
Current limit accuracy 0.5 A	2		0.4795 A	0.5205 A	
Current limit accuracy 4.5 A	2		4.4755 A	4.5245 A	
Current limit accuracy 5.0 A	2		4.975 A	5.025 A	
Current limit accuracy -0.01 A	2		-0.03001 A	0 A	
Current limit accuracy -0.05 A	2		-0.07005 A	-0.02995 A	
Current limit accuracy -0.5 A	2		-0.5205 A	-0.4795 A	
Current limit accuracy -4.5 A	2		-4.5245 A	-4.4755 A	

Test step	CH	Measurement result	Low test limit	High test limit	Pass/fail
Current limit accuracy -5.0 A	2		-5.025 A	-4.975 A	

Current noise verification test record

Model			
Serial number			
Verified by	Name:		
	Company and contact:		
	Year:	Month:	Day:
Environment	Temperature (C/F):	Humidity (%):	

Test step	CH	Measurement result	Low test limit	High test limit	Pass/Fail
Current noise (peak-to-peak)	1		N/A	.005 A _{RMS}	
Current noise (RMS)	1		N/A	.001 A _{PK-PK}	
Current noise (peak-to-peak)	2		N/A	.005 A _{RMS}	
Current noise (RMS)	2		N/A	.001 A _{PK-PK}	