

Keithley Instruments, Inc.
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System SourceMeter® Specifications

1. SPECIFICATION CONDITIONS

This document contains specifications and supplemental information for the Keithley Instruments Models 2611 and 2612 System SourceMeters®. Specifications are the standards against which the Models 2611 and 2612 are tested. Upon leaving the factory, the Models 2611 and 2612 meet these specifications. Supplemental and typical values are non-warranted, apply at 23°C, and are provided solely as useful information.

The source and measurement accuracies are specified at the SourceMeter CHANNEL A (Models 2611 and 2612) or SourceMeter CHANNEL B (Model 2612) terminals under the following conditions:

1. 23°C ± 5°C, <70% relative humidity.
2. After two-hour warm-up.
3. Speed normal (1 NPLC).
4. A/D auto-zero enabled.
5. Remote sense operation or properly zeroed local sense operation.
6. Calibration period: one year.

2. SOURCE SPECIFICATIONS

Voltage Programming Accuracy¹

Range	Programming resolution	Accuracy (1 year) 23°C ± 5°C ± (% rdg.+ volts)	Typical noise (peak-peak) 0.1Hz-10Hz
200.000mV	5µV	0.02% + 375µV	20µV
2.00000V	50µV	0.02% + 600µV	50µV
20.0000V	500µV	0.02% + 5mV	300µV
200.000V	5mV	0.02% + 50mV	2mV

Temperature coefficient (0°C–18°C and 28°C–50°C): ±(0.15 × accuracy specification)/°C.

Maximum output power and source/sink limits:² 30.603W per channel maximum. ±20.2V at ±1.515A, ±202V at ±101mA, four quadrant source or sink operation.

Voltage regulation: Line: 0.01% of range. **Load:** ±(0.01% of range + 100µV).

Noise 10Hz–20MHz: <5mV RMS typical, 20V range, 1A limit.

Current limit/compliance:³ Bipolar current limit (compliance) set with single value. Minimum value is 10nA. Accuracy same as current source.

Overshoot: <±(0.1% + 10mV) typical (step size = 10% to 90% of range, resistive load, maximum current limit/compliance).

Guard offset voltage: <4mV (current ≤10mA).

¹ Add 50µV to source accuracy specifications per volt of HI lead drop.

² Full power source operation regardless of load to 30°C ambient. Above 30°C and/or power sink operation, refer to Section 8, “Operating boundaries” in the Series 2600 Reference Manual for additional power derating information.

³ For sink mode operation (quadrants II and IV), add 12% of limit range and ±0.02% of limit setting to corresponding current limit accuracy specifications. For 1A range add an additional 40mA of uncertainty.

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System SourceMeter[®] Specifications
Current Programming Accuracy⁴

Range	Programming resolution	Accuracy (1 year) 23°C ± 5°C ± (% rdg.+amps)	Typical noise (peak-peak) 0.1Hz-10Hz
100.000nA	2pA	0.06% + 100pA	5pA
1.00000µA	20pA	0.03% + 800pA	25pA
10.0000µA	200pA	0.03% + 5nA	60pA
100.000µA	2nA	0.03% + 60nA	3nA
1.00000mA	20nA	0.03% + 300nA	6nA
10.0000mA	200nA	0.03% + 6µA	200nA
100.000mA	2µA	0.03% + 30µA	600nA
1.00000A ²	20µA	0.05% + 1.8mA	70µA
1.50000A ²	50µA	0.06% + 4mA	150µA
10.0000A ^{2.5}	200µA	0.5% + 40mA	

Temperature coefficient (0°C–18°C and 28°C–50°C): ±(0.15 × accuracy specification)/°C.

Maximum output power and source/sink limits:² 30.603W per channel maximum. ±1.515A at ±20.2V, ±101mA at ±202V, four-quadrant source or sink operation.

Current regulation: Line: 0.01% of range. **Load:** ±(0.01% of range + 100pA).

Voltage limit/compliance:⁶ Bipolar voltage limit (compliance) set with a single value. Minimum value is 10mV. Accuracy same as voltage source.

Overshoot: <0.1% typical (step size = 10% to 90% of range, resistive load; see “Current source output settling time” for additional test conditions).

Additional Source Specifications

Transient response time: <70µs for the output to recover to 0.1% for a 10% to 90% step change in load.

Voltage source output settling time: Time required to reach 0.1% of final value after source level command is processed on a fixed range.

200mV, 2V ranges: <50µs typical. **20V range:** <100µs typical. **200V range:** <700µs typical.

Current source output settling time: Time required to reach 0.1% of final value after source level command is processed on a fixed range. Values below for Iout · Rload = 2V unless noted.

1.5A–1A ranges: <120µs typical (Rload >6Ω).

100mA–10mA ranges: <80µs typical.

1mA range: <100µs typical.

100µA range: <150µs typical.

4 Accuracy specifications do not include connector leakage. Derate accuracy by $V_{out}/2E11$ per °C when operating between 18°C–28°C. Derate accuracy by $V_{out}/2E11 + (0.15 * V_{out}/2E11)$ per °C when operating <18°C and >28°C.

5 10A range accessible only in pulse mode.

6 For sink mode operation (quadrants II and IV), add 10% of compliance range and ±0.02% of limit setting to corresponding voltage source specification. For 200mV range add an additional 120mV of uncertainty.

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System SourceMeter® Specifications

- 10µA range:** <500µs typical.
- 1µA range:** <2ms typical.
- 100nA range:** <20ms typical.

DC floating voltage: Output can be floated up to ±250VDC from chassis ground.

Remote sense operating range:¹ Maximum voltage between HI and SENSE HI = 3V. Maximum voltage between LO and SENSE LO = 3V.

Voltage output headroom:

- 200V range:** Max. output voltage = 202.3V; total voltage drop across source leads (maximum 1Ω per source lead).
- 20V range:** Max. output voltage = 23.3V; total voltage drop across source leads (maximum 1Ω per source lead).

Over temperature protection: Internally-sensed temperature overload puts unit in standby mode.

Voltage source range change overshoot: Overshoot into a 200k load, 20MHz BW, 300mV typical.

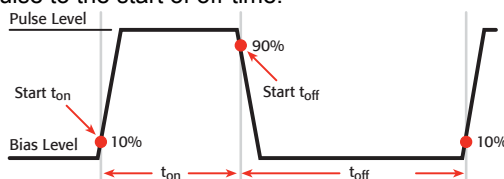
Current source range change overshoot: <5% of larger range + 300mV/Rload + 60nA typical (see “Current source output settling time” for additional test conditions).

Pulse Specifications

Region	Maximum current limit	Maximum pulse width ⁷	Maximum duty cycle ⁸
1	100mA at 200V	DC, no limit	100%
1	1.5A at 20V	DC, no limit	100%
2	1A at 180V	8.5ms	1%
3 ⁹	1A at 200V	2.2ms	1%
4	10A at 5V	1ms	2.2%

Minimum programmable pulse width:⁷ 200µs. NOTE: Minimum pulse width for settled source at a given I/V output and load can be longer than 200µs. See note 10 for typical settling times.¹⁰

7 Times measured from the start of pulse to the start of off-time:



8 Thermally limited in sink mode (quadrants 2 and 4) and ambient temperatures above 30°C. See power equations in the Reference Manual for more information.

9 Voltage source operation with 1.5A current limit.

10 Typical performance for minimum settled pulse widths:

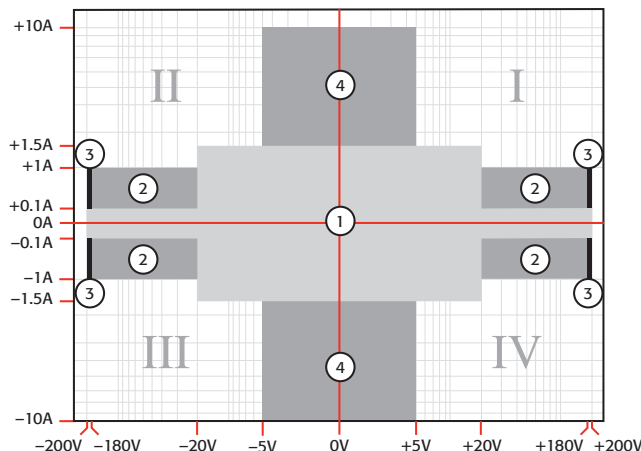
Source value	Load	Source settling (% of range)	Min. pulse width
5V	0.5Ω	1%	300µs
20V	200Ω	0.2%	200µs
180V	180Ω	0.2%	5ms
200V (1.5A limit)	200Ω	0.2%	1.5ms
100 mA	200Ω	1%	200µs
1A	20Ω	1%	500µs
1A	180Ω	0.2%	5ms
10A	0.5Ω	0.5%	300µs

Typical tests were performed using remote operation, 4W sense, Keithley 2600 ban cables and best fixed measurement range. For more information on pulse scripts, see the Series 2600 Reference Manual.

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Pulse width programming resolution: 1µs.
Pulse width programming accuracy:⁷ ±25µs.
Typical pulse width jitter: 50µs.



3. METER SPECIFICATIONS

Voltage Measurement Accuracy^{11, 12}

Range	Display resolution ¹³	Input resistance	Accuracy (1 year) 23°C ± 5°C + (% rdg.+ volts)
200.000mV	1µV	>10GΩ	0.015% + 225µV
2.00000V	10µV	>10GΩ	0.02% + 350µV
20.0000V	100µV	>10GΩ	0.015% + 5mV
200.000V	1mV	>10GΩ	0.015% + 50mV

Temperature coefficient (0°C–18°C and 28°C–50°C): ±(0.15 × accuracy specification)/°C.

¹¹ Add 50µV to source accuracy specifications per volt of HI lead drop.

¹² De-rate accuracy specifications for NPLC setting <1 by increasing error term. Add appropriate % of range term using table below:

NPLC setting	200mV range	2V–200V ranges	100nA range	1µA–100mA ranges	1A–1.5A ranges
0.1	0.01%	0.01%	0.01%	0.01%	0.01%
0.01	0.08%	0.07%	0.1 %	0.05%	0.05%
0.001	0.8 %	0.6 %	1 %	0.5 %	1.1 %

¹³ Applies when in single channel display mode.

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System SourceMeter® Specifications**Current measurement accuracy^{14,12}**

Range	Display resolution ¹³	Voltage burden ¹⁵	Accuracy (1 year) 23°C ± 5°C ± (% rdg.+amps)
100.000nA	1pA	<1mV	0.05% + 100pA
1.00000µA	10pA	<1mV	0.025% + 500pA
10.0000µA	100pA	<1mV	0.025% + 1.5nA
100.000µA	1nA	<1mV	0.02% + 25nA
1.00000mA	10nA	<1mV	0.02% + 200nA
10.0000mA	100nA	<1mV	0.02% + 2.5µA
100.000mA	1µA	<1mV	0.02% + 20µA
1.00000A	10µA	<1mV	0.03% + 1.5mA
1.50000A	10µA	<1mV	0.05% + 3.5mA
10.0000A ¹⁶	100µA	<1mV	0.4% + 25mA

Temperature Coefficient (0°C–18°C and 28°C–50°C): ±(0.15 × accuracy specification)/°C.

Contact Check¹⁷

Speed	Maximum measurement time to memory for 60Hz (50Hz) ¹⁷	Accuracy (1 year) 23°C ± 5°C ± (% rdg.+ohms)
Fast	1 (1.2)ms	5% + 10
Medium	4 (5)ms	5% + 1
Slow	36 (42)ms	5% + 0.3

Additional Meter Specifications

Load impedance: Stable into 10,000pF typical.

Common mode voltage: 250VDC.

Common mode isolation: >1GΩ, <4500pF.

Over-range: 101% of source range, 102% of measure range.

Maximum sense lead resistance: 1kΩ for rated accuracy.

Sense input impedance: >10GΩ.

14 De-rate accuracy by $V_{out}/2E11$ per °C when operating between 18°C–28°C. Derate accuracy by $V_{out}/2E11 + (0.15 * V_{out}/2E11)$ per °C when operating <18°C and >28°C.

15 Four-wire remote sense only.

16 10A range accessible only in pulse mode.

17 Includes measurement of SENSE HI to HI and SENSE LO to LO contact resistances.

4. GENERAL

Host interfaces: Computer control interfaces.

IEEE-488: IEEE-488.1 compliant. Supports IEEE-488.2 common commands and status model topology.

RS-232: Baud rates from 300 bps to 115200 bps. Programmable number of data bits, parity type, and flow control (RTS/CTS hardware or none). When not programmed as the active host interface, the SourceMeter can use the RS-232 interface to control other instrumentation.

Expansion interface: The TSP-Link expansion interface allows TSP-enabled instruments to trigger and communicate with each other.

Cable type: Category 5e or higher LAN crossover cable.

Length: 3 meters maximum between each TSP-enabled instrument.

Digital I/O interface (see Models 2601 and 2602 GENERAL specifications for circuit diagram):

Connector: 25-pin female D.

Input/output pins: 14 open drain I/O bits.

Absolute maximum input voltage: 5.25V.

Absolute minimum input voltage: -0.25V.

Maximum logic low input voltage: 0.7V, +850 μ A max.

Minimum logic high input voltage: 2.1V, +570 μ A.

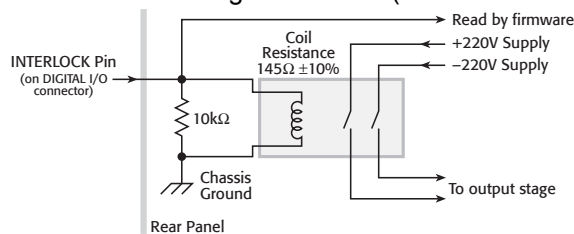
Maximum source current (flowing out of digital I/O bit): +960 μ A.

Maximum sink current at maximum logic low voltage (0.7V): -5.0mA.

Absolute maximum sink current (flowing into digital I/O pin): -11mA.

5V Power supply pin: Limited to 600mA, solid state fuse protected.

Safety interlock pin: Active high input. >3.4V at 24mA (absolute maximum of 6V) must be externally applied to this pin to ensure 200V operation. This signal is pulled down to chassis ground with a 10k Ω resistor. 200V operation will be blocked when the INTERLOCK signal is <0.4V (absolute minimum of -0.4V). See figure below:



Power supply: 100V to 250VAC, 50–60Hz (auto sensing), 250VA max.

Cooling: Forced air. Side intake and rear exhaust. One side must be unobstructed when rack-mounted.

Warranty: One year.

EMC: Conforms to European Union Directive 89/336/EEC, EN 61326-1.

Safety: Conforms to European Union Directive 73/23/EEC, EN 61010-1, and UL 61010-1.

Dimensions: 89mm high \times 213mm wide \times 460mm deep (3 1/2 in \times 8 3/8 in \times 17 1/2 in). Bench configuration (with handle and feet): 104mm high \times 238mm wide \times 460mm deep (4 1/8 in \times 9 3/8 in \times 17 1/2 in).

Weight: Model 2611: 4.75kg (10.4 lbs). Model 2612: 5.50kg (12.0 lbs).

Environment: For indoor use only.

Altitude: Maximum 2000 meters above sea level.

Operating: 0 $^{\circ}$ C–50 $^{\circ}$ C, 70% R.H. up to 35 $^{\circ}$ C. Derate 3% R.H./ $^{\circ}$ C, 35 $^{\circ}$ C–50 $^{\circ}$ C.

Storage: -25 $^{\circ}$ C to 65 $^{\circ}$ C.