

MP5000 Series Modular Precision Test System

PRELIMINARY DATASHEET



The Tektronix MP5000 Modular Precision Test System accommodates all your sourcing needs within a 1U rack space. This top-tier automated test equipment (ATE) optimizes rack space by incorporating multiple source measure units (SMUs) and power supplies with adaptable module options. Featuring three slots and dual-channel modules, it offers up to six parallel channels. For higher channel count applications, TSP-Link™ provides a solution to connect mainframes in a master-subordinate configuration, effectively allowing them to function as one unit. This facilitates the creation of an optimized source and measurement system suitable for a wide range of applications, from validating design and debugging to complex parallel test systems used in ATE.

Customers can mix and match module configurations to optimize cost, throughput, and accuracy. For applications where low current measurements and sinking capabilities aren't required, power supplies can be a cost-effective solution. For applications in which true current sourcing and high-speed measurements are required, consider an SMU module. The system supports a wide array of applications, and its high-density design conserves valuable rack space and reduces cost per channel. It's engineered to deliver fast throughput for high-channel parallel testing, saving both cost and time for production and validation test users.

Key Features

Mainframe MP5103

- Compact 1U mainframe offering significant space and cost efficiency over conventional rack-and-stack systems
- 3 configurable slots offer flexibility to mix & match PSU and SMU modules to optimize the cost-performance tradeoff
- Add or remove modules effortlessly without powering off the mainframe, thus reducing downtime
- Additional digital I/O pins (18) support efficient handshaking with other test rack equipment
- TSP-Link facilitates precise synchronization within 500 ns across multiple mainframes, ideal for high channel count parallel testing
- Employs 1 Gbps Ethernet and USB 3.0 for fast data streaming
- Features a modern touch display for simplified setup and troubleshooting

Source Measure Unit (SMU) MSMU60-2

- 2 SMU channels per module, 6 channels per mainframe
- Up to 60V and up to 1.5 A per channel
- Offers 4-quadrant voltage/current source and measure for each channel with 6½-digit measure resolution down to 100 femtoamps
- Integrated 1 MSA/s ADCs for both voltage and current measurements using fast sample rates
- Up to 6 V between force and sense allowing users more flexibility in cabling and test setup
- User selectable auto-sense resistor prevents excessive voltage at Force Hi if there are contact errors
- Asymmetric Compliance: Configure independent positive and negative limit values

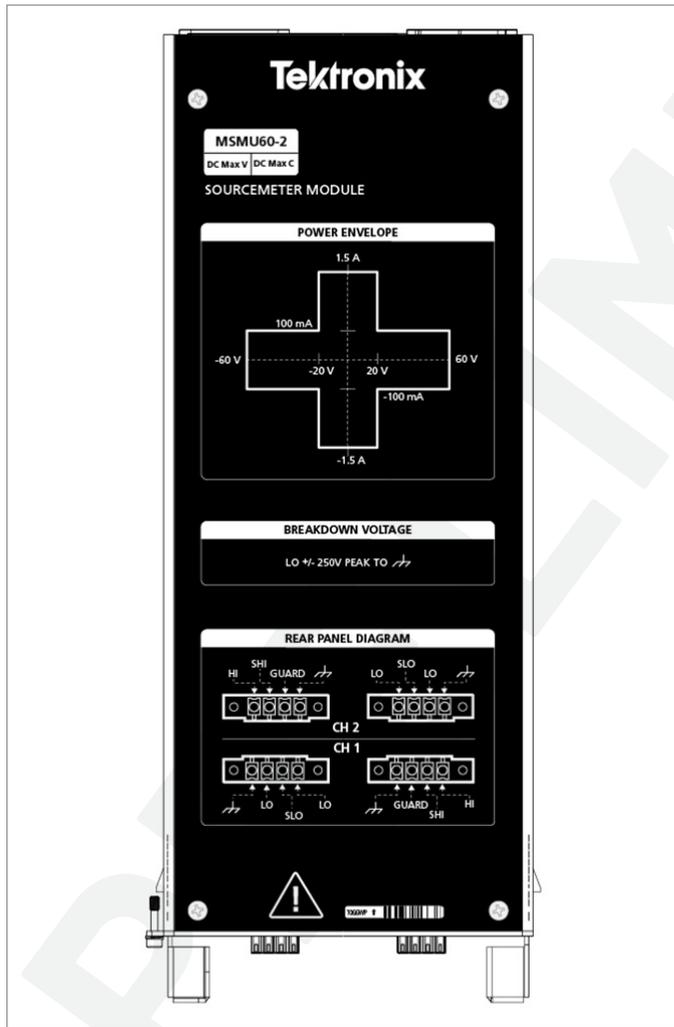


Figure 1: MSMU60-2 Module

Power Supply Unit (PSU) MPSU50-2ST

- 2 isolated channels per module, 6 channels per mainframe
- Up to 50 V and up to 5 A per channel
- Extended voltage and current ranges with up to 100 V and up to 10 A when channels are stacked in series or parallel.
- Bipolar output capability without switching the output leads
- Built-in output disconnect relay for each channel physically disconnects device under test when PSU is off
- OVP & OCP protects device from damaging signals by hardware limiting maximum voltage and current available from the PSU
- Remote sense (4-wire) for accurate voltage output at device by compensating for voltage drops at the leads

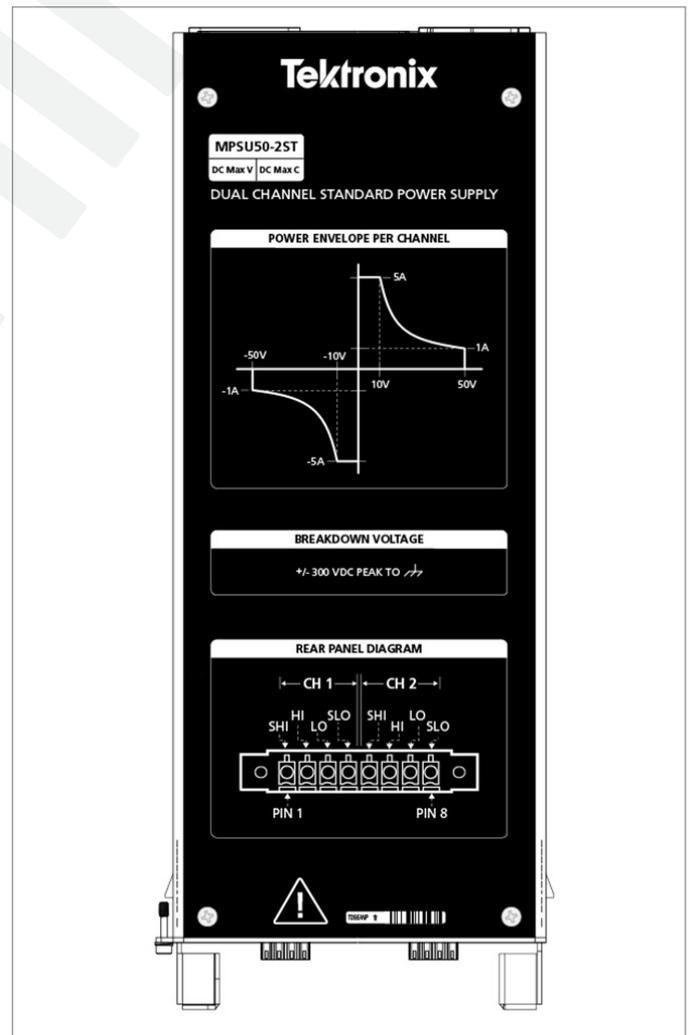


Figure 2: MPSU50-2ST Module

Software

- **Intuitive Web Interface:** A highly visual, interactive display designed for troubleshooting multi-channel setups and remote instrument monitoring
- **TSP Toolkit:** Facilitates the development of Test Script Processor (TSP™) scripts for automation within the widely-used Microsoft Visual Studio Code (VS Code) editor. More information and downloads found on the [TSP Toolkit Product Page](#)
- **Supporting Drivers:** Accelerate software development with drivers such as Python and IVI.

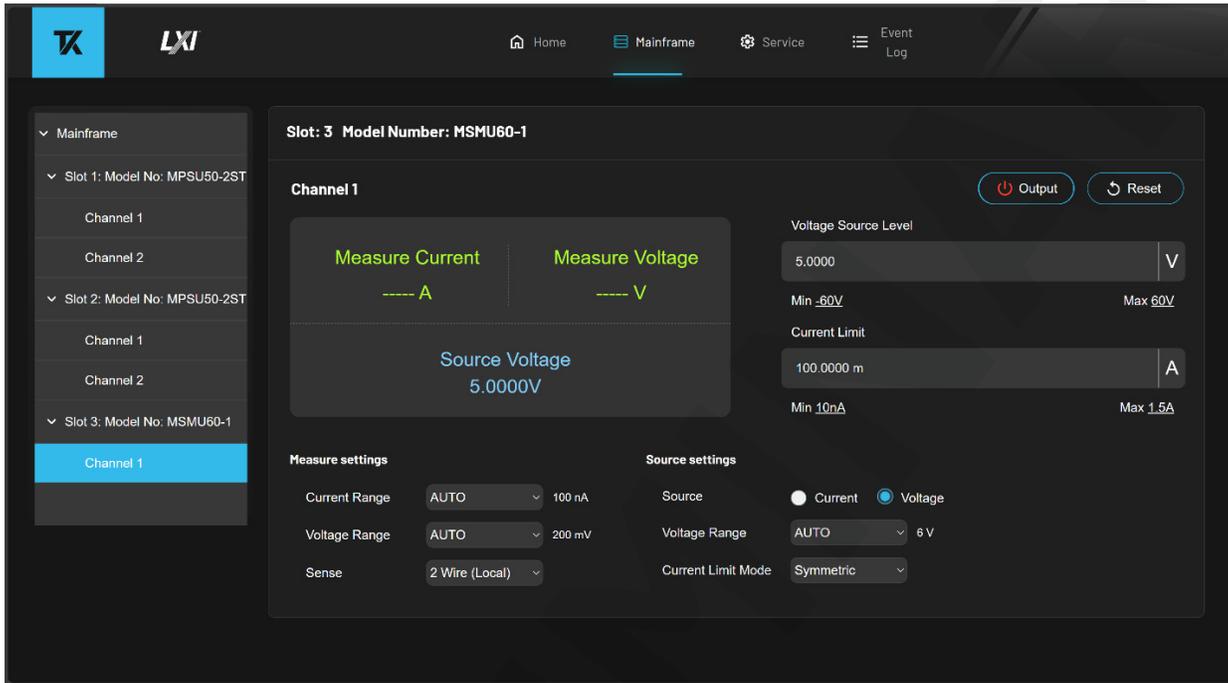


Figure 3: Web Interface for SMU Control

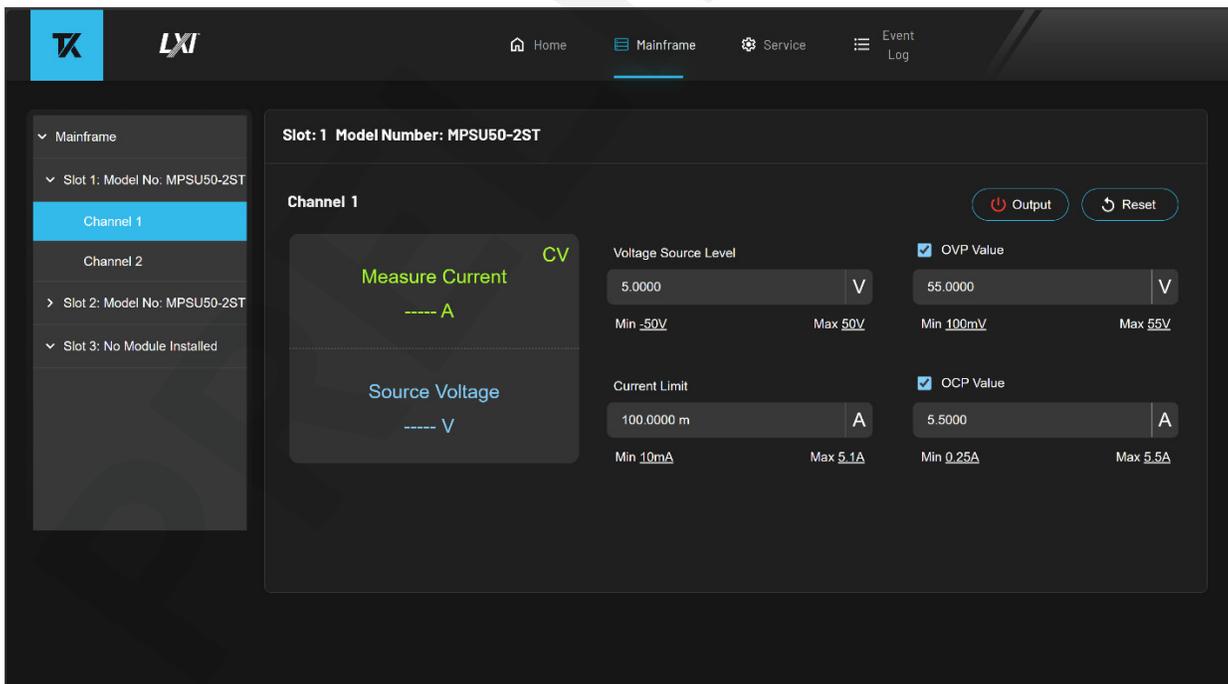


Figure 4: Web Interface for PSU Control

Specifications

All specifications are subject to change without notice.

MP5103 Mainframe

Specifications and supplemental information for the MP5000 Series Modular Precision Test System Model MP5103. Specifications are the standards against which the Model MP5103 is tested. Upon leaving the factory, the MPS5103 meets these specifications. Supplemental and typical values are nonwarranted, apply at 23 °C, and are provided solely as useful information.

Overview

Model	Description	Output Power
MPS5103	MP5000 Series, 3-Slot low profile modular mainframe	600 W

Supported Module Plug-in Instrument Cards

Model	Description
MPSU50-2ST	MP5000 PSU Module, 50 W, 50 V, 5 A, 2 channels, Standard Power Supply
MSMU60-2	MP5000 SMU Module, 30 W, 60 V, 1.5 A, 2 channels

General

Specifications Category	Specifications
USB Host (Front Panel)	USB 2.0, Type A, support for flash drives Capability: Support Firmware Upgrade
USB TMC (Rear Panel)	USB 3.0, Type C
Ethernet	RJ-45 Connector: 10/1000BASE-T IP Configuration: Static or DHCP (manual or automatic)
IEEE-488.x	Supports IEEE Std 488.2 common commands and status model topology.
Programming	Embedded Test Script Processor (TSP) scripting engine is accessible from any host interface: <ul style="list-style-type: none"> Responds to individual instrument control commands. Responds to high-speed test scripts comprised of remote commands and test script language (TSL) statements (for example, branching, looping, and math) Able to execute high-speed test scripts stored in memory without host intervention.
Real Time Clock	1 year time frame for data retention
Memory (user scripts only)	256 MB (approximately 4 million lines of code)
Front Panel Display	Multi-touch capacitive touchscreen Resolution: 480×128 RGB TFT
Additional Control	Rotary Navigation/Control Knob w/ Encoder Selection
Security Password Protection	24 characters
Triggering	Application: DIGIO & TSP-Link Input Level: TTL Input transition timing, Max: <100 ns Trigger in to trigger out: 0.5 μs Trigger timer accuracy: ±200 ns
Acoustic Noise	Sound Pressure Lp, <70dB(A), at 1 meter, open air

MSMU60-2 Specifications

Source and measurement accuracies are specified at the terminals of the MSMU60-2 module under these conditions:

1. Ambient $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$, < 70 percent relative humidity.
2. After a 30-minute warm-up period
3. Integration time setting is 1 NPLC¹
4. A/D autozero enabled or auto-cal procedure performed.
5. Remote sense operation or properly zeroed local operation
6. Calibration period: One year

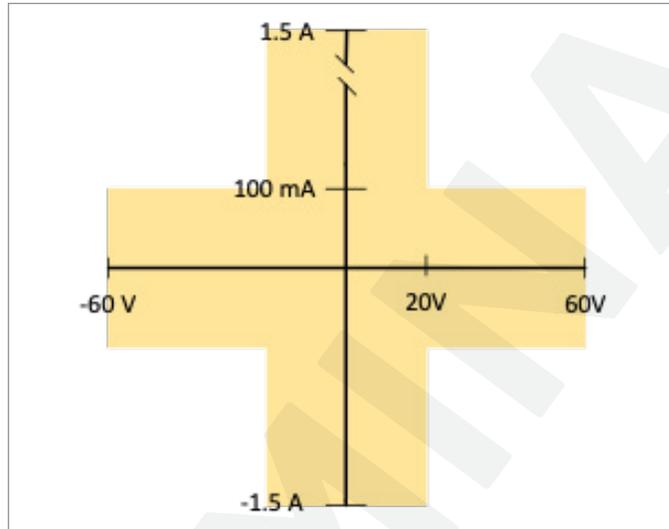


Figure 5: MSMU60-2 I/V Envelope

Maximum Output Power and Source/Sink Limits	30 W maximum per channel $\pm(60\text{ V at }0.1\text{ A})$ $\pm(20\text{ V at }1.5\text{ A})$ Four-quadrant source or sink operation
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1. 1 PLC aperture reading is calculated from averaging samples taken at 1MSa/sec over a single cycle of the detected line frequency. For 60 Hz, this is an average of 16,667 samples; for 50 Hz power line frequency, this is an average of 20,000 readings

Voltage Accuracy Specifications

Range	Source		Measure	
	Resolution	Accuracy 1 Year $\pm(\text{\% reading} + \text{volts})$	Resolution	Accuracy 1 Year $\pm(\text{\% reading} + \text{volts})$
200 mV	5 μV	0.05% + 100 μV	500 nV	0.05% + 100 μV
2 V	50 μV	0.02% + 300 μV	5 μV	0.014% + 150 μV
6 V	50 μV	0.02% + 900 μV	15 μV	0.015% + 420 μV
20 V	500 μV	0.02% + 2 mV	50 μV	0.015% + 1.4 mV
60 V	500 μV	0.02% + 5 mV	150 μV	0.015% + 4.2 mV

Current Accuracy Specifications

Range	Source			Measure	
	Resolution	Accuracy 1 Year ± (% reading + amps)	Typical Noise (Peak to Peak) 0.1 Hz to 10 Hz	Resolution	Accuracy 1 Year ± (% reading + amps)
100 nA	2 pA	0.2% + 20 pA	600 fA	100 fA	0.15% + 20 pA
1 uA	20 pA	0.05% + 100 pA	10 pA	5 pA	0.025% + 100 pA
10 μA	200 pA	0.03% + 1 nA	40 pA	25 pA	0.025% + 1 nA
100 μA	2 nA	0.03% + 12 nA	950 pA	250 pA	0.02% + 12 nA
1 mA	20 nA	0.03% + 60 nA	3 nA	2.5 nA	0.02% + 60 nA
10 mA	200 nA	0.03% + 1.2 μA	140 nA	25 nA	0.02% + 1.2 μA
100 mA	2 μA	0.03% + 6 μA	500 nA	250 nA	0.02% + 6 μA
1 A	20 μA	0.05% + 150 μA	3 μA	2.5 μA	0.03% + 150 μA
1.5 A	200 μA	0.06% + 1 mA	15 μA	5 μA	0.05% + 1 mA

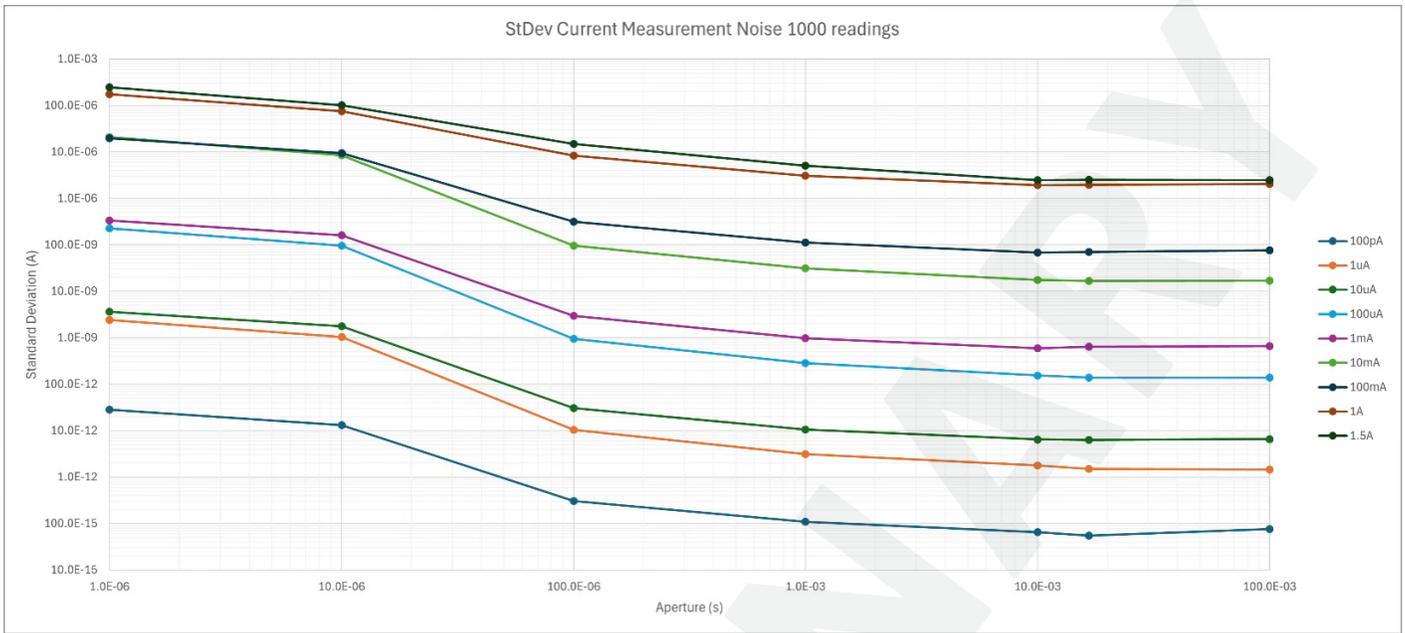
2. For temperatures 0°C to 18°C and 28°C to 50°C, accuracy is degraded by ±(0.15 × accuracy specification)/°C.

Digitizing Characteristics

Maximum Resolution	20 bits
Measurement Input Coupling	DC coupled
Sampling Rate	Programmable 1 kSa/s - 1 Msa / s
Minimum Record Time	1 μs
Maximum Record Length	5M readings

Current and Voltage Measurement Noise vs. Aperture





Additional Source Characteristics

Noise 20 Hz to 20 MHz	< 20 mVpp
Load Regulation	Voltage: 0.5 mV per mA of output load using Local Sense Current: ±(0.01% + 15 pA) of range per volt of output change
Guard Offset Voltage	< 1.5 mV + 0.1Ω * I _{out} Measured at the output terminals of the SMU Max guard current: 10 mA
Remote Sense Operating Range	Maximum voltage between HI and SENSE HI = 6 V Maximum voltage between LO and SENSE LO = 6 V
Limit	Bipolar limit Voltage: Minimum value is 20 mV; accuracy is the same as the voltage source Current: Minimum value is 10 nA; accuracy is the same as the current source Asymmetric Limit: Independent positive and negative compliance limits

Additional Characteristics

Input Impedance	> 10 GΩ
Sense High Input Impedance	> 100 GΩ

Triggering And Synchronization Characteristics

Trigger in to source change	<8 μ s
Multi-node synchronized source change (between similar SMU models)	< 0.5 μ s
Single-node synchronized source change (between similar SMU models)	< 0.5 μ s

MPSU50-2ST Specifications

Source and measurement accuracies are specified at the module terminals under these conditions when installed in the MP5000 Series Mainframe:

1. Ambient 23 °C \pm 5 °C, < 70% percent relative humidity
2. After a 30-minute warm-up period
3. Remote sense operation or properly zeroed local operation
4. Calibration period: One year

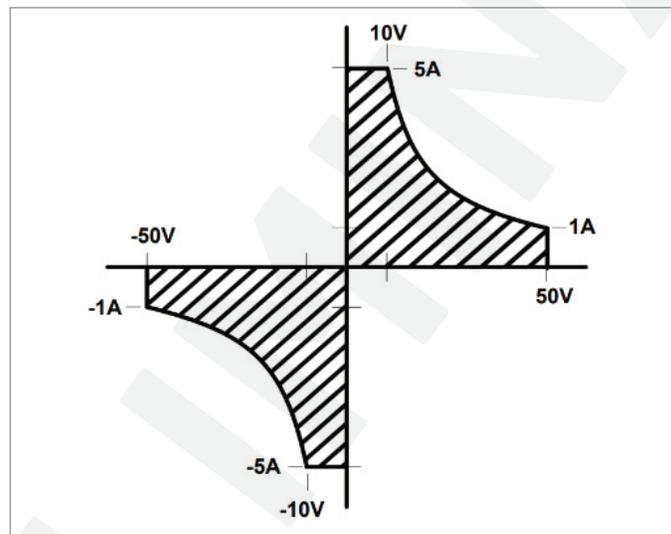


Figure 3: MPSU50-2ST Power Envelope

Maximum Output Power and Source Limits	50 W maximum per channel \pm (50 V at 1 A) \pm (10 V at 5 A)
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Source Accuracy Specifications

	Setting (Programming)			Readback (Measurement)	
	Output	Resolution	Accuracy \pm (% reading + offset) (23°C \pm 5°C)	Resolution	Accuracy \pm (% reading + offset) (23°C \pm 5°C)
Voltage	-50 V to 50 V	1 mV	\pm 0.1% + 20 mV	5 mV	\pm 0.1% + 20 mV
Current	0 A to 5 A	1 mA	\pm 0.1% + 20 mA	3 mA	\pm 0.1% + 5 mA

Voltage Limit	
50.1 V	
Load Effect (Regulation)	
Voltage	$\pm 0.01\% + 4 \text{ mV}$
Current	$\pm 0.01\% + 2 \text{ mA}$
Ripple and Noise (typical) (20 Hz to 20 MHz, 23°C \pm 5°C)	
Voltage (V _{peak-peak})	$\leq 20 \text{ mVp-p}$
Voltage (VRMS)	$\leq 5 \text{ mVRMS}$
Current (IRMS)(CC Mode)	4 mARMS

Supplemental Characteristics

Programming Ranges	
Voltage	0 V to $\pm 50.1 \text{ V}$
Current	0 mA to 5.1 A
Programming Temperature Coefficient per Deg C	
Voltage	$0.005\% \pm 0.2 \text{ mV}$
Current	$0.005\% \pm 0.1 \text{ mA}$
Measurement Temperature Coefficient per Deg C	
Voltage	$0.01\% \pm 0.2 \text{ mV}$
Current	$0.01\% \pm 0.1 \text{ mA}$
Additional Offset at Faster Measurement Settings	
Fast (Volt)	10 mV
Fast (Current)	50 mA
Common Mode Current Noise (20 Hz to 20 MHz)	
RMS	< 1mA
peak-to-peak	< 10 mA
Overvoltage Protection (OVP)	
Setting Accuracy	$1\% \pm 20 \text{ mV}$
Setting	100 mV to 55 V
Response Time	< 50 μs
Overcurrent Protection (OCP)	
Setting Accuracy	$1\% \pm 20 \text{ mA}$
Setting	100mA to 5.5A
Response Time	< 50 μs
Overtemperature Protection (OTP)	
Output Turn-off Temp	$> 101^\circ\text{C} / 214^\circ\text{F}$ (typical)
Response Time	< 1msec
Programmable Slew Rate with a full resistive load (10% to 90%)	
Rising V / Falling V	Max 10 kV / sec
Rising V / Falling V	Min 1 V / sec
Load Transient Recovery Time within settling band $\pm 0.3\text{V}$ from load step : 50% to 100%	
< 0.5 ms	
Command Processing Time	
< 1 ms	
Sinking Capabilities	
Continuous DC Max Current	$0.1 \text{ A} \pm 10\%$
Common Mode Voltage Rating	
Up to 250 V (DC + peak AC) between HI and protective earth (safety ground)	
Up to 200 V (DC + peak AC) between LO and protective earth (safety ground)	
Max Capacitance Loading	
4700 μF	

Accessory List

MP5103

Model Number	Part Number	Description	Optional	Supplied
4299-15	N/A	Fixed 1U Rack Mount Kit	Yes	Yes
174745900		Digital I/O, 30 position rectangular socket to wire	Yes	Yes
133062300	CS-1616-3	Interlock Connector	Yes	Yes
	CA-179-2A	CAT5E, RJ-45 LAN cable, 10 ft	No	Yes
	CA-568-120A	Grounding cable, 120 in.	No	Yes
	174751000	USB-C Male to Male, Non Locking	No	Yes

MSMU60-2

Model Number	Part Number	Description	Optional	Supplied
MSMU-TRX-HI	CA-701-1A	1 m, Dual Triax to Terminal Header	Yes	No
	CA-701-3A	3 m, Dual Triax to Terminal Header	Yes	No
MSMU-TRX-SLO	CA-702-1A	1 m, Single Triax SLO/LO to Terminal Header	Yes	No
	CA-702-3A	3 m, Single Triax SLO/LO to Terminal Header	Yes	No
MSMU-TRX-LO	CA-703-1A	1 m, Single Triax LO to Terminal Header	Yes	No
	CA-703-3A	3 m, Single Triax LO to Terminal Header	Yes	No
MSMU-TRX-SLO-CG	CA-705-1A	1 m, Single Triax SLO/LO to Terminal Header, LO shorted to ground	Yes	No
	CA-705-3A	3 m, Single Triax SLO/LO to Terminal Header, LO shorted to ground	Yes	No
MSMU-TRX-LO-CG	CA-707-1A	1 m, Single Triax, LO to Terminal Header, Lo shorted to ground	Yes	No
	CA-707-3A	3m, Single Triax, LO to Terminal Header, Lo shorted to ground	Yes	No

MPSU50-2ST

Model Number	Part Number	Description	Optional	Supplied
133038500		8 Position Male Screw Terminal Block	Yes	Yes

Contact Information:

PRELIMINARY

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